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# The Suicide Gene: Examining the Environmental and Genetic Impact of Someone Who Is Suicidal

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THE SUICIDE GENE: EXAMINING THE ENVIORNMENTAL AND GENETIC IMPACT OF SOMEONE WHO IS SUICIDAL

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The Suicide Gene: Examining the Environmental and Genetic Impact of Someone Who Is Suicidal

by

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**Abstract**

The progress of suicide focused research has been tremendous in recent years. There have been many theories posed that are foundational in understanding suicide. This project will examine the genetic and environmental impact of suicide. Serotonin, family heritability, twin studies, adoption studies, candidate genes, and genetic transmission of psychiatric disorders are key topics in the role genetics plays in suicide. Suicide has impacted many lives across the world. Survivors of suicide face stigma, trauma related symptoms, grief, and a whole host of other experiences. Suicide also poses a threat to the social, physical, spiritual, emotional, and psychological well-being on those who are impacted. Therefore, it is imperative that clinicians are adequately trained in academic and practical skills training that are evidenced based in order to thoroughly understand and respond to the unique obstacles that suicidal clients face. However, if a clinician is unable to provide such services, there is a danger manifested by psychological, physical, and emotional functioning, as well as continued stigmatization and increased risk of suicide. The current project was created in order to further the understanding of current theories of suicide, the genetic impact of suicide, and the environmental influence of suicide. This will be accomplished by examining the literature surrounding the many theories of suicide, existing research on the genetic impact of suicide, the literature surrounding environmental influences on suicide. In turn, this understanding and knowledge will strengthen the therapeutic alliance between the clinician and client, leading to improved clinical outcomes.

## Dedication

This doctoral specialty project is dedicated to my fiancé, family, and other people in my life who have supported me throughout this process. I also want to thank my committee members Dr. Melinda Moore, Dr. Jerry Palmer, and Dr. Theresa Botts for their patience, guidance, and support through the completion of my doctoral specialty project.

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# I. Introduction

Suicide is defined as death caused by injuring oneself with the intent to die (Centers for Disease Control and Prevention, 2022). There are numerous factors that can increase the risk of suicide or protect against it. Theories have tried to explain why suicide happens, from Schneidman's Cubic Model, Thomas Joiner's Interpersonal theory, Cognitive theories, and many more. The CDC states that in 2020, there were 12.2 million people who seriously thought about suicide, 3.2 million planned for, and 1.2 million attempted suicide (Centers for Disease Control and Prevention, 2022). Suicide also increased by 30 percent from 2000 to 2020 (Centers for Disease Control and Prevention, 2022). In 2020, there were 46,000 people who died by suicide, at a rate of one person every 11 minutes (Centers for Disease Control and Prevention, 2022).

There are different populations that are at increased risk of suicide. It is the second leading cause of death in people ages 10-24 (The Trevor Project, 2022). Lesbian, gay, bisexual, transgender, questioning, intersex, and asexual (LGBTQIA+) youth are also at significantly increased risk for suicide (The Trevor Project, 2022). LGBTQIA+ youth are more than four times as likely to attempt suicide compared to their peers, and 1.8 million LGBTQIA+ youth seriously consider suicide each year in the U.S (The Trevor Project, 2022). In 2021, The Trevor Project found that 45% of LGBTQIA+ youth seriously considered attempting suicide, including more than half of nonbinary and transgender youth (The Trevor Project, 2022).

Understanding racial and ethnic differences in rates of suicidal ideation, suicide attempts, and suicide deaths is essential for more effectively directing suicide prevention efforts (*Racial and ethnic disparities*, 2022). Access to culturally appropriate treatment, experiences of historical trauma, and other factors may be related to suicidal risk (*Racial and ethnic disparities,* 2022). Suicide is highest among American Indian and Native American populations, with a rate of 23.9 per 100,000 people (*Disparities in suicide,* 2022)

Veterans are also a population at a higher risk of suicide compared to non-Veteran populations. According to the 2021 National Veteran Suicide Prevention Annual report, 17.2 Veterans died by suicide in 2019. Veterans have an adjusted suicide rate that is 52.3% greater than the non-veteran US adult population (U.S. Department of Veterans Affairs, 2021). The rate among Veterans rose 35.9% from 2001 to 2019, from 23.3 per 100,000 in 2001 to 31.6 per 100,000 in 2019 (U.S. Department of Veterans Affairs, 2021). There was a total of 6,261 Veterans who died by suicide in 2019, and 399 fewer Veteran suicide deaths from 2019 to 2018 (U.S. Department of Veterans Affairs, 2021).

The CDC considers middle aged and older adults to be at a higher risk of suicide compared to other populations (Centers for Disease Control and Prevention, 2022). Adults aged 35-64 account for 42.7 percent of suicides in the United States and suicide is the ninth leading cause of death in this age group (Centers for Disease Control and Prevention, 2022). Adults aged 75 and older account for fewer than 10% of all suicides but have the highest suicide rate at 19.1 per 100,000 (Centers for Disease Control and Prevention, 2022). Also, men aged 75 and older have the highest rate of

suicide at 40.5 per 100,000 compared to other age groups (Centers for Disease Control and Prevention, 2022).

Kentucky is currently ranked number 19 in suicide deaths compared to other states (Centers for Disease Control and Prevention, 2022). This ranking is due to a suicide rate of 17.7 per 100,000 and 801 suicide deaths in 2020. Wyoming, Alaska, Montana, New Mexico, and Colorado are the top five highest in suicide rates in the United States (Centers for Disease Control and Prevention, 2022). While New Jersey, New York, Massachusetts, Maryland, and California are in the bottom five lowest in suicide rates in the United States (Centers for Disease Control and Prevention, 2022).

There are many organizations that are dedicated to suicide prevention across the United States and around the globe. The U.S. Substance Abuse and Mental Health Services Administration (SAMHSA) is dedicated to suicide prevention in a number of different ways. SAMHSA sponsors several suicide prevention campaigns, supports the Suicide Prevention Lifeline, and reviews the effectiveness of evidenced-based programs and practices. The American Association of Suicidology (AAS) is a nonprofit organization that promotes research, public awareness programs, public education, and training for professionals.

The American Foundation for Suicide Prevention (AFSP) is a nonprofit organization that funds research to advance understanding of suicide and suicide prevention. The National Institute of Mental Health (NIMH). NIMH conducts research on suicide and suicide prevention. NIMH also has resources and information for a variety of audiences.

Suicide is a multifaceted issue that affects many people across the United States and the world. We know that different populations are more susceptible to suicide for various reasons, and there have been many resources dedicated to these populations. There are also organizations that are dedicated to suicide prevention, research, and outreach in communities. The statistics surrounding suicide are alarming, but there are glimmers of hope. Suicide rates have decreased 5% from 2018-2020 (Centers for Disease Control and Prevention, 2022) and Veteran suicide decreased from 2018 to 2019 (U.S. Department of Veterans Affairs, 2021).

**Definition of the Problem**

One of the first articles written on suicide was published in 1898 (Tosti, 1898). We do have theories that guide our evidenced based practice, but we are still researching and uncovering more about suicide. It is essential that providers receive and understand the full scope of why someone has suicidal thoughts, attempts suicide, and dies by suicide. The genetic and environmental effect on suicide is one of the gaps in the research. It is imperative that this topic is explored to better inform providers on the different aspects of suicidal patients. Addressing this gap in research will also better inform our current accepted evidenced based practices for treating suicidal patients.

**Statement of Significance**

The American Psychological Association (APA) has created five general principles which members of the psychological community should aspire to adhere to. These principles should include a commitment to beneficence and nonmaleficence, fidelity and responsibility, integrity, justice, and respect for people's rights and dignity. These five principles are in no way enforced by the APA. However, it is expected that

ethical clinicians enter into each therapeutic relationship with a desire to implement each principle, so that a client's well-being is paramount (American Psychological Association, 2017). The APA does not provide guidelines for working with suicidal patients, suicide prevention, or suicide postvention. Significant challenges remain to ensuring that each and every provider is capable of meeting the needs of suicidal patients. The current literature review will provide a thorough examination of the existing literature related to the genetic and environmental effects on suicide.

### Purpose

The purpose of the current literature review is to aid providers in the proliferation of their knowledge of, attitude towards, and competency in working with people who are suicidal. This goal will be accomplished through a thorough examination of current theories around the understanding of suicide. The genetic and environmental impact will also be examined in order to further the understanding of suicide.

## II. Literature Review

### Method of Conducting Literature Review

Articles were accessed by utilizing Academic Search Complete and Google Scholar databases through the Eastern Kentucky University Library website. Using these databases, entries within catalogues including, but not limited to PsycINFO and APA PsychARTICLES were utilized. The keywords utilized while searching databases included, but not limited to, "Suicide," "Genetics," "Genes," "Genome-wide association studies," "Heritability," "Twin Studies," "environmental effects of suicide," and "Sociodemographic effects of suicide."

**Suicide Terminology**

Suicidology is a developing field that has its own set of specific terminology. In order to provide culturally competent services and best serve suicidal patients, a clinician must possess a thorough knowledge of the unique experiences and challenges faced by this population. The definitions of these suicide-focused terminology are not always agreed upon by researchers and clinicians. Nonetheless, understanding these terms help better inform clinicians, researchers, and scholars in different ways. Understanding suicide terminology can aid in creating and maintaining a supportive, reciprocal therapeutic alliance, leading to positive outcomes for the client. Operationally defining suicide-focused terms can also serve as a psychoeducational outreach tool to spread awareness of appropriate suicide terminology to the public. Which leads to a suicide informed society.

*Gatekeepers* are individuals in a community who have face-to-face contact with large numbers of community members as part of their usual routine; they may be trained to identify persons at risk of suicide and refer them to treatment or supporting services as appropriate (*Glossary of suicide prevention terms - SPRC* 2001).

*Means* are the instruments or object whereby a self-destructive act is carried out (i.e., firearm, poison, medication) (*Glossary of suicide prevention terms - SPRC* 2001).

*Methods* are actions or techniques which result in an individual inflicting self-harm (i.e., asphyxiation, overdose, jumping) (*Glossary of suicide prevention terms - SPRC* 2001).

*Postvention* is a strategy or approach that is implemented after a crisis or traumatic event has occurred (*Glossary of suicide prevention terms - SPRC* 2001).

*Protective factors* are factors that make it less likely that individuals will develop a disorder; protective factors may encompass biological, psychological, or social factors in the individual, family, and environment (*Glossary of suicide prevention terms - SPRC* 2001).

*Risk factors* are factors that make it more likely that individuals will develop a disorder; risk factors may encompass biological, psychological, or social factors in the individual, family, and environment (*Glossary of suicide prevention terms - SPRC* 2001).

*Self-harm* is an act with nonfatal outcome, in which an individual deliberately initiates a nonhabitual behavior that, without intervention from others, will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognized therapeutic dosage, and which is aimed at realizing changes which the subject desired via the actual or expected physical consequences (*Glossary of suicide prevention terms - SPRC* 2001).

*Suicidality* is a term that encompasses suicidal thoughts, ideation, plans, suicide attempts, and completed suicide (*Glossary of suicide prevention terms - SPRC* 2001)

*Suicide* is death caused by self-directed injurious behavior with any intent to die as a result of the behavior (O'Connor, Gaynes, & Burda, 2013).

*Suicide Attempt* is A nonfatal self-directed potentially injurious behavior with any intent to die as a result of the behavior. A suicide attempt may or may not result in injury (O'Connor, Gaynes, & Burda, 2013).

*Suicidal ideation* is passive thoughts about wanting to be dead or active thoughts about killing oneself, not accompanied by preparatory behavior (O'Connor, Gaynes, & Burda, 2013).

*Suicidal Self-directed Violence* is behavior that is self-directed and deliberately results in injury or the potential for injury to oneself. There is evidence, whether implicit or explicit, of suicidal intent. This encompasses suicide deaths and suicide attempts (O'Connor, Gaynes, & Burda, 2013).

*Suicide survivors* are family members, significant others, or acquaintances who have experienced the loss of a loved one due to suicide; sometimes this term is also used to mean suicide attempt survivors (O'Connor, Gaynes, & Burda, 2013).

*Other Suicidal Behavior and Preparatory Acts* are acts or preparation toward making a suicide attempt, but before potential for harm has begun. This can include anything beyond a verbalization or thought, such as assembling a method (e.g., buying a gun, collecting pills) or preparing for one's death by suicide (e.g., writing a suicide note, giving things away) (O'Connor, Gaynes, & Burda, 2013).

*Warning signs* are signals that can be verbal, non-verbal or behaviors that a person uses to indicate that they are at risk of suicide (Cerel et al., 2014).

*Exposed to Suicide* is anyone who knows or identifies with someone who dies by suicide. Examples of people in this group are community members, coworkers, health care workers, and community groups (Cerel et al., 2014).

*Affected by Suicide* is anyone who knows or identifies with someone who dies by suicide and is affected by experiencing psychological stress. Examples of people in this group are first responders, close friends, neighbors, and classmates (Cerel et al., 2014).

*Suicide Bereaved, Short-Term* is anyone who experienced psychological stress and formed an attachment to someone who died by suicide. They also experience these

symptoms for a short period of time. Examples of people in this group are family members, therapists, friends, and close colleagues (Cerel et al., 2014).

*Suicide Bereaved, Short-Term* is anyone who experienced psychological stress and formed an attachment to someone who died by suicide. They also experience these symptoms for a prolonged period of time with clinically significant response. Examples of people in this group are family members and close friends (Cerel et al., 2014).

*Non-suicidal Self-directed Violence* is *behavior* that is self-directed and deliberately results in injury or the potential for injury to oneself. There is no evidence, whether implicit or explicit, of suicidal intent (Brenner et al., 2011).

*Undetermined Self-directed Violence* is Behavior that is self-directed and deliberately results in injury or the potential for injury to oneself. Suicidal intent is unclear based upon the available evidence (Brenner et al., 2011).

*Suicidal Intent* is defined as past or present evidence (explicit or implicit) that an individual wishes to die, means to kill themselves, and understands the probable consequences of their actions or potential actions. Suicidal intent can be determined retroactively and in the absence of suicidal behavior (Brenner et al., 2011).

*Suicide Interrupted by Self or Others* is a person who takes steps to injure oneself but is stopped by themselves or another person prior to fatal injury. This interruption may occur at any point (Brenner et al., 2011).

**History of Suicide**

One the first journal articles that focused on suicide was written less than 125 years ago, in 1898 (Tosti, 1899). Since the late 19th century, there have been thousands of articles written to further the understanding of suicide. These articles vary tremendously

in the cause and effect of suicide. It is important for clinicians to understand the history of suicide research in order to be better informed to treat suicidal individuals.

### *History of Suicide Research*

The history of suicide research spanned many years, topics, and theories. In 1937, the American Journal of Orthopsychiatry described suicide being a community health concern and that it affects college student populations (Raphael et al., 1937). A research article in 1955 challenged the myth that all completed suicides were grouped into one category (Farberow & Schneidman, 1955).

A 1969 research article attempted to find and explain the correlation between suicide and age (Darbonne, 1969). In 1967, researchers attempted to predict suicide in a psychiatric hospital setting (Dean et al., 1967). Another research article reported that unconscious homosexuality and feminine urges in men were the central reason for men having higher rates of suicide (Zillboorg, 1937).

In more recent research, suicide has been viewed through the lens of public health. An article published in 2022 found that Native American and Alaskan Natives are at a disproportionally higher rate of suicide (*Disparities in suicide,* 2022). An article published in 2018 discussed the topic of suicide prevention (Daly et al., 2018). They discussed how technology, health care, and changing attitudes about suicide research are imperative to current suicide related concerns.

### Clinical interventions and Treatments for Suicide

There are several empirically based treatments for individuals who are suicidal. Those include the Collaborative Assessment and Management of Suicide (Jobes, 2022), Cognitive Behavioral Therapy for Suicide (Holloway et al., 2014), and Dialectical

Behavior Therapy (Vaughn, 2021). Inpatient hospitalization is also a common suicide treatment. These treatments are vital for the care and understanding of suicidal individuals.

### *Collaborative Assessment and Management of Suicidality (CAMS)*

The Collaborative Assessment and Management of Suicidality was developed by Dr. David Jobes. Dr. Jobes began his research in the 1980's and dedicated the next 30 years to developing the Suicide Status Form and the CAMS approach to treating suicidal individuals (Jobes, 2022). The CAMS Framework is first and foremost a clinical philosophy of care. It is also a therapeutic framework for suicide-specific assessment and treatment of a patient's suicidal risk. It is a flexible approach that can be used across theoretical orientations and disciplines for a wide range of suicidal patients (Jobes, 2022). Also, CAMS can be used across treatment settings and different treatment modalities (Jobes, 2022).

The CAMS approach involves the client and the clinician collaborating and for the client to be involved in the development of their own treatment plan (Jobes, 2022). CAMS can also be viewed as measurement-based care due to the clinician getting ratings of the client's suicidality every session (Jobes, 2022).

The Suicide Status Form (SSF) is a unique, multipurpose, clinical tool that guides the CAMS framework. It functions as a clinical roadmap within CAMS for assessments, treatment planning, ongoing risk, and ultimately clinical outcomes. Collaboration is at the core of the CAMS framework and the SSF. The SSF is also used as an opportunity to let the client be the "co-author," of their treatment (Jobes, 2022).

CAMS typically takes 12 weeks from start to finish, with exceptions for individual clients. The first session involves a comprehensive evaluation of the client's current suicidality, previous history of suicide, reasons for living, reasons for dying, and drivers of suicide. The client and clinician also collaboratively develop a comprehensive treatment plan. This treatment plan also includes a stabilization plan that the client can use in times of crisis. Ways of coping, people who they can call, crisis line numbers, and ways to overcome barriers are all included on the stabilization plan.

Session 2 and ongoing interim sessions are dedicated to treating patient identified "drivers." Before the treatment, every session the client rates their psychological pain, stress, agitation, hopelessness, self-hate, and their overall risk of suicide. The majority of the session is dedicated to using evidenced based practices to treating suicide (CBT, DBT, etc.). In the final session of CAMS, the clinician and client agree that the client is able to manage their suicidal thoughts and feelings. The next steps could be the resolution of CAMS and either continuing or discontinuing treatment.

The CAMS framework has been researched and has been supported empirically in a number of different ways (Jobes, 2022). A meta-analysis concluded that CAMS is a proven way of decreasing suicidal ideation and psychiatric success, following the CAMS four pillars of collaboration, empathy, honesty, and being suicide focused (Swift, Trusty, & Penix 2021). The meta-analysis also confirmed that CAMS can be utilized effectively across a variety of settings.

There have been five Randomized Control Trials (RCT's) published attesting to the effectiveness of CAMS for treating suicidal risk. RCT's are considered to be widely accepted and the highest standard of scientific research. In one RCT, the authors found

that those in the CAMS group had significantly higher satisfaction ratings than those in the control group (Comtois, Jobes, O'Connor et al., 2011). In another RCT, the authors found that CAMS was effective in college counseling center settings in regard to treating suicidal crisis, acute suicidal ideation, and fewer BPD symptoms (Pistorello et al., 2020).

Overall, CAMS is a 12-week therapeutic framework that is collaborative in nature, a multipurpose tool, and has a flexible approach. CAMS has been empirically supported to reduce suicidality in a variety of settings and is seen as an empirically supported approach to treating suicidal individuals. Further research is still being completed on CAMS and this therapeutic approach is considered an evidenced based treatment.

### *Cognitive Behavioral Therapy for Suicide*

Aaron Beck pioneered CBT and created a cognitive revolution in modern day psychotherapy. His theory has branched many forms of CBT, including the one discussed today. His framework is that individuals who have mental health concerns have core beliefs, automatic thoughts, and have muddled interactions between thoughts, feelings, and behaviors. The clinician's role is to help the client build the skills to parse out the different thought's feelings and behaviors.

The research on exactly when and who developed CBT for suicide is unclear. In 1986, Thomas Ellis wrote an article that discussed how CBT for Suicide could work and why there were gaps in suicide focused treatment (Ellis, 1986). He said, "No psychiatrists possess a systematic or comprehensive approach for dealing with suicidal patients." He also stated that dichotomous thinking, viewing suicide as a solution, cognitive distortions, hopelessness, and ineffective problem solving are core concerns for suicidal patients, and

that is congruent with Beck's cognitive model. CBT for suicide was originally designed for anyone who had a recent suicide attempt. Now, CBT for suicide is designed for anyone who has previous or current experiences with suicide.

Holloway et al. (2014), created guide for CBT for suicide where they hypothesized why this treatment would work for suicidal people and guidelines for implementing CBT for suicide. The authors hypothesized the deactivation of the client's suicidal mode, modification of the structure and content of the suicidal mode, and more construction/practice of more adaptive structural modes to promote a desire to live. They also stated that there is a sequential timeline of a suicide attempt. The timeline is as follows: event, thoughts, emotions, behaviors, suicide mode, suicide attempt, and reaction to the attempt. The authors discuss how this method is transdiagnostic, where they are not directly addressing a symptom of a mental health disorder, but CBT for suicide targets suicide ideation related behaviors and thoughts.

The second phase of CBT for suicide involves building skills. These skills according to Holloway et al. (2014), are for preventing suicide and self-directed violent behavior. Information from the conceptualization is used to identify skills-based problem areas the client and clinician can focus on. This process is collaborative and takes self-awareness from the client in order to help identify skill deficits. A possible activity for this phase includes building a hope box, where clients collect items that directly challenge their core beliefs. These items could include trophies, caring letters, pictures of family, and a whole host of client-specific items. Another activity for CBT for suicide is creating coping cards. These cards encourage clients to be action oriented in addressing their suicidal thoughts.

The third and final phase of Holloway et al. (2014), CBT for suicide is relapse prevention. Being able to retell the suicide story in CBT orientation is also important to this phase. Applying CBT skills in order to prepare for future suicidal crisis. The book also discusses how CBT for suicide can be delivered in an inpatient and outpatient setting. The only difference is the brevity of the type of session, with the inpatient setting being briefer than the outpatient.

CBT for Suicide is an evidenced based practice that is widely used and accepted as one of the few treatments to effectively treat suicidal individuals. Further research has found that there are no current certifications or specialized degrees in this field.

***Dialectical Behavior Therapy***

Dialectical Behavior Therapy or DBT is another empirically supported treatment for treating suicidal individuals. DBT was created by Marsha Linehan in the late 1970's (Vaughn, 2021). DBT has been proven to be effective in treating individuals with a variety of mental health disorders, clinical settings, and individuals who are suicidal. DBT has also been proven to be effective when delivered in various modes.

The "D" in DBT means "Dialectical." A dialectic is a synthesis or integration of opposites. Dialectical strategies help both the therapist and the client get unstuck from extreme positions. This is one-way DBT strives to balance both "acceptance" and "change." (Vaughn, 2021). The "B" stands for "behavioral" in DBT. DBT requires a behavioral approach. Clinicians assess situations and target behaviors that are relevant to the clients' goals in order to figure out how to solve the problems in their lives (Vaughn, 2021).

DBT also makes a number of assumptions that underlie all components of the treatment (Vaughn, 2021). The first assumption is that “Patients suffer from difficulties regulating their emotions”. The second assumption is “Patients may not have caused all of their problems, but it is up to them to solve them”. The third and last assumption is “We help patients move towards goals that they define”. These assumptions allow clinicians to see clients in the best possible light.

As mentioned previously DBT can be delivered in various different modes. Individual therapy emphasizes motivating the client, and structuring treatment for best application of the skills learned in session (Vaughn, 2021). Skills training is also a mode of treatment delivery for DBT. Skills training focuses on mindfulness, distress tolerance, interpersonal effectiveness, and emotional regulation. Skills training is frequently taught in groups during weekly sessions, and the full skills curriculum runs for 24 weeks (Vaughn, 2021). Group leaders assign homework to help clients practice the skills in their everyday lives. Briefer schedules that teach only a subset of the skills have also been developed for particular populations and settings.

DBT has been proven to be an evidenced based practice in treatment of suicidal individuals. DBT has also been the subject of many RCT’s. Linehan found that in 12 months of standard DBT treatment reductions in self-harm behavior, completion of treatment, and reduction in length of inpatient hospitalization stays compared to treatment as usual were evident (Linehan et al., 1991). Another RCT found that six months of DBT treatment reduced suicidal ideation, hopelessness, anger, and depression in adults with borderline personality disorder, as well as Veterans (Koons et al., 2001). Finally, an

additional RCT discussed reductions in suicide attempts, hospitalizations, and increases in adherence to treatment with 12 months of DBT treatment (Linehan et al., 2006).

Overall, DBT is an evidenced based practice that is used to treat a wide range of presenting concerns. It has also been proven to be effective in treating individuals with suicidal ideation, thoughts of self-harm, and suicide attempt survivors. DBT has also reduced overall length on inpatient hospital stays in certain populations. This treatment has been proven to be delivered in a variety of modes successfully. Based on the literature, DBT can be considered one of the most effective treatments for suicidal individuals.

***Inpatient Hospitalization***

Hospitalization for suicide is considered a standard of care in the United States. Hospitalization can be either voluntary or involuntary in nature. This literature review will focus on the involuntary hospitalization aspect of treating suicidal individuals. In 1982, the state of Kentucky established statute 202.A.026. This statute says, "No person shall be involuntarily hospitalized unless such person is a mentally ill person." Then, the three following criteria need to be met in order hospitalize someone involuntarily. The first criteria someone needs to present a danger or threat of danger to self, family, or others as a result of mental illness. The second criteria is when a person can reasonably benefit from hospitalization. The third and last criteria is that hospitalization needs to be the least restrictive mode of treatment presently available.

Involuntary hospitalization can also be viewed as s the legal process by which a person is confined in a psychiatric hospital because of a treatable mental disorder, against his or her wishes. The first official "psychiatric" commitment took place in 1752 in

Philadelphia, Pennsylvania (Fariba & Gupta, 2022). However, the history of civil commitment dates back to the 4th century B.C., by Hippocrates. Hippocrates suggested that individuals with mental illness should be confined to a secluded and comforting environment (Fariba & Gupta, 2022). By 1403, the first provisional "mental asylum" was established, as Bedlam Hospital designated a wing for the inpatient care of the "mentally insane" (Fariba & Gupta, 2022).

The topic of involuntary commitment is inherently a polarizing topic that has raised issues of concern since its inception. On either side of the debate are those in favor of patient autonomy against those committed to upholding the principle of beneficence (Fariba & Gupta, 2022). Civil commitment is ubiquitous in the psychiatric setting. Not only must clinicians be cognizant of the nuanced variations of differing jurisdictions, but they must also appropriately assess the necessity of initiating an involuntary hospitalization. It is no longer sufficient that a patient simply exhibits "psychotic" symptoms to be hospitalized but instead must meet a specific threshold criterion (Fariba & Gupta, 2022). Furthermore, the clinician will evaluate whether the patient is appropriate for hospitalization while also considering the necessity to uphold patient autonomy (Fariba & Gupta, 2022).

A documentary that was posted to YouTube in 2019 discussed what the involuntary hospitalization process is like in the state of Florida. In Florida, this is called the "Baker Act," and states if someone is in danger of themselves, they can be involuntarily hospitalized for 72 hours (Vice News, 2019). The documentary reported that between 2011 and 2016, the rate of involuntary hospitalizations rose by 50% for individuals under the age of 18 (Vice News, 2019). An issue that was raised in the

documentary was the care that these individuals do not have access to long term mental health care (Vice News, 2019). This has resulted in an increase of repeated involuntary hospitalizations (Vice News, 2019). This shortage in long-term mental health care was reported to be due to lack of mental health professionals, community resources, and insurance coverage for mental health care (Vice News, 2019).

## Current Theories of Suicide

The conceptualization of suicide has been synthesized into various theories. These theories have informed clinicians in the understanding of suicidal individuals, as well as informing the treatment of people who are suicidal. These theories have undergone and are still being researched to ensure the continued support of these theories. As mentioned previously, suicide is a relatively new field and new theories are still being developed.

### *Dr. Thomas Joiner's Interpersonal Theory of Suicide*

Dr. Thomas Joiners Interpersonal Theory of Suicide is a widely accepted and understood method of conceptualizing suicide. Joiner wrote a book that highlights his theory, this book is called *Why People Die by Suicide*. Joiner's theory proposes that an individual will not die by suicide unless they have both the desire to die by suicide and the ability to do so. These criteria are perceived burdensomeness, thwarted belongingness, and acquired capability of suicide. Perceived burdensomeness and Thwarted belongingness create the "Desire for suicide," according to Joiner's theory (Joiner, 2009). While the acquired capability for suicide creates the ability to die by suicide through developing a fearlessness of pain, injury, and death (Joiner, 2009). According to the theory, they acquire through a process of repeatedly experiencing painful and otherwise provocative events (Joiner, 2009).

Perceived burdensomeness is the view that one's existence burdens family, friends, and/or society. This view can produce the idea "my death will be worth more than my life to family, friends, society, etc.," (Joiner, 2009). Thwarted belongingness is the experience that one is alienated from others, not an integral part of a family, circle of friends, or another valued group (Joiner, 2009).

While feelings of burdensomeness and low belongingness may instill a desire for suicide, they are not sufficient to ensure that desire will lead to a suicide attempt. In order for this to occur, the theory suggests a third element must be present: the acquired ability for lethal self-injury (Joiner, 2009). The basis for this proposition rests primarily on the principles of opponent-process theory, which suggests that with repeated exposure to an affective stimulus, the reaction to that stimulus shifts over time such that the stimulus loses its ability to elicit the original response and, instead, the opposite response is strengthened (Solomon, 1980). In light of this, it is hypothesized that the capability for suicide is acquired largely through repeated exposure to painful or fearsome experiences. This results in habituation and, in turn, a higher tolerance for pain and a sense of fearlessness in the face of death. Acquired capability is viewed as a continuous construct, accumulating over time with repeated exposure to salient experiences and influenced by the nature of those experiences such that more painful and provocative experiences will confer greater capacity for suicide (Joiner, 2009).

The Interpersonal Theory of Suicide has been supported by research to be effective with a variety of different patient populations and diagnoses. One article found that women with bulimic-spectrum pathology saw an increase in suicidal ideation that was correlated with perceived burdensomeness and thwarted belongingness (Lieberman

et al., 2021). Another article found that perceived burdensomeness and thwarted belongingness were associated with suicidal ideation, and acquired capability was associated with suicidal individuals with autism spectrum disorder (Dow et al., 2021).

Overall, Dr. Thomas Joiner's Interpersonal Theory of Suicide captures the perceived burdensomeness and thwarted belongingness, which create the desire for suicide. While the acquired capability component captures the ability to enact self-injury or a suicide attempt, research has supported each individual element of Joiner's theory, as well as his theory as a whole.

### *Cognitive Behavioral Theory of Suicide*

The Cognitive Behavioral Theory of Suicide (CBT-SP) is based on a diathesis-stress model of suicidal behavior (Stanley et al., 2009). Theoretically, the diathesis for suicidal behavior includes a combination of factors, such as sex, religion, familial and genetic components, childhood experiences and psychosocial support system. In this model, stressors trigger suicidal behavior in the context of an individual who possesses the diathesis. Stressors include a variety of psychosocial events, such as interpersonal conflict, work, or school-related difficulties. CBT-SP acts to modify reactions to stressors both acutely and chronically in the context of vulnerability (Stanley et al., 2009). A central focus of CBT-SP is the identification of risk factors stressors, including emotional, cognitive, behavioral, and family processes active just prior to and following the adolescent's suicide attempt or recent suicidal crisis. This theory also focuses on the deficits individual's ability or motivation to cope with the suicidal crisis (Stanley et al., 2009).

CBT-SP is based on Dr. Aaron Beck's cognitive-behavioral model. According to this theory, an individual's biopsychosocial vulnerabilities can interact with suicidal thoughts and behaviors to produce a "suicide mode." Suicide is distinct from any medical or mental health conditions and can occur in the context of many diagnoses. Accordingly, treatment directly targets suicide-related thoughts and behaviors and is considered transdiagnostic in nature (CDP, 2016).

### *Shneidman's Cubic Model of Suicide*

Shneidman was an early pioneer of the psychological understanding and treatment of suicidality. In 1968, he founded the American Association of Suicidology and the principal US journal for suicide studies, Suicide and Life-Threatening Behavior (Models of Suicide, 2022). Until Shneidman, suicide was seen as the consequence of mental illness or derangement.

The "cubic model" of suicidality, states that there are three dimensions that are assessed for risk of completing suicide. The first is "psychache," this can also be interchanged with "mental pain," and/or "psychological pain" (Models of Suicide, 2022). Psychache refers to the nonsituation-specific, chronic hurt, anguish, or despair that causes individuals to seek escape from the pain (Models of Suicide, 2022). The second component of this theory is press, also known as stress. The third and final component is perturbation, which can also be referred to as agitation.

These three components are rated on a scale of one to five, with one being low and five being high. Shneidman's cubic model states when all three components are at a five, the risk for completed suicide is high (Models of Suicide, 2022). This model also

believes unendurable psychache is a central reason for why individuals consider suicide (Models of Suicide, 2022).

One study suggests that the concept of "psychache" is an important predictive factor to suicide among college students, according to Shneidman's cubic model (Montemarano et al., 2018). The same study also found that depression and hopelessness did not have the same predictive strength as psychache (Montemarano et al., 2018). Another study confirmed the validity of the psychache scale, and that individuals are motivated to escape psychache (Holden et al., 2001).

Shneidman's cubic model has been validated through multiple studies and been proved to be a commonly used theory in understanding a suicidal individual. Shniedman was a trailblazer in the field of suicide research and believed that suicide was a solution to the unendurable. Overall, this theory can contribute to the greater conversation surrounding the genetic and environmental impact of suicide.

***Integrated Motivational-Volitional Model of Suicide.***

The Integrated Motivational-Volitional Model (IMV) of Suicide proposes that defeat and entrapment drive the emergence of suicidal ideation and that a group of factors, entitled volitional moderators, govern the transition from suicidal ideation to suicidal behavior (Models of Suicide, 2022). According to the integrated motivational-volitional model. Volitional motivators include access to the means of suicide, exposure to suicidal behavior, capability of suicide (fearlessness about death and increased physical pain tolerance, planning, impulsivity, mental imagery, and past suicidal behavior (Models of Suicide, 2022).

The IMV model's development was guided by the principle of the desire to synthesize the extant evidence into a detailed theoretical framework that could make predictions about the factors that lead people to think about suicide and those factors which govern whether people act on their thoughts (O'Connor & Kirtley, 2018). Until Joiner proposed his interpersonal theory of suicide (IPT), for the most part, the theoretical literature did not account for the distinction between the prediction of ideation versus enaction. In this regard, the IMV model is a second-generation model, which, alongside the IPT is a theoretical perspective which explains the suicidal process consistent with the ideation-to-action framework (O'Connor & Kirtley, 2018). These more recent models specifically hypothesize that the factors leading to the development of suicidal thinking are distinct from those that govern behavioral enaction, i.e., attempting or dying by suicide (O'Connor & Kirtley, 2018).

Central to the motivational phase of the IMV model is the relationship between defeat, humiliation, and entrapment, leading to suicidal ideation (O'Connor & Kirtley, 2018). These elements are drawn from a concept known as 'arrested flight', which was adopted from evolutionary psychology and originally used to explain behavioral states observed in individuals with depression. Arrested flight describes the experience of feeling as though one has been brought down (defeated) and has no prospect of escape or rescue (entrapment) (O'Connor & Kirtley, 2018).

The final theoretical perspective drawn upon within the IMV model is the differential activation hypothesis, which poses that when an individual experiences distress, an association is formed between the feeling of distress and, in this case, suicidal ideation (O'Connor & Kirtley, 2018). Even once an individual is no longer acutely

distressed, these pathways lie dormant until triggered by a negative mood state or stress (O'Connor & Kirtley, 2018).

The IMV model is a three-phase biopsychosocial framework that delineates the final common pathway to suicidal ideation and behavior (O'Connor & Kirtley, 2018). As noted above, the pre-motivational phase describes the biopsychosocial context, identifying vulnerability factors and triggering negative events (O'Connor & Kirtley, 2018). The motivational and volitional phases are operationalized at two different levels. From a higher-order perspective, the core constructs of defeat/humiliation, entrapment, suicidal ideation, and suicidal behavior form the backbone of the model and span both phases.

Overall, the IVM model of suicide a contemporary ideation-to-action model of suicidal behavior. The tri-partite IMV model contends that suicide is a behavior, preceded by ideation and intention formation and, crucially, it seeks to explain the transition from suicidal ideation to behavioral enactment (O'Connor & Kirtley, 2018). The IVM model also has been empirically supported and is continuing to reaffirm the model's validity (O'Connor & Kirtley, 2018).

**The Genetic Impact on suicide**

The main focus of this literature review is to examine the impact of genetic and environmental influences on suicide. These topics have been researched since the early 20$^{th}$ century and are subjects of current research. These topics are imperative to explore in terms of how clinicians conceptualize, assess, and treat suicidal individuals. These topics are thought to be gaps in our current understanding of suicidality that need to be explored.

Research has been conducted that looks at the role of family hereditability in suicide. Rainer (1984) reviewed previous twin studies, adoption studies, and family histories for suicidal individuals. The study used surveys to collect data from 243 patients with a family history of suicide (Rainer, 1984). Of these 243 patients, 48.6 percent had attempted suicide, 56.4 percent had a depressive disorder, and 34.6 percent had a recurrent affective disorder (Rainer, 1984). Of the patients who did not have a family history of suicide, 21.8 percent of individuals had attempted suicide (Rainer 1984). The findings clearly show that there is an increase in suicide attempts among individuals with family history of suicide, compared to individuals without family history of suicide. This study contributes to the broader narrative of suicide being related to genetics, but it can be questioned whether the family impact is environmental or genetic in nature.

Twin studies have been a key method to examine if there is a genetic influence of suicide. Roy et al. (1991) reviewed 11 case studies involving suicidal monozygotic and dizygotic sets of twins. The authors reported that the rate for suicide for monozygotic twins (13.2%) was higher than dizygotic twins (0.7%) (Roy et al., 1991). Also, ten out of the eleven pairs had a first degree relative who had been hospitalized for a psychiatric condition (Rainer, 1984). These results were explained to be due to psychiatric disorders associated with suicide (Roy et al., 1991). The results from this review somewhat contradict the results from other sources that argue genetics influence suicide. The authors reviewed statistics from eleven case studies, and the results showed a clear inherited influence of suicidal behavior. It could not be determined whether the influence was due to a purely genetic influence, or the influence of a psychiatric condition. The issue of psychiatric conditions vs. genetics influences is common in the literature

(Thornton et al.,2016). Some believe that there is a genetic influence of psychiatric conditions, and some believe that it is an inherited genetics concern. This review overall adds to the overall discussion surrounding the role of the genetic contributions to suicide.

There are further studies among adults who exhibit suicidal behavior in relation to genetics. Roy (1992) found that there were 100 suicides in Vienna and Los Angeles. Six of them had parents who died by suicide, 88 times higher than the expected rate (Roy 1992). The author also reported that from a different study, 11% of 109 suicide attempters had a family history of suicide (Robins et al., 1957). The authors also reviewed a study by Egeland and Sussex (1985). This study reported on the 26 suicide victims from the Old Order Amish of Lancaster County in southeastern Pennsylvania from 1880 to 1980 (Egeland & Sussex, 1985). This study found that most families from this community had an affective, depressive, or bipolar disorder (Egeland & Sussex, 1985). A second finding is that almost three quarters of the 26 suicide victims' families had tendencies for affective disorders and suicide, compared to other families' tendencies to have an affective disorder and no suicide (Roy, 1992). It was concluded that the genetic transmission of psychiatric disorders contributed to the overall genetic influence of suicide. The findings from this review contribute to the genetic influence of suicide (Roy, 1992). The author reported from an Amish study that most of the families had some sort of an affective, depressive, and/or bipolar disorder in addition to being suicidal. However, psychiatric disorders were controlled for, and it was found the presence of a psychiatric disorder was not necessary for suicide. One limitation for this study was the small sample sizes, these results could not be generalized to a larger population without completing a study with a larger sample size.

Further research has been completed on twins to add to the understanding of genetics influencing suicide. Statham et al. (1998) conducted phone interviews with 5,995 twins from a previous twin panel survey. The authors reported that if an individual in this study had an identical twin attempt suicide, they were ten times more likely to also attempt suicide (Statham et al., 1998). This association was reported to be significantly stronger with identical twins than fraternal twins (Statham et al., 1998). It was also reported that the authors genetic model-fitting yielded a heritability of suicidality of approximately 45% (Statham et al., 1998). Major depression was found to be a strong predictor of suicide, as well as neuroticism, and social phobia (Statham et al., 1998). Individuals who reported a religious affiliation of Roman Catholic were less likely to report a suicide attempt. Psychiatric history, traumatic experiences, personality, and sociodemographic variables were a stronger predictor of suicidal thoughts/suicide attempts than genetic heritability (Statham et al., 1998). Even though psychiatric disorders were significant in predicting suicide attempts, the genetic influence was reported to be significantly independent of psychiatric disorders (Statham et al., 1998). Overall, this study somewhat confirms other sources that support the role of genetics in suicide. This study clearly shows genetics causing an increase in suicide attempts in twins. However, there was also strong evidence for psychiatric conditions, sociodemographic variables, and suicide attempts. The authors were able to control for both genetic influence and psychiatric conditions, and they were significant independent of each other. This is a key finding due to the evidence for and against genetic influence due to psychiatric conditions. One limitation of this study was that the participants were

not assessed for a history of suicidal thoughts/behaviors. This research contributes to the overall narrative of the genetic influence of suicide.

There have been further studies that have examined the role of depression in the genetic influence of suicide. Roy et al (1999) conducted a literature review and found that there are confounds to many studies focused on the genetics of suicide. One of these confounds is the subjects may have nongenetic exposure to family violence, low parental involvement, and/or imitation of suicidal behavior by a family member (Roy et al., 1999). The second reported confound is that the genetic transmission of psychiatric disorders that are associated with suicide (e.g., schizophrenia, depressive disorders, and substance use disorders) are responsible for the higher rate of suicidal behavior (Roy et al., 1999). The authors also concluded that there is a lack of studies that result in unilateral pairs of suicides in families, therefore they suggest the genetic influence of suicide is polygenic (Roy et al., 1999). The results from this review somewhat contradict the sources that argue genetics have an influence on suicide. The authors found that there has been a lack of research and findings that discuss the nongenetic familial influence of suicide. The confounds the authors listed could be considered environmental effects of suicide. Another confound was the role of psychiatric disorders in the genetic influence of suicide. A major debate in the genetics of suicide is if psychiatric conditions are an environmental or genetic influence. This review suggests that psychiatric influences could be environmental, while psychiatric disorders that influence suicide are possibly genetic rather than suicide itself being genetic. This review contributes to the overall discussion of the influence of genetics in suicide.

Research involving the role of genetics and neurotransmitters in regard to suicide has been conducted. Mitchell et al. (2000) reviewed literature regarding the role of genetics, and the serotonergic system in influencing suicide. The authors reviewed a study that found four clusters of Amish families who had multiple suicide deaths (Mitchell et al., 2020). They stated that "The clustering of suicide in Amish pedigrees follows the distribution of affective illness in the kinship and suggests a role of inheritance" (Egeland & Sussex, 1985). This study also found that the serotonergic abnormalities could influence violent and impulsive behavior (Egeland & Sussex, 1985). This evidence somewhat confirms the other studies that endorse genetics being related to suicide. The findings from Mitchell et al. (2000) suggest that genetics can be clearly linked to suicide. However, the population sample size studied was small compared to other similar studies. Also, serotonin abnormalities linked to behaviors that could lead to suicide but were not a predictive factor of suicide.

Serotonin and twin studies have been researched to examine the hereditability of suicide. Kamali et al. (2001) reviewed literature relating to twin studies that show the heritability of suicide, as well as the role of serotonin. The authors found a study that examined 399 pairs of twins, with monozygotic pairs having 13.2 percent concordance rate for suicide, compared to dizygotic pairs having a 0.7 percent concordance rate (Roy et al. 1995). Kamali et al., (2001) found that decreased serotonin levels were associated with depression and other mental health concerns that could lead to suicide. The findings from the review have aligned with other articles regarding serotonin levels causing the genetic influence of suicide (Stanley & Mann, 1983). Kamali et al. (2001) stated that they could not definitively say whether the genetic heritability was due to suicide or due to a

family mental health diagnosis. This continues to confirm the possibility that suicide could be linked to genetics, the environment, and serotonin.

Twin studies have been a common in examining the relationship between genetics and suicide. Roy and Segal (2001) conducted this study to attempt to replicate findings from previous studies that found monozygotic twins were at a higher risk for suicide than dizygotic twins. The authors collected data on 28 new pairs of twins in which one twin died by suicide (Roy & Segal, 2001). In this study, it was found that four out of the 13 monozygotic twins were concordant for suicidal behavior compared to the zero of the 15 dizygotic twin pairs (Roy & Segal, 2001). The authors discussed these results confirming their own previous research as well as seven previous studies with 452 twin pairs that found monozygotic twins were at more risk of suicide than dizygotic twin pairs (Roy & Segal, 2001). It was also discussed how suicide is a multidetermined act, involving psychodynamic, psychiatric, socio-economic, and biological determinants (Roy & Segal, 2001). The findings from this study contribute to the literature regarding the genetic influence of suicide. The authors found that monozygotic twins were more likely to die by suicide compared to dizygotic twins (Roy & Segal, 2001). The literature surrounding twin studies have produced similar results. Monozygotic twins have the same genes, therefore have less genetic variability compared to dizygotic twins. These studies have shown that if one twin dies by suicide, it is more likely that a monozygotic twin will die by suicide based on the genetic similarity. These findings continue to support the literature surrounding twin studies and the genetic influence of suicide (Stanley & Mann, 1983).

Another article examined the idea of genetic predisposition towards suicidal behaviors. Turecki (2001) reviewed the literature surrounding genetic predisposition and previous family studies relating to suicide. They reported that in a twin study with 6000 subjects, genetic factors accounted for 45% of the variance in suicidal thoughts and 55% of the variance in suicide attempts (Statham et al., 1998). The author also described the term "gene candidate" which describes a gene that could be a good match for suicidal genetic predisposition. Turecki (2001) stated that the serotonin receptor 2A would be a good gene candidate due to several postmortem studies done on suicidal individuals (Stanley & Mann, 1983). This study confirms the possibility of genes being a factor to suicide. It also confirms serotonin as being a possible neurotransmitter associated with suicidal behaviors. This review continues to add to the possibility that genetics are related to suicide. However, the author reported that further research needed to be done in order to clearly separate environmental family mental health factors from genetic influence.

Major depression and suicidal behavior have been known to alter the serotonergic system, and the following review of the literature discusses further the role of serotonin and suicide. Mann et al. (2001) discussed how previous studies reported that the decrease in serotonin receptor sites can lead to major depression. The authors also stated that alcoholism, aggression, impulsivity, and substance use all carry an elevated risk for suicide (Mann et al., 2001). These factors are also associated with serotonergic abnormalities. Mann et al., (2001) concluded that many serotonergic abnormalities have been found in individuals who attempted and completed suicide. The evidence from this review reaffirms other sources that state that genetics affect suicide (Roy, 1992). The

findings of Mann et al. (2001) clearly show that the less serotonin receptor sites someone has in the brain increases risk in suicide.

Twin studies have been known to be associated with attempting to find out if genetics do influence suicide. The following study was carried out with 3,416 adolescent female twins. Gowinski et al. (2001) found that monozygotic twins were more likely to have a suicide attempt than dizygotic twins, other siblings, biological parents, and other relatives. The authors described not knowing whether the familial influence of suicide attempts was genetic or environmental. Gowinski et al. (2001) also found that 46.1% of subjects reporting a suicide attempt had one alcohol dependent parent. The evidence from this study somewhat confirmed other sources that used twin studies to argue that genetics do have an effect on suicide. Twin studies have been shown in previous research to confirm the genetic impact of suicide (Roy & Segal, 2001). This study's findings further confirms that evidence. The authors could not definitively deny the role of the environment in their study and reported that 41.6% of individuals had an alcohol-dependent parent. This factor could be viewed as environmental and contributing to the environmental impact on suicide. Also, one limitation of this study was the subjects were only female, these results could not be generalized to anyone who is not female identifying.

One research article has focused on the genetic influences of suicidality on men, while controlling for psychiatric disorders. Fu et al. (2002) gathered 7,369 male-male twin pairs that were born between 1939 and 1957 where both siblings served active-duty military during the Vietnam era. The overall heritability estimates of suicide without controlling for psychiatric disorders was 47% (Fu et al., 2002). Alternatively, the estimate

for total familial effects, including shared environmental effects, on a suicide attempt were 49% (Fu et al., 2002). When the authors controlled for the effects of psychiatric disorders, the heritability estimates for suicidal behavior were decreased but remained significant while the shared environmental effects were not significant (Fu et al., 2002). The evidence from this study has somewhat contributed to the argument that genetics do influence suicide. Fu et al. (2002) clearly found a relationship between genetics and suicide through their twin study. On the other hand, they also found a relationship between shared environmental factors that were just as strong. When they included the factor of psychiatric disorders, both genetics and shared environment estimates decreased. Although, the genetics estimate did stay statistically significant. This contributes to the broader idea of genetics affecting suicide, but also adding to environmental effects for suicide.

Additional research has been done on trying to discover if suicide is heritable. Baldessarini and Hennen (2004) gathered research involving the genetics of suicide risk, this research included twin and adoption studies. The authors reported that more than 20 studies consistently indicated that the risk of suicidal behavior increased by three times when a first-degree relative who had been suicidal, depressed, or somewhat mentally ill (Baldessarini & Hennen, 2004). On the other hand, the studies failed to distinguish whether the increased suicidal risk was due to environmental or genetic causes. Baldessarini and Hennen (2004) concluded that polygenic inheritance is widely suspected in the genetic influence of suicide, but there is no established genetic model and mode of inheritance. This article somewhat confirmed and denied other sources that argue genetics influence suicide. The authors clearly found a relationship between increased

suicidal behaviors and first-degree relative suicidality, depression, and other mental health concerns. But the authors could not definitively say this increase was due to genetics. Overall, this adds to the broader idea that genetics could influence suicide, as well as poses an alternative viewpoint that suicide could be caused by a multitude of genetic causes.

The neurochemistry of suicidal behavior has also been research in regard to genetics. Bondy et al. (2006) conducted a literature review surrounding the genetics of suicide, specifically serotonin related neurotransmitters. They found that Post-mortem studies with brains of suicide victims revealed evidence for reduced serotonin transporter sites in the prefrontal cortex, hypothalamus, occipital cortex, and brainstem (Mann et al. 1996). Mann et al. (2003) stated, low serotonergic input might contribute to impaired inhibition, creating a greater propensity to act on suicidal or aggressive feelings. This review supports other studies that state the neurotransmitter serotonin can be linked to the genetics of suicide (Stanley & Mann, 1983). The findings show that the smaller the serotonin receptor site, the increased likelihood of suicide. This continues to build towards the idea that genetics can influence suicide through neurotransmitters.

The adolescent population has been used to determine whether there could be a relationship between genetics and suicide. Cho et al. (2006) completed a study on adolescent twin suicide rates using a national data set. The authors described wanting to further the research on the hereditability of suicide and risk factors associated with suicide. The sample set of this study was 1448 participants. Cho et al. (2006) Found that monozygotic or identical twins are more likely to have suicidal ideation/attempts compared to dizygotic or fraternal twins. However, the authors described this difference

to not be statistically significant (Cho et al., 2006). This evidence somewhat contradicts other studies that support genetics being related to suicide. The findings of Cho et al. (2006) somewhat show a genetic influence of suicide, but not enough of a difference to firmly say genetics were definitely related to suicide. This contributes to the possibility that genetics and suicide are related, but it also continues to raise doubts on the strength of the relationship between the suicide and genetics.

Another study has focused on the genetic link of suicide with individuals with affective disorder and bipolar disorders. Cavazzoni et al. (2007) examined the distribution of suicide attempts and completed suicides in 539 subjects from 78 families with affective and bipolar disorders. The authors found that families fell into one of three groups corresponding to a low (<0.1%), intermediate (17.8%), and high risk (87.8%) risk for suicide in affectively ill subjects (Cavazzoni et al., 2007). It was also found that families that had a high prevalence of bipolar disorder were at a higher risk of becoming affectively ill and attempting/completing suicide during the course of their mental illness (Cavazzoni et al., 2007). The authors also discussed their relatively small sample size, and how an increased sample size would give a better indication of the relationship between bipolar disorder and suicide. These results somewhat coincides with other articles relating to genetics influencing suicide. Cavazzoni et al. (2007) showed that there is a link between suicide among families with affective and bipolar disorders. It did not show whether or not the suicide was caused by a genetic predisposition to suicide or by a history of mental health concerns. This continues to build and add to the idea that there could be a link between suicide and genetics. Conversely, there is still research that needs

to be done to separate the factors of mental health disorders and suicide in order to definitively say that there is a link between suicide and genetics.

Dr. Thomas Joiner created the Interpersonal Theory of Suicide, and wrote a book called *Why People Die by Suicide*. In this book he reported on the genetic and neurobiology of suicide. Joiner (2007) states that twin studies 13% to 19% were concordant for death by suicide, compared to dizygotic twin pairs which were less than 1%. The book also states that a family history of suicide increases suicide risk twofold (Joiner, 2007). Joiner also discusses the role of serotonin in his book. The serotonin transporter gene was highlighted due to its ability to control how much serotonin gets to neurons in the brain (Joiner, 2007). Also, the author discusses genotypes that could contribute to suicide. Specifically, there is an emerging consensus that the *s*/*s* genotype have more dysregulated serotonin systems than others with different genotypes (Joiner, 2007). The author referenced a postmortem study that found the *s*/*s* genotype to be more common in suicide victims than other genotypes, although the difference was not statistically significant (Mann et al., 2000). The evidence from this book chapter further confirms the role of genetics in suicide. The chapter summarizes common themes of serotonin, twin studies, and genotypes as evidence for the genetic influence on suicide. The author goes on further to discuss the environmental impact in terms of personality and impulsivity. This adds to the broader narrative that suicide is influenced by genetics in a multitude of ways, the author also contributes somewhat to the environmental impact of suicide.

Research has been completed on the neurotransmitter serotonin and candidate genes in relation to suicide and genetics. Carballo et al. (2008) reviewed the literature and

discussed the concept of a "Endophenotype." Which is a 'measurable component along the pathway between disease and distal genotype (Carballo et al., 2008). The authors delved into clinical endophenotypes, which include hopelessness, neuroticism, impulsivity, and aggression. These clinical endophenotypes can be viewed as predictive factors to suicide. Carballo et al. (2008) also discussed neurochemical endophenotypes, and these include serotonin and cerebrospinal fluid (CSF). Serotonin has been a well-known neurotransmitter that involves emotional and cognitive functions including suicidal behavior (Carballo et al., 2008). CSF was also described to transport serotonin neurotransmitters to the brain (Carballo et al., 2008). According to Carballo et al. (2008) the relationship between the clinical endophenotype impulsivity, and neurochemical endophenotypes serotonin and CSF lead to the hypothesis that the lack of serotonergic functioning can possibly cause impulsive suicidal behavior (Carballo et al., 2008). The authors describe it being unlikely that there is one dominant gene responsible that suicide is dependent on. Rather, they hypothesize that a combination of multiple genes is at play for the genetic influence of suicide. This evidence confirms that of other studies that state serotonin has an influence in the genetic relationship of suicide. The findings from Carballo et al. (2008) clearly describe the lack serotonin transmitters and receptors being prominent in suicidal individuals. This continues to add to the idea that genetics have a key role in how we understand suicide.

One study wanted to examine if children of parents who were admitted for psychiatric hospitalization were at more risk for suicide compared to children's parents who were hospitalized for an accident. Kuramoto et al. (2010) used children and adolescents 0-17 years of age who experienced maternal (N =5,600) and paternal (N =

17,847) in 1973-2003 in Sweden. The authors found that maternal descendants had increased risk for a suicide attempt (Kuramoto et al., 2010). Children of paternal suicide had a significant increase in suicide attempt hospitalizations, this was attributable to anxiety and depressive disorders. Overall, children who experienced a parent suicide were more likely to be hospitalized for suicide than the control group (Kuramoto et al., 2010). The evidence from this study neither confirms nor denies the genetic influence on suicide. The authors found that there is an increased risk of suicide attempt hospitalization for children who either mother or father had a suicide attempt hospitalization. The article did not conclude whether these results were due to environmental causes of genetic causes. Arguments can be made for both an environment and genetic influence in this study.

Research has been conducted on familial clustering of suicide risk. Tidemalm et al. (2011) wanted to expand the research surrounding the aggregation of suicide in families. The authors used familial clustering of completed suicide in a Swedish total population sample and compared suicide rates among relatives of all 83,951 suicide decedents from 1952–2003 with those among relatives of population controls (Tidemalm et al., 2011). The results from this study found the genetic risk of suicide among full siblings was 50%, compared to half-siblings which was 25% (Tidemalm et al., 2011). They also found that monozygotic twins (100%) were at higher genetic risk for suicide than dizygotic twins (50%), while cousins had a higher genetic effect that the control (Tidemalm et al., 2011). Finally, the authors reported that shared environmental factors play a role in suicide, this was reported to be due to the shared environment siblings of individuals who died by suicide (Tidemalm et al., 2011). The results from this study have

somewhat supported other studies that argue genetics influence suicide (Roy, 1992). The authors found that full siblings of individuals were at higher genetic risk for suicide compared to half siblings. Monozygotic twins were also found to be at a higher risk for suicide than dizygotic twins. The literature has firmly supported twin studies being indicative of genetic influence of suicide (Roy & Segal, 2001). Environmental influences could not be ruled out of this study, and this has been a consistent them across the literature (Roy & Segal, 2001). Overall, this study contributes and reaffirms the case for the genetic influence of suicide.

Additional research has been conducted on the role of serotonin and the genetic influence of suicide. Wang et al. (2018) used 516 cases from previous studies as the sample for their study. The authors wanted to further the understanding of the role of the genetic influence of the serotonergic system on suicide, due to previous research being unclear on the subject. It was found that there were some initial associations between specific serotonin genes, but the significance did not survive the correction for multiple testing (Judy et al., 2012). It was discussed that possible gene-gene interactions and susceptibility variants could be the cause of these findings (Judy et al., 2012). The evidence from this study contradicts other studies that support the genetic influence on suicide, and specifically serotonins influence on suicide (Stanley & Mann, 1983). The authors did not find a relationship between serotonin pathways and suicide. Limitations of this study included its sample size and lack of ability to detect more sensitive variants in the serotonergic system. Serotonin has been investigated in influencing suicide due to its role in mood regulation and association with some psychiatric disorders. Overall, this study contributes to the narrative surrounding the genetic influence of suicide.

Adoption studies are commonly used to examine the genetics of suicide, and further research has been done on this topic. Petersen et al. (2014) studied familial environmental factors by studying the occurrence of suicide attempts in biological and adoptive siblings of adoptees who attempted suicide compared to siblings of adoptees with no suicide attempt. The study was based on the Danish Adoptive Register, which contains records on all 14,425 non-familial adoptions (Petersen et al., 2014). The authors findings showed that rate of attempted suicide has a genetic basis in that rate was elevated more than three times than in full biological siblings of adoptees who attempted suicide. However, the genetic associations appeared to be independent of psychiatric admissions, the mechanisms involved in genetic transmission of risk of suicidal behavior may imply undiagnosed psychiatric conditions or psychological pathways under genetic control (Petersen et al., 2014). This research has confirmed the other sources that argue suicide is influenced by genetics (Statham et al., 1998). The authors clearly found that full biological siblings of adoptees were three times more likely to attempt suicide. The authors could not definitively rule out or control for psychiatric disorders as an explanation for the increase in suicide attempts. These results can be further evidence for the role of genetics in suicide, but the lack of control for psychiatric disorders could be viewed as shared environment characteristics having an influence on suicide.

Genome wide association studies have been a common way of examining the relationship between genes and suicide. Sokolowski et al. (2014) conducted a review of genome wide association studies and evaluated their ability to determine if genes do influence suicide. The authors found that there were eight total genome wide association studies specifically examining suicide (Sokolowski et al., 2014). It was also found that

with these eight studies, the genetic influence was not independent of psychiatric conditions, which was listed as a limitation (Sokolowski et al., 2014). Another finding from this review is that the hereditability of suicide is between five and ten percent across studies (Sokolowski et al., 2014). A limitation to genome wide association studies is that the replication of their high sample sizes would be difficult to replicate (Sokolowski et al., 2014). Finally, the authors found that genome wide association studies did not detect specific gene variants, and focused on too many "common" variants, which was posed as a limitation. (Sokolowski et al., 2014). This study somewhat confirms other sources that endorse a genetic influence for suicide. The authors examined the methods and findings from genome wide association studies. They discovered that these studies did find a significant influence of genetics on suicide. However, they did raise concerns over common issues regarding the influence of psychiatric disorders and sample sizes in these types of studies. Genome wide association studies play a key role in the understanding of genetics and suicide. This type of study has possible limitations highlighted by this study but is supported to examine this topic. This review contributes to the overall narrative of the genetic influence of suicide.

The clinical and genetic factors associated with suicide have also been researched. Antypa et al. (2016) studied clinical and genetic factors associated with suicide in mood disorder patients. The mood disorders that were specifically studied were major depressive (MDD) and bipolar disorders (BD). The authors found that individuals with specific gene markers (MAPK1 & CREB1, year) would be more susceptible to suicide than those without those gene markers (Antypa et al., 2016). Within this study, another article was cited that stated the heritability of a suicide attempt is 40% (Mcguffin et al.,

2001). Antypa et al. (2016) also discussed how the precise genetic predisposition of suicide could not be fully understood as of yet, dysregulation in the neurotransmission of serotonin can lead to impulsivity and/or suicidal behavior. A clinical factor that the authors found to be the most impactful for suicide was anxiety (Antypa et al., 2016). The evidence somewhat coincided with the other sources that hypothesize genetics having an influence on suicide. The findings from Antypa et al. (2016) discussed specific gene markers that could be linked to suicide. The authors also discussed the role of serotonin as being an established as strong neurobiological evidence of suicide. Antypa et al. (2016) also discussed how anxiety was shown to increase suicidality in this study as a clinical or environmental factor. Overall, this adds to builds the idea that suicide is influenced by genetics.

One study focused on the underlying genetic predispositions between anorexia nervosa (AN), major depressive disorder (MDD), and suicide attempts (SA). Thornton et al. (2016) used 6,899 female twin participants and wanted to see the overlapping genetic and environmental influence. The authors found that AN, MDD and SA were all influenced by shared genetic factors (Thornton et al., 2016). They discussed their results revealed the proportion of genetic variance in liability to a trait attributable to genetic factors and estimating to which extent genetic and environmental factors are shared among phenotypes (Thornton et al., 2016). One relevant limitation to this study is that it was completed with only Swedish participants. This limits the results from being applied to broader populations. The evidence from this study has confirmed other sources that hypothesize genetics can influence suicide. Even though the sample set was limited, this

information can be added to the larger idea that genetics play a role in influencing suicide.

The relationship between depression, genetic risk factors, and suicidal ideation has been examined in the current literature. Dutta et al. (2017) assessed for active and passive suicidal ideation in a Sri Lankan population-based twin registry with 3,906 twins and a 2,016 non-twin sample. The authors found a lifetime prevalence of suicidal ideation of 13.0% in men, and 21.8% in women (Dutta et al., 2017). There was also no reported difference in suicidal ideation between the twin and non-twin samples (Dutta et al., 2017). Environmental factors that were strongly associated with suicidal ideation were depression, abnormal fatigue, alcohol use, and tobacco use (Dutta et al., 2017). It was also found that genetic inheritance accounted for 57% of the heritability, but this finding was mediated by the environmental factor of depression in women (Dutta et al., 2017). The genetic heritability of men was found to be independent of depression (Dutta et al., 2017). The results of this study somewhat confirmed other sources that support genetics influencing suicide. The genetic influence for suicidal ideation was found to be more prevalent in women than men. However, depression was found to be a mediating factor in women and not men. The authors also could not rule out environmental factors in their findings. Findings that there is a genetic risk of suicide, but also environmental influences that could alter the results of the study has been a common trend in the literature (Tidemalm et al., 2011). Whether environmental influences can be independent of the genetic influence of suicide remains to be a vital question in the literature.

Additional research has been conducted on the genetic influence of suicide through chromosomes. Fiori et al. (2011) used 333 French Canadian participants who

died by suicide, as well as 389 participants who did not die by suicide. The authors wanted to specifically examine the X chromosome due biological males having higher rates of suicides (Fiori et al., 2011). The results of this study found there were five specific chromosomal markers and nine chromosomal marker pairs that are associated with suicide (Fiori et al., 2011). When the factor of depression was accounted for, several other chromosomal markers were considered significant for suicide (Fiori et al., 2011). One of the aims of this study was to identify genetic factors that may explain the gender moderation of suicide risk (Fiori et al., 2011). The result of this study further supports the argument that genetics influence suicide. There has been some research to date about how chromosome influence suicide. This research is imperative to finding out whether genetics do in fact play a role in suicide. The authors clearly found specific chromosomal markers that can be associated with suicide in both men and women. They also confirmed their hypothesis that there are inherit genetic risks of suicide by being a biological male. One limitation of this study is it was conducted with a French-Canadian population. Further studies would need to be conducted with broader sample sets in order for the results to be generalized to other populations. This study continues to add to the mounting evidence that genetics do affect suicide.

Further studies have been done on the role of serotonin, adrenaline. gamma-aminobutyric acid (GABA), family studies, and twin studies with suicide. Aydin et al. (2019) review of the literature discussed how serotonin is the most investigated neuromodulator in suicide and suicidal behavior. They also report the serotonergic system is associated with depression and impulsive-aggressive behaviors, which could lead to suicide (Aydin et al., 2019). The authors also discuss the role of adrenaline and

suicide. They state that adrenaline can have effects on cognitive functioning, which could lead to suicide. One of the findings from their review found that in post-mortem studies, it was found that the hypothalamus and frontal cortex had increased adrenaline receptors (Aydin et al., 2019). The authors also found inadequate evidence in the role of GABA in suicide due to the lack of studies on the subject. It was also discussed how the transmission of suicidal behavior is highly familial. This is due to the transmission of intermediate phenotypes such as impulsivity, neuroticism, and aggression (Brent & Melhem, 2008). Twin studies were reported to have better control of shared environmental effects, and it is estimated that the hereditability of suicide is between 21% and 50% (Aydin et al., 2019). The findings from this review somewhat confirm other studies that show support for the influence of genetics on suicide. The role of serotonin has been further confirmed to play a significant role in the hereditability of suicide in this study. The further research on family and twin studies have also added to the conversation. Aydin et al. (2019) reporting a 21% to 50% hereditability rate of suicide in the twin study is a strong argument for the case of genetics and suicide. GABA was also found to not play a role in suicide in multiple studies. This furthers the conversation surrounding the multifaceted nature of suicide and genetics.

Research has been conducted on the potential role of bipolar disorder (BD) as a genetic risk factor for suicide. Mania et al. (2019) conducted a literature review surrounding the analysis of data for sociodemographic, genetic, and clinical risk factors for suicide in BD. The authors discussed how the evidence for this topic is preliminary, and no genetic factors were found to have a strong effect on suicide in BD (Mania et al., 2019). However, the authors did discuss the role of a few genetic polymorphisms,

neurobiological alterations, and peripheral biomarkers abnormalities have been found to be correlated to suicide in preliminary studies (Mania et al., 2019). The results from this study somewhat align with other studies that suggest a genetic influence on suicide. There was not strong evidence relating to genetics influencing suicide. Though, there have been preliminary studies that suggest genetics, biomarkers, and neurobiological alterations could be targets of future studies. The authors of this study discussed how these preliminary results needed to be replicated in order to further support the genetic risk factors for suicide in BD.

Genome-wide association studies have been completed with participants of European origin. However, a genome wide association study has also been conducted on the Japanese population. Otsuka et al. (2019) wanted to examine the heritability of suicide in the Japanese population due to the disproportionately high suicide rate in Japan compared to the rest of the globe. In this study, the authors combined two separate datasets to get 746 suicides and 14,049 non-suicide controls in the Japanese population (Otsuka et al., 2019). One finding from this study was that specific gene was not found to cause heritability in suicide (Otsuka et al., 2019). The authors explained this could be due to the genetic variability in psychiatric conditions associated with suicide and regional differences in Japan (Otsuka et al., 2019). It was also found that a shared gene in both data sets related to age could support genetics influencing suicide (Otsuka et al., 2019). The evidence from this study somewhat goes against other sources that claim genetics influence suicide. The authors did not find a specific gene tied to suicide when other genome wide associations have found specific genes (Tumolo, 2022). This could be due to the population set not being of European origin. However, the authors found a specific

gene in younger cohorts that died by suicide. This suggests that future studies could be conducted on younger participants in order to further see if genetics influence suicide. This study contributes to the overall narrative of genetics and suicide.

Further research has been conducted on genome-wide association studies in regard to the genetic heritability of suicide. Erlangsen et al. (2020) wanted to examine the heritability for a suicide attempt with a sample set with individuals who were born in Denmark after 1981 and were diagnosed with severe mental disorders prior to 2013 (n = 57,377). The authors found the heritability of suicide within this sample set was 4.6% (Erlangsen et al., 2020). It was also reported that this percentage was much less than previous twin studies, and this was due from the lack of control surrounding social contamination (Erlangsen et al., 2020). The heritability of suicide was also found to be less impactful when accounting for mental health disorders such as schizophrenia and ADHD (Erlangsen et al., 2020). However, it was found that the heritability for suicide increased to 9.6% when accounting for individuals with autism spectrum disorder (Erlangsen et al., 2020). The authors also could not confidently say that their results regarding genetic risk of suicide were not better explained by mental health disorders. The results from this study somewhat contradict other sources arguing that genetics do have an influence on suicide. Genetic heritability was found in the sample set used by the authors, but the results were not significant when accounting for mental health conditions. The authors indicated that future studies should be focused on trying to discover the evidence of genetic influence of suicide independent of mental health conditions. Some researchers consider the role of mental health disorders to be environmental due to its influence on suicide, as well as genetic if the disorder is

commonly associated with suicide. Overall, this research adds to the narrative surrounding genetics and suicide.

Research has been conducted to examine the shared heritability of a suicide attempt. Ruderfer et al. (2020) wanted to investigate the genetic influence of suicide as well as the clinically predicted probability of attempting suicide. The authors conducted two large scale genetic analysis of suicide attempts based on population samples (Ruderfer et al., 2020). One from a national effort with direct assessment of suicide attempt through online questionnaire and one from a hospital system where suicide attempt risk was predicted based entirely on clinical features from electronic heath records data. (Ruderfer et al., 2020). The authors found that in each population sample, the genetic risk for suicide was 4% (Ruderfer et al., 2020). It was also found that this genetic risk was not independent of psychiatric disorders such as major depressive disorder and neuroticism (Ruderfer et al., 2020). Insomnia was found to be strongly genetically correlated with psychiatric disorders and suicide attempts (Ruderfer et al., 2020). Overall, the results from this study somewhat contradict the evidence from other sources regarding the genetic risk of suicide. However, the authors clearly found multiple influences on the genetic inheritance of suicide. The role of psychiatric disorders has been debated in the genetic influence of suicide. Insomnia is also an emerging factor in influencing the heritability of suicide. Future research needs to be conducted to discover if genetics can be totally independent of psychiatric disorders when examining influences of suicide.

Research has been conducted on the genetic influence of suicide and substance use disorders. Colbert et al. (2021) used a genome-wide association study as their main

method of examining data. They found several key findings in their study. Firstly, they found correlations between suicide attempts, deaths, and self-harm behavior (Colbert et al., 2021). Secondly, it was found that substance use disorders were correlated with suicide related behavior (Colbert et al., 2021). Thirdly, the correlation between substance use disorders and suicide-related behaviors withstood genetic contributions from depression and risk tolerance (Colbert et al., 2021). Lastly, some substance use disorders appeared to be more closely genetically related to certain suicide-related behaviors, indicating possible specificity (Colbert et al., 2021). One limitation of this study was it was unable to specifically identify genetic influences of suicide-related behaviors. Overall, this study somewhat goes against sources that support a genetic influence for suicide. The authors found significant correlations with substance use disorders generally, and with specific substance use disorders. These correlations were in spite of variables such as depression and risk tolerance. This finding is impactful due to the strong correlation between depression and suicide across many studies. The authors did not indicate that genetics influenced suicide on their own without the effect of substance use disorders. This goes against previous studies that support this theory (Roy, 1992). This study also adds new information to the narrative of the genetic influence of suicide due to the lack of studies found on the effect of substance use disorders and the genetic influence of suicide.

Further studies have been done on the genetic contributions to suicidal thoughts and behaviors. DiBlasi et al. (2021) wanted to examine the literature surrounding the genetic architecture of suicide when it comes to the phenotypes of suicide, suicidal ideation, suicide attempts, and deaths by suicide. The authors the data source UK

Biobank for the data in their review. One of the results from this review discussed the genetic influence of suicide across the ancestry of different races. They found that it was unclear whether or not there could be significant genetic correlations can be observed across cohorts of different ancestries (DiBlasi et al., 2021). It was also found that the strongest genetic correlation for suicidal ideation was major depressive disorder (DiBlasi et al., 2021). The genetic risk of a suicide attempt was found to be strongly correlated with the risk of major depressive disorder, but there was also evidence that supported the genetic risk of suicide independent of psychiatric conditions (DiBlasi et al., 2021). The results from this study have found evidence that strengthens the claim of genetics influencing suicide. The authors found that the genetic inheritance of psychiatric disorders influences suicidal ideation and suicide attempts. They also found that suicide attempts could have a genetic influence independent of psychiatric disorders. However, the authors could not confidently say that this genetic influence could be generalized to a diverse set of ancestries. In addition to other sources, this review adds to the growing evidence for a genetic influence of suicide. But there are concerns, such as the applicability of these findings to a diverse set of individuals.

There have been additional studies on trying to confirm whether suicide has genetic or environmental causes. Edwards et al. (2021) study wanted to examine the extent to which the genetic and environmental etiology of suicide attempts and suicide death is shared or unique. The authors used Swedish national registry data for a large cohort of twins, full siblings, and half siblings (N=1,314,990) born between 1960 and 1990 and followed through 2015 (Edwards et al., 2021). It was found that suicide attempt and death are moderately hereditable, and substantially, but not completely genetically

correlated (Edwards et al., 2021). There were also modest environmental correlations with suicide (Edwards et al., 2021). The authors concluded that both genetic and environmental influences on risk are temporally dynamic, particularly among men (Edwards et al., 2021). The findings from this study supported other sources that claim genetics influence suicide. It also partially supports an environmental impact on suicide. The study found that suicide attempts, and deaths were moderately heritable in this set of Swedish twins. This adds to the narrative that genetics/heritability do affect suicide, but it cannot be definitively confirmed due to environmental impacts.

Research has been conducted on the genetic risk for adult suicide attempts and suicidal behaviors in young children. Lee et al. (2022) wanted to examine whether genetic susceptibility to suicide attempts is associated with suicidal thoughts and behaviors in children. The data was gathered and analyzed the Adolescent Brain Cognitive Development study, with 11,878 participants being used in the study. The authors found among the participants, the risk for suicide attempts increased three times from baseline to follow-up year two (Lee et al., 2022). While suicidal ideation nearly doubled in the same time frame (Lee et al., 2022). Also, the authors measured polygenic risk scores (PRSs), which represent the additive genome-wide genetic risk each individual carries (Lee et al., 2022). The authors found that adult suicide attempts and PRSs were statistically significant when youth suicide attempts rose (Lee et al., 2022). This was not found to be true for suicidal ideation within the study (Lee et al., 2022). The effects of major depressive disorder (MDD) and attention deficit hyperactivity disorder (ADHD) were examined to see whether PRSs and suicide attempts were independent of these psychiatric conditions. The results were that ADHD and MDD were significantly

associated with children's suicide attempts and suicidal ideation (Lee et al., 2022). However, it was also found that PRSs and children's suicide attempts were significant independent of MDD and ADHD (Lee et al., 2022). Lastly, the authors examined the effect of other environmental factors on children's suicide attempts. They found that single parent status and lack of parents' college education were the most significant correlates of children's suicide attempts (Lee et al., 2022). The evidence from this study supports the argument that genetics influence suicide. The authors clearly found that suicide attempts influenced by genetics rose in children, independent of psychiatric conditions and other environmental factors. The presence of psychiatric conditions in suicidal individuals has been well supported throughout the literature (DiBlasi et al., 2021). The independence of psychiatric conditions, whether inherited or not, from the genetics of suicide is one of the key concerns for researchers. Overall, this study continues to build support for the independent genetic risk of suicide, while affirming that psychiatric conditions do play a role in influencing suicide.

Research has been done on the genetic effect of self-injurious thoughts and behaviors. Mirza et al. (2022) reviewed the methodological considerations surrounding suicide genetic research. One of the results of the review discussed how the instruments used across studies varied greatly, collapsing suicide phenotypes together (Mirza et al., 2022). The authors suggest that this could leave out important patterns, especially in suicidal thoughts compared to behaviors. Another finding was that other studies excluded participants that could have neurological disorders, intellectual disability, and substance use disorders (Mirza et al., 2022). Also, the authors found the limitation of age in many studies (Mirza et al., 2022). They found only one genome wide association study that

targeted youth, compared to many studies with high mean ages (Mirza et al., 2022). This review claims that there is a lack of understanding surrounding how much is shared vs. distinct when it comes to suicidal ideation, suicidal behavior, and genetics. The authors also argue that there are sample and demographic limitations when it comes to individuals with neuroglial disorders, intellectual disability, substance use disorders, and age. This review contradicts sources that argue genetics are influential of suicide (Roy, 1992). It also provides an alternative viewpoint to many commonly accepted studies about genetics and suicide.

Another study has been completed to attempt to dissect the shared genetic difference of a suicide attempt, psychiatric disorders, and known risk factors. Mullins et al. (2022) conducted a genome wide association study of 29,782 suicide attempt cases and 519,961 controls. They also attempted to control for psychiatric disorders to find out if genetics can be an independent factor of suicide. The results from this study found that chromosome 7 was the most significant influence in terms of genetics (Mullins et al., 2022). It was also found that there was a genetic influence of suicide, independent of psychiatric conditions (Mullins et al., 2022). However, the authors also found strong evidence between psychiatric conditions and suicide (Mullins et al., 2022). The results from this study have contributed to the evidence that genetics do influence suicide. The authors found a specific chromosome that could be linked to the genetic inheritance of suicide. It was also found that the genetic influence of suicide is independent of psychiatric conditions. Psychiatric conditions have been known to be an external influence of suicide, but also have been considered to be a genetic influence if there is a family history of certain psychiatric conditions. It was determined in this study that the

influence of psychiatric conditions was in fact genetic, but in other sources, it has been an environmental influence (Erlangsen et al., 2020). Overall, this study contributes to the broad narrative that genetics influence suicide.

Research has been done on to see whether the genetic influence of insomnia has an impact on suicidal behavior. Nassan et al. (2022) discussed how restless leg syndrome and insomnia have emerged as risk factors for suicidal behavior. The authors define insomnia as Insomnia is a clinical diagnosis characterized by difficulty falling or staying asleep that is associated with distress and/or dysfunction (Nassan et al., 2022). They also reported that in recent studies, insomnia has been linked to increased longitudinal risk for suicidal behavior (Nassan et al., 2022). Nassan et al. (2022) collected the data for this study in various medical databases. The results from this study found that insomnia is a risk factor for major depressive disorder and bipolar disorder (Nassan et al., 2022). It was also found that insomnia was a risk factor for suicide, independent of any psychiatric disorders (Nassan et al., 2022). On the other hand, the effect of insomnia on suicidal behavior was more pronounced among patients with major depressive disorder. Overall, these results strengthen the evidence for genetics being a factor in suicide. This study showed that if a person has a genetic predisposition for insomnia, it could be a risk factor for suicidal behavior. One of the main concerns regarding genetics influencing suicide is the outside influence of psychiatric conditions. This study controlled for major depressive disorder and bipolar disorder. It found that even though including these disorders had a strengthened effect for insomnia and suicidal behavior, the genetic risk for insomnia was an independent factor for suicidal behavior. One limitation of this study that it mainly used data from individuals of European descent, and results may not be generalized to

people of different races. This study contributes to the idea that there is a genetic influence of suicide.

Additional genome-wide association studies have been completed on the role of genes on suicidal thoughts and behaviors. Tumolo (2022) used a population sample of 633,778 U.S. military veterans to examine four genes possibly associated with suicide. The first gene possible like to suicide is an estrogen receptor which has been previously identified as a gene associated with posttraumatic stress disorder and depression (Tumolo, 2022). A dopamine receptor, which has been associated with suicide attempts, schizophrenia, mood disorders, attention-deficit/hyperactivity disorder (ADHD), risky behaviors, and alcohol use disorder has been found as a potential gene influencing suicide (Tumolo, 2022). Also, a gene expressed in brain tissue, which has been associated with multiple psychiatric conditions and is elevated in the brains of people who die by suicide (Tumolo, 2022). Lastly, a gene associated with antisocial behavior, substance use, and ADHD could be a potential gene associated with increased suicidal thoughts and behaviors (Tumolo, 2022). The findings from this source support other sources that argue a genetic influence on suicide (Stanley & Mann, 1983). The specific genes listed in this study further affirm the evidence from other genome-wide association studies regarding the genetic influence of suicide. Further replication of these results in necessary to continue to strengthen the evidence on a genetic influence on suicide.

**The Environmental Impact on Suicide**

Research has been conducted on the role of environmental factors possibly impacting suicide risk. Hasselback et al. (1991) conducted a multivariate study to examine sociodemographic factors to suicide in a Canadian population. Firstly, the authors found that more affluent individuals were less likely to dies by suicide, highlighting socioeconomic status as risk factor for suicide (Hasselback et al., 1991). Also, it was found that unemployment status was not a significant predicting factor to suicide (Hasselback et al., 1991). No religion was found to be a significant predictor of suicide in this study (Hasselback et al., 1991). Lastly, the less population dense areas of Canada were found to have higher rates of suicide than higher population areas (Hasselback et al., 1991). Overall, the results from this study somewhat confirm and disconfirm other studies that support an environmental impact of suicide. Socioeconomic status has been mentioned in previous literature as a risk factor for suicide (Runkle et al., 2022), and it was also found in this study. However, unemployment status was not found in this study to be a significant predicting factor of suicide, compared to other literature that supports this factor (Borges et al., 2010). No religion and geographic location were also discovered to be environmental factors influencing suicide.

Additional research has been conducted on gender differences and age as environmental risk factors in influencing suicide. Stein et al. (2002) conducted a population-based study on gender and age differences in those who attempt suicide. The results from this study found smaller attempt in suicide in males (Stein et al., 2002). Females had a higher rate suicide attempts compared to males, except for the age group of 65-74 (Stein et al., 2002). Younger age group participants were found to have higher

suicide ratios in male and female participants (Stein et al., 2002). The findings from this study somewhat align with other sources that support an environmental impact on suicide. Previous findings have shown that gender differences are a possible environmental influence on suicide. However, the findings from this study report that women have a higher suicide attempt rate compared to men. This finding somewhat goes against other studies that show men attempt suicide at a higher rate than women (Pawlak et al., 2018). This study contributes to the overall narrative surrounding the environmental impact of suicide.

Additional research has been conducted to determine whether gender differences in suicide risk are affected by sociodemographic factors. Kwan et al. (2005) wanted to examine the possible sociodemographic factors that could influence of low male-to-female suicide rations in Far Eastern populations. The authors found that there was a high suicide rate in non-working male populations (Kwan et al., 2005). Occupational status was determined to not be a sociodemographic risk factor for women (Kwan et al., 2005). Men were also more likely to die by suicide if they were single compared to married men (Kwan et al., 2005). Meanwhile, women marital status was less important due to smaller suicide ratios (Kwan et al., 2005). Men were more likely to die by suicide with increased age, while women were less likely to die in middle age than men (Kwan et al., 2005). The findings from this study confirm other studies that argue an environmental impact on suicide. Age, occupational status, and marital status have been cited in previous research as potential environmental influences on suicide (Kim & Lee, 2017;Borges et al., 2010; Borges et al., 2010). This study further confirms these previous findings through the results of this study.

Additional research has been conducted on the role pf psychiatric conditions and sociodemographic variables influencing suicide. Mohammadi et al. (2005) aimed to determine the lifetime prevalence and pattern of comorbidity on self-reported suicidal attempts in the general population of Iran. 45.3% of the suicide attempters reported at least one psychiatric condition in their lifetime (Mohammadi et al., 2005). Major depression, panic disorder, and obsessive-compulsive disorder made up the highest percentage of psychiatric conditions associated with suicide attempters (Mohammadi et al., 2005). Other sociodemographic factors that were linked to increased suicide attempts were younger age, female gender, being married, and being highly educated (Mohammadi et al., 2005). The results from this study somewhat align with other sources that support an environmental impact on suicide. Psychiatric conditions such as major depression have been cited in the literature as an empirically supported risk factor for suicidal risk (Crump at al., 2014). The findings from this study further confirm previous studies regarding psychiatric conditions as an environmental risk factor (Crump at al., 2014). Also, this study resulted in female gender and younger age being an environmental risk factor, which aligns with the findings in the literature (Mania et al., 2019). However, being married and higher education were found to be risk factors in this study, which goes against previous study's findings (Borges et al., 2010). This could be due to cultural considerations in Iran.

Repetition of suicide attempts in patients have been examined for sociodemographic factors in research. Scoliers et al. (2009) aimed to examine different sociodemographic variables in patients with repeated suicide attempts. The findings from this study suggest that being female is a possible factor in increasing non-fatal repetition

of suicide attempts than being male (Scoliers et al., 2009). Regardless of gender, being in young and middle adulthood increased repetition in suicide attempts (Scoliers et al., 2009). Lastly, lower educational achievement was also found to be a risk factor that increased repetition in suicide attempts (Scoliers et al., 2009). The findings from this study align with other studies that argue an environmental influence on suicide. Gender, age, and low educational level all have been mentioned in previous research suggesting that they are influences of suicide environmentally (Pawlak et al., 2018; Mania et al., 2019). Some studies have reported men being more likely to have a suicide risk, compared to other studies that discuss women having a higher suicide risk based on other environmental factors (Pawlak et al., 2018). Therefore, the findings from this study further support the argument of the environmental impact of suicide.

Continued research has been conducted on environmental risk factors associated with suicide attempts. Borges et al. (2010) used data from the World Health Organization to examine suicidal behaviors and suicide risk factors over a 12-month period. The authors found female sex and younger age were associated with suicidal environmental risk (Borges et al., 2010). Lower education, lower income, and unemployment were also found to be risk factors associated with suicide. Lastly, parent psychopathology were highlighted as risk environmental factors for suicide (Borges et al., 2010). The findings from this study support other sources that argue environmental risk factors influence suicide. Female sex and younger age have been cited in previous studies as environmental factors increasing suicidal risk (Mania et al., 2019). This study's findings further supported these risk factors. The current study found lower education, low income, and unemployment status as environmental factors for suicide, which reflects

previous research on these risk factors (Scoliers et al., 2009;Runkle et al., 2022). Parent psychopathology was also listed as an environmental risk factor for suicide. This finding could also be determined to be a genetic influence as well as an environmental influence based on the literature. Future research should determine the environmental and/or genetic nature of this risk factor.

Mental health disorders and anxiety related disorders have been examined in the research as an environmental risk factor for suicide. Nepon et al. (2010) aimed to examine the relationship between anxiety disorders, suicide attempts, and other sociodemographic factors. The authors found that the presence of a substance use disorder was a significant sociodemographic risk factor for suicide (Nepon et al., 2010). Panic disorder was also found to be independently associated with higher suicide risk (Nepon et al., 2010). It was also found that post-traumatic stress disorder (PTSD) was an independent risk factor for suicide (Nepon et al., 2010). Lastly, the presence of a personality disorder elevated risk for suicide in those with PTSD and anxiety related disorders (Nepon et al., 2010). The findings from this study support previous research regarding the environmental influence on suicide. Mental health disorders have been shown in the literature to be possible environmental risk factors for suicide (Thornton et al. 2016), and the findings with PTSD/anxiety related disorders in this study further confirm those findings. Finally, the current study found substance use disorders elevated risk of suicide, and this confirms previous literature surrounding substance use disorders as an environmental risk factor for suicide (Vaszari et al., 2011).

Additional research has been conducted on the role of substance use and other sociodemographic factors influencing suicide. Vaszari et al. (2011) used a sample of 462 female cocaine users, 87% of which were African American, to identify risk factors for lifetime suicidal ideation. The authors found that 50% of the participants met a least one criterion for lifetime suicidal ideation (Vaszari et al., 2011). Several forms of abuse such as childhood sexual, physical and rape after the age of fifteen were considered risk factors for suicidal ideation (Vaszari et al., 2011). Lastly, psychiatric disorders and depression were found to be significant risk factors that increased suicidal ideation (Vaszari et al., 2011). There are several key findings in this study that support previous literature on the environmental risk for suicide. Substance use has been documented in previous research supporting its environmental impact on suicide (Carmel et al., 2016), and the results of this study further strengthen this evidence. Also, the presence of psychiatric disorders has been well-documented as an environmental risk factor for suicide (Crump at al., 2014). This evidence continues to be supported by the findings of this study

Further research has been conducted on the environmental risk factors in major depression (MD) and suicidal behavior (SB). Mandelli and Serretti (2013) examined the gene-environmental interaction and influence in MD and SB. The authors reported that environmental factors such as stressful life events have a significant influence on depression but not suicidal behavior (Mandelli & Serretti, 2013). Family environment was also cited as a potential environmental risk factor for suicide (Mandelli & Serretti, 2013). Lastly, the authors found that the presence of childhood trauma interacted with genes that increased SB (Mandelli & Serretti, 2013). The results of this study somewhat

align with the other sources that support an environmental influence on suicide. The authors found that family environment, stressful life events, and childhood trauma interacted with a possible genetic influence of suicide to overall increase suicidal behavior and major depression. However, the authors also discussed how further research needs to be done on environmental factors in order to strengthen the argument for an environmental influence on suicide.

Additional research has been conducted on sociodemographic, psychiatric, and somatic risk factors associated with suicide. Crump at al. (2014) used data from a national cohort study of 7,140,589 Swedish adults followed for 8 years for suicide mortality (2001–2008) (Crump et al., 2014). The first finding was that all psychiatric disorders, especially depression, were the strongest risk factor in predicting suicide (Crump et al., 2014). Physical health conditions such as chronic obstructive pulmonary disease (COPD), cancer, spine disorders, asthma and stroke were significant risk factors associated with suicide (Crump et al., 2014). Lastly, sociodemographic factors such as low income, low education, and non-employment were significant risk factors linked to suicide (Crump et al., 2014). The findings from this study support other sources that find that there is an environmental impact on suicide. Psychiatric conditions have been supported in the literature to be influences on suicide (Costantini et al., 2014), this study found psychiatric conditions to be an environmental impact on suicide. Physical health conditions were also cited as risk factors of suicide. Other environment factors included employment and educations related factors. The findings from this study contribute to the overall narrative of the environmental impact of suicide.

Additional research has been conducted on environmental and clinical correlates in individuals with major depressive disorder (MDD). Lim et al. (2014) interviewed 547 patients with MDD in six different east Asian countries for sociodemographic and clinical factors related to suicidality. One finding from the study was that the more severe the MDD in a participant, the higher their suicidality was (Lim et al., 2014). Age, education, and sex were not found to be significant environmental risk factors of suicide (Lim et al., 2014). Due to cultural considerations within Asian culture, lack of social support was found to be a risk factor for suicide in this population (Lim et al., 2014). Lastly, the authors found that women were more likely to be suicidal compared to men according to their sample set (Lim et al., 2014). This finding was cited to possibly be explained by the low socioeconomic status of women in Asia, and other cultural considerations (Lim et al., 2014). The results of this study somewhat confirm other sources that claim environmental factors impact suicide. The presence of psychiatric disorders has been well documented as an environmental influence on suicide (Costantini et al., 2014;Crump at al. 2014). This article contributes to the broad narrative surrounding this topic, as well as furthers the evidence by finding severity of MDD impacting the severity of suicidality. However, the authors did not find age, sex, and education as significant environmental impacts of suicide. This goes against other sources that have found these factors to influence suicide (Scoliers et al., 2009;Mania et al., 2019;Pawlak et al., 2018).

The role of substance use as an environmental factor has been examined in association with suicide risk. Carmel et al. (2016) wanted to examine substance use, as well as other clinically relevant related factors in their role of possibly influencing

suicide. 867 primary care patients that reported drug use in the last 90 days were used as the sample set for this study. The authors reported that 40% of individuals who reported recent substance use reported a lifetime suicide attempt (Carmel et al., 2016). Individuals at high suicide risk were also found to have higher rates of substance use severity and were more likely to have a comorbid psychiatric condition (Carmel et al., 2016). Finally, the authors mentioned that since most of the primary care patients were underprivileged and disadvantaged, the results might not generalize to all primary care populations due to environmental factors (Carmel et al., 2016). Overall, the results of this study support other sources that argue an environmental effect of suicide. Substance use can be considered an environmental factor associated with suicide due to previous research (Vaszari et al., 2011). The independence of substance use, and psychiatric conditions supports the argument for the environmental effect of suicide due to the possible genetic influence of psychiatric conditions.

Additional research has been conducted on environmental characteristics related to suicide. Rancāns et al. (2016) conducted a population-based study using 2,816 participants from Latvia as their sample set. One finding from this study described feelings of loneliness and non-cohabitation were significant environmental risk factors for suicide (Rancāns et al., 2016). It was also found that lower education could be considered a significant risk factor for suicide (Rancāns et al., 2016). Lastly, the authors found that serious types of suicidal behavior where more prevalent in men ages 35-54, while mild types of suicidal behavior were equal in men and women ages 35-54 (Rancāns et al., 2016). The authors reported that a limitation of this study was a clear definition of a suicide attempt, which could lead to concerns about accuracy and validity of the answers

given (Rancāns et al., 2016). The results of this study somewhat confirm other sources that support the environmental influence of suicide. Lower education and feelings of loneliness have been examined and is supported in the literature surrounding environmental risk factors of suicide (Scoliers et al., 2009;Kodaka et al., 2017). However, the lack of a clear definition of a suicide attempt could play a key role in the validity of this study. Not having a clear definition of suicide-related terms could impact the view and support of the environmental impact on suicide.

Additional research has been conducted on environmental factors possibly associated with suicide. Werbeloff et al. (2016) wanted to examine the demographic and psychiatric factors associated with suicide using 4,914 participants in a 25-year longitudinal cohort study. The authors found that male sex, psychiatric hospitalizations, and previous suicide attempts elevated suicide risk (Werbeloff et al., 2016). Also, the authors found that the presence of depression was a significant risk factor for increasing suicide risk (Werbeloff et al., 2016). The findings from this study further support other sources that claim environmental risk factors influence suicide. Previous research has shown that gender and previous suicide attempt history are potential environmental factors for suicide (Borges et al., 2010) (Choi et al., 2017). The findings from this study further support this evidence. Lastly, this study found that depression was a significant environmental risk factor for suicide. This adds to the mounting evidence for psychiatric conditions such as depression in influencing suicide.

Gender and factors associated with gender have been examined in the literature as a potential environmental risk factor for suicidal ideation. Kimand Lee (2017) examined gender-specific factors associated with the use of mental health services (MHS) for

suicidal ideation (SI). The results from this study found that male participants that live in urban environments, were widowed, and had frequent alcohol use were more likely to use MHS for SI (Kim & Lee, 2017). Female specific risk factors were self-rated poor health, less contact with friends, and less religious activity (Kim & Lee, 2017). Age, education level, experience of depressed mood, depression diagnosis, and suicide attempts were associated with the use of MHS for SI in males and females (Kim & Lee, 2017). The findings from this study support other sources that argue and environmental influence of suicide. Marital status and substance use were environmental risk factors associated in with increased use of MHS for SI. Other studies have supported these findings as environmental risk factors for suicide (Carmel et al., 2016;Villanueva et al., 2019). Poor health has also been cited in previous research as an environmental risk factor for suicide and was supported with the findings in this study (Choi et al., 2018). Lastly, regardless of gender, age, educational, psychiatric condition status, and previous suicide attempt have been found in previous research (Mania et al., 2019;Vaszari et al., 2011;Borges et al., 2010;Choi et al., 2017), and the argument for these factors in environmental risk for suicide have been further sustained in this study.

Research has been conducted on the influencing environmental factors on females in Japan. Kodaka et al. (2017) wanted to examine the psychosocial and psychiatric characteristics of female suicide completers through a psychological autopsy. The authors interviewed families of 92 suicide completers, examining sociodemographic factors such as psychiatric conditions, suicide behavior history, financial stress, and substance use (Kodaka et al., 2017). The results of this study found that 90% of suicide completers had a mental disorder (Kodaka et al., 2017). It was also found that men were more likely to be

diagnosed with an alcohol use disorder, compared to females being more likely to be diagnosed with an eating disorder (Kodaka et al., 2017). Family problems and feelings of loneliness were also significant risk factors in females (Kodaka et al., 2017). Finally, females had a higher prevalence of a history of self-harm and suicide behaviors compared to men (Kodaka et al., 2017). Overall, the results of this study support other sources that claim environmental factors influence suicide. Psychiatric conditions have been a supported risk factor for suicide (Crump at al. 2014), and this study further strengthens the argument for environmental influence on suicide. Substance use has also been cited in other sources (Carmel et al., 2016), and the findings from this study support substance use as an environmental risk factor for suicide. A further direction of this study could examine whether the psychiatric conditions in the victims were inherited genetically.

Additional research has been conducted on if suicide risk factors are gender specific. Pawlak et al. (2018) examined 20 factors described in the literature (sociodemographic and clinical factors as well as family burden) in association with suicidal behavior. The authors also analyzed whether the significance of those factors differs between males and females (Pawlak et al., 2018). Firstly, the authors found family history of psychiatric disorders, affective disorders, psychoactive substance abuse/dependence, family history of attempted/completed suicide, occurrence of specific symptoms in the course of depressive episode (inappropriate guilt, sense of worthlessness, early morning awakening), and psychotic symptoms were factors associated with elevated suicide risk (Pawlak et al., 2018). It was also found that having children increased suicide attempts in males but not in females (Pawlak et al., 2018). The significant risk factors associated with suicide in men were having children and the

presence of psychotic symptoms (Pawlak et al., 2018). Risk factors that were specific to females include family burden of committed suicides and total suicide attempts/suicides, affective disorders, and abuse/dependence on psychoactive substances; patients' age at onset of MDD, inappropriate feelings of guilt and worthlessness, psychotic symptoms, and comorbidity with mood disorders of substance abuse/dependence (Pawlak et al., 2018). Overall, the findings from this study support other sources that argue the environmental influence on suicide. Gender differences have been examined in other studies (Borges et al., 2010) and the results from this study further support the influence of gender on suicide as an environmental factor.

Overall health has been examined in previous literature as an environmental risk factor for suicide. Racine (2018) conducted a study on the role of potential risk factors specific to chronic pain influencing suicide risk. The authors found unemployment status a sociodemographic factor significantly associated with chronic pain and increased suicidality (Racine, 2018). Another significant factor that increased suicidality was poor mental health and depression (Racine, 2018). Lastly, chronic pain and intensity of pain were found to be significant risk factors of suicide (Racine, 2018). The results from this study align with other sources that support an environmental influence on suicide. Unemployment has been shown in previous literature to be an environmental risk factor for suicide (Borges et al., 2010), and that is further confirmed in the findings from this study. Also, the presence of psychiatric conditions have been found in this study as a significant risk factor for suicide and the literature supports this finding (Costantini et al., 2014). Lastly, physical health concerns have been cited in the literature as a potential risk

factor for suicide (Kim & Lee, 2017) and the results from this research further contribute to the argument.

Additional research has been conducted on the role of psychiatric conditions and sociodemographic factors influence on suicide. Bhatt et al. (2020) wanted to examine the risk factors associated with psychiatric patients. The authors found that there were no significant sociodemographic factors associated with suicide in psychiatric patients. Factors such as single marital status, unemployment, and low education level did not significantly differ between the case and control groups in this study (Bhatt et al., 2020). The results from this study go against other studies that support an environmental influence on suicide. The authors found that no sociodemographic factors were significant in influencing suicide in psychiatric patients compared to the control population. These findings do not align with previous findings that sociodemographic factors do influence suicide in psychiatric patients. Lastly, factors such as marital status, unemployment, and low education level have been associated as environmental factors for suicide in previous research (Borges et al., 2010;Villanueva et al., 2019). The findings from this study did not support these as environmental factors of suicide. The findings from this study indicate that these factors potentially do not apply to psychiatric populations.

Sleep has been researched in order to see whether it is a potential risk environmental factor for suicide. Drapeau et al. (2019) conducted a literature review of studies that screened sleep patients for risk of suicide. The results from this review suggest that sleep disturbance is an independent risk factor for suicide risk and eventual suicide (Drapeau et al., 2019). Sleep apnea has also been found to be a possible risk

factor for suicide (Drapeau et al., 2019). Another finding was narcolepsy could be associated with an increased risk of all of suicide across all age groups when compared with the general population (Drapeau et al., 2019). Insomnia was a significant factor to elevating suicidal risk, but only when the presence of depression and previous suicidal behavior (Drapeau et al., 2019). The authors also reported that nightmares could be a cause of suicidal risk, but there is lacking empirical evidence in this area (Drapeau et al., 2019). The results from this study align with other sources that support an environmental influence on suicide. Sleep and nocturnal wakefulness have been mentioned in previous research as environmental risk factors of suicide (Tubbs et al., 2021). The results of this review further support the previous findings. Also, one result of this study included the presence of psychiatric disorders possibly impacting insomnia and suicidal risk. This finding further suggests the presence of psychiatric disorders influencing suicide environmentally.

Additional research has been conducted on the role of bipolar disorder (BD) as an environmental factor on suicide compared to the general population. Mania et al. (2019) conducted a literature review surrounding the analysis of data for risk factors for suicide in BD. Female gender, young age, and psychosocial isolation were found to be risk factors for suicide in BD (Mania et al., 2019). The authors also found weak evidence for race and high religious belief as sociodemographic factors for suicide in BD (Mania et al., 2019). The results from this study align with other studies that support an environmental influence on suicide. Gender and age have been cited in previous literature supporting an environmental impact on suicide (Pawlak et al., 2018;Mania et al., 2019.

This study further supports this claim, with young age and female gender being specific to individuals with BD.

Dual diagnosis has been examined in the literature as a sociodemographic and environmental influence on suicide. Restrepo et al. (2019) wanted to compare the risk of suicide, sociodemographic and clinical characteristics in three designated groups: dual diagnosis, substance-related disorder without other comorbid mental disorder, and any mental disorder without the presence of co-occurring substance related disorders. The authors found a strong association between dual diagnosis and suicidal behavior in the general population (Restrepo et al., 2019). Comorbid mental health disorder and substance related disorders were found also to be significant, but less significant than dual diagnosis (Restrepo et al., 2019). Lastly, any mental disorder was also shown through this study to be a significant risk factor of suicide (Restrepo et al., 2019). The results from this study align with other studies that support an environmental influence on suicide. Psychiatric conditions have been shown through the literature to be a possible predictor of suicidal behavior (Crump at al. 2014), and the results of this study further strengthen that argument. The main finding from this study was that dual diagnosis of mental health conditions is strongly associated with suicidal behavior, which also furthers the position of mental health disorders influencing suicide environmentally.

Additional research has been conducted on gender differences associated with suicidal risk. Villanueva et al. (2019) aimed to identify gender-based characteristics and risk factors related to suicidal ideation using data from a Spanish crisis line. The first finding from this study was that women were twice as likely to report suicidal ideation, even though twice as many men called into the crisis line (Villanueva et al., 2019).

Specific suicide risk factors regarding women included those who were unpartnered, reported physical health concerns, those who were unemployed, and older women (Villanueva et al., 2019). While men were more likely to engage in substance use and report depression (Villanueva et al., 2019). The findings from this study support other studies that claim environmental factors influence suicide. Gender differences have been shown to elevate suicidal risk in previous studies (Borges et al., 2010). Marital status, unemployment status, psychiatric conditions, substance use, and physical health concerns were shown to be potential environmental risk factors for suicide in this study. These risk factors have been also supported in the literature (Kim & Lee, 2017'Borges et al., 2010;Crump at al. 2014;Choi et al., 2018;Carmel et al., 2016), strengthening the argument for an environmental influence on suicide.

Mental health disorders and eating disorders and their impact on suicide have been examined in the literature. Abdi et al. (2020) conducted a case-cohort study with two cohorts of thirty women that were interviewed after a suicide attempt in a hospital setting. The authors found in this study that bulimia nervosa and anorexia nervosa were found to elevate suicide risk (Abdi et al., 2020). However, it was also found that bulimia nervosa and anorexia nervosa had no significant correlation with sociodemographic and environmental factors (Abdi et al., 2020). Some of these factors included marital status, age, employment status, and educational level (Abdi et al., 2020). The findings from this study somewhat go against other studies that support an environmental impact of suicide. The authors did not find that marital status, educational level, age, and/or employment status to be significant factors influencing suicide alongside eating disorders. These environmental factors have been highlighted in previous research to be significant factors

influencing suicide (Borges et al., 2010;Kim & Lee, 2017;Mania et al., 2019). However, the influence of bulimia nervosa and anorexia nervosa on suicide strengthen the argument for mental health disorders as an environmental impact to suicide according to this study.

Additional research has been done on the sociodemographic, environmental, and gender differences that could influence suicide. Hedna et al. (2020) conducted a population-based study to examine the sociodemographic factors associated with suicide among users and non-users of antidepressants (AD). The authors found that unmarried men that were both users and non-users of ADs had a higher suicide risk than women or married men (Hedna et al., 2020). Also, suicide risk was elevated 3-fold in women without AD treatment who were born outside of Nordic countries (Hedna et al., 2020). It was also determined that increased alcohol use elevated suicide risk in men (Hedna et al., 2020). Lastly, Lower suicide risk was observed in blue-collar women who used ADs (Hedna et al., 2020). The results from this study confirm other sources that support an environmental impact on suicide. Marital status continues to be a possible environmental factor influencing suicide (Kim & Lee, 2017). This study also highlighted that antidepressant treatment and an impact on women. Also, substance use, and specifically alcohol use has continued to be shown in the literature to be a possible environmental factor of suicide (Hedna et al., 2020).

Additional research has been done on age and other sociodemographic factors of suicide among those presenting in an emergency room department. Kim et al. (2020) examined risk factors associated with suicide such as age and attempt method in emergency department patients. The authors found that suicide attempts were more prevalent in females (Kim et al., 2020). In terms of gender differences, females were

more likely to attempt suicide than males (Kim et al., 2020). However, there were no gender differences found in suicide attempts in individuals who were 65 and older (Kim et al., 2020). Of those who were hospitalized for suicide attempts, 27.8% had a previous suicide attempt (Kim et al., 2020). There were 14.55% of the patients who were hospitalized for suicide had a suicide attempt in the following year after hospitalization (Kim et al., 2020). Interpersonal relationship issues was the factor most likely to cause a suicide attempt in young and middle-aged patients (Kim et al., 2020). Physical illness was the most common factor in older patients (Kim et al., 2020). Financial stress was also a common factor for suicide attempts compared to other age groups (Kim et al., 2020). Lastly, the presence of psychiatric conditions were most likely to cause a suicide attempt across ages (Kim et al., 2020). The results from this study support other studies that argue an environmental impact on suicide. The authors found that females were more likely to attempt suicide in men, and previous literature supports this finding (Borges et al., 2010). Previous suicide attempts were found to be factors in increased suicide attempts. This finding further supports suicide attempt history as an environmental factor. Physical illness in older populations was found in this study, and further strengthened the evidence of health issues being an environmental factor for suicide (Choi et al., 2018). Finally, psychiatric conditions have been cited in previous research as an environmental factor on suicide (Vaszari et al., 2011). The results of this study pertaining to psychiatric condition status support those previous findings.

Environmental suicide risk factors have been examined in suicide attempters (SAs), suicide ideators (SIs), and multiple suicide attempters (MSAs). Park et al. (2020) investigated trends and differences in suicide risk factors across suicidality groups in a

cross-sectional study. Firstly, the authors found that a history of trauma increased risk for all three suicidality groups (Park et al., 2020). Secondly, it was found that family history of a suicide attempt increased risk for suicide in all three suicidality groups (Park et al., 2020). Thirdly, the presence of psychiatric conditions elevated risk of suicide in all three sociality groups (Park et al., 2020). Alcohol use also elevated the risk for suicide in SIs, SAs, and MSAs (Park et al., 2020). Lastly, MSAs had a higher proportion of psychiatric diagnosis compared to the other two suicidality groups (Park et al., 2020). The findings from this study support other studies that argue an environmental impact on suicide. Family history of suicide was found to be significant in increasing suicidality in this study. This was cited as an environmental factor, which has had support in the literature, but also could be considered a genetic factor in future research (Stanley & Mann, 1983). Psychiatric conditions as environmental risk factors for suicide have also been discussed and have been further supported in this study (Crump at al. 2014). Substance use has also been established in the literature as a potential environmental risk factor for suicide (Carmel et al., 2016), which has been further reinforced by the findings of this research. This study contributes to the overall narrative surrounding the environmental impact on suicide.

Research has been conducted on the role of sociodemographic risk factors for suicide across health settings. Elzinga et al. (2021) conducted a population-based study to examine differences between suicide decedents and a reference population. The results of this study found that decreased mental health care usage increased likelihood of suicide (Elzinga et al., 2021). Also, the authors found that being middle and old aged increased the risk for suicide (Elzinga et al., 2021). Lastly, male gender, income level, and being in

a one-person or one-parent household were found to be sociodemographic factors linked to increased risk for suicide (Elzinga et al., 2021). The results from this study support other sources that argue an environmental impact on suicide. Age has been examined and shown to potentially be an environmental risk factor for suicide (Mania et al., 2019), and this study furthers that evidence. Living alone and income level have been cited as possible environmental risk factors for suicide (Kim & Lee, 2017;Runkle et al., 2022), which the findings from this study adds additional evidence.

Research has been conducted on the role of post-traumatic stress disorder (PTSD) in being an environmental risk factor of suicide. Fox et al. (2021) used a Swedish database of 3,177,706 participants in a longitudinal study to examine the effects of PTSD on suicide. One finding from the study was that PTSD was a significant risk factor of suicide, with individuals diagnosed with PTSD twice as likely to die by suicide (Fox et al., 2021). Another finding was that the significance of PTSD and suicide was controlled for and found independent of other psychiatric conditions such as major depressive disorder (Fox et al., 2021). Also, the significance of PTSD and suicide was found to be independent of prenatal mental health diagnosis (Fox et al., 2021). Overall, the findings from this study somewhat align with other sources that support an environmental influence of suicide. The authors not only found a significant correlation between PTSD and suicide, but the authors also found this correlation to be independent of other psychiatric conditions. Also, the authors found the findings were independent of parental psychotic conditions. This study contributes to the greater discussion around the environmental impact of suicide.

Psychiatric conditions have been researched in order to determine their impact on suicide both genetically and environmentally. Additional research has been conducted on the role of psychiatric conditions, specifically, treatment resistant depression (TRD) in influencing suicide. Reutfors et al. (2021) conducted a population-based study using a national Swedish registry as their sample set. The authors found that a serious suicide attempt in the last year increased risk of suicide eightfold, while a serious attempt more than a year ago increased risk fourfold in those with TRD (Reutfors et al., 2021). High education was also a significant risk factor of suicide in those with TRD (Reutfors et al., 2021). Also, substance use disorders were considered a risk factor for suicide in the TRD population (Reutfors et al., 2021). The results of this study somewhat confirm the other sources that argue an environmental impact on suicide. These results further confirm the role of psychiatric conditions and depression in influencing suicide environmentally. Also, the findings from this study continue to show support for the role of substance use disorders as an environmental factor of suicide. However, the authors' finding that high education is a factor of suicide goes against previous literature suggesting low education is a risk factor for suicide (Rancāns et al., 2016). The authors mentioned that this could be due to the specific nature of TRD.

Further research has been conducted on the role anxiety disorders, depressive disorders, and other environmental factors in influencing suicide. Wiebenga et al. (2021) aimed to examine the differing risk factors for suicide between 1,576 suicidal and non-suicidal patients. The authors found that suicidal patients were more likely to have fewer years of education compared to non-suicidal patients (Wiebenga et al., 2021). Also, presence of a depressive disorder was a risk factor for suicide compared to anxiety

disorders (Wiebenga et al., 2021). Suicidal patients with a previous attempt were also found to be younger in age and have an alcohol use disorder compared to non-suicidal patients (Wiebenga et al., 2021). Lastly, suicidal patients with a previous suicide attempt were more likely to have a traumatic experience compared to non-suicidal individuals (Wiebenga et al., 2021). The results from this study align with other studies that support an environmental impact on suicide. Previous studies have cited psychiatric conditions as an environmental risk factor for suicide. The findings from this study strengthen the evidence for psychiatric conditions as an environmental factor for suicide. Previous studies have supported the finding from this study that younger age is a predictive sociodemographic factor for suicide (Mania et al., 2019). Finally, substance use disorders have been a theme in the literature as an environmental influence on suicide (Carmel et al., 2016). The results from this study support the evidence in the literature surrounding substance use disorders as an environmental influence on suicide.

Research has been conducted on sociodemographic variables in the differences between suicidal ideation and suicide attempts. Doherty et al. (2022) investigated to see if sociodemographic factors in depressed patients differentiated patients with only suicidal thoughts from those who have attempted suicide. The findings from this article suggest that women were more likely to have suicidal thoughts compared to suicide attempts (Doherty et al., 2022). However, the authors found no significant differences in sociodemographic variables such as age, marital status, number of children, religion, nationality, financial difficulties, and living situation in influencing suicide (Doherty et al., 2022). Lastly, patients without a suicide attempt were more likely to have graduated from high school and less likely to have only graduated from junior high school/ninth

grade (Doherty et al., 2022). The results from this study somewhat disagree with other sources that support an environmental impact on suicide. This study did not find that sociodemographic variables such as marital status, financial difficulties, age, and living situation to be significant risk factors for suicide environmentally. This finding goes against previous sources that support these variables as risk factors for suicide (Villanueva et al., 2019;Runkle et al., 2022;Kim & Lee, 2017;Mania et al., 2019).

Research has been conducted with adolescents on the environmental impact of suicide. Runkle et al. (2022) conducted a literature review on the environmental risks of suicide in the adolescent population. The authors found two key results in their review. The first was that history of suicide ideation, access to lethal means, and preexisting mental health conditions were considered significant precursors to suicide (Runkle et al., 2022). It was also highlighted how unmet mental health needs, socioeconomic disadvantage, parental support, and exposure to environmental disasters elevated the risk of suicide in adolescents (Runkle et al., 2022). The results of this review have confirmed the environmental impact on suicide. The authors found several key risk factors associated with suicide. The presence of mental health conditions was considered an environmental impact due to the research not including family data. The results also show how multifaceted the environmental risk of suicide is due to a number of factors playing a role in this review. Overall, this review contributes to the overall narrative of the environmental impact of suicide.

**Conclusion**

The genetic and environmental impact on suicide has been explored through the literature. Genetics and suicide have been discussed in popular texts such as Dr. Thomas

Joiner's *Why People Die by Suicide* (Joiner, 2009). The evidence for genetics influencing is strong but not conclusive. Serotonin levels and receptor sites have been cited in the research as one of the strongest indicators of a genetic influence on suicide (Stanley & Mann, 1983). The research says that the less and smaller the receptor sites, the higher likelihood someone will engage in suicidal behavior (Stanley & Mann, 1983). Genome-wide association studies have been discussed in the literature to be the future directions of examining the role of serotonin and other neurotransmitters in influencing suicide (Sokolowski et al., 2014). There is some evidence for specific chromosomes and other genetic factors influencing suicide (Sokolowski et al., 2014). However, there is not enough evidence to confidently say there is a specific chromosome linked to suicide.

Psychiatric conditions such as, major depressive disorder and substance use disorders have been cited in the literature as a possible influence on suicide (Antypa et al., 2016). These psychiatric conditions among others have been linked to increased risk of suicide (Colbert et al., 2021) (Antypa et al., 2016). The literature also debated whether the role of psychiatric disorders is genetic or environmental in nature. On one hand, it has been established that psychiatric conditions can be passed down and give future generations a higher predisposition to those psychiatric conditions through genetics (Colbert et al., 2021). Psychiatric conditions can also be viewed as an environmental influence due to conditions created by a person's psychiatric condition, and other environmental issues relating to psychiatric conditions (Brent & Melhem, 2008).. Many articles that were researching the genetic influence on suicide mentioned psychiatric conditions as a limitation and a target for future studies. It is the author's opinion that psychiatric conditions can be a genetic influence of suicide, but the lack of control for

environmental concerns makes it difficult to say that psychiatric conditions are a genetic influence of suicide definitively.

Twin studies played a significant factor in the discussion of the genetic impact on suicide. These studies used monozygotic twins (identical) and dizygotic twins (Fraternal). Twin studies are considered significant due to monozygotic twins having the same genes, therefore have less genetic variability compared to dizygotic twins (Roy et al., 1991). These studies resulted in monozygotic twins having a higher rate in death by suicide compared to dizygotic twins (Roy et al., 1991). These studies provide some of the strongest evidence for the role of genetics in suicide and contribute greatly to the overall discussion.

Family studies were also found to contribute to the overall discussion of the genetic influence of suicide. These studies were conducted as population-based studies that conducted biological children vs adopted children in the same families (Statham et al., 1998).. Family studies generally examined if a parent attempted/died by suicide; that their biological children were at a significantly higher risk for suicide (Statham et al., 1998). Genetic heritability of suicide was found in these family studies to contribute to the overall narrative of the genetic influence on suicide (Statham et al., 1998). Although, the authors of these studies reported that they could not control for environmental influences on suicide. This is a significant limitation that affects the strength of family studies contributions to the genetic influence on suicide.

The environmental influence of suicide was examined in the literature and this literature review. Many of the studies regarding the genetic influence on suicide discussed the role of environmental influences that limited the strength of their argument

(Elzinga et al., 2021). The author examined the role of environmental influences on suicide in order to explore these possible limitations and future directions of suicide research. Psychiatric conditions were one of the largest possible environmental factors influencing suicide (Erlangsen et al., 2020). Marital status was also another significant factor influencing suicide environmentally in this literature review (Kwan et al., 2005). The research found that people who were not married and unpartnered were more likely to die by suicide (Kwan et al., 2005). Occupational status and socio-economic status (SES) were also found to be significant, with those who were unemployed and low SES to be at higher risk of suicide (Kwan et al., 2005). Low amounts of sleep and increased health issues/concerns were also found to increase the likelihood of suicide (Nassan et al., 2022).

The main hypothesis of this literature review wanted to see if there was a genetic influence on suicide. The results of this literature review confirmed that that there is a genetic influence of suicide. However, there are significant questions that still need to be answered. How strongly do genetics influence suicide? The author found no research regarding how strongly genetics influence suicide. Do environmental influences negate the genetic influence of suicide? It is clear that future research needs to be focused towards controlling for environmental factors in order to determine if genetics can stand alone as a cause for suicide. Research focused on biology and neurochemistry seem to be the strongest path to determining whether or not suicide is affected by genetics.

It has been well established that environmental/socio-demographic influences contribute greatly to how we conceptualize, treat, and research suicide. Environmental influences on suicide are a barrier to truly understanding the genetic influence on suicide.

It also shows how complex and nuanced this issue is to understand and research. Environmental issues will need to continue to be researched in order to further understand suicide.

Lastly, the research surrounding genetic and environmental influence of suicide is growing. This research will need to continue to grow in order to definitively say whether there is a genetic influence of suicide and how strong that influence is. GWAS, Family, neurotransmitter, and chromosomal focused studies should be considered future directions in terms of the type of research involving the genetic influence on suicide. Controlling for environmental factors should also be a future direction of research. The genetic influence of suicide is complex, but there is a foundation of knowledge to continue to build upon in order to understand this issue and suicide as a whole.

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