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Psychometric evaluation of the Adversity Childhood Experience International Questionnaire (ACE-IQ) in Malawian adolescents

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Abstract

Background: Adverse childhood experiences (ACEs) can have lifelong adverse impacts on health and behavior. While this relationship has been extensively documented in high-income countries, evidence from lower-income contexts is largely missing. In order to stimulate greater research on the prevalence and consequences of ACEs in low-income countries, the World Health Organization (WHO) developed the ACE-International Questionnaire (ACE-IQ).

Objective: In this paper, we explore the factor structure, validity and reliability of the original ACE-IQ, and evaluate whether potential adaptations improve its predictive validity.

Participants and setting: Four hundred and ten adolescents (age 10–16 years old) from Malawi.

Methods: The adolescents answered an adapted version of ACE-IQ and Beck Depression Inventory (BDI).

Results: Taken together, our results suggest that (a) the ACE-IQ is structured in three dimensions: household disruption, abuse, and neglect; (b) there is support for the validity of the scale evidenced by the correlation between subdimensions (average across 13 correlations, phi = .20, p<0,01; across subdomains (phi = .10, p<0,01); partial agreement among children with the same caregiver (ICC = .43, p < .001) and correlation between ACE and depression (predictive validity; r = .35, p < .001); (c) information on the timing of the adversities ("last year" in addition to "ever") modestly improved the predictive value of the ACE-IQ in models of depression (from R^2 = .12 to .15, p < .001); and (d) additional HIV-related questions showed low endorsement and a modest correlation with BDI (r=.25 p<0,01).

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Conclusion: Our findings suggest that the ACE-IQ is appropriate for use among adolescents from a low-income context.

Keywords

adverse childhood experiences; ACE; psychometric evaluation; adolescence; HIV

Introduction

Adverse childhood experiences (ACEs) designate the most common sources of stress that children may suffer early in life, including multiple types of abuse; neglect; violence; and household dysfunction (Boullier & Blair, 2018). ACEs can have lifelong impacts on health and behavior. For example, children exposed to a greater burden of ACEs demonstrate higher levels of alcohol and drug abuse, are more likely to drop out of school, and engage in riskier sexual behavior during adolescence (Bethell, Newacheck, Hawes, & Halfon, 2014; Borelli, Ho, & Epps, 2018; London, Quinn, Scheidell, Frueh, & Khan, 2017; Perez, Jennings, Piquero, & Baglivio, 2016). During adulthood, growing evidence suggests that ACEs are associated with health declines (including diabetes, hypertension, obesity and other chronic diseases, psychopathology, cancer, and mortality), as well as high school non-completion, unemployment and reduced earnings (Felitti, 2002; Felitti et al., 1998; McLafferty et al., 2015; Metzler, Merrick, Klevens, Ports, & Ford, 2017).

While the relationship between ACEs and poor health has been extensively documented in high-income countries, evidence from lower-income contexts (Ye & Reyes-Salvail, 2014) is more limited. This is particularly concerning given that emerging evidence suggests that ACEs are even more frequent in low- and middle-income countries (LMIC) (Benjet, 2010). LMIC studies of individual or small clusters of adversities suggest they may similarly influence health over the life course. Yet, there are at least three important limitations in the existing LMIC literature on ACEs. First, existing studies generally do not capture the cumulative impact of ACEs on behavioral outcomes (Almuneef, Qayad, Aleissa, & Albuhairan, 2014; Soares et al., 2016). Many focus instead on one type of adversity, or a small cluster of related adversities (e.g. physical, sexual and emotional abuse). The instruments that have been developed to capture childhood adversity are similarly limited in scope. For example, the Perception of Child Maltreatment Scale (PCMS) (Fakunmoju & Bammeke, 2013), the Childhood Experiences of Violence Questionnaire (CEVQ) (Walsh et al., 2008), the International Child Abuse Screening Tool (ICAST) (Zolotor et al., 2009) and others (Levis, 2012) focus on individual experiences of abuse and neglect, but exclude important adversities at other ecological levels (e.g., witnessing violence within the family or community). Second, most LMIC studies have been based on retrospective adult reports of childhood experiences; the result is that there is often a multiple decade lag between the occurrence and reporting of ACEs. Thus, the existing LMIC data are potentially subject to recall bias (Reuben et al., 2016) and may underestimate the prevalence of abuse (Naicker, Norris, Mabaso, & Richter, 2017). Third, there is a lack of data on multiple forms of violence and traumatic experiences among younger children, as research has focused on late adolescence exposures to ACEs (Devries et al., 2018). A recent review calls for efforts to

develop reliable, valid ways of measuring ACEs among children and adolescents (Devries et al., 2018).

In order to stimulate greater research on the prevalence and consequences of ACEs in LMICs (Almuneef et al., 2014; Anda, Butchart, Felitti, & Brown, 2010; World Health Organization, 2011, 2012a), the World Health Organization (WHO) developed the ACE International Questionnaire (ACE-IQ) (World Health Organization, 2012b). The ACE-IQ was adapted from the long-running Centers for Disease Control and Prevention (CDC) and Kaiser Permanente's Adverse Childhood Experiences Study in the U.S. (Felitti et al., 1998). The original ACEs instrument has been well validated among adult samples in the U.S. (Ford et al., 2014; Murphy et al., 2014) and it is currently undergoing additional reliability and validity testing in that country (Bethell et al., 2017). For the ACE-IQ, questions were added to increase the international cultural applicability and to better reflect a wide array of exposures that may be more commonly encountered outside the U.S. (Anda et al., 2010). Specifically, the questionnaire was expanded to cover community and collective violence, as well as peer-to-peer violence. While the ACE-IQ was designed to be administered to adults, the questionnaire was also field tested among adolescents (13–19 years old) as part of ACE-IQ development (World Health Organization, 2011). The ACE-IQ has since been used in several countries, including Germany (Wingenfeld et al., 2011), Netherlands (van der Feltz-Cornelis et al., 2019), China (Chang, Jiang, Mkandarwire, & Shen, 2019; Ho, Chan, Chien, Bressington, & Karatzias, 2019), Lebanon (Naal, El Jalkh, & Haddad, 2018), Kenya (Goodman, Martinez, Keiser, Gitari, & Seidel, 2017), Brazil (Soares et al., 2016), Saudi Arabia (Almuneef et al., 2014), Iraq (Al-Shawi & Lafta, 2015), South Africa (Quinn et al., 2018; Kidman, Nachman, Dietrich, Liberty, & Violari, 2018; Mall, Mortier, Taljaard, Roos, Stein, & Lochner, 2018), Nigeria (Kazeem, 2015), Korea (Kim, 2017), Tunisia (El Mhamdi et al., 2018) and Vietnam (Tran, Dunne, Vo, & Luu, 2015). Despite its rapid uptake, data on its psychometric properties and validity are currently limited, especially in low-income country settings for which no psychometric evaluation of the ACE-IQ has been conducted to date.

We respond to this gap by examining the psychometric properties of the ACE-IQ among rural adolescents in Malawi, a sub-Saharan low-income country. Specifically, we explore the factor structure, validity and reliability of the original ACE-IQ, and evaluate whether potential adaptations improve its predictive validity. This analysis uses baseline data from an ongoing longitudinal study focused on how early childhood experiences contribute to later adolescent Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS) risk; this study is nested within the larger Malawi Longitudinal Study of Families and Health (MLSFH) (Kohler et al., 2015). In addition to examining the properties of the original ACE-IQ, we also examine the value of two additional components that may be of critical importance for adolescents. First, in contexts of endemic HIV, adolescents may experience additional HIV/AIDS-related adversities that are not adequately captured by the ACE-IQ, but which may add importantly to the cumulative burden of adversity. Thus, questions on HIV-specific adversities (e.g., having a parent or household member who died of AIDS) were added to the ACE-IQ instrument implemented in the MLSFH. Second, we incorporated the timing of adverse experiences into the MLSFH survey. The timing of adversity may importantly shape health outcomes and behaviors for adolescents; yet, most

existing studies only capture a single measure of ACE occurrences across the entire childhood (i.e., up to age 18).

Methods

Setting and sample

This study is conducted as part of the Malawi Longitudinal Study of Families and Health (MLSFH) (Kohler et al., 2015), an ongoing project based in all three regions of Malawi (North, South, Center) that provides 20-years of data documenting the lives, health, and demographic/socioeconomic changes of individuals in a poor sub-Saharan context. The majority of the MLSFH study population engages subsistence agriculture, complemented by some smallholder cash crops (primarily tobacco and cotton), casual agricultural labor and small-scale market activities, such as selling second-hand clothing and vegetables. Schooling levels in general are relatively low, but have been increasing rapidly among adolescents in recent years (Soler-Hampejsek et al., 2018). HIV is widespread, with rural prevalence of 7.5% among adults, 5% among male and 9% among female adults (15–49 years old) (Malawi National Statistical Office, 2017). The MLSFH Cohort Profile (Kohler et al., 2015) provides a detailed discussion of MLSFH, including the initial sample selection, data collection rounds and content, attrition and comparisons to nationally-representative population samples.

The adolescent cohort for the MLSFH ACE study was established by selecting all adolescents who were listed as household/family members by MLSFH respondents during the 2008 or 2010 MLSFH data collection, and who were expected to be 10–16 years old in 2017. The selected MLSFH adolescents were traced during 2017–18, and if found, approached for potential participation in this MLSFH adolescent study. Current age was verified prior to enrollment, and if eligible, adolescents were enrolled after consent was obtained from the caregivers (usually, but not always, parents) and assent given by the adolescents themselves. Only three caregivers refused to give consent for adolescent participation.

Present analyses are based on the initial phase of data collection in Mchinji District in July 2017 that included 410 adolescents and their primary caregivers. Adolescents were 10 to 16 years old (M = 12.99; DP =1.74) and 47% were female. Almost all (94%) reported attending school. Their caregivers were mainly female (91%) and 70% had not completed primary school. Besides mosquito nets (82% of the participants) and a pit latrine (80%), caregivers reported low access to basic household assets, such as a metal roof (36%) and a bed with a mattress (21%).

Data collection

Respondents were interviewed individually and privately at their home. The surveys were completed on tablets by trained interviewers and read out loud in their local language (chiChichewa). The surveys had been translated into the local language by a professional translator; and supervisors and interviewers reviewed the translation during training. Interviewers were trained and instructed to monitor and evaluate a participant's well-being

and emotional stability during the interview, and referral procedures were in place. During the study and for a period for two months after completion of the data collection round, a "hot line" was established at the local MLSFH implementation partner (IKI Malawi), allowing respondents to call and obtain additional information about resources and be linked to support. Institutional Review Board (IRB) approval was obtained from Stony Brook University and the National Health Science Research Committee (NHSRC) in Malawi.

Measures

Adverse Childhood Experience International Questionnaire – ACE-IQ (World Health Organization, 2012b): This instrument asks how often adolescents experienced 13 domains of adversity while they were growing up. Questions cover family dysfunction; physical, sexual and emotional abuse and neglect by parents or caregivers; peer violence; witnessing community violence, and exposure to collective violence. In addition to capturing whether the respondent had ever experienced each type of adversity, we adapted the survey questions to ask whether the adversity was experienced in the past year (current adversity). An ACE score was operationalized by summing the number of ACEs reported for each period. The ACE-IQ has two options for coding: binary or frequency (World Health Organization, 2012b). For the binary coding, the final score refers to the sum of each event reported, independent of frequency. For the frequency coding, the final scores consist of the sum of the events, which occurred at a predefined frequency, as specified in the Guidance for Analyzing ACE-IQ (World Health Organization, 2016). This second coding scheme is meant to discriminate between more and less severe forms of adversity.

ACE-HIV module: The MLSFH adaptation of the ACE-IQ included a new ACE-HIV module. The HIV module contained 21 HIV-related questions about household mortality, morbidity, orphanhood; sibling residence, and community HIV prevalence. As with the ACE-IQ, adolescents were asked whether they experienced each event ever and in the past 12 months. Using those events reported with adequate frequency, a final score was calculated by summing HIV-related events experienced in each time period.

Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961): The Beck Depression Inventory (BDI) is a 21-item, self-report inventory that measures characteristic attitudes and symptoms of depression (e.g., mood, irritability, insomnia and self-dislike). Previous studies reported high internal consistency, with alpha coefficient of .81 for nonpsychiatric populations (Beck, Steer, & Garbin, 1988).

Analysis Plan

Descriptive statistics examined endorsement rates within each of the 13 subdomains of the ACE-IQ, as well as overall scores on the ACE-IQ composite. To examine factor structure, we performed an exploratory analysis using principal components on the ACE-IQ subdomains, with PROMAX rotation to assist in interpretation. Because the subdomains were coded as binary, we performed this analysis on the tetrachoric correlation matrix. We use the factor analysis to determine whether the internal structure of the ACE-IQ is similar in Malawian adolescents compared to previous investigations with other populations, not to

identify which items should be included in the ACE score, or to propose a new structure underlying the scale.

To examine validity, we examined the pattern of individual item correlations within versus across subdomains, with the prediction that correlations within subdomains should be stronger in magnitude. Next, we tested for agreement between respondents who reported having the same primary caregiver (i.e., they are likely siblings), with the prediction that we should see moderate levels of agreement if the instrument is working properly. To compute agreement, we computed Intraclass coefficients for respondents who shared a caregiver using empty random effects models in SAS PROC MIXED with overall ACE-IQ score as the criterion. We also tested whether ICC's are relatively larger for families that are more intact (that is, where the siblings have not been separated), and for subdomains of the ACE where one would expect more agreement within a family (specifically, we computed the ICC for the parental absence domain, and compared to the bullying subdomain).

To establish predictive validity, we examined the correlation between the ACE-IQ score and Beck Depression Inventory (BDI) score. We also computed ACE-IQ scores using the more stringent "frequency" coding scheme, as well as ACE-IQ scores restricted to events reported to have occurred in the past year, and test these scores' associations with BDI. In regression models, we examined whether these additional coding schemes add unique predictive variance in predicting BDI.

Finally, we examined the frequency characteristics and, where appropriate, the predictive validity of the 21 newly created items for HIV-related adverse events.

Results

Descriptive data on thirteen ACE-IQ binary subdomains

Positive responses using the binary scoring measures ranged from 6% (sexual abuse) to 99% (community violence). Overall score on the ACE-IQ binary version averaged 6.2 (median = 6.0), ranging from 0 to 12. Over 99% of the sample reported at least one ACE and nearly 30% of the sample reported more than 7. Of the 410 adolescents surveyed, only one elected not to complete the ACE-IQ; two others had missing data.

Factor Structure

A principal components analysis (PCA) on the tetrachoric correlation matrix was performed. Due to the very high endorsement rate of "community violence" and low endorsements of "sexual abuse" and "someone with mental health issues" (see Table 1) these domains were not included in the factor analysis due to their low variability; thus, analyses were performed on the tetrachoric correlation matrix comprised of the remaining 10 subdomains. An initial model generated four factors with Eigen value > 1. However, the fourth factor had a value only barely greater than 1 (1.01), which was not much larger than the next largest value (.91). Upon examination of the scree plot, a three-factor solution seemed more appropriate. Thus, the analysis described below was constrained to extract three factors.

After rotation, a clear “household dysfunction” factor emerged, comprised of four items (household member drug use, incarcerated, parental divorce or death, collective violence). A second factor, “abuse” was comprised of physical and emotional abuse and domestic violence. The third factor, “neglect” was comprised of physical and emotional neglect, and experience of bullying.

We also conducted a factor analysis including “sexual abuse” and “mental health,” because there was some variability in these two domains as compared to “community violence.” We again observed a three-factor solution, with most items loading on the same factors described above. “Mental health” loaded on “household dysfunction” and “sexual abuse” loaded on “neglect.” However, “physical neglect” no longer clearly loaded on a single factor, instead relating moderately to both “neglect” and “household dysfunction.” As the overall pattern is similar, yet somewhat clearer without the two low-incidence items, we have presented the 10 domain model in the body of the paper.

Evidence for validity

Within/across domain associations: In a valid measure, we would generally expect that individual questions within a domain (e.g., emotional neglect) would be more strongly associated with one another than with items in other domains. Four of the subdomains are comprised of more than one item measuring a type of experience, and thus allow for a comparison of correlations within versus between subdomains. As expected, the phi coefficients for item correlations were higher within subdomains (average across 16 correlations, phi = .21) than across subdomains (average across 89 correlations, phi = .10).

Partial agreement among children with the same caregiver: As predicted, we observed substantial agreement in overall 13 domain ACE-IQ score between adolescents who reported currently having the same primary caregiver (n=261) ICC = .44, $p < .001$. In addition, this agreement was stronger among the subset of these respondents who reported less disruption in their household members (i.e., did not indicate that they had ever lived apart from their sibling, n = 194, ICC = .52, $p < .001$). Finally, agreement was stronger within a subdomain affecting the household as a whole (e.g., “parents absent,” ICC = .58) than on a subdomain where we might expect responses to differ more between siblings (e.g., “bullied,” ICC = .39).

Predictive validity: To examine whether the ACE-IQ has predictive utility in this population, we examined the association between overall experience of adverse events and depression measured by BDI score. Consistent with prior research, we observed a moderate, positive correlation ($r = .35$, $p < .001$) (Kim, 2017). See Table 2.

As noted, in addition to the “binary” version of the ACE-IQ, we also coded the more stringent “frequency” version. Using the higher thresholds for a “yes’ response yielded much lower total ACE scores (mean = 2.9 median = 3.0). However, the association with BDI was similar in magnitude to the binary version ($r = .36$, $p < .001$). A regression analysis revealed that adding the frequency version of the ACE-IQ to model (again with BDI as the outcome) that already included the binary version resulted in a slight increase in R^2, from .

13 to .15 (p< .001). Both predictors were uniquely significant predictors in this model, p's <. 01). See Table 2.

Adapted versions of the ACE-IQ: time frame and HIV module

Comparable results were observed using the version of the ACE-IQ that restricted experiences to those that occurred in the past year. Overall levels were lower, (mean = 4.4, median = 4.0), and the association with BDI was positive and moderate in magnitude (r = . 38). A regression analysis again showed a slight increase in predictive power by adding the "last year" version of the ACE to a model already including the standard binary version, from R^2 = .13 to .15, p < .001. The "last year" variable was a significant predictor (p<.01) while the standard binary version was marginally significant (p=.05).

Finally, we examined the 21 items designed to measure disruptions and adverse experiences that might be specifically related to HIV disease. Most items showed very low levels of endorsement (e.g., 2% had a parent die of HIV), precluding the ability to examine associations with depression. However, three items showed moderate levels of endorsement (7% reported someone in household died from HIV, 28% reported that at some point in time a sibling was not living with them, 37% reported that someone living with them died of some cause). A composite of these three items showed a modest correlation with BDI; adding them to a model already included the standard ACE binary version as a predictor increased the R^2 from .13 to .145, p < .01. Both predictors were significant in this model, p's < .05. See Table 2.

Discussion

Research on childhood adversity is expanding globally, and it is now being conducted in LMIC. The ACE-IQ was developed to accurately quantify the prevalence of ACEs, to document their relationship to later life consequences, and to evaluate the success of primary interventions in such contexts (World Health Organization, 2012b). Our study is the first to examine the psychometric properties of the ACE-IQ either in a low-income country or among an adolescent population, both of which represent priority populations for the study and amelioration of ACEs. We found support for the validity of the ACE-IQ scale among a community sample of adolescents living in rural Malawi.

The validity of the ACE-IQ scale was evidenced by the 1) correlation between subdimensions; 2) the partial agreement among children with the same caregiver; and 3) and the correlation between ACEs and depression. Moreover, we identified three dimensions (household disruption, abuse and neglect) consistent with theory and prior empirical evidence. These results differ on slightly from published factor analysis of the original ACE instrument in adults. While both structures recognize and reflect that multiple domains jointly contribute to long-term health (Browne & Finkelhor, 1986; Tottenham & Sheridan, 2010), the latter reported household dysfunction, physical/emotional abuse, and sexual abuse dimensions (Ford et al., 2014). It is notable that our current results - identifying neglect as the third dimension – more closely reflect theoretical frameworks long used to study adversity (Anda, Butchart, Felitti, & Brown, 2010; Dong et al., 2004; Dube et al., 2001; Dube et al., 2003; World Health Organization, 2012b).

In addition to characterizing the psychometric properties of the ACE-IQ, we also sought to evaluate the added value of potential adaptations. We found that information on the timing of the adversities ("last year" in addition to "ever") improved the predictive value of the ACE-IQ in models of depression, but only modestly. This additional contribution of timing should be further explored in relation to other key outcomes, as other constructs may be differentially sensitive to the timing of ACEs in the developmental pathway (Bosch et al., 2012; Kiff et al., 2012; Shiner, Allen, & Masten, 2017; Wolitzky-Taylor et al., 2017). For some health outcomes, such as cardiac diseases later in life, repeated exposure to adversity may be a more important determinant than the timing of adversity (Friedman et al., 2015). For others, particularly those outcomes mediated by brain function and structure, the timing of adverse experiences in relation to development may be more critical (Friedman et al., 2015; Tottenham & Sheridan, 2010). We also hypothesized that in endemic contexts such as Malawi, measuring HIV-related experiences would add meaningful information to the ACE score. However, all but three HIV-related questions showed very low endorsement. In modelling depression, a composite of these three items only slightly improved on the predictive power of the ACE-IQ.

This is study is not without limitations. Our results are based on self-report and we have no observation or confirmation of the reported experiences. There may be social desirability bias, common in self-reports on sensitive topics (Fisher, 1993). In addition, our data (to date) are cross-sectional and do not allow for use of a test-retest procedure to examine ACE-IQ reliability. Nonetheless, our results are consistent with studies investigating the psychometric properties of the original ACE survey among adults in the U.S. (Ford et al., 2014; Murphy et al., 2014), and the growing literature supporting the ACE-IQ's validity across a wide array of populations and settings. For example, studies of adult prison inmates in Nigeria (Kazeem, 2015) and of psychosomatic inpatients, college students and adults in Germany found evidence of concurrent validity between the ACE-IQ and the Childhood Trauma Questionnaire (Wingenfeld et al., 2011). A study in Romania similarly concluded that a short version of ACE-IQ, focusing on child abuse items only, was valid among school-aged adolescents (Meinck, Cosma, Mikton, & Baban, 2017). Finally, our psychometric analyses focused primarily on the ACE-IQ as a whole and examined convergent validity with depression as well as factor structure. Future studies could perform a more comprehensive analysis of individual item-level performance in this population using Item Response Theory; in addition, future work could establish test-retest reliability, as well as additional evidence of convergent validity. Together with our findings from Malawi, the weight of evidence suggests that the ACE-IQ is appropriate for use among adolescents across diverse settings. The ACE-IQ could thus be used to quantify the prevalence of ACEs and to evaluate policies and interventions to protect vulnerable children in LMIC.

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Table 1.

Descriptive data on thirteen ACE-IQ binary subdomains

	ACE	Lifetime Prevalence
Subdomains		
Individual	Emotional neglect	91%
	Emotional abuse	71%
	Physical neglect	39%
	Physical abuse	68%
	Sexual abuse	6%
Family	Substance abuser in household	31%
	Someone with mental health issues	7%
	Incarcerated household member	17%
	Domestic violence	70%
	Parents dead or divorced	56%
Peer	Bullied	51%
Community	Community violence	99%
	Collective violence	17%

Table 2.

Predictive validity of ACE-IQ "binary," ACE-IQ "frequency," and HIV composite scores with depression (BDI)

ACE-IQ version	Pearson r	R^2
Binary scoring	.35	.13
Frequency scoring	.36	.13
Binary and Frequency in one model		.15
HIV composite	.25	.06
Binary and HIV in one model		.15

All values are significant, p's <.001