6 Stress–Diathesis Model of Suicidal Behavior

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CONTENTS

6.1 INTRODUCTION

Suicide and attempted suicide are complex behaviors, and a large number of proximal and distal risk factors have been identified (Hawton and van Heeringen, 2009). These risk factors can be categorized in explanatory models, which may help to understand suicidal individuals and facilitate the assessment of suicide risk.

Early models have identified key determinants operating during the development of disorders or behavioral problems. For example, psychologists have developed schema models that focused on cognitive characteristics of, for example, depression, anxiety, and personality disorders. This conceptual approach and the empirical research motivated by such models have led to significant insights into these disorders (Ingram and Luxton, 2005). Stress has also been identified as a key determinant of psychopathology, so that a variety of models have featured stress as a primary determinant. Such models suggest that severe enough negative events can precipitate disorders even without reference to individual biological or psychological characteristics.

The stress model of suicidal behavior is an example of such models. It is based on the observation that stressful life events are commonly recognized as triggers of suicidal behavior. A variety of explanatory models, including those applied by lay people, have indeed featured stress as a primary determinant of suicidal behavior.

Such models indicate that negative life events if severe enough can precipitate suicidal behavior even without the existence of individual predisposing psychological or biological characteristics.

Until recently, most studies of suicidal behavior were based on such early models and thus restricted to one domain of possible risk factors, for example, social, psychiatric, or psychological. As pointed out by Mann et al. (1999), such studies are too narrowly focused to estimate the relative importance of different types as risk factors or their interrelationship. A model of suicidal behavior has to take into account proximal and distal risk factors and their potential interaction (Hawton and van Heeringen, 2009). Stress models of suicidal behavior can indeed not explain the observations that even extreme stress does not lead to suicidal behaviors in all exposed individuals. Such observations have led to the recognition that the development of suicidal behavior involves a vulnerability or diathesis as a distal risk factor, which predisposes individuals to such behavior when stress is encountered.

This chapter will review the scientific literature on the stress–diathesis model of suicidal behavior. Preceding this review, general issues regarding the origins, definitions, and components of stress–diathesis models will be addressed. The concluding discussion will point at the advantages of using stress–diathesis models for treating and preventing suicide risk and address issues with regard to future research.

6.2 STRESS–DIATHESIS MODELS: GENERAL ISSUES

Diathetic individuals respond with abnormal or pathological reactions to physiological stimuli or the ordinary conditions of life that are borne by the majority of individuals without injury (Zuckerman, 1999). The concept of diathesis has been intuitively straightforward and discussed intensively in the literature, but few precise definitions are available. (Ingram and Luxton, 2005). A diathesis is commonly conceptualized as a predispositional factor, or a set of factors, that makes possible a disordered state. It reflects a constitutional vulnerability to develop a disorder.

The diathesis concept has a long history in medical terminology. The word diathesis stems from the Greek idea of predisposition, which is related to the humoral theory of temperament and disease (Zuckerman, 1999). The term has been used in a psychiatric context since the 1800s. Theories of schizophrenia brought the stress and diathesis concepts together and the particular terminology of diathesis–stress interaction was developed by Meehl, Bleuler, and Rosenthal in the 1960s (Ingram and Luxton, 2005).

In the modern sense, the biological traits produced by the genetic disposition are the diathesis. The term "diathesis" has, however, been broadened to include cognitive and social predispositions that may make a person vulnerable to a disorder such as depression. In this broader sense, the diathesis is the necessary antecedent condition for the development of a disorder or problem, whether biological or psychological. The "cry of pain" model of suicidal behavior, as described in detail further in this chapter, is a clear example of such a psychological approach to the

study of the diathesis to suicidal behavior. In most models, whether biological or psychological, the diathesis alone is not sufficient to produce the disorder but requires other potentiating or releasing factors to become pathogenic. The diathesis, in this case, includes the vulnerability to stress (Zuckerman, 1999).

Most stress–diathesis models presume that all people have some level of diathesis for any given psychiatric disorder (Monroe and Hadjiyannakis, 2002). However, individuals may differ with regard to the point at which they develop a disorder depending on the degree to which predispositional risk factors exist and on the degree of experienced stress. Thus, relatively minor stressors may lead to a disorder in persons who are highly vulnerable. This approach presupposes additivity, that is, the idea that diathesis and stress add together to produce the disorder. Ipsative models more specifically posit an inverse relationship between components such that the greater the presence of one component the less of the other component is needed to bring about the disorder. Thus, for example, minimal stress is needed for depression to occur in individuals with a strongly depressogenic schema (Ingram and Luxton, 2005). Such models assume a dichotomous diathesis, that is, either one has it (a gene, a unique combination of genes, or a particular brain pathology) or one does not have it (Zuckerman, 1999). If the diathesis is absent, there is no effect of stress so that even severe stress will not lead to the development of the disorder. When the diathesis is present, the expression of the disorder will be conditional on the degree of stress: as stress increases so does the risk for the disorder in persons who possess the diathesis (Ingram and Luxton, 2005). However, most disorders in the psychiatric domain probably have a polygenic basis that allows for varying degrees of the diathesis agent, including variations in neurotransmitter activity levels. In this case, the probability of a disorder would increase as a function of both levels of stress and strength of the diathesis.

The conceptualization of a diathesis as dynamic implies that such a diathesis is continuous rather than dichotomous. For example, schema models of depression were commonly regarded as dichotomous models: if an individual possesses a depressogenic schema he or she is at risk of depression when events that activate this schema occur. More recent discussions of the schema model have however pointed at the possibility of a continuous character by describing the depressogenic nature of schemata as ranging from weak or mild to strong.

In line with the possibility of a continuous diathesis it should be noted that the interaction between stress and a diathesis might not be static, and change over time. The diathesis may increase or decrease so that the amount of stress needed for the development of pathology may need to decrease or increase, respectively. The "kindling" phenomenon (Post, 1992) provides an example of the dynamic character of the interaction between stress and vulnerability: repeated occurrences of a disorder may cause neuronal changes that result in more sensitivity to stress. The kindling theory thus proposes that diatheses may change so that more or less stress becomes necessary to activate vulnerability factors (Ingram and Luxton, 2005). It is however not clear whether the diathesis changes under the influence of negative circumstances or whether residua and scarring add to the diathesis and thus increase vulnerability.

Finally, a diathesis may theoretically consist of one single factor or be constituted by multiple components. Polygenic disorders or interpersonal cognitive theories provide examples of diatheses that are composed by multiple factors.

6.3 STRESS–DIATHESIS MODELS OF SUICIDAL BEHAVIOR

Early descriptions of the roles of stress and a diathesis in the development of suicidal behavior were grounded in sociobiology (De Catanzaro, 1980). Further studies focused on cognitive psychological characteristics. For instance, studying a college population Schotte and Clum (1982) described a stress/problem-solving model of suicidal behavior in which poor problem solvers under high life stress are considered to be at risk for depression, hopelessness, and suicidal behavior. Rubinstein (1986) developed a stress–diathesis theory of suicide, in which the effects of specific situational stressors and the categories or predisposing factors of vulnerable individuals in a given culture were integrated in a biocultural model of suicidal behavior. Mann and Arango (1992) then proposed a stress–diathesis model based on the integration of neurobiology and psychopathology, which still forms the basis for much of the current research in suicidology. Particular emphasis was thereby given to changes in the serotonin system and how these may represent a constitutional risk factor as opposed to a state-dependent risk factor for suicidal behavior.

The following sections will focus on the stress component and the diathesis component of stress–diathesis models of suicidal behavior, followed by a description of a number of such models.

6.3.1 Stress Component

Psychosocial crises and psychiatric disorders may constitute the stress component of stress–diathesis models of suicidal behavior (Mann et al., 1999). It is difficult to separate the impact of psychosocial adversity from that of psychiatric illness. Poverty, unemployment, and social isolation have all been implicated in suicide. These factors are clearly not independent from each other or from psychiatric illness. Psychiatric disorders can lead to job loss, to breakup of marriages or relationships, or to the failure to form such relationships. Moreover, psychiatric illness and psychosocial adversity can combine to increase stress on the person (Mann, 2003).

Many studies have focused on state-dependent characteristics of psychiatric disorders, which may be associated particularly with suicide risk. These include the severity of depression, levels of hopelessness and mental pain, and cognitive characteristics. With regard to an effect of severity of depression, study results have not been equivocal as some (e.g., Mann et al., 1999), but not all (e.g., Forman et al., 2004), studies show that the risk of suicide increases with elevated levels of severity of depressive symptoms. There appears to be more agreement about the association between increased levels of hopelessness and an increased risk of suicide in depressed individuals. A substantial number of studies have focused on state-dependent cognitive characteristics of depressive episodes in association with an increased risk of suicide. More particularly, Beck's theory of modes has been shown to offer a framework for conceptualizing suicidal behavior, which is useful for treatment and prevention.

Modes are defined as interconnected networks of cognitive, affective, motivational, physiological, and behavioral schemata that are activated simultaneously by relevant environmental events and result in goal-directed behavior. Thus, suicidal individuals may experience suicide-related cognitions, negative effect, and the motivation to engage in suicidal behavior in the context of a depressive episode and following exposure to triggering life events. Mental pain (or "psychache") thereby appears to be an emotional and motivational characteristic of particular importance (Troister and Holden, 2010).

It appears however that some of these state-dependent characteristics are to be regarded more appropriately as trait dependent and thus as a part of the diathesis. The emergence of cognitive suicidal modes and feelings of hopelessness during suicidal crises may indeed be regarded as activations of trait-dependent vulnerability characteristics.

6.3.2 Diathesis Component

Genetic effects, childhood abuse, and epigenetic mechanisms may be involved in the etiology of the diathesis to suicidal behavior (Mann and Haghgighi, 2010). Clinical studies have indeed shown that reported childhood adversity, such as deprivation and physical or sexual abuse, is a risk factor for psychopathological phenomena in later childhood and adulthood, including depression and suicide. Not all individuals will however develop psychopathology following exposure to childhood adversity, indicating the existence of a diathesis in some but not all individuals. Neuroanatomical, physiological, and genomic alterations may contribute to the long-lasting detrimental effects of exposure to childhood adversity on the risk of psychopathology (Miller et al., 2009). The study by McGowan et al. (2009) provides an intriguing example of how environmental influences may affect the expression of genes. The involvement of serotonin and other neurotransmitters, the (epi)genetics of suicidal behavior, and the role of gene–environment interactions are discussed in Chapters 2, 3, and 10–14. Postmortem and neuroimaging studies have clearly demonstrated structural and functional changes in the brains of individuals with a history of suicidal behavior, which may correlate with components of the diathesis (see Chapter 10; van Heeringen et al., 2011a). Postmortem findings include fewer cortical serotonin neurons in key brain regions such as the dorsal and ventral prefrontal cortex, which also appear to correlate with components of the diathesis (Mann, 2003).

These components may include aggression and/or impulsivity, pessimism and hopelessness, and problem-solving or cognitive rigidity. Some of these characteristics are discussed as intermediate phenotypes of suicidal behavior elsewhere in this book. Recent studies have used neuropsychological approaches to the study of the diathesis, and have focused particularly on decision-making processes (Jollant et al., 2007; Dombrovski et al., 2010; van Heeringen et al., 2011b).

Currently available evidence as reviewed in this chapter suggests that the diathesis to suicidal behavior is continuous. It can be hypothesized that the diathesis becomes more pronounced during the course of the suicidal process that commonly precedes completed suicide (van Heeringen, 2001). Suicide is indeed commonly preceded by nonfatal suicide attempts, which are commonly repeated with an increasing degree

of medical severity, suicidal intent, or lethality of the method used. Several studies have provided support for a kindling effect on the occurrence of suicide attempts. Findings from clinical studies point at the possibility that each time such a suicidal mode becomes activated, it becomes increasingly accessible in memory and requires less triggering stimuli to become activated the next time. This phenomenon can be used to explain findings from epidemiological studies in suicide attempters showing that each succeeding suicide attempt is associated with a greater probability of a subsequent suicide attempt (Leon et al., 1990; Oquendo et al., 2004; van Heeringen, 2001).

The concept of a continuous diathesis may explain differences in suicidal behavior between individuals, for example, why individuals differ in their suicidal reaction to similar life events varying from deliberate self-harm with no or minor physical consequences to completed suicide. Repeated exposure to stressors may thus gradually diminish the resilience toward stress, due to which stressors of decreasing severity may lead to suicidal behaviors with increasing suicidal intent. Increasing evidence points at a role of increasing neuropsychological deficits in the medial temporal cortex–hippocampal system, perhaps due to the detrimental effects of stress hormones on serotonergic neurons. As discussed in more detail elsewhere in this book, studies of levels of the serotonin metabolite 5-HIAA in the cerebrospinal fluid of suicide attempters have shown that (1) depressed suicide attempters have lower levels than depressed non-attempters, (2) repeating attempters have lower levels than so-called first-evers, (3) the use of violent methods is associated with lower levels than the use of non-violent methods, and (4) attempted suicide patients with lower levels show a poorer survival in terms of death from suicide (for a review see, van Heeringen, 2001). Such findings point at a possible increase of the vulnerability to suicidal behavior during the suicidal process, which is paralleled by a decrease in serotonergic functioning.

6.4 EXAMPLES OF STRESS–DIATHESIS MODELS OF SUICIDAL BEHAVIOR

6.4.1 Cognitive Stress–Diathesis Model of Suicidal Behavior

Williams and Pollock (2001) have described a diathesis for suicidal behavior in cognitive psychological terms, that is, the "cry of pain" model, which was elaborated in the "differential activation model." According to the "cry of pain" model, suicidal behavior represents the response to a situation that has three components:

1. *Sensitivity to signals of defeat*: Using the "emotional Stroop task," Williams and colleagues clearly demonstrated attentional biases (or so-called perceptual pop-outs) in association with suicidal behavior—an involuntary hypersensitivity to stimuli signaling "loser" status increases the risk that the defeat response will be triggered.
2. *Perceived "no escape"*: Limited problem-solving abilities may indicate to persons that there is no escape from problems or life events. Further study has revealed that such limited abilities correlate with decreases in the specificity of autobiographical memories. To generate potential solutions

to problems, a person apparently needs to have access to the past in some detail. Overgeneral memories prevent the use of strategies, which are sufficiently detailed to solve problems.

3. *Perceived "no rescue"*: The occurrence of suicidal behavior is associated with a limited fluency in coming up with positive events that might happen in the future. This limited fluency is reflected not only by the perception that there is no escape from an aversive situation but also by the judgment that no rescue is possible in the future. It is thereby interesting to note that the fluency of generating positive future events correlates negatively with levels of hopelessness, a core clinical predictor of suicidal behavior. This suggests that hopelessness does not consist of the anticipation of an excess of negative events, but indicates that hopelessness reflects the failure to generate sufficient rescue factors.

The identification of the neuropsychological correlates of the three cognitive components reflects an interesting characteristic of the "cry of pain" model, in addition to its clinical relevance. The authors state that, in this sense, the model fits in life events and biological research. The study of the biological underpinnings of hopelessness and mental pain, as discussed elsewhere in this chapter, indeed suggests that the components of this model can be studied using neurobiological research approaches and thus may contribute to our understanding of the pathophysiology by identifying possible endophenotypes of suicidal behavior.

6.4.2 Clinical Stress–Diathesis Models of Suicidal Behavior

Mann et al. (1999) proposed a stress–diathesis model based on the findings from a clinical study of a large sample of patients admitted to a university psychiatric hospital. When compared to patients without a history of suicide attempts, patients who had attempted suicide show higher scores on subjective depression and suicidal ideation, and reported fewer reasons for living. In addition, suicide attempters show higher rates of lifetime aggression and impulsivity, comorbid borderline personality disorder, substance use disorder or alcoholism, family history of suicidal acts, head injury, smoking, and childhood abuse history. The risk for suicidal acts thus is determined not only by a psychiatric illness (the stressor) but also by a diathesis as reflected by tendencies to experience more suicidal ideation and to be more impulsive and, therefore, more likely to act on suicidal feelings. More in particular, Mann and colleagues describe a predisposition to suicidal acts that appears to be part of a more fundamental predisposition to both externally and self-directed aggression. Aggression, impulsivity, and borderline personality disorder are key characteristics, which may be the result of genetic factors or early life experiences, including a history of physical or sexual abuse. A common underlying genetic or familial factor may therefore explain the association between suicidal behavior with the aggression/impulsivity factor and/or borderline personality disorder, independent of transmission of major depression or psychosis. Suicide risk was also associated with past head injury, and the authors hypothesize that aggressive–impulsive children and adults are more likely to sustain a head injury, which may lead to disinhibition and aggressive behavior. The serotonin neurotransmission system may also

play a role. Given the evidence linking low serotonergic activity to suicidal behavior, it is conceivable that such low activity may mediate genetic and developmental effects on suicide, aggression, and alcoholism (Mann et al., 1999).

Based on a review of studies of clinical predictors of suicide, McGirr and Turecki (2007) have provided a second example of a clinical stress–diathesis model. The model is based on the clinical observation that psychopathology, for the most part, appears to be a necessary but not sufficient factor for suicide. Therefore, a promising avenue for improved clinical detection is the elucidation of stable risk factors predating the onset of psychopathology, through which suicidal behavior is salted out. The authors describe personality characteristics as stable risk factors, which can be regarded as reflecting preexisting endophenotypes and which interact with the onset of psychiatric disorders (the stressor) to result in suicide. While the authors acknowledge the potential role of personality characteristics such as neuroticism and introversion in relation to suicide, they focus their review on impulsivity and aggression. Impulsivity is in this context regarded more as a behavioral dimension than as the explosive or instantaneous actions relating to an inability to resist impulses. The behavioral dimension describes behaviors that appear to occur without reflection or consideration of consequences, are often risky or inappropriate to the situation, and are accompanied by undesirable outcomes. They do not necessarily include aggressive behaviors, but high levels of impulsivity correlate with high levels of aggression. A correlation between aggression, impulsivity, and hostility has been confirmed in suicide completers using psychological autopsy approaches. Studies of fatal and nonfatal suicidal behavior have indeed pointed at a role of this behavioral dimension. Impulsivity thus appears to be involved not only in self-harming behaviors without suicidal intent but also in high-lethality and fatal suicidal behaviors.

With respect to aggression, more extensive histories of aggression have been associated with suicide attempts in clinical samples and those meeting criteria for major depression and bipolar disorder. Disruptive aggression appears to distinguish female ideators who attempt suicide from those who do not. More extensive histories of aggression, assault, and irritability have been associated with adolescent suicide completion. In addition, depressed suicides and borderline suicides exhibit higher levels of aggressive behaviors than diseased controls.

Levels of impulsivity thus tend to correlate with those of aggression and hostility. Evidence suggests that these characteristics fall under a superordinate factor relating to the familial transmission of dyscontrol psychopathology.

The involvement of impulsivity and aggression in the diathesis of suicidal behavior has been a matter of debate since many years. The controversy is fueled by, among others, epidemiological observations that many attempted and completed suicides do not appear to be aggressive or impulsive and by theoretical discussions about the multifaceted nature of the aggression and impulsivity concepts.

6.4.3 Neurobiological Model of Suicidal Behavior

Using a functional neuroimaging technique, Jollant et al. (2008) provide an example of a third, that is, neurobiological approach to stress–diathesis models of suicidal behavior. This model of suicidal behavior was investigated by exposing young males

with a history of depression to angry, happy, and neutral faces while being euthymic. Findings in young males with a history of attempted suicide were compared to those in young males without such a history. Relative to affective comparison subjects, suicide attempters showed greater activity in the right lateral orbitofrontal cortex (Brodmann area 47) and decreased activity in the right superior frontal gyrus (area 6) in response to prototypical angry versus neutral faces, greater activity in the right anterior cingulate gyrus (area 32 extending to area 10) to mild happy versus neutral faces, and greater activity in the right cerebellum to mild angry versus neutral faces. Thus, suicide attempters were distinguished from non-suicidal patients by responses to angry and happy faces that may suggest increased sensitivity to others' disapproval, higher propensity to act on negative emotions, and reduced attention to mildly positive stimuli. It is concluded that these patterns of neural activity and cognitive processes may represent vulnerability markers of suicidal behavior in men with a history of depression.

6.5 DISCUSSION

Although there are many pathways to suicide, studies in the domains of neuropsychology, cognitive psychology, neurobiology, and clinical psychiatry have provided increasing evidence in support of a stress–diathesis model of suicidal behavior. While depression is the common final pathway to suicidal behavior, the vast majority of depressed individuals neither attempt nor complete suicide. It appears that a diathesis to suicidal behavior differentiates depressed individuals who will kill themselves from other depressed patients. The diathesis may be due to epigenetic effects and childhood adversity and is reflected by a distinct biological, psychological, or clinical profile. This profile may include aggression/impulsivity, pessimism and hopelessness, and deficient problem solving. The involvement of aggression/impulsivity has recently been questioned and it has been suggested that the study of decision making and emotion regulation may help to refine this endophenotype (Brent, 2009).

The application of stress–diathesis models to suicidal behavior has substantial implications for the identification of suicide risk and the prevention of suicidal behavior. The identification of trait-dependent vulnerability factors can be expected to facilitate early recognition of suicide risk. Vulnerability traits are open to modification early in life, and interventions during sensitive periods of development may have durable effects on personality and thereby affect vulnerability to suicide (McGirr and Turecki, 2007). In the context of prediction and prevention, it is important to note that trait-dependent components of the diathesis can be demonstrated and treated beyond depressive episodes. For example, reducing the diathesis for suicidal behavior might be possible as evidenced by the clinical effects of lithium, clozapine, or cognitive behavioral therapy (Mann, 2003). Lithium appears to reduce the rate of suicidal behavior independently of its mood-stabilizing effects in patients with unipolar or bipolar disorder. Clozapine reduces suicidal behavior in schizophrenia independently of its antipsychotic action. The mechanisms that underlie the antisuicidal effects of lithium and clozapine are not known, but both medications affect a component of the diathesis to suicidal behavior, that is, the serotonergic system.

Further research of the applicability of stress–diathesis models to suicidal behavior is however needed. For example, it remains to be demonstrated whether the diathesis to suicidal behavior is continuous or dichotomous, and whether stress–diathesis models of suicidal behavior are additive or interactive. An important issue is the potential interdependence of the stress and diathesis components, as components of the diathesis may increase the probability of exposure to stressors. For example, Jollant et al. (2007) clearly demonstrated that impaired decision making, that is, a potential component of the diathesis to suicidal behavior, increases the risk of problems in affective relationships in suicide attempters. A recent study of a stress–diathesis model of adolescent depression showed that adolescents with a negative cognitive style are more at risk of depression following stressful life events, but also demonstrated that individuals at risk are more likely to report stressors that are at least partly dependent on their behavior. This model suggests a cycle that perpetuates across time, hinting at the mechanisms that may both initiate and maintain or worsen depressive symptoms in adolescence (Kercher and Rapee, 2009). The applicability of a similar stress–diathesis model to suicidal behavior and its implications for our understanding of the dynamic nature of this model remain to be demonstrated. The interdependence of stress and diathesis components would however also mean that interventions targeting the diathesis may also decrease exposure to stressors and suggests that relief of stress effects would enhance the efficacy of therapeutic interventions.

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