The Relationship Between Social Connectedness and Mental Health in Those With Epilepsy

Naomi Tubbs and Amanda C. Miller*
Department of Psychology and Neuroscience, Regis University

ABSTRACT. Individuals with epilepsy are at a much greater risk of developing depression than the general population (Butler et al., 2019). We sought to understand the relationship between epilepsy, social connectedness, and depression. Specifically, we examined the degree to which an individual's sense of connection to their friends and family predicts depressive symptoms among those with and without epilepsy. We analyzed data from the National Longitudinal Study of Adolescent to Adult Health Wave IV dataset, which included 5,114 individuals aged 24–32. Seventy-one of the participants in this sample reported an epilepsy diagnosis, and we randomly selected 71 participants without epilepsy from the dataset to serve as controls. We used stepwise multiple regression analyses to examine the extent to which epilepsy, friend connectedness, and family connectedness predicted depression. 

\[
F(3, 76) = 7.51, \quad p < .001, \quad R^2 = .23. 
\]

Epilepsy significantly predicted depression, \(\beta = .81, \quad p < .001\). Friend connectedness was also a significant predictor of depression, \(\beta = -.23, \quad p = .03\), but family connectedness was not, \(\beta = -.11, \quad p = .30\). This pattern of results seems to hold for participants with and without epilepsy. We conclude that friend connectedness is an important factor to consider when working with individuals with epilepsy who experience depressive symptoms. Further research is needed to fully understand the factors that contribute to depression in those with epilepsy.

Keywords: epilepsy, depression, social connectedness, friend connectedness, family connectedness

Individuals with epilepsy are more prone to depression than the general population, likely due to the biological mechanism of epilepsy and the social and emotional factors that those with epilepsy face (Butler et al., 2019; Catena-Dell’Osso et al., 2013). A large portion of those with epilepsy suffer from anxiety and depression, making it even more difficult to cope with the disorder (Butler et al., 2019). As a result of this and other factors of the illness, those with epilepsy are significantly less likely to graduate from high school, attain a job, and are more likely to need public assistance (Maslow, Haydon, Ford et al., 2011). Those who graduate high school and move onto college are also less likely to graduate from college, and those who get a job have a lower mean income than the general population (Maslow et al., 2011). They are also significantly more likely to die from suicide than the general population (Catena-Dell’Osso et al., 2013). On top of this, children with epilepsy report higher rates of vulnerability, disempowerment, and discrimination (Chong et al., 2016). This leads to the question of which factors of epilepsy make people with it more prone to these negative consequences. By identifying these factors, we may find ways to lower the risk for these consequences.
**Social Connectedness, Mental Health, and Epilepsy**

**Epilepsy and Depression**
Depression is the most common comorbidity of epilepsy and affects up to 62% of patients (Blaszczyk & Czuczwar, 2016). In those with epilepsy, the more intense the epilepsy is, the more intense the depression is as well (Reilly et al., 2019). To examine this relationship, Reilly et al. (2019) tested a group of individuals who underwent surgery as epilepsy treatment on the presence of depression and anxiety before and after the surgery. The more the surgery decreased seizures, the better the improvements were in mental, emotional, and behavioral functioning (Reilly et al., 2019). It is possible that this is because the severity of epilepsy relates to the level of stress felt by the patient, and chronic stress has a strong tie to depression (Blaszczyk & Czuczwar, 2016). Treating depression in those with epilepsy has been shown to greatly improve their quality of life, even if no epilepsy symptoms were treated (Gilliam et al., 2019).

When trying to treat both epilepsy and depression simultaneously via vagus nerve stimulation surgery, a method that has been shown to improve symptoms for both illnesses, those who underwent surgery had fewer depressive symptoms regardless of the type and severity of depression and experienced a 50% seizure reduction (Spindler et al., 2019). Therefore, surgically altering one area of the brain can help treat both epilepsy and depression. This suggests that perhaps the same regions in the brain could be active in both epilepsy and depression. The location of the epilepsy, specifically if in the limbic area, can make patients more susceptible to depression (Henning & Nakken, 2011). Depression in these patients also tends to be highly correlated with the seizure frequency and severity but can also be independent from how the seizures present (Henning & Nakken, 2011). Treating depression in those with epilepsy is critical, as managing mood symptoms is an important factor for helping those with epilepsy (Conway et al., 2018).

**Social Connectedness and Depression**
A variable that may be an important predictor of depression outcomes among individuals with epilepsy is their level of social connectedness. Social connectedness has to do with one’s amount and quality of relationships with others and significantly affects individuals’ health and well-being (Lamblin et al., 2017). Weak friend and family connectedness are associated with depressive symptoms in the general population (Ge et al., 2017). Those who experience social isolation are also much more likely to be diagnosed with depression (Ge et al., 2017). Strong social connectedness with one’s parents and friends is associated with a decrease in social anxiety and depressive symptoms (Ge et al., 2017). Because many depression and anxiety disorders are characterized by perceived social disconnection, researchers exposed participants to sessions of positive activity intervention as an attempt to increase perceived social connection and decrease negative affect, which included anxiety and depressive symptoms (Taylor et al., 2020). Positive activity intervention involved group-administered strategies designed to mimic the thought patterns and behaviors of happy people, with the goal of increasing happiness in the participants. Consistent with previous research, Taylor et al. (2020) found that, as perceived social connectedness increased, negative affect decreased.

**Epilepsy and Social Connectedness**
Unfortunately, those with neurological disorders have consistently reported being less socially connected than the general population (Willard et al., 2019). Because those with epilepsy who report being more connected to friends show higher levels of social functioning, it is critical that researchers aim to better understand the relationship between social connectedness and epilepsy (Willard et al., 2019). To explore this relationship, a sample of individuals with either epilepsy, cancer, diabetes, or heart disease were assessed on their relationships with their parents, their religious organization, and their peers at school (Maslow et al., 2012). Those with high levels of school connectedness were more likely to graduate and attain a job; this relationship was not seen in parent or religious group connectedness. This is important, as the outcome of graduation and job attainment rates are challenges for those with epilepsy. Interestingly, individuals with epilepsy tend to feel socially disconnected from their peers without neurological disorders, but not from their peers with a similar neurological disorder (Willard et al., 2019). Unfortunately, there is a lack of research examining how levels of social connectedness differ between those with epilepsy and the general population, and how this in turn affects the mental health of the patient.

**Epilepsy, Social Connectedness, and Depression**
The strong correlations between these different factors lead one to wonder how epilepsy and social connectedness relate to depression. Engel et al. (2021) assessed anxiety symptoms, depressive symptoms, beliefs about their illness, family functioning, social stigma, and connectedness among a group of participants with epilepsy. They found that anxiety and depression are very high among those with epilepsy compared to the control group and have a strong correlation to their view of their illness, their relationship with their families, and the social stigma among their peers. The authors concluded that those with epilepsy could be more likely to suffer from depression due to low self-esteem. If this low self-esteem
comes in part from the negative interactions with their peers due to the stigma of epilepsy, it could be that positive interactions with family and peers may be especially important for these individuals. Public stigma on illness is positively correlated to self-stigma (Schorr, 2016), so having a strong relationship with family and peers could be especially important among individuals with epilepsy.

Because strong relationships with one's family seems to be a positive factor against depression, some researchers have asked the question of what it is about these relationships that are helpful. For those with epilepsy, people who were able to talk to their family openly about their illness and how they are feeling had lower stress levels and better ways of handling their stress than those who did not communicate well with their family (Chew et al., 2018). Negative interactions with family members have also been shown to be related to lower quality of life in those with epilepsy (Han et al., 2015). Even the way that the family views epilepsy is related to behavioral problems in children with epilepsy, as the stigma could be associated with parenting decisions (Carlton-Ford et al., 1997). Because those with epilepsy tend to have poorer psychosocial outcomes than their peers, family connectedness is very important. These findings may suggest that social connectedness to family could help explain the relation between epilepsy and depression, but looking at family connectedness as a mediator has yet to be examined.

Our goals were to gain a better understanding on which aspects of social connectedness are most related to depression in those with epilepsy—specifically, whether connectedness to friends or family has a stronger association with depression symptoms among those with and without epilepsy. Research has evaluated how social connectedness with friends and family leads to different career outcomes in those with epilepsy, but not how it affects their mental health outcomes. We hypothesized that epilepsy and friend and family connectedness would significantly predict depression. We also hypothesized that friend and family connectedness would be better predictors of depression for those with epilepsy than those without. We predicted friend and family connectedness would mediate the relationship between epilepsy and depression, thus offering insight into the established connection between these two variables. By understanding this relationship, researchers might be able to find ways to improve levels of social connectedness among those with epilepsy, which may be associated with decreased depressive symptoms.

**Methods**

**Add Health**

We analyzed data from Wave IV of the National Longitudinal Study of Adolescent to Adult Health (Add Health) data set, accessed via the Passion Driven Statistics (Dierker, 2019) platform. Add Health is a school-based study designed to examine the developmental and health trajectories across the life course of adolescence into young adulthood (Harris, 2009). The Add Health researchers collected the Wave IV data via in-home interviews. We did not require institutional review board approval because we used archival, publicly available data.

The participants included 5,114 individuals, mean age 29.00 years; SD = 1.78; range = 24–32. The majority of the sample (62.40%) identified as White, 23.03% as Black or African American, 5.06% as multiple races, 3.23% as Asian or Pacific Islander, 0.92% as American Indian or Native American, and 5.36% as other. A large portion of the participants’ highest level of education was a high school diploma (16.3%). Many completed up to technical training (9.9%). The majority went to some college (34.3%). A large amount completed up to a bachelor’s degree (19.4%), and some completed a master’s degree (5.0%), or a doctoral degree (0.7%).

Seventy-one of the participants reported an epilepsy diagnosis. We randomly selected 71 of the participants with no epilepsy diagnosis to serve as the control group in our study, in order to maintain groups of equal sample size. The participants in our sample with epilepsy were 51.6% female and 48.4% male, and the participants without epilepsy were 50.70% female and 49.3% male, $\chi^2(142) = 0.11, p = .74$. One participant chose not to answer. There was no age difference between the two groups, epilepsy, $M = 29.18, SD = 1.72$, and no epilepsy, $M = 28.85, SD = 1.92$, $t(140) = -1.11, p = .27$.

**Social Connectedness**

We calculated family connectedness by combining participants’ scale responses to: “How often do you and your (mother figure) see each other?” “How often do you and your (mother figure) talk on the telephone, exchange letters, or exchange email?” “You are satisfied with the way your (mother figure) and you communicate with each other” (reverse coded because the original Likert response scale was 1 = strongly agree to 5 = strongly disagree), “How close do you feel to your (mother figure)” and all of the same questions but with “father figure” in the place of “mother figure.” Dias et al. (2018) used similar variables for their measures of social connectedness, specifically the number and quality of interactions with members of one’s family. See Table 1 for means and standard deviations of the family connectedness composite variables by epilepsy group. Because the variables were on different scales (see Table 1), we converted each of the raw scores to a z score so that we could then compute a mean family
connectedness composite score. Higher scores indicate higher family connectedness.

We measured friend connectedness by participants’ response to: “how many close friends do you have? (Close friends include people whom you feel at ease with, can talk to about private matters, and can call on for help)”. Participants responded using the following scale: 1 = none; 2 = 1 or 2 friends; 3 = 3 to 5 friends; 4 = 6 to 9 friends; 5 = 10 or more friends. Hodge et al. (2013) also used the number of close friends as a measure of how connected one is to their friends. They found that the more friends an individual has, the more socially connected.

<table>
<thead>
<tr>
<th>TABLE 1</th>
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<tbody>
<tr>
<td>Means and Standard Deviations (in Parentheses) of the Different Factors of Social Connectedness Among Those With and Without Epilepsy</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Epilepsy</th>
<th>No Epilepsy</th>
<th>Cohen’s d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of friends</td>
<td>1–5</td>
<td>3.00 (1.02)</td>
<td>3.06 (1.06)</td>
</tr>
<tr>
<td>Frequency talk to father figure</td>
<td>0–5</td>
<td>3.10 (1.53)</td>
<td>3.67 (1.29)</td>
</tr>
<tr>
<td>Frequency talk to mother figure</td>
<td>0–5</td>
<td>4.44 (0.75)</td>
<td>4.16 (1.15)</td>
</tr>
<tr>
<td>Satisfied communication with father figure</td>
<td>1–5</td>
<td>4.04 (1.19)</td>
<td>4.02 (1.32)</td>
</tr>
<tr>
<td>Satisfied communication with mother figure</td>
<td>1–5</td>
<td>4.53 (0.74)</td>
<td>4.30 (0.98)</td>
</tr>
<tr>
<td>Frequency sees father figure</td>
<td>0–5</td>
<td>3.00 (1.53)</td>
<td>2.82 (1.35)</td>
</tr>
<tr>
<td>Frequency sees mother figure</td>
<td>0–5</td>
<td>3.24 (1.32)</td>
<td>3.12 (1.30)</td>
</tr>
<tr>
<td>Closeness to father figure</td>
<td>1–5</td>
<td>3.90 (1.24)</td>
<td>4.17 (1.10)</td>
</tr>
<tr>
<td>Closeness to mother figure</td>
<td>1–5</td>
<td>4.62 (0.69)</td>
<td>4.44 (0.90)</td>
</tr>
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<tr>
<th>TABLE 2</th>
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<tbody>
<tr>
<td>Means and Standard Deviations (in Parentheses) of the Different Factors of Depression Among Those With and Without Epilepsy</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Epilepsy</th>
<th>No Epilepsy</th>
<th>Cohen’s d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Felt sad</td>
<td>0.82 (0.85)</td>
<td>0.56 (0.63)</td>
<td>0.34</td>
</tr>
<tr>
<td>Felt depressed</td>
<td>0.70 (0.96)</td>
<td>0.35 (0.61)</td>
<td>0.44</td>
</tr>
<tr>
<td>Felt disliked</td>
<td>0.49 (0.83)</td>
<td>0.30 (0.57)</td>
<td>0.27</td>
</tr>
<tr>
<td>Felt the blues</td>
<td>0.61 (0.93)</td>
<td>0.30 (0.62)</td>
<td>0.39</td>
</tr>
<tr>
<td>Felt bothered</td>
<td>0.76 (0.92)</td>
<td>0.45 (0.67)</td>
<td>0.39</td>
</tr>
<tr>
<td>Enjoyed life</td>
<td>0.86 (0.87)</td>
<td>0.59 (0.69)</td>
<td>0.34</td>
</tr>
<tr>
<td>Felt happy</td>
<td>1.07 (0.87)</td>
<td>0.86 (0.76)</td>
<td>0.26</td>
</tr>
<tr>
<td>Just as good</td>
<td>1.19 (1.03)</td>
<td>0.89 (0.89)</td>
<td>0.31</td>
</tr>
<tr>
<td>Ability to focus</td>
<td>1.24 (0.89)</td>
<td>0.86 (0.82)</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Note: *p < .05.

they perceive themselves to be. Higher scores indicate greater friend connectedness. See Table 1 for the mean and standard deviation of the friend connectedness variable by epilepsy group.

**Depression**

We calculated a depression score by combining participants’ responses to Add Health questions modeled on the Center for Epidemiologic Studies - Depression (CES-D) scale (Radloff, 1977). These questions asked how often in the past seven days the participants felt sad, felt like people disliked them, enjoyed life, felt happy, felt depressed, had the blues, felt just as good as other people, had a hard time staying focused on what they were doing, and felt bothered. Each variable’s scale was 0–3. Three items were reverse-scored: “I was happy,” “I enjoyed life,” and “I felt I was just as good as other people.” We averaged the raw scores to form a composite depression variable. Higher values indicated greater depression. See Table 2 for means and standard deviations of the depression composite variables by epilepsy group.

**Results**

**Family Connectedness**

The correlation between depression and family connectedness was \( r = -0.15, p < .001 \). We conducted a multiple-regression analysis to test whether epilepsy and family connectedness predicted depression. We used the “linear regression” function in the R-based statistical program, jamovi. Depression was the dependent variable. We entered epilepsy (coded 1 = epilepsy, 0 = no epilepsy) and family connectedness as predictors. As shown in Table 3, having epilepsy significantly predicted depression; however, family connectedness did not. The overall model was statistically significant, \( F(2, 78) = 8.50, p < .001, R^2 = .18 \), which suggested that family connectedness and epilepsy together accounted for about 18% of the variance in depression. We ran a follow-up up regression model in which we added the interaction term of epilepsy x family connectedness to the model to test whether family connectedness differentially predicted depression for those with and without epilepsy, but the interaction term was not significant.

Finally, we ran a mediation analysis to test whether family connectedness mediated the relationship between epilepsy and depression. We conducted the mediation analysis using the medmod module of the R-based statistics program jamovi. We estimated the standard errors using bootstrapping from 1,000 samples. We found a significant direct relationship between epilepsy and depression (Estimate = 0.50, SE = 0.13, 95% CI = [.26, .78], \( p < .001 \)), but the indirect relationship...
between epilepsy and depression, mediated by family connectedness, was not significant (Estimate = 0.002, SE = 0.02, 95% CI = [–.04, .04], p = .91).

**Friend Connectedness**
The correlation between depression and friend connectedness was \( r = -0.19, p < .001 \). Using the same method employed in the previous multiple-regression analysis, we found that epilepsy and friend connectedness were both significant predictors of depression. The overall model was statistically significant, \( F(2, 133) = 12.19, p < .001, R^2 = .16 \), which suggested that friend connectedness and epilepsy together accounted for approximately 16% of the variance in depression. See Table 4 for regression results. We ran a follow-up regression in which we added the interaction term (Epilepsy x Friend Connectedness) to the model, but the interaction was not significant.

We then ran a mediation analysis to test whether friend connectedness mediated the relation between depression and epilepsy. Using the same method as in the previous mediation analysis, we found a significant direct relationship between epilepsy and depression (Estimate = 0.30, SE = 0.09, 95% CI = [0.13, 0.47], \( p < .001 \)), but the indirect relationship between epilepsy and depression, mediated by friend connectedness, was not significant (Estimate = 0.01, SE = 0.03, 95% CI = [–0.05, 0.07], \( p = .75 \)).

**Comparing Family and Friend Connectedness**
We also included both family and friend connectedness variables in the same regression model to allow us to compare the relative influence of these two variables in predicting depression. We ran two stepwise regression models. In both models, we entered epilepsy in Block 1. In the first model, we next entered friend connectedness in Block 2 and family connectedness in Block 3. In the second model, we entered family connectedness in Block 2 and friend connectedness in Block 3. In model 1, epilepsy and friend connectedness were significant predictors, but family connectedness was not and added only .01 to \( R^2 \). See Table 5. However, after controlling for epilepsy and family connectedness in model 2, friend connectedness accounted for a significant amount of variance and added .05 to \( R^2 \).

**Discussion**
We investigated the degree to which social connectedness and epilepsy predicted depression among young adults. We specifically examined whether an individual’s sense of connectedness to their friends and family played a similar role in predicting depression for individuals with and without epilepsy. Consistent with previous research, we found epilepsy to be a significant predictor of depression, meaning those with epilepsy were more prone to depression than the general population (Bazarnik, 2018; Blaszczyzk & Czuczwar, 2016; Butler et al., 2019; Gilliam et al., 2019). Additionally, friend connectedness predicted depression, but family connectedness did not. The interaction between friend connectedness and epilepsy was not a significant predictor of depression, nor was the interaction between family connectedness and epilepsy significant. This means that friend and family connectedness play a similar role in predicting depression for those with and without epilepsy.

Furthermore, we examined whether friend and/or family connectedness mediated the relationship between depression and epilepsy. Because friend and family connectedness play such a large role in depression in general...
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(Ge et al., 2017), and those with epilepsy are more prone to depression (Blaszczyk & Czuczwar, 2016), we were curious to see if connectedness was partially responsible for the overlap between them. We predicted that strong connectedness to family and friends could potentially explain a significant difference in the level of depression for those with epilepsy. Our results did not support this idea; neither friend nor family connectedness mediated the relation between epilepsy and depression. Therefore, friend and family connectedness did not explain why those with epilepsy are more prone to depression.

Consistent with previous literature, friend connectedness significantly predicted depression (Ge et al., 2017; Nguyen et al., 2019). Kail and Carr (2020) showed that those who are removed from their usual daily life circumstances, are more likely to experience isolation and depression. Specifically, they tested individuals who were adjusting to retirement and found that retirement itself did not significantly predict a change in depressive symptoms, but that social support from friends did. This suggests that friend connectedness is extremely critical for one’s well-being and can be a significant predictor of whether an individual will develop symptoms of depression. This is especially relevant to those with epilepsy, as they are more likely to be hospitalized and separated from their usual surroundings than their peers.

Contrary to our hypothesis, family connectedness did not significantly predict depression. Family connectedness has been shown to negatively correlate with depression and suicidal ideation (Arango et al., 2019). Our results did indicate a significant negative correlation between family connectedness and depression; however, family connectedness no longer predicted depression once we added epilepsy to the regression model. Thus, our study contributed to the literature by suggesting that family connectedness can be an important predictor of depression, but that this relation might be less informative in the context of other variables. Future studies should examine the strength of the relation between family connectedness and depression when other physical health conditions are considered.

Our study did have many limitations. We were limited to the questions included in the Add Health dataset and could therefore not choose from the most accurate measures found in the literature. Due to the variables we were able to include in our family connectedness and our depression measure, the study was likely not fully representative of everything that family connectedness and depression consist of. We were not able to conclude whether our measures were valid and future studies are therefore necessary to confirm our results. We were also limited because a relatively small proportion of the Add Health sample was diagnosed with epilepsy, which decreased our statistical power. Another limitation of our study is that there are many differences among the participants, and it would be a leap to assume that all of our findings were due only to the factors we were assessing. Our models accounted at most for 23% of the variance in depression. This means that there is a large portion of the variance in depression unaccounted for and thus our models fail to include many variables that could explain why those with epilepsy are significantly more prone to developing depression.

This limits the extent to which our results can be generalized to the population of those with epilepsy, especially because our sample size of those with epilepsy was small. We also cannot generalize beyond American culture. Other cultures may espouse different views toward physical and/or mental health, and these views likely shape the experiences and outcomes of individuals diagnosed with epilepsy. Additional cross-cultural research is necessary to generalize results to those with and without epilepsy. Overall, the need for future research cannot be emphasized enough in order to test our conclusions.

Our results show that friend and family connectedness affect individuals with and without epilepsy similarly. Research on increasing social connectedness could be applied to populations with epilepsy as well as the general population. Our data showed a significant relationship between epilepsy, depression, and friend connectedness, suggesting that friend connectedness could be an important predictor of depression in those with epilepsy. However, friend connectedness played a small role in the overall variance in depression in those with and without epilepsy so further research is needed to fully understand why those with epilepsy have higher rates of depression than the general population. Specifically, future research should seek to find which aspects of friend and family connectedness are the strongest in terms of increasing perceived social connectedness. By gaining a better understanding in this area, we would be able to find the most effective ways to target social connectedness and in turn, ways to target depression.

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Author Note
We have no known conflict of interest to disclose.

Positionality Statement: Naomi and Amanda identify as heterosexual, cisgender White women. All authors are nondisabled and do not have epilepsy and acknowledge that their perspectives are influenced by their positions within all of these dimensions of identity.

Correspondence concerning this article should be addressed to Amanda C. Miller, Department of Psychology, Regis University, 3333 Regis Blvd, Denver, CO 80221, United States. Email: amiller@regis.edu

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