Loneliness in Kenyan Adolescents: Socio-Cultural Factors and Network Association with
Depression and Anxiety Symptoms

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Abstract

Objective: Loneliness is associated with negative mental health outcomes and is particularly common among adolescents. Yet, little is known about the dynamics of adolescent loneliness in non-Western, low-income nations. Accordingly, we estimated the severity of loneliness in a sample of Kenyan adolescents and used mixed-effects regression modelling to determine the socio-cultural factors associated with loneliness. We also used network analysis to examine the associations between loneliness, depression, and anxiety at the symptom-level. **Method:** We analyzed data from a large sample ($N = 2,192$) of school-attending Kenyan adolescents aged 12-19 (58.3% Female, 41.7% Male). Standardized measures of loneliness (ULS-8), depression (PHQ-8), and anxiety (GAD-7) were used. **Results:** Our mixed-effects model revealed that female and lower-income adolescents felt lonelier. The perception of feeling alone emerged as the aspect of loneliness most strongly linked to depression and anxiety symptoms. **Conclusions:** Our findings establish an estimate of loneliness levels in Kenyan adolescents, and reveal socio-cultural factors associated with loneliness. We found that perceptions of isolation more strongly linked loneliness to psychopathology than did objective measures of isolation or preferences for social contact. Finally, we identify specific aspects of loneliness that could prove to be treatment targets for youth psychopathology; however, further research is needed. Limitations, future directions, and clinical implications are discussed.

Keywords: loneliness, adolescents, network analysis, depression, anxiety

Loneliness in Kenyan Adolescents: Socio-Cultural Factors, Network Structure,
and Association with Depression and Anxiety Symptoms

Loneliness, which has been deemed a public health concern by medical professionals and psychologists alike (Holt-Lunstad, 2017; Hunter, 2012), is common among adolescents (Cacioppo et al., 2000; Heinrich & Gullone, 2006; Madsen et al., 2018). Adolescents are particularly susceptible to loneliness due to developmental and emotional shifts during this stage of life, including changes in companions, identity exploration, and physical maturation (Laursen & Hartl, 2013). Importantly, loneliness places youth at risk for a variety of negative health outcomes. Loneliness during adolescence is associated with suicidal ideation (Heinrich & Gullone, 2006; Schinka et al., 2012), social withdrawal (Woodhouse, Dykas, & Cassidy, 2011), poorer physical health (Stickley et al., 2014), and psychopathology (Hawkey & Cacioppo, 2010). In adolescents, loneliness has been consistently and closely linked to depression ($.40 < r < .65$; Cacioppo, Hughes, Waite, Hawkey, & Thisted, 2006) and social anxiety, as found in a recent meta-analysis of over one hundred studies (Maes et al., 2019). Although the harmful effects of loneliness have been documented across the lifespan, they may be most impactful during adolescence (Hawkey & Capitanio, 2015).

Loneliness in Sub Saharan African Youth

Despite the profound clinical import of loneliness on adolescent mental health, little is known about loneliness in low-income and non-Western countries, such as those in Sub Saharan Africa (SSA). Our current understanding of loneliness and its relationship to psychopathology relies primarily on research done with samples from high-income Western countries. It is likely that the experience of loneliness, as well as its links to psychopathology, varies cross-culturally, especially in low-income regions like SSA where prevalence rates of psychopathology are high

(Patel & Stein, 2015) and treatment options scarce (Patel, Flisher, Hetrick, & McGorry, 2007). Because young people are more vulnerable to loneliness (Cacioppo et al., 2000), and almost 50% of the Kenyan population is aged 19 or younger (United Nations Children's Fund, 2016), there is a particular need for research dedicated to understanding youth loneliness in Kenya.

Research on loneliness should be guided by previous literature on Kenyan youth psychopathology, which underlines the importance of considering aspects of local socio-cultural context (Osborn, Venturo-Conerly, Wasil, Schleider, & Weisz, 2020). Previous studies have posited that the prevalence of moderate to severe levels of depression and anxiety in Kenya—often greater than 40% among adolescents—may result from high levels of poverty (Osborn, Venturo-Conerly et al., 2020). As poverty has been identified as a risk factor for loneliness among adolescents in other low-income countries (Devi, Verma, & Shekhar, 2013), Kenyan adolescents may be particularly vulnerable to loneliness as well. Additionally, the Kenyan education system, which several observers have pointed out is particularly competitive and places high levels of psychosocial pressure on adolescents (Maina & Njoroge, 2015; Yara & Wanjohi, 2011), has been implicated as a primary reason for why older adolescents report elevated depression and anxiety symptoms (Ndeti et al., 2008; Osborn, Venturo-Conerly et al., 2020). In addition, at the within-population level, many Kenyan youth attend boarding schools from a young age and are separated from their caregivers and families; thus, boarding school students may be at greater risk for loneliness (Schaverien, 2011).

A Network Analytic Approach to Loneliness

Network analysis has provided a novel, psychometrically innovative method to understand psychopathology and related constructs (McNally, 2016). Several researchers have noted that contemporary psychiatry too often overlooks the role of cultural context in the

emergence and expression of psychopathology (Lewis-Fernández & Aggarwal, 2013). Although loneliness has largely been understood in the context of Western research, it is a *subjective* experience of isolation influenced by personal, societal, and cultural variables (van Staden & Coetzee, 2010). Facets of culture, such as emphasis on individualism versus collectivism and norms regarding the nature and extent of closeness in relationships, may shape how individuals experience, cope with, and understand loneliness (Rokach, 2018).

With this in mind, we opted to employ an atheoretical approach to examine Western psychological constructs in Kenya: network analysis. The network approach to psychopathology may be a promising way to investigate relationships and underlying dynamics between psychological constructs in a culturally sensitive manner. Network analysis conceptualizes these phenomena as dynamic systems of traits/symptoms which co-occur because they cause and influence each other (Borsboom, 2017); thus, this approach circumvents the assumption that “depression,” “anxiety,” and “loneliness,” are terms that refer to the same monothetic latent referents across cultures.

Networks are visualized as sets of symptoms (represented by *nodes*) connected via *edges* that represent the strength and sign of their association with one another (Borsboom & Cramer, 2013). This approach not only enables an intuitive visualization of psychological constructs, but also allows for the identification of central nodes (i.e., symptoms that have many strong connections to other symptoms) that may be promising targets for clinical intervention (McNally, 2016). Through this approach, we can move beyond considering loneliness as single entity and examine it as the multi-dimensional and complex construct that the literature suggests it is (Yanguas et al., 2018). Specifically, a network analysis may help identify which of the elements of loneliness – e.g., an evaluation of one’s social network, self-perceptions, or

subjective feelings such as sadness, frustration, distress, c.f. Yanguas et al., 2018 – are most strongly linked to psychopathology among youths, and may thus be key treatment targets for this particular group (Hinton, McNally, Fairfax, & Harachi, 2020).

The network approach also enables us to further investigate the relationship between loneliness and psychopathology at the symptom level (McNally, 2016). By integrating multiple psychological constructs (i.e., depression and loneliness) into the same network, this approach reveals associations between specific symptoms of different constructs. Therefore, it is possible to identify important associations between specific aspects of loneliness and particular depressive and anxiety symptoms (Boorsboom & Cramer, 2013). This is important because there is reason to believe that some symptoms of depression are more strongly linked to loneliness than others (Qualter et al., 2010). For example, given its subjective nature, loneliness may be more strongly associated with emotional symptoms (e.g., depressed mood, anhedonia) and less strongly associated with psychobiological symptoms (e.g., poor appetite, sleep difficulties) of depression. Additionally, the important associations between loneliness and youth psychopathology may serve as potential targets for therapeutic interventions in which psychiatric comorbidities are an issue (Fried et al., 2017). As such, a network analysis of loneliness and forms of psychopathology is of interest not just for youth in SSA, but also of interest in the study of psychopathology more generally.

The Present Study

In the present study, we aimed to expand our understanding of loneliness among Kenyan adolescents in a large, diverse sample in Kenya. Specifically, our aims were to (1) assess the overall level of loneliness in Kenyan youth, (2) assess the association between loneliness and socio-cultural variables of interest, and (3) model a network of loneliness, depressive symptoms,

and anxiety symptoms, and identify which aspects of loneliness are most related to these forms of psychopathology in Kenyan adolescents. The present study is, to the best of our knowledge, the first of its kind to investigate socio-cultural correlates of loneliness in SSA adolescents, and the first to consider loneliness as a dynamic constellation of traits, rather than a single node, in a network analysis.

Method

The R Code and de-identified dataset used in our analyses, as well as all supplemental materials, are publicly available online at <https://osf.io/2364f/>.

Participants

All procedures were approved by a local ethics review board – the Maseno University Ethics Review Committee (MUERC) – prior to the start of data collection. We used baseline data from a randomized controlled trial of a positive psychology intervention (called *Shamiri*) conducted in the greater Nairobi area of Kenya during the summer of 2019 (Trial registered in the Pan African Clinical Trials Registry: [PACTR201906525818462](https://pactr.org/record/PACTR201906525818462)). Information about the *Shamiri* intervention can be found elsewhere (Osborn et al., 2020). A total of 2,192 Kenyan high school students from four secondary schools completed a questionnaire battery in their classrooms. Schools were selected to ensure the resulting sample would reflect the sociocultural and socio-demographic diversity in Kenya. Adolescents were eligible to participate if they consented and were enrolled in the participating schools. Parental consent and written informed consent/assent were obtained for all adolescents per research ethics procedures at MUERC.

Measures

UCLA Loneliness Scale - Shortened Form (ULS-8). The ULS-8 measures severity of trait loneliness, i.e., general perceptions of social isolation (Russell, 1996). The ULS-8, which

contains 8 items, demonstrates psychometric properties similar to the original 20-item version (Russell, 1996). Total ULS-8 scores range from 8 to 32, with higher scores indicating greater trait loneliness. To the best of our knowledge, the ULS-8 has never been used with Kenyan samples. Internal consistency for this scale was adequate in our sample ($\alpha = .74$).

Patient Health Questionnaire-8 (PHQ-8). The PHQ-8 is a brief diagnostic and severity measure for depression (Kroenke et al., 2009). The PHQ-8, which is the eight-item version of the PHQ-9, excludes the suicidal ideation item which may be stigmatizing for Kenyan youth (Osborn, Venturo-Conerly et al., 2020). Scores of the PHQ-8 range from 0 to 24, with higher scores indicating greater severity of depression symptoms (Kroenke et al., 2009). The PHQ-8 has shown adequate internal consistency in previous Kenyan adolescent samples ($\alpha = .73$; Osborn, Venturo-Conerly et al., 2020). Internal consistency for the PHQ-8 was adequate in our sample ($\alpha = .78$). In our sample, 33.81% of participants reported moderate-to-severe depressive symptoms, as established by PHQ-8 cut-off norms from studies examining adolescents in Kenya (Osborn, Wasil et al., 2020; Osborn, Venturo-Conerly et al., 2020) and the United States (Kroenke et al., 2009).

Generalized Anxiety Disorder Screener-7 (GAD-7). The GAD-7 is a brief screener for anxiety used in both clinical practice and research (Spitzer, Kroenke, Williams, & Löwe, 2006). Total GAD-7 scores range from 0 to 21, with higher scores indicating greater anxiety severity (Spitzer et al., 2006). The GAD-7 has shown good internal consistency with other Kenyan adolescent samples ($\alpha = .82$; Osborn, Venturo-Conerly et al., 2020). Internal consistency for the GAD-7 was good in our sample ($\alpha = .82$). In our sample, 31.30% of participants reported moderate-to-severe anxiety symptoms, as determined by GAD-7 cut-off norms from studies

conducted in Kenya (Osborn, Wasil et al., 2020; Osborn, Venturo-Conerly et al., 2020) and the United States (Spitzer et al., 2006).

Demographic Questionnaire. We collected socio-cultural information through a demographic questionnaire (see Supplementary Materials S1). Participants reported their age, gender, tribe, financial status (wealthy, quite well-off, not quite well-off, or poor), and hometown (rural area, small town, big town, city).

Plan of Analysis

Associations between Loneliness and Socio-Cultural Variables. We first calculated the mean of self-reported loneliness in the sample. Next, we conducted a mixed effect linear regression model to assess for the association between loneliness and socio-cultural variables of age, gender (dummy coded *male* vs. *female*, reference category = *male*), tribal classification (coded as *majority* vs *minority*, reference category = *majority*), financial status (coded as *poor*, *lower middle class*, *upper middle class* and *wealthy*, reference category = *wealthy*), and school type (coded as *boarding* vs. *non-boarding*, reference category = *non-boarding*). A mixed-effect linear model was used because of the hierarchical nature of our data, in which student's data were nested in schools. In our model, we included a random intercept that allowed for school variation in loneliness scores. Missing data were imputed five times using the Fully Conditional Specification (FCS) methodology implemented using the multivariate imputation by chained equations (mice) algorithm in R (Buuren & Groothuis-Oudshoorn, 2011).

Network Analyses. To examine the network structure of loneliness symptoms and their relationship to symptoms of depressive and anxiety-related psychopathology, we first computed a network of only loneliness symptoms. Next, we computed a network that combined loneliness symptoms with symptoms of depression and anxiety.

Identifying redundant nodes. Because no network analyses had yet been conducted on loneliness features, we first identified items from the ULS-8 that may be redundant with one another (i.e., have the same correlations with all other nodes in the network), thus obscuring meaningful aspects of network structure. We used the *goldbricker* function from the *networktools* package (Jones, 2020) in R to identify redundant nodes, using a relatively permissive threshold (nodes were considered “bad pairs” if they had less than 25% significantly different correlations with all other nodes). We then combined “bad pairs” of nodes using the *net_reduce* function (Jones, 2020) via principal components analysis (PCA).

Graphical LASSO. We computed all of our networks as regularized partial correlation networks, in which symptoms are represented by nodes, and the strength of association between nodes is represented by edge thickness. The sign of the relationship is represented by either solid lines (positive sign) or dashed lines (negative sign). After eliminating redundant items, we computed the regularized partial correlation network for loneliness symptoms using a graphical LASSO (Least Absolute Shrinkage and Selection Operator) algorithm using the *glasso* (Friedman, Hastie, & Tibshirani, 2010) and *qgraph* (Epskamp, Cramer, Waldorp, Schmittmann, & Boorsboom, 2012) packages. The graphical LASSO algorithm calculates the edges between nodes by computing partial polychoric correlations between them, and then applying an L1 penalty that drives trivially small edges to zero. This returns a “sparse” network consisting of only edges that are likely to be observed above chance. Due to recent research suggesting that the graphical LASSO algorithm does not optimally remove trivial edges, we used a gamma hyperparameter (γ) of 0 for our network (Williams & Rast, 2019). Thus, the network estimation method that we used allows us to examine relationships between symptoms that are likely

genuine, and which account for the influence of all other symptoms in the network (McNally, 2016).

Expected Influence. In order to determine which symptoms of loneliness were most central to the network, we calculated one-step expected influence (EI; Robinaugh, Millner, & McNally, 2016) using the *networktools* package (Jones, 2020). EI is calculated by summing all edges for a given node, taking the sign of each edge into account. Thus, EI reflects both the strength and direction a given node's net association with all other nodes, taking into account negative associations (Robinaugh et al., 2016).

Stability Analyses. We estimated the stability of our estimated network by calculating correlation stability (CS) coefficients with the *bootnet* package (Epskamp, Borsboom, & Fried, 2017). A CS coefficient represents the proportion of cases that can be eliminated while still keeping a correlation of at least 0.7 with the original centrality metrics of interest within a 95% confidence interval. We calculated CS coefficients for both edge weight and EI in *bootnet* by performing 1,000 case-dropping bootstraps.

Combined Network Analyses. We next examined the symptom-level structure of relationships between loneliness and anxiety and depression-related syndromes by combining items from the ULS-8, PHQ-8, and GAD-7 in a regularized partial correlation network. This network was computed with a method analogous to that of the loneliness-specific network (i.e., graphical LASSO).

In order to determine which symptoms of loneliness are most closely related to those of the other syndromes, we used a metric called Bridge Expected Influence (BEI; Jones, Ma, & McNally, 2017). BEI is computed analogously to EI, but only considers edges between a given node and nodes from other communities in its calculation. In the current study, we considered

loneliness symptoms, anxiety symptoms, and depression symptoms as three separate communities of nodes. We calculated BEI estimates for each node of loneliness in relation to the depression community of nodes, and another set of BEI estimates for each node of loneliness in relation to the anxiety community. Thus, we were able to examine loneliness' links to specific syndromes while accounting for all relationships in the combined network. Loneliness nodes with higher BEI are more likely to be "bridge nodes" that spread activation between loneliness and either the depression or anxiety syndrome. We estimated the stability of our combined network analogously to our loneliness network analyses, but also calculated CS coefficients for all BEI estimates.

Because participants were drawn from different schools, there might have been meaningful differences between networks, depending upon the random effect of school. Therefore, as a follow-up analysis, we examined whether the relationships between all nodes in our combined network might differ depending upon school. To this end, we conducted model-based recursive partitioning of our combined network (Jones, Mair, Simon, & Zeileis, 2019) using the *networktree* package (Jones, Simon, & Zeileis, 2018), which determines whether the goodness-of-fit index for the model is associated with covariates of interest. In this analysis, we included each participant's school as a covariate upon which the network was partitioned.

Results

Descriptive Statistics

Table 1 shows socio-cultural characteristics for the sample. The mean for the ULS-8 was 19.39 (SD = 4.83) across the whole sample.

Loneliness and Socio-Cultural Factors

Table 2 shows the results of a linear mixed effect model showing the association between self-reported loneliness scores and the socio-cultural variables of age, gender, tribal status, school type, and financial status. After accounting for all other socio-cultural variables and within-school variability, female gender was associated with higher loneliness scores ($\beta = 0.13$, $p = 0.016$). Adolescents from poor backgrounds ($\beta = 0.08$, $p = 0.002$) and those from lower to middle-income backgrounds ($\beta = 0.19$, $p < 0.001$) also reported higher loneliness scores than their counterparts from “wealthy” backgrounds. No effect emerged for age ($\beta = -0.01$, $p = 0.993$), tribal status ($\beta = -0.41$, $p = 0.073$), or school type ($\beta = 1.56$, $p = 0.331$).

Network of Loneliness, Depression, and Anxiety

Prior to conducting a network of loneliness, depression, and anxiety symptoms, we conducted a network of only loneliness features. Our initial analyses indicated that two nodes from the loneliness network were redundant with one another (i.e., “I feel left out” and “I feel isolated from others”). Therefore, they were combined into a single node referring to the subjective perception of feeling alone (i.e., “feeling alone”) using PCA. That is, this variable consisted of the first principal factor of the two redundant nodes. This “feeling alone” node displayed the highest EI in the network. See Table 3 for a key of node names for all network analyses. See Supplementary Materials S2 for a depiction of the loneliness network, as well as expected influence metrics for each node.

See Figure 1 for a depiction of the combined network of loneliness, anxiety, and depression symptoms, as well as BEI values for each symptom of loneliness with respect to both the anxiety and depression communities. Overall, loneliness symptoms showed much higher BEI values with respect to the depression community, as opposed to the anxiety community. The perception of feeling alone emerged as the symptom of loneliness most likely to bridge the

loneliness and depression communities and was also the aspect of loneliness most connected to anxiety. Lack of extraversion demonstrated a negative bridge expected influence on the anxiety community. See Supplementary Materials S3 for a table of the unregularized partial correlations between all nodes. CS coefficients revealed an acceptable level of stability in the combined network for edge weight ($CS(\text{cor} = 0.7) = .75$), expected influence ($CS(\text{cor} = 0.7) = .75$), and bridge expected influence ($CS(\text{cor} = 0.7) = .75$). Our model-based recursive partitioning analysis revealed that the combined network did indeed vary based upon school, but in a non-random manner. A significant difference in network structure was found between participants from boarding schools and day schools. Inspection of the networks revealed that the network derived from boarding school attendees was denser than those of day school attendees (i.e., showed stronger connections between nodes overall). See Supplementary Materials S4 for a depiction of this comparison.

Discussion

This study provides the first assessment of the association between self-reported loneliness and socio-cultural variables in Sub-Saharan African youth. It is also the first to apply the network analytical approach to loneliness and its relationship to syndromes of depression and anxiety. Although several previous studies have included loneliness as a single node within a network (Aalbers, McNally, Heeren, De Wit, & Fried, 2018; Robinaugh, LeBlanc, Vuletich, & McNally, 2014), here we included loneliness as a dynamic causal system. Overall, our findings point to two important socio-cultural factors, gender and socio-economic status, that may influence loneliness in Sub-Saharan African youth. They also identify facets of loneliness that may be most closely linked to psychopathology in this population and could be candidates for further longitudinal studies that more rigorously examine their potential causal role in

exacerbating psychopathology. Of note, our diverse Kenyan sample was largely representative of the diversity in Kenya secondary schools (see Osborn et al., 2020).

Loneliness and Socio-Cultural Factors

Associations between socio-cultural factors (e.g., age, gender, family income) and self-reported loneliness amongst Kenyan youths indicated mixed support for previous research. No significant effect emerged for age. This finding is particularly curious because existing literature suggests that loneliness may vary according to age (Spithoven et al., 2015). In addition, female adolescents reported significantly greater loneliness than their male counterparts in our sample. This diverges from previous research examining gender differences in adolescent loneliness. A recent meta-analysis of over 500 studies found that males were, on average, significantly lonelier than females across childhood, adolescence, and young adulthood (Maes, Qualter, Vanhalst, Van den Noortgate, & Goossens, 2019). However, a separate meta-analysis found non-significant gender differences in adolescent loneliness (Mahon, Yarcheski, Yarcheski, Cannella, & Hanks, 2006). These inconsistencies may result from differences in the instruments used, age of the individuals sampled, and local socio-cultural context (Luhmann & Hawkley, 2016). It is important to note that the majority of studies reviewed in these meta-analyses were conducted in Western nations, implicating potential gender differences in loneliness based on socio-cultural context. Future studies are required to ascertain the nature of the association between gender and adolescent loneliness, and whether this association is moderated by cultural background, age, or other factors.

We also found that Kenyan adolescents from poorer backgrounds reported greater loneliness than their wealthier peers. This is consistent with empirical evidence that supports an association between lower socio-economic status and loneliness across the lifespan (Schinka et

al., 2012). Although most studies have examined adult or elderly samples, previous studies examining youth loneliness have produced similar findings. For instance, in India, living below the poverty line has been identified as a significant risk factor for loneliness in youths (Devi et al., 2013). Previous research has proposed several explanations for why low-income youth may feel lonelier: they may be excluded from their communities, face stigma and discrimination, and have fewer opportunities to engage with their peers and participate in group activities (Devi et al., 2013; Stewart et al., 2008). Further, the inextricable link between poverty and poor mental health (e.g., prevalence of depression and anxiety symptoms) may extend to loneliness (Kilburn et al., 2016). That said, it is important to consider socio-economic status was assessed via self-report, which may not be as accurate as other objective measures of socio-economic status. Future research will be required to replicate these findings. Finally, socio-cultural factors only explain a very small proportion of the variance in our model. This is not surprising because studies with similar samples (e.g., Osborn, Venturo-Conerly, et al., 2020) have observed that the variance in well-being measures—e.g., depression and anxiety—is sometimes more closely linked to commonly shared macro-level factors, such as poverty, than to culture-specific socio-cultural variables.

Loneliness, Depression, and Anxiety Network

Overall, loneliness showed various links to both depression and anxiety symptom communities. However, loneliness was more robustly linked to depression symptoms as evidenced by its nodes' higher BEI values in reference to that community. The perception of *feeling alone* emerged as the main bridge symptom between loneliness and depression and was also the aspect of loneliness most connected to anxiety. Interestingly, *lack of extraversion* displayed a relatively small negative BEI in reference to the anxiety community, and was among

the smallest BEI values in reference to the depression community. Indeed, prior studies have noted that the long form of UCLA Loneliness scale includes several personality-based items that may have little to do with pathological aspects of loneliness (e.g., outgoing, friendly, shy; Jenkins, Sanchez, & Olivas-Hernández, 2019).

Our comparison of networks across schools revealed stronger connections between nodes overall in boarding schools (i.e., a denser network). A denser network may indicate that activation of one node in a network is more likely to activate other nodes. Thus, increases in the severity of one symptom may lead to higher levels of psychopathology overall (van Borkulo et al., 2015). Although comparisons between day and boarding schools were not a main focus of this study, it is possible that students in boarding schools have more labile psychopathology networks due to risk factors such as early separation from parents and caregivers (Schaverien, 2011). Further research is needed to substantiate this possibility.

Our findings support previous studies that have suggested robust links between loneliness and depressive symptoms. For instance, Mullarkey, Marchetti, & Beevers (2019) examined the roles of various features and symptoms of depression via a network analysis. They found that loneliness emerged as one of the most central symptoms in the depression network and identified the sadness-loneliness edge as one of the strongest associations in the network (Mullarkey et al., 2019). Given the consistently strong links between depression and loneliness, Mullarkey et al. (2019) propose that targeting loneliness in mental health interventions may effectively reduce adolescent depressive symptoms. Our findings support this notion. Nevertheless, research with randomized controlled experimental designs is needed to substantiate this claim.

Further, our symptom-level analyses shed light on specific ways in which loneliness contributes to symptoms of depression and anxiety. Overall, depression and anxiety symptoms

were more closely linked to subjective feelings of isolation than personality factors (e.g., level of extraversion) or objective measures of isolation (e.g., quantity of social connections).

Incidentally, the perception of feeling alone was also the most central node in our preliminary loneliness network, even though this network was not the focus of our study. These findings converge with previous research suggesting that the adverse health effects of loneliness are more attributable to feelings of isolation than they are to objective social isolation (Cornwell & Waite, 2009; Masi et al., 2011). For example, in one study, perceptions of peer rejection significantly increased youths' risk of depression, while objective levels of rejection did not (Qualter et al., 2010). In another study with European youth, more frequent loneliness predicted higher levels of anxiety even after controlling for experiences of peer rejection and victimization (Løhre, 2012).

Our findings contribute to a growing literature base urging loneliness interventions to target underlying perceptions of isolation rather than an exclusive focus on social factors (e.g., number of friends) or personality factors (e.g., extraversion). Since perceptions of isolation exhibited the highest levels of centrality in our network, interventions that target these perceptions may enact the most change on greatest number of loneliness symptoms (Robinaugh et al., 2016). Although loneliness interventions have traditionally focused on reducing objective isolation, often through enhancing social skills and increasing social contact (Jeste, Lee, & Cacioppo, 2020), our results support more recent findings that treatments for loneliness should also target underlying perceptions of isolation, perhaps through cognitive therapy (Cacioppo et al., 2015; Rodriguez, Bellet, & McNally, 2020). Consistent with this proposition, a meta-analysis investigating the efficacy of loneliness interventions found that interventions that target cognitive factors of loneliness are significantly more successful than those targeting social factors (Masi et al., 2011). Our findings suggest that these cognitive interventions may be more efficacious

because they are acting on more central nodes of the loneliness network. However, it is also possible that perceptions of isolation were more central to the network because other nodes jointly gave rise to this perception. Further research with longitudinal designs is needed to disambiguate the causal direction at play in this finding.

Limitations and Future Directions

Our study is not without limitations. First, we did not make any a priori hypotheses; as these were the first analyses of their kind in this population, our aims were exploratory in nature. Thus, replications of our findings in other samples are warranted. In addition, due to the cross-sectional nature of the data, causality cannot be inferred (McNally, Heeren, & Robinaugh, 2017). For example, we cannot conclude whether loneliness is a risk factor or an effect of depression in our sample. However, our network analysis points to specific aspects of loneliness that are likely key players in its emergence and its relationship to other forms of psychopathology. Future research should investigate the relationships between loneliness, depression, and anxiety via a longitudinal network analysis, which reveals dynamic causal relationships by examining changes in symptoms over time (McNally et al., 2017). Our cross-sectional between-persons design may also obscure important intra-individual network dynamics in the relationships between aspects of loneliness and mental disorder symptoms (Fisher, Reeves, Lawyer, Medaglia, & Rubel, 2017). Further research with time-series idiographic networks could provide more clarity on how these processes unfold within individuals (Epskamp, Boorsboom, & Fried, 2018).

Another limitation is that the subjective meaning, and thus endorsement, of loneliness and depressive and anxiety symptoms is influenced by cultural context. As the measures that we used were primarily developed in Western settings, further investigation with culturally attuned instruments is necessary to replicate or clarify our findings. Although the psychometric

properties of the measures have been documented with Kenyan youths elsewhere (Osborn et al., 2020), and the shortened UCLA Loneliness Scale (ULS-8) is widely used to measure adolescent loneliness globally, including in various non-Western countries (e.g., Turkey, Malaysia, Zimbabwe, China; Doğan, Cotoğlu, & Tekin, 2011; Swami, 2008; Wilson et al., 1992; Xu et al., 2018), we encourage future research efforts examining whether such measures are appropriate in SSA given its cultural context. This research may be particularly useful because though our measures meet the $>.70$ Cronbach's alpha threshold, the levels of internal consistency in our study are not particularly strong. A thorough validation—and perhaps socio-cultural adaptation—of these measures is needed. Another limitation is the fact that edges in networks, as well as centrality metrics such as EI and BEI, are not interpretable as standardized effect sizes, since they are derived from regularized partial correlations. Thus, centrality estimates such as the BEI of loneliness nodes should be interpreted as indicators of their potential clinical importance relative to other aspects of loneliness, rather than absolute values indicating “clinical significance” writ large.

Ultimately, should future explorations confirm and expand upon some the findings of our present study, the replicable points of linkage between loneliness and depression and anxiety-related psychopathology may suggest of future directions for treatment and preventive efforts. For example, work that has explored the relationship between gratitude and depression/anxiety has shown that more grateful people exhibit positive states and wellbeing outcomes (Froh et al., 2009), and has led to the development of mental health interventions that attempt to increase gratitude in order to reduce depressive/anxiety symptoms (Mann et al, 2017), some of which have been trialed with Kenyan youths (Osborn, Venturo-Conerly et al., 2020; Osborn, Rodriguez, Wasil et al., 2020).

Conclusions

In this study, we used cross-sectional data from a large sample of Kenyan adolescents to investigate overall levels of loneliness and the association between loneliness and socio-cultural factors. We also used network analysis to assess which features of loneliness are most strongly linked to depression and anxiety symptoms. Taken together, our results suggest that females and adolescents of lower socio-economic status are at particular risk for higher levels of loneliness among SSA youth, and that inroads to the treatment of psychopathology in this population might be most effectively made by targeting perceptions of isolation. However, further research is needed to substantiate the efficacy of any such intervention. Regardless, this study provides a step toward closing two major gaps in the literature: the nature of the relationship between loneliness and psychopathology, and the experience of loneliness in an understudied population (SSA adolescents).

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Tables

Table 1.

Sample Characteristics. Our sample was drawn from four secondary schools in Nairobi and Kiambu counties Kenya with attention to ensure the resulting sample would reflect the socio-demographic and socio-cultural diversity in Kenya (see Osborn et al., 2020 for more information on sampling).

Characteristic	N	%
Sex		
Female	1246	58.33
Male	890	41.67
Age		
12	6	0.29
13	65	3.13
14	520	25.01
15	713	34.30
16	533	25.64
17	186	8.95
18	45	2.16
19	11	0.53
School		
School A	801	36.56
School B	914	41.72
School C	226	10.31
School D	250	11.41
Tribe		
Majority	1184	56.57
Minority	909	43.43
Financial Status		
Wealthy	147	6.90
Upper Middle Class	1266	58.86
Lower Middle Class	610	28.84
Poor	93	4.40
School Type		
Boarding	1715	78.28
Day	476	21.72

Table 2.

Results of mixed effect linear model showing the association between loneliness and socio-cultural variables.

<i>Predictors</i>	UCLA_Total		
	<i>Estimates</i>	<i>CI</i>	<i>p</i>
(Intercept)	18.73	15.00 – 22.46	<0.001
Age	-0.01	-0.20 – 0.19	0.933
Gender [Male]	-1.26	-2.33 – -0.19	0.021
Tribal_Classification [Minority]	-0.41	-0.85 – 0.04	0.073
Financial_Status [Quite well-off]	0.81	-0.06 – 1.68	0.067
Financial_Status [Not quite well-off]	1.98	1.07 – 2.89	<0.001
Financial_Status [Poor]	2.08	0.77 – 3.39	0.002
School_Type [Non-Boarding]	1.56	-1.59 – 4.70	0.331
Random Effects			
σ^2	21.34		
τ_{00} School	2.46		
ICC	0.10		
N School	4		
Observations	1974		
Marginal R ² / Conditional R ²	0.060 / 0.157		

Table 3.

Node Names and Corresponding Symptoms for Network Analyses.

Loneliness Nodes		Anxiety Nodes		Depression Nodes	
Node Name	Symptom	Node Name	Symptom	Node Name	Symptom
No Friend	<i>Lacking companionship</i>	Nervous	<i>Nervousness, anxiety, feeling on edge</i>	Anhedon	<i>Anhedonia</i>
No Support	<i>Not having anyone to turn to</i>	No Ctrl	<i>Inability to control worry</i>	DepMd	<i>Depressed mood</i>
Not Extra	<i>Not being an outgoing person</i>	Worry	<i>Worrying too much</i>	Sleep	<i>Sleeping too much or too little</i>
Can't Find	<i>Inability to find companionship</i>	No Relax	<i>Difficulty relaxing</i>	Fatig	<i>Fatigue</i>
Distress	<i>Unhappiness with being withdrawn</i>	Restless	<i>Restlessness</i>	Appetit	<i>Appetite disturbance</i>
Alone Crowd	<i>Feeling that people are around but not with me</i>	Annoyed	<i>Easily annoyed or irritable</i>	Guilt	<i>Excessive guilt or shame</i>
Feel Alone	<i>PCA combination of feeling left out and feeling isolated from others</i>	Future	<i>Fearing something awful might happen</i>	Concen	<i>Concentration difficulties</i>
				PsycMtr	<i>Psychomotor retardation or agitation</i>

Figures

Figure 1. Left side: Regularized partial correlation network of loneliness items, depression symptoms, and anxiety symptoms. Right side: Bridge expected influence values for each symptom of loneliness with respect to the anxiety and depression symptom communities.