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Life-History Factors Influence Teenagers' Suicidal Ideation: A Model Selection Analysis of the Canadian National Longitudinal Survey of Children and Youth

John P. Ziker[1] and Kristin Snopkowski[1]

Abstract

Suicidality is an important contributor to disease burden worldwide. We examine the developmental and environmental correlates of reported suicidal ideation at age 15 and develop a new evolutionary model of suicidality based on life history trade-offs and hypothesized accompanying modulations of cognition. Data were derived from the National Longitudinal Survey of Children and Youth (Statistics Canada) which collected information on children's social, emotional, and behavioral development in eight cycles between 1994 and 2009. We take a model selection approach to understand thoughts of suicide at age 15 ($N \approx 1{,}700$). The most highly ranked models include social support, early life psychosocial stressors, prenatal stress, and mortality cues. Those reporting consistent early life stress had 2.66 greater odds of reporting thoughts of suicide at age 15 than those who reported no childhood stress. Social support of the primary caregiver, neighborhood cohesion, nonkin social support of the adolescent, and the number of social support sources are all associated with suicidal thoughts, where greater neighborhood cohesion and social support sources are associated with a reduction in experiencing suicidal thoughts. Mother's prenatal smoking throughout pregnancy is associated with a 1.5 greater odds of suicidal thoughts for adolescents compared to children whose mother's reported not smoking during pregnancy. We discuss these findings in light of evolutionary models of suicidality. This study identifies both positive and negative associations on suicidal thoughts at age 15 and considers these in light of adaptive response models of human development. Findings are relevant for mental health policy.

Keywords

Canada, adverse childhood experiences, adaptive plasticity, executive function, life history trade-offs, present orientation, social support system, suicidality

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Suicide is a persistent public health problem at the global scale (Naghavi, 2019). Suicide is estimated to take approximately 800,000 lives a year, and suicide attempts affect many more people; suicide was the second leading cause of death among 15–29 year olds globally in 2016 (World Health Organization, n.d.). In the United States, the Centers for Disease Control reported a 35% increase in age-standardized suicide rates between 1999 and 2018 (Hedegaard et al., 2020). Of particular concern is the increase in suicide rates for females aged 10–14 (Ruch et al., 2019) and males aged 15–19 (Miron et al., 2019). The propensity for self-harm and suicidality is certainly a topic to which evolutionary-minded research should be contributing. Despite hundreds of studies into thousands of variables across half a century, traditional risk factors have been shown to be poor predictors of suicidal thoughts and behaviors under the methodological constraints of the existing literature (Franklin et al., 2017). In response, some researchers suggest pivoting

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away from identification of suicide risk factors in favor of individual clinical engagement (Mulder et al., 2016), while others have called for better integration of known environmental and psychological factors with additional units of analyses, such as behavior and physiology, with a focus on malleable mechanisms (Cha et al., 2018).

It is our hope that an evolutionary-developmental approach to suicidality, utilizing life history theory, will help to better understand the interplay between biological and psychological mechanisms, developmental conditions and, ultimately, improve the study of risk factors for suicidal thoughts and behaviors.

Previous Evolutionary Models

There are three prominent existing evolutionary models for suicidal behavior: Soper's (2018) "pain-and-brain" model, Syme et al.'s (2016)/Syme & Hagen (2019) signaling models, and deCatanzaro's (1980, 1981) diathesis–stress/burdensomeness model.

Pain and Brain

The pain-and-brain model considers suicide to be an unfortunate by-product of the complexity of the human brain in which the mechanisms evolved to deal with complex social lives interact with a species-typical imperative to avoid pain (Soper, 2018, p. 125). From this interaction, a persistent threat of suicide creates selective pressures favoring the evolution of anti-suicide defenses, or "keepers"—a suite of psychological mechanisms geared to downregulate "emotional aversiveness and the impetus to seek escape" (Soper, 2018, p. 139). Such keepers may manifest as common mental disorders, such as anxiety, thus making individuals appear to act irrationally. In addition, pain- and brain-type "fenders" are the result of gene-culture coevolution to maintain meaningful outlook and restrict the idea of suicide, including religious beliefs and traditions (Culotta, 2019; Humphrey, 2018). The pain-and-brain model is also founded on a general developmental pattern where suicidality is virtually unknown in early life, but incidences increase rapidly in puberty (Nock et al., 2013). The pain-and-brain model hypothesizes that suicide is a way to escape psychological pain (cf. Campbell, 1975; Gunn, 2017), distress that may originate from childhood experiences, which links to "escape" theories in suicidology (Gunn, 2014). In other words, Soper's model takes into consideration general developmental patterns related to social complexity as the background. Suicidality in this model is a by-product of cognitive adaptations to complex social life and emotional pain, which are counteracted by evolved psychological mechanisms and cultural institutions.

Signaling Models

The bargaining model of suicidal behavior (Syme et al., 2016) proposes that suicidal ideation and attempts are an honest signal of desperation (i.e., psychosocial stress) that communicates need for social support and/or dissatisfaction with a forced social condition (e.g., an arranged marriage). A follow-on cross-cultural analysis looks at suicide attempts as a way to make a costly apology for some kind of social or reproductive transgression (Syme & Hagen, 2019). Both signaling models imply suicidality occurs as a means of costly (credible) signaling (Hagen, 2011). For individuals whose fitness is severely constrained, putting one's life under risk of self-harm could improve fitness, if the effect of the action influences others to change their behavior toward that individual. Key evidence for the bargaining model and costly apology model comes from the ethnographic record (e.g., Billaud, 2012; Niehaus, 2012; Staples & Widger, 2012). In both models, suicide attempts are adaptive strategies and help to explain cross-cultural patterns in suicidality occurring in non-Western contexts. Completed suicides are viewed as an unfortunate by-product. Both models emphasize the importance of social support, which is a common theme of suicide in the anthropological and sociological literature (Durkheim, 1951). The cross-cultural evidence presented in Syme et al. (2016) on the relevance of social support is important to note, given the significance of cross-cultural data to evolutionary research on human behavior.

Diathesis–Stress/Burdensomeness Model

An early evolutionary approach to suicidality by deCatanzaro (1980, 1981) looks for factors that explain suicide as either maladaptive behavior or neutral in the evolutionary sense. deCatanzaro (1980) sets up four heuristics to explain suicidal behavior. The first is based on the idea that cultural learning can outstrip our biological adaptations. In other words, humans essentially have the capability to learn maladaptive behaviors. The second model is a mismatch hypothesis: Adaptive mechanisms no longer function as in their original evolved purpose in extremely stressful, novel environments. The third model is based on inclusive fitness or group selection theory: in limited circumstances, suicide is an adaptive response to being a burden on relatives or group members because of low reproductive potential. The last model proposes that suicide is a neutral trait where it would be "tolerated by evolution," if it does not affect the gene pool because individuals would be unlikely to have future reproductive success. In the discussion portion of the 1980 article, deCatanzaro agrees with Carr that there may be predispositions to suicidality that interact with environmental stressors. The first two models view suicide in some way as maladaptation following Dawkins' comment. The last two models are similar in that they take into consideration senescence or low reproductive potential and burden on relatives. deCatanzaro (1980) notes the role of stress in Models 2 and 4, particularly evolutionarily novel stressors, and calls for more investigation into the developmental role of stress without ignoring "predisposing factors" (deCantanzaro 1980, p. 288). Lester (2014, p. 61) notes an important issue with deCantanzaro's model is in understanding the growing rates of suicide among youth.

Psychosocial stress is a common element across these evolutionary models. What Gunn (2017) calls social pain, or emotional pain arising from threatened social attachments, is the central motivating feature of his model and is a key feature of one half of Soper's (2018) model. Psychosocial stress is implicit in the signaling models and is implicit for adaptive suicide within deCatanzaro's conception of burdensomeness. In respect to the role of learning maladaptive behavior, there is some overlap between deCantanzaro's first models and the signaling models (but only for completed suicide). In the pain-and-brain model, suicide is the maladaptive outcome of pain. In contrast, deCantanzaro's last two models view suicidality as an adaptive strategy, as do the signaling models. Important for our approach is deCantanzaro's idea of the developmental role of psychosocial stress and interaction with predisposing factors. In addition, we are interested in an approach that is both cross-culturally valid and takes into consideration evolved psychobehavioral design features.

Need for A New Model of Suicidality

One reason for a new approach is to better integrate evidence from the preventative medicine, public health, and neuroscience literature on the topic. A major focus has been on adverse childhood experiences (ACEs) which include a variety of childhood stressors such as household dysfunction and emotional, physical, and sexual abuse. While not particularly evolutionarily-minded, numerous publications link one's ACEs to a variety of health disruptions and cognitive impairments leading to early death—from drug use and depression to suicide attempts (Brockie et al., 2015; Brown et al., 2009; Caleyachetty et al., 2018; Felitti et al., 1998). ACEs are reported to have a "dose–response relationship" with many health problems. This means that a person's cumulative ACEs score has been shown to have a strong, graded relationship to numerous health, social, and behavioral problems throughout their life span, including suicide risk (Abdelraheem et al., 2019; Afifi et al., 2008; Bruffaerts et al., 2012; Cha et al., 2018; Dube et al., 2001). This approach is consistent with the extensive work on the developmental origins of health and disease (Heindel & Vandenberg, 2015; Schulz, 2010), much of which views these health effects as developmental constraints as opposed to developmental plasticity and adaptation over the life course (Gluckman et al., 2007).

In psychology, early life stress is typically portrayed as a factor "impairing" or "dysregulating" executive function (Bos et al., 2009; Fishbein et al., 2009; Hostinar et al., 2012). Psychological research shows links between impaired or dysregulated executive function and risk factors for suicidal behavior. Saffer and Klonsky (2017) find self-reported levels of executive functioning to be associated with increased risk of suicidal ideation and attempts in a large online study of U.S. adults. Sánchez Loyo et al. (2013) similarly found that suicide attempters have problems with inhibitory control in social contexts, along with alterations in executive functions. In addition, blunted stress response and impairment of executive function following a stress test have been associated with a family history of suicide (McGirr et al., 2010). Jollant et al. (2005) used the Iowa gambling task to investigate violent and nonviolent suicide attempters and controls and found a specific impairment in decision-making, hypothesizing a diathesis–stress model. Using a neuropsychological question battery with 50 nonmedicated patients with major depressive disorder, Keilp et al. (2001) found those with highly lethal suicide attempts performed significantly worse than other groups in the domain of executive functioning. These studies and other psychological studies tend to view the connection between executive function (or its elements) and suicidality as a result of dysregulation or impairment. However, from a life history perspective, these effects can be viewed as trade-offs resulting from the adaptive calibration of the stress response system to early life adversity (Ellis & Del Giudice, 2019).

Life history approach to suicidality. Life history theory examines how organisms allocate energy throughout the life span. Originally developed in biology to explain species' reproductive strategies (Cole, 1954; MacArthur & Wilson, 1967; Pianka, 1970; Stearns, 1976), more recently researchers have begun to use life history theory as a way to examine phenotypically plastic responses to early life factors in humans. Much of this research focuses on how family dynamics and stressors earlier in life influence "life history events," such as pubertal timing, age at first reproduction, and age at sexual initiation (Del Giudice, 2009; Del Giudice & Belsky, 2010; Ellis, 2013; Ellis & Del Giudice, 2019), and more rarely, investment in offspring (Hill & Kaplan, 1999). Others studies have focused on the

Box 1. Definitions.

Executive function—The mental processes to make goal-directed behaviors, including inhibitory control, working memory, and cognitive flexibility (Cohen, 2017). Executive function helps us to plan, focus attention, switch gears, and juggle multiple tasks (Center on the Developing Child at Harvard University, 2011)

Present orientation—The mental processes enabling detection of threats and opportunities (vigilance), impulsive reactions (little deliberation) in order to respond quickly, and steep future discounting to motivate the capture of immediate benefits (Frankenhuis et al., 2016)

Psychosocial stressor—A life situation that creates an unusual or intense level of stress that may contribute to the development or aggravation of mental disorder, illness, or maladaptive behavior (e.g., divorce, the death of a child, prolonged illness, unwanted change of residence, a natural catastrophe, or a highly competitive work situation; American Psychological Association, n.d.)

Suicidality—Suicidal behavior spanning suicidal ideation, plans, and attempts (Auerbach et al., 2017)

effects of early life factors on personality development (Figueredo et al., 2005), risky adolescent behavior (Ellis et al., 2012; Simpson et al., 2012), and psychopathology (Del Giudice, 2014; Hurst & Kavanagh, 2017). This growing body of work calls for an explicit integration of evolutionary theories of suicidality with insights from life history theory.

Much of the research applying life history theory to adolescent risk-taking and psychopathy utilizes the concept of fast–slow continuum, where early life harshness causes adaptive calibration to a faster life history strategy characterized by mating effort, early reproduction, and greater number of offspring with trade-offs in "reduced health, vitality, and longevity" (Ellis & Del Giudice, 2019, p. 115). Slower strategies are characterized by delayed reproductive development and sexuality, stable pair bonds and parenting effort, an orientation toward future outcomes, and low impulsivity (Ellis & Del Giudice, 2019). We follow Ellis and Del Giudice's call to go beyond dysregulation, diathesis–stress, and fragmentation by integrating life history theory to understand stress, developmental adaptation, and health.

Following other adaptive models of development (Ellis & Del Giudice, 2019; Frankenhuis et al., 2016), we expect the development of costly but adaptive strategies in stressful, harsh, and unpredictable environments. One effect of the modulation to costly strategies is that cognition becomes more "present-oriented," a state characterized by more vigilance, impulsivity, and a greater degree of future discounting (Frankenhuis et al., 2016). A recent meta-analysis (Amlung et al., 2019) finds that most individuals with disorders, including major depressive disorder, exhibit steeper future discounting ("delay discounting") than controls. Specifically relating to suicide, Dombrovski et al. (2011) find people who attempted low-lethality suicides displayed an exaggerated preference for immediate rewards compared with nonsuicidal depressed and healthy control subjects, although this was not found with high-lethality attempters. A more recent study using functional MRIs (Dombrovski & Hallquist, 2017) finds that impaired decision-making in suicide attempters is paralleled by disrupted future value signals in the ventromedial prefrontal cortex. Future discounting appears to be associated with a host of psychiatric disorders and at least some types of suicidality.

Our hypothesis is that under states of decreasingly relevant social support and increasingly harsh (measured as extrinsic mortality risk) and unpredictable (measured as rapidly changing environments) socioenvironmental conditions, adolescents will experience greater rates of suicidal ideation. Rather than view this process purely as dysregulation, however, we propose that under certain life history conditions modulation to present orientation is part of an evolved adaptive response, which occurs irrespective of the potential for self-harm and threats to well-being (Frankenhuis & de Weerth, 2013). While the link between impulsivity (or specific constructs of impulsivity) and suicidality has been debated (Auerbach et al., 2017; Millner et al., 2020), the psychological literature has fair support for a connection between dysregulated executive function (i.e., more present orientation/future discounting) and suicidality. In more supportive environments (with less stress and more predictability), cognitive development is characterized by executive functioning, which is more goal-directed, planned, and deliberative (Cohen, 2017). Modulations occur as part of the organism's "organized response" to the environment that is the product of evolution (Tooby & Cosmides, 1992, p. 84).

Life History Variables

Social support is relevant to both alloparental care, a common feature of the human reproductive strategy, and the building of social relationships outside the immediate family during middle childhood (Koster & Leckie, 2014; Kramer, 2010). Questions about how human systems of cooperation, sharing, and social structure (social support) vary with local environments is a key aspect of human behavioral ecology (Cronk, 1991; Nettle et al., 2013; Winterhalder & Smith, 2000). Social support networks have been shown to buffer risk of injury (Sugiyama, 2004), provide help where needed (Snopkowski & Sear, 2015), and help build trusting, cooperative relationships (Power, 2017). The preventative medicine literature points to the importance of social support across the social-ecology of the child as well as in preventative (upstream) and treatment (downstream) programs (Ports et al., 2017). In addition, appeal to social support is significant in cross-cultural analysis of the signaling models of suicidality (Syme et al., 2016; Syme & Hagen, 2019).

Prenatal stress is thought to be relevant to more permanent changes in human physiology (Chaby, 2016). For example, prenatal stress and exposure to glucocorticoids are associated with low birth weight babies and higher plasma cortisol levels throughout life, indicating high hypothalamic–pituitary–adrenal (HPA) axis calibration. Higher HPA levels are associated with neuropsychiatric disorders and altered brain function (Nath et al., 2017). Middle childhood is a unique stage in human life history during which children become increasingly interested in social relationships outside the family. The biological effects of stress are known to occur into middle childhood (Farrell et al., 2018; McDade et al., 2017; Tyrka et al., 2016) continuing to affect the HPA axis (Flinn et al., 2011). We expect that early and middle childhood stress will be as or equally important to adaptive development as prenatal stress.

Environmental harshness and uncertainty, measures of extrinsic mortality, are often considered in explaining human life history trade-offs, particularly relating to reproductive scheduling. A number of studies have compared the effects of the two factors indicating a complex interplay (Simpson et al., 2012; Sung et al., 2016). Snopkowski and Ziker (2020) examining several types of variables simultaneously, found that early life psychosocial stressors and extrinsic mortality along with unpredictability, social support, and intergenerational conflict were important factors in predicting sexual initiation by Canadian youths. In response to high extrinsic mortality and concomitant probabilities of shorter life spans, earlier entry into reproductive effort and earlier reproduction make sense in terms of adaptive response. In uncertain

environments, it is hypothesized that traits reducing *variance* in reproductive fitness will be favored, even if they result in some reduction in arithmetic mean fitness (Stearns, 2000). Such reductions may bear out in human populations under the conditions of prolonged economic uncertainty (Nolin & Ziker, 2016). Following the research on life history trade-offs on reproductive scheduling, we consider extrinsic mortality cues, measured by environmental harshness and unpredictability as risk factors for suicidal ideation as part of adaptive calibration to the environment.

Predictions

This article contributes to the evolutionary literature on suicidality by integrating life history theory in an exploratory analysis of a longitudinal study of children and youths. In particular, rather than viewing suicidal ideation as the direct result of a stress-induced developmental constraint or dysregulation, we examine the proposition that suicidal ideation is a correlate of the shift to present-oriented cognition, which is a facultative response to adverse social environments (Nettle, 2004, 2014). We do not mean the modulation to present orientation to be confused with established therapeutic techniques in suicide prevention, such as mindfulness treatment (Luoma & Villatte, 2012), that are strategies to promote self-control and manage daily life (i.e., treatments to support executive function) through raising present-moment awareness or contact with the present.

If our prediction is accurate, we would expect that early life variables associated with adolescent present orientation would also be predictive of suicidal ideation, including reduced social support and increased early life psychosocial stress along with heightened environmental harshness and unpredictability. We use a model selection approach to test all relevant variable sets. For example, if Canadian teenagers' self-reports of suicidal ideation at age 14–15 are most strongly related to prenatal factors alongside all these other variable sets and controls, then permanent phenotypic changes (diathesis) are implicated (deCatanzaro, 1980). If psychosocial stressors are the predominant predictors of Canadian teenagers' suicidal ideation, then a developmental constraint (pathology) interpretation without adaptive response is most reasonable (Pepper & Nettle, 2017). This result would align most closely with the pain-and-brain model and the diathesis–stress models of suicidality. If variables representing social support, psychosocial stressors, environmental harshness, and uncertainty are combined predictors of suicidal ideation, then an adaptive developmental interpretation is more justified. This result would also align more with the signaling models for suicidality (given the role of social support) and burdensomeness model but also provide support for a life history perspective on suicidal ideation. Public health and social work professionals in Canada, as elsewhere, are interested in what can be done to ameliorate the risks of suicidal behavior. If it can be shown that certain types of social support help to buffer against suicidal ideation while certain risks and uncertainties favor it, then such findings could help better target health policy.

Method

Study Sample

The data come from the Canadian National Longitudinal Survey of Children and Youth (NLSCY), a longitudinal study conducted by Statistics Canada in eight waves from 1994 to 2008. The NLSCY was designed to collect data on the factors influencing a child's social, emotional, and behavioral development (Statistics Canada, 2010). The topics covered include health of children and their caregivers, information on physical development, learning and behavior, and information on their social environment (including their family, friends, schools, and communities). The target population was comprised of the noninstitutionalized civilian population in Canada's 10 provinces, but excluded children living on First Nation reserves or Crown lands, full-time members of the Canadian Armed Forces, and residents of some remote regions (Statistics Canada, 2007). We were granted authorization to utilize the NLSCY by Statistics Canada via the Prairie Regional Research Data Centre (RDC) at the University of Calgary. The initial research was conducted at the RDC branch at the University of Lethbridge with follow-up work at the University of Calgary. Our project was reviewed and approved by the Social Sciences and Humanities Research Council of Canada.

We utilize all waves of data collection in the NLSCY, following children who were under 2 years in the first cycle (to include those with information on their prenatal conditions). There were 4,696 children surveyed in Wave 1 in 1994–1995. Follow-up surveys were conducted every 2 years. In Wave 8 (conducted in 2008–2009), the children originally surveyed were 14 and 15 years old. The "person most knowledgeable about the child" referred to as the primary caregiver was surveyed at each wave, and once the child turned 10, questionnaires were answered by the child as well. Our dependent variable, suicide ideation is taken from the question: "In the past 12 months, did you seriously consider attempting suicide?" Adolescents were asked this question in Waves 7 (corresponding to ages 12 and 13) and 8 (corresponding to ages 14 and 15). If an adolescent reported yes in either wave, they were coded as experiencing suicidal ideation. If they answered "no" in both waves, they were coded as not experiencing suicidal ideation.

Statistical Analysis

We use a model selection approach to compare the "fit" of a variety of logistic regression models to the data set to see which models best predict whether the adolescent has "seriously considered attempting suicide" (self-reported). A model is selected based on the Akaike information criterion (AIC) that calculates the fit of the model with a penalty for each additional parameter (Burnham & Anderson, 2011; Towner & Luttbeg, 2007). This

process selects the model that best "fits" the data, but it cannot provide an absolute quality. The approach quantifies the quality of that fit relative to other models. We follow the following procedure to rank our models: (1) identify alternative "sets of variables" based on the theoretical predictions above, (2) determine the best parameters within each set of variables by minimizing AIC values to produce a strong set of independent variables that represent each model, (3) fit a priori candidate models to the data representing all combinations of variable sets, (4) calculate AIC values for each candidate model, and (5) rank the models in ascending order of these values. The best supported model is the model with the lowest AIC value. There is no critical value at which an AIC difference is "significant," but as a general rule, an AIC difference of four to seven means a model has significantly less support than the best supported model (Burnham & Anderson, 2011). We also calculate *importance* of each variable set by summing the Akaike weights for each model that a given variable set appears in (Burnham & Anderson, 2011). Those sets with *importance* values closer to one are included in more of the best supported models. By using an evidence-based approach based on likelihoods, we are better able to quantify the relative evidence for alternative models (Towner & Luttbeg, 2007). The same sample needs to be used when comparing different models, so only those individuals with information on all necessary variables are included in our sample. This leads to a sample size of approximately 1,700 adolescents (this number is rounded to protect subject confidentiality) aged 14–15 years old. Unfortunately, there is no straightforward way to conduct multiple imputation using a model selection approach. If there are systematic differences between those who complete the survey across waves and those that do not, this limits the application of our results to nonrespondents.

We included over 30 independent variables in the initial stages of model selection. The NLSCY utilized question batteries including a variety of parental and community indicators (including parenting strategies, parental health, sociodemographics, and neighborhood quality). We utilized STATA Version 13 and analyzed unweighted logistic regression models using sets of variables to choose those with the lowest AIC. Our main sets of variables include the following: (1) early life psychosocial stressors, (2) mortality cues (measured as environmental harshness and uncertainty), (3) social support, and (4) prenatal factors. For all models, the following control variables were included: sex, the primary caregiver's religious attendance, number of siblings, and ethnicity. Ethnic group is defined as "the ethnic or cultural group the child's ancestors belong to" or the child's "race or color." This was grouped into three categories: children who were reported as "North American Indian, Inuit/Eskimo, or Métis," children who were identified as "French, English, Scottish, Irish, Italian, Ukrainian, Dutch, Polish, or Portuguese" and then those belonging to *other* groups, including "Chinese, South Asian, African, Haitian, Jamaican, Arab/West Asian, Filipino, South East Asian, Latin American, Japanese, Korean, or other." While this *other* category is overly expansive, sample sizes from these individual categories were too small to run separately. Additionally, given that some individuals identify as more than one ethnic group, priority was given to the *Native American Indian* group, then *other*, then *European ancestry*, based on relative sample sizes of the groups. We also examined a wealth indicator, age of the child (in months), the primary caregiver's birth country, and the primary caregiver's educational level, but none of these variables improved the base model and were not included in any models.

Results

Table 1 provides information on the variables included in each of the models, with an indication of which variables were kept in the "best" (minimal AIC) base model for each variable set (see Step 2 above).

Descriptive Statistics

Table 2 displays the descriptive statistics for suicidal thoughts and measures representing *early life psychosocial stressors*, *mortality cues*, *social support*, and *prenatal factors*. In our sample, adolescents are 14 or 15 years old, with a mean age of 15.2 years. They are 49% female and 51% male. Approximately 13% of adolescents reported that they have had suicidal thoughts, which is comparable to studies of U.S. high school students (Lowry et al., 2014).

Only one variable was included in the best supported *early life psychosocial stressors* model: a child's exposure to stressful events from age 4 to 13. This variable was measured as any event or situation that caused them a great amount of worry or unhappiness, averaged across the five waves. Other variables including the number of childhood residential moves, number of childcare changes, parental depression, frequency of excessive parental drinking, household violence, parental residence, and parental childrearing scales were not included in the best model of suicidal thoughts (based on minimizing the AIC value). The mean frequency that a child experienced a stressful event is 0.31, which corresponds to one stressful event every third wave (or about every 6th year). These stressful events can include abuse or fear of abuse, staying in a foster home, separation from parents, alcoholism or mental health issues in the family, divorce or separation of parents, conflict between parents, death in the family, moving households, change in household member, stay in the hospital, illness/injury of the child or a close family member, or other factors. An examination of these factors shows that "other factors" were most frequently cited; across waves, this factor was reported between 28% and 35% of the time. The second most frequently cited reason was "death in the family" (excluding parents), which was reported 21%–24% of the time, depending on the wave. In Wave 7, two additional categories were added, including death of a pet and problems at school. Problems at school were reported to be a cause for a great amount of worry for 11% of adolescents and reduced the rate of "other factors" to 22%. While the other variables included in the *early life psychosocial stressors*

Table 1. Explanatory Variables Included in the Final Round of Model Selection for Suicidal Thoughts.

Life History Variable Set	Variable	How It Is Measured	Included in Best Supported Model
Psychosocial stressors	Primary caregiver's frequency of excessive drinking	The number of times the primary caregiver reported being drunk (average across years); log transformed.	
	Violence in the household (ages 8–13)	The frequency that the parent reported the child sees adults or teenagers physically fighting, hitting, or trying to hurt others in the household (3 = *often*, 2 = *sometimes*, 1 = *seldom*, 0 = *never*; averaged across waves).	
	Primary caregiver's depression (ages 0–7)	Depression scale from nine questions, where higher scores indicate more depressive symptoms (possible range = 0–36, averaged over waves).	
	Stressful event (ages 4–13)	Whether the child ever experienced any event or situation that caused them a great amount of worry or unhappiness (1 = *yes*, 0 = *no*, averaged across waves).	x
	Ineffective parenting scale (ages 2–11)	Ineffective parenting scales from seven questions where higher values represent more ineffective parenting (range = 0–28, averaged over waves).	
	Rational parent interactions (ages 2–11)	Rational parenting scale from four questions where higher values represent rational parenting behaviors. An example includes calmly discussing the problem when your child breaks the rules (possible range = 4–20, averaged across waves)	
	Consistent parent interactions (ages 2–11)	Consistent parenting behavior scale from five questions where higher values represent more consistent parenting. An example includes following through on punishment after telling a child they will be punished if they do not stop a behavior (range = 0–20, averages across waves)	
	Parental residence	Who does the child live with at last wave (coded as 0 = *both biological parents*, 1 = *biological mother and stepfather*, 2 = *biological mother and no father*; 3 = *other*)	
	Number of moves (up to age 7)	How many times in the child's life (up to age 7) has they changed their usual place of residence?	
	Changes in childcare (up to age 9)	Overall, how many changes in childcare arrangement has this child experienced since you began using childcare, excluding periods of care by parent or parent's spouse?	
Mortality cues	Primary caregiver has health limitations	The primary caregiver's response to: "Does a physical condition or mental condition or health problem reduce the amount of activity you can do at home, at work, or at school, in caring for children or in other activities (e.g., transportation or leisure)" 1 = *yes to any*; 0 = *no*. Averaged across waves for both primary caregiver and their spouse (if there is one) when child was between 8 and 13	x
	Father's health limitations	Categorical variable representing health limitations (see question for primary caregiver above) of one's father or father figure, coded as: 0 = *no limitation, biological father*, 1 = *health limitation biological father*, 2 = *no limitation, nonbiological father*, 3 = *health limitation nonbiological father*, 4 = *no father/father figure*. Averaged across waves when child was between 8 and 13	
	Primary caregiver's chronic illness	The primary caregiver's response to: "Do you have any of the following long-term conditions? Food or digestive allergies, respiratory allergies such as hay fever, any other allergies, asthma, arthritis or rheumatism, back problems, high blood pressure, migraine headaches, chronic bronchitis or emphysema, sinusitis, diabetes, epilepsy, heart disease, cancer, ulcers, effects of stroke, and any other long-term condition" 1 = *yes to any*; 0 = *no*. Averaged across waves	
	Death of a parent	If the child's mother or father died before the child's 16th birthday (1 = *yes*, 0 = *no*)	x

(continued)

Table 1. (continued)

Life History Variable Set	Variable	How It Is Measured	Included in Best Supported Model
Social support	Primary caregiver's social support [a]	Primary caregiver's Social Support Scale from eight questions where higher values indicate the presence of social support. An example includes, "There is someone I trust whom I would turn to for advice if I were having problems" (range = 0–24, averaged over waves)	x (ages 8–13)
	Neighborhood cohesion [b]	Perceived Neighborhood Cohesion Scale from five questions where higher values indicate a higher degree of neighbor cohesiveness. An example includes, "People around here are willing to help their neighbors" (range = 0–15, averaged over waves)	x (ages 8–11)
	Childcare type	A categorical variable indicating the type of childcare, coded as: 0 = *childcare by parents only*, 1 = *childcare by other kin*, 2 = *mix of kin and nonkin childcare*, and 3 = *nonkin childcare*	
	Kin social support (of adolescent)	Child's response (ages 10–13) to whether they can talk about themselves or their problems to a grandparent or other relative (1 = *yes*, 0 = *no*)	
	Nonkin social support (of adolescent)	Child's response (ages 10–13) to whether they can talk about themselves or their problems to a friend of the family, babysitter, counselor/teacher at school, a coach or leader, or other nonrelative (1 = *yes*,0 = *no*)	x
	Number of individuals providing social support (of adolescent)	Number of individuals that the child reports they can talk to about themselves or their problems, other than close friends, including (each category can only contribute one individual): mother, father, stepmother, stepfather, brother, sister, grandparent, other relative, friend of the family, babysitter, parent's boyfriend, teacher/counselor, coach/leader, and other	x
Prenatal factors	Mother's alcohol consumption during pregnancy	Whether the birth mother drank during pregnancy, coded as 2 = *drinking throughout pregnancy*, 1 = *drinking during part of pregnancy, but not all of it*, 0 = *no drinking during pregnancy*	
	Mother's smoking frequency during pregnancy	Whether the birth mother smoked during pregnancy, coded as 2 = *smoking throughout pregnancy*, 1 = *smoking throughout part of pregnancy, but not all of it*, 0 = *no smoking during pregnancy*	x
	Mother's gestational diabetes	Whether the birth mother suffered from pregnancy diabetes (1 = *yes*, 0 = *no*)	
	Poor birth health	The primary caregiver's response to "Compared to other babies in general, would you say that the child's health at birth was . . . " coded as 5 = *poor*, 4 = *fair*, 3 = *good*, 2 = *very good*, 1 = *excellent*	

[a]Variable was included for ages 0–7, 8–13, or 0–13 in combination (where ages 0–13 could not be used in conjunction with the other two age ranges given redundancy). [b] Variable was included for ages 4–7, 8–11, or 4–11 in combination (where ages 4–11 could not be used in conjunction with the other two age ranges given redundancy).

model are also indicative of stress, it seems that our variable representing more general stress resulted in a model with a lower AIC than models including variables indicative of specific stressors.

The variables included in the best supported *mortality cues* model are primary caregivers' health limitations from age 8 to 13 and death of a parent. Death of a parent is a significant source of stress and is not one of the ACEs. Other mortality cues such as primary caregiver's health limitations are subtle signals of environmental harshness. Primary caregiver's health limits are included when the child is between 8 and 13 years old. The average health limitation is 0.132, indicating about 13% of primary caregivers (or their spouses) have health limitations. Approximately 3% of children in the sample experienced a death of a parent.

The best supported *social support* model included the following variables: nonkin social support from age 10 to 13, the primary caregiver's reported social support when the child was between 8 and 13 years old, neighborhood cohesion when the child was between 8 and 11 years old, and the number of individuals the adolescent reported as sources of social support. The nonkin social support variable is a response by the child (ages 10–13) to whether they can talk about themselves or their problems to a family friend, babysitter, counselor/teacher at school, a coach or leader, or other nonrelative. The Social Support Scale, which ranges from 0 to 24, indicates the primary caretaker's perception of social support. The average is approximately 20 out of a possible 24, suggesting that most primary caretakers feel they have social support. The Neighborhood Cohesion Scale, which ranges from 0 to 15, has an average of approximately 11. This suggests that people feel that, on average, their neighbors are generally helpful and look out for one another. Finally, the number of individuals the child reported as sources of social support includes the number of individuals reported—with options including one's mother, father,

Table 2. Descriptive Statistics for Variables Used in the Study.

Variable	Mean or %	*SD*
Had suicidal thoughts	13.04%	
Control variables		
Sex (female)	49%	
Primary caregiver's religious attendance (5 = *at least weekly*, 4 = *at least monthly*, 3 = *3–4 times/year*, 2 = *1–2 times/year*, 1 = *none*)	2.78	1.32
Number of siblings	1.3	0.92
Ethnicity		
European	82.8%	
Native American	8.2%	
Other	9.0%	
Early life psychosocial stressors		
Stressful event (ages 4–13)	0.31	0.29
Mortality cues		
Primary caregiver (or their spouse) has health limitations	0.132	0.23
Death of a parent	3.08%	
Social support		
Primary caregiver's social support (ages 8–13)	19.57	2.81
Neighborhood cohesion (ages 8–11)	10.65	2.14
Adolescent has nonkin social support	65.4%	
Number of individuals providing social support	3.58	2.10
Prenatal factors		
Mother's smoking during pregnancy		
None	74.6%	
Some of pregnancy	4.2%	
All of pregnancy	21.3%	

stepmother, stepfather, brother, sister, grandparent, other relative, friend of the family, babysitter, parent's boyfriend, teacher/counselor, coach/leader, or other individual.

The variable that was included in the best supported *prenatal* model was mother's smoking during pregnancy. Approximately 74.6% of expectant mothers reported not smoking, while 21.3% reported smoking throughout pregnancy, and the remaining 4.2% reported smoking during part of their pregnancy. *Prenatal factors* including mothers drinking during pregnancy, mother's gestational diabetes, and birth health were not included in the "best" model (as measured by lowest AIC score) of suicidal thoughts.

Model Comparison

Table 3 displays the AIC values for different combinations of models. The model with the lowest AIC value includes variables representing *early life psychosocial stressors*, *prenatal factors*, and *social support*. Models with AIC values within three of the lowest value also have a high level of support. We found three additional models within this limit (see Table 3). These models include variables representing *early life psychosocial stressors* and *social support* (second best model) along with both *mortality cues* and *prenatal factors* (third best model) or just *mortality cues* (fourth best model).

We examine the importance of each set of variables, providing an indication of the relative importance of that variable set compared to others across all models. This is calculated by summing the Akaike weights for each model that a given variable set appears in. The results clearly indicate that *social support* and *early life psychosocial stressors* are highly important variable sets for predicting suicidal thoughts (see Table 4). The other two variable sets, *prenatal factors* and *mortality cues*, while included in several of the top models, have a much lower level of importance.

Table 5 displays the parameter estimates from the top ranked models. With the set of control variables, we find that being female is associated with an increased likelihood of having suicidal thoughts, a result that mirrors frequencies of major depression in the United States and Canada (Albert, 2015). Also, the more frequent religious attendance reported by the primary caregiver, the lower the odds of the child having suicidal thoughts. Increased number of siblings is associated with a reduced likelihood of suicidal thoughts. Ethnic group is also significantly associated with suicidal thoughts. The results of this ethnicity variable show that those who identify as "Native American Indian, Inuit/Eskimo, or Métis" report higher suicidal thoughts than those of European ancestry and those who identify as *other* have consistently lower, but not significant, suicidal thoughts compared to those of European ancestry.

Early life psychosocial stress is measured as the exposure to events or situations that cause worry or unhappiness. We find that exposure to such stressful events throughout childhood is associated with an increased likelihood of having suicidal thoughts at age 15. *Social support* variables include nonkin support of the child, the primary caregiver's social support (when the child was between ages 8 and 13), neighborhood cohesion, and number of individuals providing social support. When children report having a family friend, babysitter, counselor/teacher at school, a coach or leader, or other nonrelative available to talk about problems, the frequency of suicidal ideation is higher. This is counterintuitive but can be understood in conjunction with the number of individuals the child seeks social support from, where greater numbers of people are associated with a reduction in suicidal ideation. An additional analysis was conducted to see the effects of these variables separately. A model with nonkin support (excluding amount of social support) has a nonsignificant effect ($p > .9$) with an odds ratio of 1.009. A model with the amount of social support alone (excluding nonkin support) shows a significant negative effect, as before. This suggests that the protective effect of social support on reducing suicidal ideation is less effective when this social support comes from nonkin. The primary caregiver's reported social support (someone available to talk to about problems) is associated with an increase in the child's suicidal thoughts. This is also surprising. It is possible that a primary caregiver's increased social support may reflect support-seeking behavior resulting as children manifest signs of mental health challenges. Alternatively, this result might represent a conflict of interest between the primary caregiver and the child concerning the former's time and energy

Table 3. Comparison of 16 Statistical Models With All Permutations of Independent Variable Sets of Interest for Predicting Suicidal Thoughts at Age 14/15.

Model	*k*	AIC	Δ_i	w_i
1. Stressors + social support + prenatal	**13**	**1,024.144**	**0**	**.363**
2. Stressors + social support	**11**	**1,024.61**	**0.466**	**.288**
3. Stressors + mortality + social support + prenatal	**15**	**1,025.682**	**1.538**	**.168**
4. Stressors + mortality + social support	**13**	**1,025.719**	**1.575**	**.165**
5. Mortality + social support	12	1,032.178	8.034	.007
6. Social support + prenatal	12	1,032.226	8.082	.007
7. Social support	10	1,034.042	9.898	.003
8. Stressors	7	1,046.37	22.226	<.001
9. Stressors + prenatal	9	1,046.416	22.272	<.001
10. Stressors + mortality	7	1,047.546	23.402	<.001
11. Stressors + mortality + prenatal	11	1,048.054	23.91	<.001
12. Mortality + prenatal	10	1,054.222	30.078	<.001
13. Mortality + social support + prenatal	14	1,054.222	30.078	<.001
14. Mortality	8	1,054.397	30.253	<.001
15. Prenatal	8	1,055.39	31.246	<.001
16. Base model (control variables only)	6	1,056.4	32.23	<.001

Note. Control variables included in all models. *k* refers to the number of fitted parameters; Δ_i refers to the change in AIC between the lowest value and the variable of interest; w_i refers to the Akaike weight (the relative likelihood of the model being the best). The four most likely models are bolded. AIC = Akaike information criterion.

Table 4. Importance of Variable Sets (Calculated as the Sum of the Akaike Weights of All Models in Which the Variable Sets Appear).

Variable Sets	Importance
Social support	1
Early life psychosocial stressors	0.9845
Prenatal factors	0.5379
Mortality cues	0.3401

allocation. Finally, where neighborhood cohesion is greater, we find a slight decrease in the likelihood of having suicidal thoughts. The *prenatal* model indicates that a mother's prenatal smoking (throughout pregnancy) is associated with an increased likelihood of her child's thoughts of suicide at age 15. Variables representing *mortality cues*, including the primary caregivers' health limitations and death of a parent, show that parental health limitations and death of a parent are both associated with an increased likelihood of suicidal thoughts at age 15.

Discussion

Importantly, many variables do not predict suicidal ideation when also including life history and social support factors. For example, variables representing socioeconomic status, country of origin, and education level of the primary caregiver are not included in our best models. These findings are important to an understanding of the resiliency of human developmental processes.

The life history variables of significance include *social support*, *early life psychosocial stressors*, *prenatal factors*, and *mortality* (harshness and uncertainty) *cues*. *Social support* variables include nonkin support of the child, the primary caregiver's social support (when the child was between ages 8 and 13), neighborhood cohesion, and number of individuals providing social support. We view these variables as relevant to the human behavioral ecology framework. Alloparenting, care by people other than parents, has been found to improve survival rates in natural fertility populations (Burkart et al., 2009; Kramer, 2015; Sear & Mace, 2008). In other words, it takes a village to raise a child. Given the evolutionary importance of allocare in our species, it is not surprising to anthropologists to find that social support variables are the most important across all our models. A lingering question has to do with the counterintuitive effects of the child's reported nonkin support and social support of the primary caregiver. Following the logic of the bargaining model, it is possible that a weaker party in a conflict may seek out third-party support. It might be that children are reporting to adults at school and elsewhere when they face conflicts at home; however, there are professional/ethical and social limitations that prevent teachers, counselors, coaches, and others from directly intervening. This explanation is consistent with our statistical reanalysis that excluded number of individuals providing social support, which showed a nonsignificant effect of nonkin social support. Considering the fact that the social support variable set was most important across our model selection analysis, we cannot disregard suicidality as an adaptive response to social conflict as modeled in the bargaining model.

In considering the effects of *early life psychosocial stressors*, we utilized the question from the NLSCY that reported exposure to events or situations that cause worry or unhappiness. This stressful event question is our strongest explanatory variable and this variable set came out a close second in importance to *social support*. We find that exposure to such stressful

Table 5. Parameter Estimates for Top Ranked Models.

	Model 1			Model 2			Model 3			Model 4		
Variable	*OR*	*SE*	*p*	*OR*	*SE*	*p*	*OR*	*SE*	*p*	*OR*	*SE*	*p*
Sex												
Female	2.23	.40	<.01	2.24	.40	<.01	2.19	.40	<.01	2.20	.40	<.01
Primary caregiver's religious attendance	0.85	.06	.03	0.83	.06	.01	0.85	.06	.02	0.83	.06	.01
Number of siblings	0.90	.09	.28	0.89	.09	.25	0.90	.09	.31	0.90	.09	.28
Ethnicity (ref = European ancestry)												
Native American	1.61	.45	.09	1.64	.45	.08	1.58	.45	.10	1.61	.45	.09
Other	0.84	.35	.67	0.81	.34	.62	0.86	.35	.71	0.83	.34	.66
Stressful event	2.66	.81	<.01	2.80	.85	<.01	2.40	.76	.01	2.51	.79	<.01
Primary caregiver's social support	1.11	.04	<.01	1.10	.04	<.01	1.11	.04	<.01	1.11	.04	<.01
Neighborhood cohesion	0.92	.04	.05	0.92	.04	.03	0.92	.04	.06	0.92	.04	.04
Nonkin social support (child)	1.75	.37	.01	1.73	.37	.01	1.73	.37	.01	1.71	.36	.01
Number of individuals providing social support (child)	0.78	.04	<.01	0.79	.04	<.01	0.78	.04	<.01	0.79	.04	.00
Mother's smoking during pregnancy (ref = none)												
Some of pregnancy	0.83	.41	.70				0.84	.42	.72			
All of pregnancy	1.51	.30	.04				1.48	.30	.05			
Primary caregivers have health limitations							1.37	.51	.41	1.37	.51	.40
Parent died							1.59	.54	.18	1.67	.57	.13
Constant	0.04	.03	<.01	0.05	.03	<.01	0.03	.02	<.01	0.04	.03	<.01
AIC	1,024.144			1,024.61			1,025.682			1,025.719		

Note. $N = 1{,}700$. AIC = Akaike information criterion.

events throughout childhood is associated with increased likelihoods of having suicidal thoughts at age 15 as predicted by all our evolutionary models. While this measure is less specific than the classic list of ACEs, it extends the ACEs' focus on household dysfunction. Importantly, the result shows that the primary caregiver's *perception* of their child's exposure to stressful events is predictive of suicidal ideation in their child at age 15 in the same manner as ACEs (Ports et al., 2017). Of course, it is hard to know the exact mechanism by which stressors influence later life suicidal ideation (if at all) through this question. We have done our best not to overextend our findings, although other possibilities, like an ongoing unstable home life, may explain both earlier stressors and adolescent suicidal ideation.

The *prenatal* findings, that maternal smoking throughout pregnancy is associated with increased suicidal ideation at age 15, are consistent with known effects of mother's prenatal smoking on child health, including behavioral disorders (Ko et al., 2014; Silberg et al., 2003; Wakschlag et al., 1997). Possible etiology includes increased maternal testosterone (Rizwan et al., 2007), epigenetic changes (Joubert et al., 2016), other factors inherited from the mother (Wakschlag et al., 1997), or family effects, not smoking itself (Cnattingius et al., 2011), indicating that there are potential confounds between smoking and suicidality. A series of pregnancy complications occur with maternal smoking during pregnancy (Castles et al., 1999). Irrespective of the proximate cause, the prenatal findings indicate that some early developmental conditions may influence individuals' predispositions to behavioral disorders.

We tested a series of variables representing *mortality cues*, including the primary caregivers' health limitations and death of a parent, which are both associated with increased suicidal thoughts. *Mortality cues* are not included in the list of 10 classic ACEs, which are divided into abuse, neglect, and household dysfunction, but are an important environmental harshness variable considered in life history theory. Interestingly, death of a parent was included as a variable in the *mortality cues* model and also as one of the possible stressful events listed in the NLSCY. This is unlikely a problem for the multicollinearity assumption of regression, however, since only 2% of adolescents who experienced a stressful event lost a parent in our data set. Given our analysis plan to identify variables that are most representative of the life history factors we wanted to test and minimize AIC values, including both variables is justified. Since *mortality cues* were included in most of our top models, we cannot disregard the effects of adaptive response to cues of social–environmental harshness affecting cognitive orientation and, thus, opening up vulnerability to suicidality.

Cues related to environmental unpredictability (number of moves, changes in childcare) were not included in our final model selection process. It is possible that the variables we considered to relate to unpredictability were not tracking the kinds of unpredictability that would affect cognitive development. However, given this result, environmental unpredictability does not appear to be a strong candidate for consideration of adaptive responses relevant to suicidality.

Limitations

A limitation of this analysis is that the NLSCY, while extensive, was not designed to examine suicidal ideation from an evolutionary perspective. The study is limited to analyzing

only those measures that the NLSCY included, and this makes interpretability difficult. For example, the NLSCY did not collect the direct equivalent of ACEs. While the *early life psychosocial stressors* variables are proxies for classic ACEs, we have no way of checking this assertion. Additionally, we do not know whether a given child was diagnosed with any mental health disorder in childhood, which may have some bearing on adolescent suicidal ideation relevant to the diathesis–stress model.

Our analysis strategy has some strengths, namely, that it allows us to examine a large number of variables, but it also comes with significant limitations. First, a large proportion of individuals were removed from the analysis due to missing information. There is no easy way to conduct multiple imputation in model selection. Second, it is possible that sets of variables are selected that may be somewhat collinear. This was observed with the *social support* variables, where social support by kin and nonkin are correlated ($r = .30$), and with stressful event and parental death, both included in their respective best fit model. Third, our analyses can identify the best fit model, but it cannot quantify the quality of that model or determine its predictive ability. Finally, these models represent correlations, we cannot tell whether there are any causal mechanisms at play. Further, we cannot determine the proximate mechanisms (or mediators) by which these relationships may act.

Conclusions

We find that including factors derived from life history theory improves explanatory models of suicidal ideation based on psychosocial stress alone. The NLSCY was designed and implemented before the ACE study was published (Felitti et al., 1998), and while we cannot directly compare the NLSCY measures of *early life psychosocial stressors* to ACEs, we find that such stressors are consistent predictors of suicidal ideation at age 15 across the best models. This finding is consistent with aspects of the pain-and-brain model of suicidality and the ACE study itself. However, we also find that *social support* is the most important variable set, and in the form of neighborhood cohesion and number of sources of social support for adolescents are both associated with reduced suicidal thoughts. We are encouraged to find a positive influence of rich social environments. *Early life psychosocial stress* and *social support* may be particularly important factors in populations undergoing urbanization or other forms of social marginalization. A primary caregiver's self-reported level of social support is associated with an increase in suicidal thoughts for the adolescent. However, we cannot rule out that this finding is a result of parents' help seeking prior to the actual manifestation of the child's suicidal thoughts or conflict between the child and the caregiver. Nonkin social support by itself does not reduce the odds of suicidal ideation. In general, the importance of social support across our model selection analysis is relevant to the adaptive response process and provides policy makers some indication of the need to structure programs to foster kin-based social support.

Prenatal factors and *mortality cues* were included in some of the best models but tend to have less importance than *social support* and *early life psychosocial stressors*. *Prenatal factors* as indicated by mother's prenatal smoking show an increased rate of suicidal ideation for children born to mothers who smoked throughout pregnancy (compared to not smoking at all). Importantly for prevention, *prenatal factors*, because they occur so early in development, are likely to be a more permanent phenotypic calibration. *Mortality cues*, such as parental death and primary caregivers' health limitations, are also associated with increased suicidal thoughts, although not significantly so in final models. *Mortality cues* as representative of environmental harshness are known to affect the timing of reproductive scheduling and also appear to have some influence on suicidal ideation as shown here. It is possible that influence occurs via adaptive informational plasticity responding to current environments that shift decision making to present orientation (Nettle & Bateson, 2015). This finding is also consistent with aspects of the bargaining and diathesis–stress models for suicidality. However, by viewing these effects in terms of life history trade-offs, we unite modulations of cognition and more well-known modulations of reproductive behavior into one evolutionary framework.

One future direction in this line of research might examine the proximate mechanisms that relate adaptive calibration of the stress response system (HPA axis) and present orientation/future discounting. Similarly, the measures of present orientation as relates to vulnerability to suicidal thoughts and behaviors across the life span need empirical study. Additionally, more work could be done to help social workers and health policy makers better apply insights from a life history trade-offs approach to behavioral health.

We hope that this study adds to efforts to stem suicidal ideation in North America and, globally, through identification of life history factors that correlate to suicidal ideation in this longitudinal sample of Canadian youth. An approach to suicidality including life history factors should continue to improve our understanding. A recent study by Geoffroy et al. (2020) using the NLSCY data found that for half the participants attempting suicide in youth (past-year self-reports staring at 12 years old), suicide attempts continued into adulthood (23 years old). Adolescent depression/anxiety, mother's depression, and preteen attention deficit hyperactivity disorder were significant risk factors. Our study shows that these trajectories start in early life, indicating a need for early life prevention strategies, and that life history factors should be taken into consideration when developing such clinical or educational interventions. Behavioral health issues, such as suicidality, are an important contributor to mortality across the globe but particularly worrisome where rates are increasing. Our study is meant to add to a growing body of evolutionary research on suicidality and the larger literature on the topic. Understanding the relationship between evolved psychology, its adaptive development in the context of life history factors, and health

outcomes may help practitioners and policy makers create more supportive and stable environments needed for better mental and behavioral health.

Authors' Note

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