Depression in adolescents: Causes, correlates and consequences

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Science Brief

A multidisciplinary approach to research improves our understanding of mental health in youth.

By Randy P. Auerbach, PhD, ABPP

Randy P. Auerbach is an assistant professor at Harvard Medical School. He also is the director of clinical research for the Division of Child and Adolescent Psychiatry and the director of the Child and Adolescent Mood Disorders Laboratory at McLean Hospital. Auerbach conducts multidisciplinary research in children, adolescents and young adults using a multimodal approach to determine why depressive symptoms unfold, how self-injurious and suicidal behaviors develop, and what changes in the brain during treatment. This work is funded by grants from the National Institute of Mental Health, the Klingensten Third Generation Foundation, the Dana Foundation and several private foundations, and it has resulted in over 60 published scientific papers and book chapters, as well as a book (with C.A. Webb and J.G. Stewart), Cognitive Behavior Therapy for Depressed Adolescents (Routledge, 2016). Auerbach is the recipient of several awards, including the David Shakow Early Career Award and the Society for Clinical Child and Adolescent Psychology Early Career Award. Author website.

Depression in adolescents is a serious public health concern. Recent epidemiological data show that approximately 11 percent of youth will experience depression (Avenevoli, Swendsen, He, Burstein, & Merikangas, 2015), and these episodes are associated with downstream negative consequences later in adolescence (e.g., academic difficulties, risky behavior engagement, nonsuicidal self-injury) and adulthood (e.g., lower income levels, higher divorce rates, suicidality) (e.g., Auerbach, Kim, et al., 2014; Auerbach, Tsai, & Abela, 2010; Avenevoli, Knight, Kessler, & Merikangas, 2008). Most notably, an alarming 75 percent of individuals experiencing depression during adolescence will make a suicide attempt in adulthood (Nock, Green, et al., 2013). Despite these unsettling statistics and associated negative consequences, the etiological mechanisms contributing to the onset and maintenance of depression in adolescence remain unclear. To address this key gap, my research uses a multidisciplinary and multimodal approach to determine why depressive symptoms emerge and how self-injurious and suicidal behaviors develop in response to depression.

Etiological Models of Depression

Historically, research on depression vulnerability relied on cross-sectional or two time-point designs, which provide limited insight into the temporal unfolding of depressive symptoms. To overcome this limitation, we completed a series of multi-wave, longitudinal studies (spanning four months to four years) designed to disentangle the time-lagged relationship between vulnerability factors, stress and subsequent depressive
symptoms. This approach highlighted the within-person relationship between fluctuations in stress and negative affectivity, and thus provided new insight into the temporal unfolding of depressive symptoms among children of affectively-ill parents and community samples of adolescents (Auerbach, Eberhart, & Abela, 2010; Auerbach & Ho, 2012; Auerbach, Ho, & Kim, 2014).

Specifically, this work investigated both diathesis-stress and stress generation models of adolescent depression. The diathesis-stress framework posits that vulnerability factors (i.e., diatheses) are dormant in the absence of stress. However, once stress arises, it activates these factors, thereby increasing the likelihood that vulnerable individuals will experience depression. In our prospective studies of children and adolescents, we found robust support for several cognitive diatheses including rumination (Abela, Aydin, & Auerbach, 2007), deficient perceived control (Auerbach, Eberhart, & Abela, 2010), hopelessness (Abela, Gagnon, & Auerbach, 2007) and self-criticism (Adams, Abela, Auerbach, & Skitch, 2009). As adolescents are regularly exposed to interpersonal stressors (Rudolph, 2008), we also examined stress generation models of depression, which propose that specific vulnerability factors predict relational, or interpersonal, stressors, that in turn, contribute to adolescent depression. Using this approach, we found that both cognitive (e.g., self-criticism — Auerbach, Ho, & Kim, 2014) and interpersonal (e.g., diminished social support — Auerbach, Bigda-Peyton, Eberhart, Webb, & Ho, 2011) vulnerability factors led to interpersonal stressors, contributing to higher levels of depressive symptoms over time.

Given the potentially synergistic relationship between diathesis-stress and stress generation models, we next sought to develop an integrated cognitive-interpersonal model of depression with the understanding that stress generation models contribute to our understanding of how stressors arise whereas diathesis-stress models explain why depressive symptoms unfold. In merging these models, we demonstrated that family conflict generates peer-specific stressors through a spillover effect (Repetti, 1989). When these stressors occur, they activate underlying cognitive diatheses (e.g., depressogenic views about the self). Once activated, these depressogenic diatheses contribute to the onset of depressive symptoms (Auerbach & Ho, 2012). We have found that the integrated model provides a more comprehensive understanding of the development of depressive symptoms than either the diathesis-stress or stress-generation models considered alone. Therefore, our work has continued to test integrated models incorporating behavioral, neurobiological and genetic indicators to advance understanding of key contributors to depression onset, depression recurrence and response to depression treatment.

**Behavioral and Neural Mechanisms Underlying Depressogenic Biases**

As outlined in our earlier work, major depressive disorder (MDD) is characterized by depressogenic biases (Auerbach, Ho, et al., 2014), and recent research has explored the behaviors and neural substrates underlying these biases (Auerbach, Webb, Gardiner, & Pechtel, 2013; Shestyuk & Deldin, 2010). To date, less research has examined behavioral and neural dysfunction among currently depressed adolescents, and consequently, we designed a study that uses scalp-recorded event-related potentials (ERPs) — which provide excellent temporal resolution in the millisecond (ms) range — to assess the time course of cognitive-affective processes associated with specific depressogenic biases.

Using a self-referential encoding paradigm, positive and negative adjectives matched on arousal, word length and frequency of use were presented to adolescent participants, who were then asked to indicate whether each word accurately described them. We found that, relative to healthy adolescents, depressed youth endorsed more negative and fewer positive words and free recalled and recognized fewer positive words. With respect to ERPs, the task was designed to elicit the P1, an early ERP waveform thought to reflect processes associated with semantic monitoring (Kissler, Herbert, Winkler, & Junghofer, 2009), and the late positive potential (LPP), a positive-going ERP complex believed to index more effortful elaboration and encoding (Fischler & Bradley, 2006). As hypothesized, healthy youth had greater P1 positivity for positive versus negative words, while depressed adolescents exhibited greater P1 amplitudes following
negative words than positive words. Further, depressed adolescents demonstrated a greater LPP for negative words as opposed to positive words, indicating sustained activity for encoding negative versus positive self-referential information. Conversely, the healthy group showed greater sustained positivity for positive as opposed to negative words. Source localization with low magnetic resonance tomography (LORETA) indicated that these group differences may reflect dysfunction in frontolimbic cortical regions (i.e., under-recruitment of the inferior frontal gyrus and medial temporal gyrus) among depressed adolescents (see Figure 1; Auerbach, Stanton, Proudfit, & Pizzagalli, 2015).

Figure 1. LORETA Contrasts for Healthy versus Depressed Adolescents Following Negative Words

Note. Reprinted with permission from Journal of Abnormal Psychology. Results of independent t-tests contrasting current density for healthy versus depressed adolescents following negative words in the Self-Referential Encoding Task (Blue: Healthy Control (HC) > Major Depressive Disorder (MDD); Red: MDD > HC). Statistical maps are thresholded at p < .01 (minimum cluster size: 5 voxels) displayed on the MNI template: (A) Medial Temporal Gyrus (100 – 200 ms poststimulus), (B) Inferior Frontal Gyrus (100 – 200 ms poststimulus), (C) Precentral Gyrus (100 – 200 ms poststimulus), (D) Inferior Frontal Gyrus and Middle Temporal Gyrus (400 – 600 ms poststimulus).

Additionally, depression in adolescence is often characterized by emotion-processing biases (Joormann & Gotlib, 2006). Although emotion-processing biases in MDD have received significant attention, results have been mixed. In reviewing the literature, we found that relative to healthy individuals, depressed participants exhibited greater accuracy for recognizing sad faces (Mandal & Bhattacharya, 1985), less accuracy for happy faces (Mandal & Palchoudhury, 1985) and a general deficit across all emotions (Gur et al., 1992; Murphy et al., 1999). Joormann and Gotlib (2006) used faces with morphing emotions that changed continuously, and interestingly, found that depressed adults required greater intensity of expressions to recognize happy emotions but lower intensity to identify sad emotions. Our research sought to clarify emotion-processing biases in depressed youth. As dysfunction in the prefrontal cortex (PFC) has emerged as one of the most consistent findings in depression, we tested whether deficits therein would be related to these emotion-processing biases. Understanding this relationship is critical given that neurobiological models of emotion-processing have emphasized the role of the PFC particularly as this relates to both emotion identification and regulation (see Phillips, Drevets, Rauch, & Lane, 2003a, 2003b).

Results from our study indicated that relative to healthy adolescents, depressed youth were able to detect sad faces at lower intensity (i.e., facial emotion on a range from 10-100 percent), but were less accurate for happy faces across all intensities. Additionally, depressed youth showed greater resting theta and alpha current density (i.e., reflecting reduced brain activity) in the dorsolateral prefrontal cortex (DLPFC; see Figure 2A). Extending previous research, we also demonstrated that lower accuracy for happy faces was associated with greater resting EEG theta current density in the DLPFC (Figure 2B). This suggests that decreased DLPFC activity may reflect impaired information and affective processing (Auerbach, Stewart, et al., 2015) Taken together, these studies indicate that depressed adolescents demonstrate a bias towards negative self-referent words and sad faces that may arise from frontolimbic dysfunction, which may have important implications for the onset and maintenance of depressive symptoms.

Figure 2A. Theta Activity LORETA Whole-brain Contrasts for Healthy Versus Depressed Adolescents

Note. Reprinted with permission from Depression and Anxiety. Results of independent t-tests contrasting current density for theta activity in healthy versus depressed adolescents (Red: MDD > HC). Statistical maps are thresholded at p < 0.05 (minimum cluster size: 5 voxels) displayed on the MNI template: (A) Left
Superior Frontal Gyrus, (B) Left Middle Temporal Gyrus, and (C) Left Inferior Frontal Gyrus.

Figure 2B. Association between Happy Accuracy and DLPFC Resting Theta Current Density

Note. Reprinted with permission from Depression and Anxiety. Correlations across all participants for mean happy accuracy and left BA9 theta current density (r = -.29, p = .045)

Individual Differences in Responding to Depressive Symptoms

Prospective studies conducted in my laboratory have demonstrated that depressed adolescents often utilize risky behaviors (e.g., precocious sexual behaviors, substance use) to attenuate the painful negative affect associated with depressive symptoms. As these behaviors provide temporary relief, they become reinforced and increase the likelihood that adolescents will repeat them in the future to manage their symptoms, rather than actively addressing the issues that may have triggered depressive symptom onset (Auerbach & Gardiner, 2012; Auerbach, Tsai, & Abela, 2010). In reviewing data from community samples, a certain subset of depressed youth use suicidal behaviors to manage their depressogenic emotional states.

Suicide is the second leading cause of death among adolescents ages 13-18 (Centers for Disease Control and Prevention, 2013), and therefore identifying factors that place adolescents at risk for suicide attempts is a pressing priority. We have begun examining the impact of impulsivity and early life stress on suicidality among depressed adolescents hospitalized for inpatient psychiatric care. To date, results have indicated that different domains of impulsivity (e.g., negative urgency, a tendency to act rashly when stressed) are uniquely associated with suicide attempts (after controlling for current symptoms, suicide ideation and suicide plans) (Auerbach, Stewart, & Johnson, under review), and additionally, behavioral disinhibition (i.e., acting without thinking) increases the likelihood of suicide attempts exclusively in youth with a history of child sexual abuse. Specifically, compared to adolescents with low disinhibition, youth with high disinhibition had a 6.5-fold increased likelihood of reporting a past suicide attempt, but this relationship only existed among those with a history of childhood sexual abuse (Stewart et al., 2015).

Our research also has sought to identify mechanisms that differentiate depressed suicide ideators from attempters. Importantly, depression is a strong predictor of suicide ideation and plans but shows a weaker association with suicide attempts. Moreover, only a third of adolescent ideators make a suicide attempt (Nock et al., 2013), and thus differentiating depressed suicide ideators and attempters is a critical frontier in suicidology research. In a recent study, we compared depressed adolescent suicide ideators and attempters with similar levels of depression, anxiety and suicidal ideation to ensure that any resulting differences could not be attributed to symptom severity. Results indicated that suicide attempters exhibited higher levels of anhedonia (i.e., reduction in the experience of pleasure) relative to suicide ideators, and the presence of anhedonia diminished the pursuit of rewards (as assessed in an objective computer-based task) (Auerbach, Millner, Stewart & Esposito, 2015). It is believed that this deficit may play a key role in increasing the chronicity and severity of suicidality, and by following adolescents after discharge from inpatient psychiatric care, it will allow us to test the prospective impact of these risk factors.

Summary and Future Directions

Depression has a pernicious impact across the lifespan, and our work has taken a systematic approach to improve our understanding of the psychosocial and neurocognitive mechanisms implicated in the onset and maintenance of MDD in adolescents. We are eager to build on this progress, and presently we are investigating predictors (e.g., neural activity) of treatment response in a cognitive behavior therapy trial for adolescent depression. We believe these findings hold enormous promise to help channel depressed youth into appropriate clinical settings, which could, ultimately, improve early identification of and
treatment for depression.

Acknowledgements

The research described is the direct result of invaluable mentorship, unceasing dedication from colleagues and students, and limitless support from family and friends. Importantly, I am grateful to the many families with whom we have worked. Your time and efforts have brought us closer to clarifying the etiology of depression, and by extension, improving early identification and treatment. These projects were supported through funding from: NIMH K23MH097786, the Klingenstein Third Generation Foundation, the Dana Foundation: Clinical Neuroscience Research Grant and the Tommy Fuss Fund.

References


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