



The Assessment of Adverse Childhood Experiences: Factor Structure and Convergent Validity of Multiple Measures

Keith S. Dobson^{1*}, Dennis Pusch², Julia Poole³, Meghan McKay¹

¹Department of Psychology, University of Calgary, Calgary, Canada

²Southport Psychological Services, Calgary, Canada

³National Health Service, London, England

ABSTRACT

Although there is consistent evidence that adverse childhood experiences (ACEs) are related to adult health problems, much of the extant literature rests upon retrospective recall of ACEs and the establishment of adult correlates of those memories. A number of measures of ACEs have emerged, each with their own specific foci and administrative elements. The current study examined the convergent validity of four of the most commonly employed ACE measures in a single sample of 283 adult outpatients in primary care settings. The study revealed high internal reliability for each scale and high correlations among the scales. Factor analyses, however, revealed specific dimensions and factor structures for each of the scales. Thus, while there were common factors related to sexual abuse, physical abuse and family dysfunction, unique other dimensions also emerged, often with lower internal reliability. The overall performances of the scales are reviewed, and recommendations are made for the use of specific ACE measures for specific purposes. Directions for future research are provided.

ARTICLE HISTORY

Received: March 05, 2021

Accepted: March 19, 2021

Published: March 26, 2021

KEYWORDS

Adverse childhood experiences; Assessment; Reliability; Validity; Factor analysis

Introduction

It is widely recognized that adverse childhood experiences (ACEs), such as physical, sexual or emotional abuse can have severe and long-lasting negative effects across the lifespan [1]. Other experiences such as physical or emotional neglect and a cluster of family circumstances (e.g. caregiver mental illness, substance use, or incarceration; parental separation or divorce; domestic violence) are also frequently recognized as forms of childhood adversity. Indeed, researchers often treat various forms of adverse childhood experiences as discrete and equivalent, in that they often tally the number (and not the frequency or severity) of childhood adversities and then correlate the number of adversities with a range of negative childhood and adult outcomes [2]. Studies have also demonstrated increasing likelihood or odds of various adult disorders with increasing numbers of ACEs [3].

The landmark Kaiser-Permanente study [1] demonstrated strong relationships between the recall of

ACEs and subsequent physical and mental health problems among adults. Other studies have since confirmed these relationships [3,4], and extended them to other conditions such as increased adult health care utilization [5], worse adult economic status [6], and even risk for premature death [1]. A robust literature supports the conclusion that childhood adversity is a major risk factor for chronic adult mental and physical health problems [4,7,8].

As the concept of childhood adversity has become increasingly recognized as a risk factor for poor health outcomes across the lifespan, several measures of ACEs have emerged. These include the original Adverse Childhood Experiences Questionnaire [1], which was designed rationally to assess a wide range of adverse childhood experiences. The ACEs questionnaire has been supplemented by other scales, including the Child Abuse and Trauma Scale [9,10], the Child Trauma Questionnaire [11], and the World Health Organization Adverse Childhood Experiences International Questionnaire [12]. These scales all ask adult respondents to retrospectively report personal

Contact: Keith S. Dobson ✉ ksdobson@ucalgary.ca; Tel: +1 (403) 220-5096; 📍 Department of Psychology, University of Calgary, 2500 University Drive, NW, Calgary, Alberta, Canada

Citation: Dobson KS, Pusch D, Poole J, McKay M (2021) The Assessment of Adverse Childhood Experiences: Factor Structure and Convergent Validity of Multiple Measures. *Am J Prev Med Public Health* Volume: 7, Issue: 3

Copyrights: © 2021 The Authors. This is an open access article under the terms of the Creative Commons Attribution NonCommercial ShareAlike 4.0 (<https://creativecommons.org/licenses/by-nc-sa/4.0/>).

experiences that occurred in the first 18 years of life, even though in some cultures that age does not necessarily signal the end of childhood, while individuals in other cultures who are 18 years of age may be functioning fully in adult roles. Further, these scales vary in the number of childhood experiences that they assess, and whether response options are dichotomous (i.e. did the experience occur or not) or dimensional (i.e., how frequent a given event occurred, or the severity of its consequences). There are in addition several short forms of these questionnaires, as well as adapted versions of ACE scales for specific languages. The measurement of ACEs is a critical issue. Conceptually, there are implications for understanding the long-term impact of ACEs and the conviction the field can have about the conclusions about observed relationships. There are also practical implications for the utilization of ACEs as risk factors for health problems across the lifespan within health care settings. Ideally, ACEs scales should possess internal reliability and single factor structure, as they purport to measure the single construct of childhood adversity. The measurement of this construct should also be consistent among measures [13] and across time [14]. Although studies of the internal consistency of several ACE measures exist, as described below, no study to date has compared the internal structures of several measures in a single sample, nor has any study examined the concurrent validity of multiple measures of ACEs. Both of these issues were studied here. More specifically, four of the most commonly used measures of ACEs were studied in a sample of patients in primary care clinics. These measures included the Adverse Childhood Experiences Questionnaire [1], the Child Abuse and Trauma Scale [10], the Child Trauma Questionnaire [11], and the World Health Organization ACEs International Questionnaire [12]. It was expected that each scale would demonstrate single factor structure, and that the correlations amongst the scales would be high.

Methods

This study was reviewed and approved by the Conjoint Health Research Ethics Board at the University of Calgary (file CHREB15-0349). Research funds came from a grant awarded by the Palix Foundation, but the foundation had no input to the study design or analyses.

Inclusion and exclusion criteria

As the goal of this study was to examine the psychometric properties of four ACE questionnaires in a broad sample of patients in a health care setting, there were minimal inclusion and exclusion criteria.

The key criteria were that the participant had obtained the age of 18, had the ability to provide informed consent, and had sufficient English language capacity to complete the surveys unaided. No other diagnostic or other inclusion criteria were utilized in this study, and no exclusionary criterion was invoked.

Participants

The participants for this study consisted of individuals who attended their family physician office for an outpatient visit. In order to participate, the physician (s) responsible for the office or clinic had to provide permission for patients sitting in their waiting room to be approached, and the clinic was provided with an honorarium in consideration of this disruption to their normal clinic procedures. When a patient arrived for their appointment with their family physician, they were advised that a study that had been approved by the clinic was taking place. If the patient was willing to be approached and learn more about the study, they took a card from the desk as they checked in for their appointment. Thereafter, a research assistant would approach patients who held the card, explain the study, and seek informed consent. Patients who consented were given the option to complete the questionnaires in paper format, in which case they were given the materials and a pre-addressed and pre-paid envelope. Alternatively, participants could complete the surveys in an on-line format, in which case they were given the information to link to the survey. On completion and regardless of how much they completed in the surveys, participants were offered a \$ 25 gift card, in consideration of their participation.

A total of 487 patients were approached in the clinics, of which 341 provided informed consent (70.0%) and accepted to complete the questionnaires. Of these participants, 283 (82.9%) completed the surveys and provided data that could be analyzed.

Measures

In addition to the ACE measures, participants completed a brief demographic form, which provided information about the nature of the sample. They also completed several questionnaires that assessed their mental and physical health care status, not directly relevant to the current study. They also reported whether or not they had ever received a diagnosis of a range of chronic physical and mental disorders, as another aspect of the research project focused on the relationship between reported ACEs and adult health care status. Those participants who wished to obtain the gift card also provided their name and mailing information, but this information was kept separate

from all other research information to protect confidentiality.

ACEs Questionnaires

The Adverse Childhood Experiences Questionnaire [1] consisted of 29 questions that evaluate various aspects of childhood experience, generally considered in the categories of sexual abuse, physical abuse, and family dysfunction/neglect. Several categories of question are further divided into sub-questions. For example, the question about domestic violence between parents or parental figures includes four specific questions about the occurrence and frequency of several behaviors that relate to domestic violence (e.g. pushing, hitting, kicking, and threats of violence). Scoring the ACE Questionnaire requires that questions that are comprised of several sub-questions are considered as a set, such that the presence of any positive response within that set is taken as the presence of that form of childhood adversity.

The ACE Questionnaire also uses both a dichotomous and continuous format for some questions. For example, the question "Were your parents ever separated or divorced?" is responded to with either a simple "Yes" or "No" response, whereas many other items are responded to with a choice among "Never", "Once, twice" "Sometimes", "Often", and "Very Often" response options. As a consequence of this fact, and due to the requirements of factor analysis, all items were converted to a dichotomous format, using rules developed by the test makers [1] to determine the presence of a given childhood adversity.

The Child Abuse and Trauma Scale [9,10] is a 38 item self-report quantitative measure of the extent of various forms of physical, sexual, and emotional maltreatment. Its items assess a range of childhood adversities, including sexual and physical mistreatment and punishment, psychological mistreatment, physical or emotional neglect, and a negative home environment. Items are rated on a 5 point dimensional frequency scale, where 0 reflects "never" and 4 reflect "always".

Studies of the CATS suggest that it is reliable, as its internal reliability was .86 in the initial study [10], and .90 in a later study of 897 college students [9], where the test retest reliability over a 6 to 8-week interval was reported as .89. In a further extension of the CATS, [15] also reported an internal reliability of .90 in a university sample, and significant associations between almost all of the CATS dimensions and concurrent measures of anxiety and depression.

The Child Trauma Questionnaire [11] is another retrospective self-report questionnaire of adverse childhood experiences. The CTQ is comprised of 28 items, three of which measure minimization/denial

and 25 of which measure ACEs. The latter items are divided into five scales of emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect scales, each with five items. Items are rated on a dimensional scale of 1 (never true) to 5 (very often true), resulting in potential scale scores of 5 to 25.

The CTQ has been subjected to considerable empirical scrutiny. It has shown both strong internal reliability and test-retest reliability, with values ranging from .79 to .81 [11,16]. It has demonstrated convergent validity with clinician rated ACEs [2] and prediction of chronic medical conditions [17]. It has been translated and tested in several countries, including Norway [18], Germany [19], and Turkey [20]. Dovran A reported the ability to replicate the proposed 5 factor model of the CTQ [18]. In a study with a large sample of university males and females [21], however, significant gender differences emerged in a factor analysis of the CTQ. Specifically, the original 5 factor model did not fit the data well for females, as the Physical Abuse subscale was found to be "conceptually invalid". The authors of this study recommended different assessment of Physical Abuse for males and females.

The World Health Organization's Adverse Childhood Experience International Questionnaire [12] was developed in response to an awareness that although childhood adversity can take a variety of forms, including abuse, neglect, and family dysfunction, none of the above ACE measures captures the trauma associated with war, armed conflict, or forced displacement. In recognition of this limitation of other scales, [22] adapted other ACE questionnaires and added items related to exposure to armed conflict and displacement when they studied a large study of displaced Eritrean refugees. The resulting items included a composite of items like those on other ACE measures, but also items related to risk of death, observation of violence and death, and the direct effects of displacement and refugeeism, among others. The authors found that all types of trauma studied (mental health problems in parents or siblings, childhood maltreatment, traumatic childhood events, trauma related to displacement) were associated with both mental health problems and poor quality of life among adults. Trauma associated with displacement was particularly acute for the relationship with poor quality of life for females.

In recognition of the importance of specific trauma related items in refugee populations, an international ACE research network was formed by the World Health Organization (WHO) in 2009, and a draft ACE-IQ was developed. The scale includes 30 items, some of which are dichotomous, but most of which are answered on a dimensional scale of 4 (never) to 1

(many times). The scale was developed to be administered in either a self-report format or through trained interviewers for illiterate respondents. This measure went through field testing in seven countries and with several refugee samples [12]. Based on these experiences, it was found that the interview took on average about 20 to 30 minutes to administer, and had high acceptability among respondents. Some modifications were made to the scale and it was published. In a recent study of the WHO ACE-IQ [23], it was found that both childhood adverse events and traumatic experiences related to war predicted symptoms of post-traumatic stress disorder, and that ACEs were specifically related to arousal and avoidance scales of PTSD symptoms. To our knowledge, no study of the reliability and factorial validity of the WHO ACE-IQ have been conducted prior to the current study.

Results

Prior to other analyses, all scales were examined for missing data and evidence of careless responding (such as a series of the same response). Among the 283 respondents, there were no cases that indicated careless responding or where more than 1% of the responses were missing, so in most cases the small proportion of missing data was estimated using the average of the total score for the given scale for each participant. In a small number of cases (8) there was missing information for all items on a given scale and so no estimate was made for that specific scale. As a result, a minimum of 275 cases were available for every analysis. Next, as the ACE questionnaires varied in terms of their use of dichotomous versus dimensional scales, and to directly compare all scales, all items were transformed into dichotomous response formats. To do so, the decision rules that were provided by scale developers were employed. If scale developers had not provided explicit decision rules, the comparable rules were employed as for those scales where the rules had been provided. All decision rules are available on request.

The item scores for each scale were examined and a tetrachoric correlation matrix was developed for all items, separately for all scales. Descriptive statistics, including scale means, internal reliabilities, and correlations were conducted with SPSS, v. 21. Tetrachoric factor analyses were conducted in Stata, with Promax rotations as the scales were highly correlated. What is reported below first are the unconstrained factor analyses of the scales. Given the pattern of these results, a second set of factor analyses was conducted, in which the scales were constrained to a 4 factor solution, with Promax rotation. The descriptive statistics for the total and sub-scales, and KR-20 internal

reliabilities [24] of these scales are then presented, as are correlation matrices within each scale for the 4 factor solutions. Finally, the internal reliabilities and correlations among the four ACE questionnaires are presented.

Original factor analyses

The original Adverse Childhood Experiences Questionnaire [1] had a total of 29 items. When these items were subjected to an unconstrained factor analysis, six factors emerged with an eigenvalue of ≥ 1.0 . Item loadings of .40 or more were examined and the factors were interpreted as related to: (1) low emotional support, (2) sexual abuse, (3) parental conflict, (4) physical and emotional abuse, and (5) neglect and family dysfunction, respectively in order of percent of variance accounted for. Six of the items, however, loaded significantly on more than one factor. Further, the factor related to neglect had several items on it that were difficult to interpret (e.g. a partner being threatened with a weapon).

The Child Abuse and Trauma Scale [9,10] includes 38 items. These items yielded eight factors with eigenvalues greater than 1.0 when initially factor analyzed. On inspection, the first four factors were related to: (1) verbal/physical abuse, (2) sexual abuse, (3) neglect, and (4) domestic violence, respectively in order of percent of variance accounted for. Factors 5 through 8 were more difficult to interpret. For example, factors 5 and 8 were each comprised of a single item and factor 6 had three items, which did not appear to form a factor (i.e. positive loadings on being hit/beaten by parents, understanding the reasons for punishment, and a negative loading on seeking help outside of the home). In summary, a 4-factor solution appeared the most compelling.

The Child Trauma Questionnaire [11] has 25 items related to ACEs. These items were written as five scales of emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect scales, each with five items. When factor analyzed in the current study, however, a 4-factor solution emerged. On inspection, these factors were clearly identifiable as: (1) emotional neglect and abuse, (2) sexual abuse, (3) physical abuse, and (4) physical neglect, respectively in order of percent of variance accounted for. Stated otherwise, all of the original items on the emotional abuse and emotional neglect scales loaded together on the first factor, and did not emerge as distinct from each other.

The 30 items of the World Health Organization's Adverse Childhood Experience International Questionnaire [12] yielded an original 8-factor solution when factor analysed. The first five factors were interpreta-

ble as related to: (1) sexual abuse, (2) being witness to violence, (3) physical abuse, (4) family dysfunction, and (5) domestic violence, respectively in order of percent of variance accounted for. The sixth factor comprised two positively loaded items related to displacement (forced to live somewhere else, deliberate destruction of home) but two negatively loaded items (witnessing someone else being cut or injured; living with someone who was mentally ill or suicidal) and was largely uninterruptable. The last two factors each comprised one item.

Rotated factor analyses and factor statistics

Given the range of factor structures above, and to simplify and rationalize the factor structures of the various ACEs scales, a 4 factor solution was imposed on each of the above scales, using Promax rotation to permit correlations among the scales. The results of these analyses are reported below and appear to be an ideal factor structure for each scale, as discussed in turn. The results of the factor analyses are presented first, followed by descriptive statistics for each factor analytic solution.

When constrained to a 4 factor solution, the Adverse Childhood Experiences Questionnaire [1] generated a solution that accounted for 27.15% of the total variance (Table 1). The factors were interpreted as: (1) a factor related to general family dysfunction, (2) a reverse factor that consisted of items that indicated

family support and care, (3) a clear factor related to sexual abuse, and (4) a final somewhat unclear factor that was primarily related to physical abuse. Table 2 presents the descriptive information for these factors. As can be seen there, the scales had a range of 13% to 22% of participants who endorsed the different types of ACEs, and the four factors each had acceptable reliability, as the Kuder-Richardson 20 [24] measures of internal reliability ranged from .78 to .86. Finally, the scale correlations were all significant, and ranged from .38 to .53, indicative of moderate correlations among the various aspects of childhood adversity.

The four-factor solution of the Child Abuse and Trauma Scale yielded three relatively clear factors related to: (1) domestic violence, (2) sexual abuse, and (3) neglect (Table 3). The fourth factor was labelled as punishment, but it was somewhat unclear; it was comprised of 5 items that included 3 items related to punishment and 1 item related to a home full of violence, but also a negative loading on an item related to seeking help outside of the family. Reflecting the clarity of these factors, the first three factors had acceptable internal reliabilities of .91, .79 and .79, respectively (Table 4). In contrast, the fourth factor had a low internal reliability of .59. Factor correlations ranged from .30 and .64 and all were statistically significant.

The factor analytic results of the Child Trauma Ques-

Table 1. Factor analytic results forced to 4 factors-ACEs Measure.

Item #	Content	Factor I-Family Dysfunction	Factor II-Family Support	Factor III-Sexual abuse	Factor IV-Physical abuse
% Variance; Total=27.15%		7.3	7.02	6.62	6.21
43	Not enough to eat	0.93			
46	Parents too drunk to take care	0.69			
48	Had to wear dirty clothes	0.76			0.4
41a	Push, shove, slap partner	0.73			
41b	Kick/ bite/ hit partner	0.77			
41c	Repeatedly hit partner	0.58			
41d	Threaten partner with weapon	0.47			
28a	Problem drinking/ alcoholism	0.9			
34a	Parents separated/ divorced	0.56			
44r	Some to protect/ care for you		0.85		

56r	Someone to take you to doctor		0.58		
47r	Some made you feel special		0.91		
49r	Felt loved		0.89		
51r	Family looked out for you		0.73		
54r	Family felt close to each other		0.86		
57r	Family a source of support		0.86		
58a	Swore, insulted, put down		0.47		0.54
59a	Touched in a sexual way			0.75	
60a	Touched other in a sexual way			0.86	
61a	Attempted sexual intercourse			0.98	
62a	Had sexual intercourse			0.9	
39a	Parent in prison			0.79	
38	Parent had suicide attempt			0.4	
37	Parent depressed/mentally ill			0.56	0.43
58c	Pushed, showed, slapped				0.86
58d	Hit or injured				0.86
58e	Action to be feared of-physical				0.81

Note: Only factor loadings of $\geq .40$ are reported. The factor analysis was forced to four factors, using Pro-max rotation which permits correlated factors.

Table 2. Descriptive information for scale factors and factor correlations-ACEs Measure.

	Factor I-Family Dysfunction	Factor II-Family Support	Factor III-Sexual abuse	Factor IV-Physical abuse
Mean	0.13	0.14	0.18	0.22
SD	0.2	0.26	0.23	0.24
Internal reliability (KR-20)	0.81	0.86	0.78	0.84
Factor I Correlation	-	0.49	0.48	0.52
Factor II Correlation		-	0.38	0.53
Factor III Correlation			-	0.46
Factor IV Correlation				-

Note: All correlations are significant at $p < .001$.

Table 3. Factor analytic results forced to 4 factors-CATS Measure.

Item #	Content	Factor I-Do- mestic vio- lence	Factor II-Sexu- al abuse	Factor III-Ne- glect	Factor IV-Pun- ishment
% Variance; Total=43.35%		16.72	11.76	10.8	4.18
97	Home full of violence	0.55			0.5
110	Hit/ beat by parents	0.61			
113	Physically mal-treated	0.63			
77	Ridiculed by parents	0.69			
84	Insulted by parents	0.79			
101	Parents lashed out	0.83			
108	Blamed wrongly by parents	0.88			
83	Felt unwanted/ neglected	0.78			
95	Felt disliked by parents	0.76			
90	Wanted to leave family	0.69			
92	Thought about running away	0.6			
96	Parents often angry	0.82			
104	Parents yelled	0.93			
114	Stressful childhood	0.53			
80	Strict code of behavior	0.79			
82	Punished for not following strict rules	0.89		-0.47	
88	Punished as child	0.58	0.45		
85	Sexual activity with adult		0.97		
89	Traumatic sexual experience		0.86		
102	Sexual trauma		0.91		
93	Witness to physical violence		0.41		
111	Sexual experience w. parent		0.81		

105	Fear of sexual maltreatment		0.59	0.54	
107	Left alone as child			0.76	
112	Had to take care of self			0.82	
87	Parents not at school events			0.66	
79	Parents verbally abusive			0.59	
109	Parents drunk/used drugs			0.79	
86	Parents unhappy w. other			0.51	
91	Witness sexual maltreatment			0.46	
78	Sought outside help				-0.68
81r	Understood punishments				0.87
94r	Felt punishment deserved				0.63
100r	Punishment fit the crime				0.54

Note: Only factor loadings of $\geq .40$ are reported. The factor analysis was forced to four factors, using Pro-max rotation which permits correlated factors.

Table 4. Descriptive information for scale factors and factor correlations-CATS Measure.

	Factor I-Domestic violence	Factor II-Sexual abuse	Factor III-Neglect	Factor IV-Punishment
Mean	0.19	0.19	0.19	0.12
SD	0.24	0.25	0.26	0.21
Internal reliability (KR-20)	0.91	0.79	0.79	0.59
Factor I Correlation	-	0.61	0.64	0.48
Factor II Correlation		-	0.52	0.32
Factor III Correlation			-	0.3
Factor IV Correlation				-

Note: All correlations are significant at $p < .001$.

tionnaire [11] were somewhat complicated (Table 5). The first factor included 12 items, of which 5 were related to emotional abuse or verbal violence in the household, but the other 7 were reverse coded items that involved family support and care (i.e. represented by the lack of family support and care). This factor

was labelled as family dysfunction. In contrast, the second and third factors clearly emerged as related to sexual abuse and physical abuse, respectively. The fourth factor was interpreted as one of neglect, but the items were in fact not as cohesive as a single label might imply. Specifically, items on the fourth factor

included two items that were related to neglect, but a reverse item related to having someone to protect the child, and a reverse loaded item about being hit so hard as to have to go to hospital. Reflective of the clarity of the factor items, the first three factors had relatively acceptable internal reliabilities of .90, .92 and .79, respectively, but the fourth factor had an unacceptable internal reliability of .63. It is also notable

that the fourth factor had an endorsement rate of only 4%, which suggests that the factor is not representative of typical aspects of childhood adversity. Further, the correlations with the fourth factor were notably lower than among the other factors, suggesting that these items did not capture the same conceptual domain as the other three factors.

Table 5. Factor analytic results forced to 4 factors-CTQ Measure.

Item #	Content	Factor I-Family Dysfunction	Factor II-Sexual abuse	Factor III-Physical abuse	Factor IV-Neglect
% Variance; Total=31.56%		11.73	8.95	8.14	2.74
159	Called ugly or lazy	0.76			
164	Parent wished I was not born	0.74			
174	Felt hated in family	0.8			
170	Insulted/ hurt in family	0.83			
181	Felt emotionally abused	0.68			
158r	Someone to protect me	0.78		-0.44	0.4
182r	Someone to take me to dr.	0.58			
163r	Felt loved	0.99			
169r	Family looked out for others	0.8			
175r	Family felt close to others	0.71			
184r	Family a source of support	0.82			
161r	Felt special/ important	0.67	0.47		
171	Was physically abused		0.42	0.58	
176	Someone tried sexual touch		0.95		
177	Threatened for sex		0.8		
179	Attempted/ watched sex		0.95		
180	Was molested		0.84		
183	Was sexually abused		0.82		
165	Hit so hard-hospital			0.52	-0.48

167	Family hit me-body mark			0.73	
168	Punished with belt, etc.			0.81	
171	Was physically abused			0.58	
173	Hit so hard was noticed			0.8	
162	Wore dirty clothes			0.5	0.68
157	Not enough to eat				0.95
Note: Only factor loadings of $\geq .40$ are reported. The factor analysis was forced to four factors, using Pro-max rotation which permits correlated factors.					

The World Health Organization’s Adverse Childhood Experience International Questionnaire [12] provided a relatively clear and interpretable factor solution (Tables 6 and 7). The factors reflected items of: (1) physical abuse, (2) domestic neglect, (3) systemic violence (e.g. being beat up or threatened; being beaten or having family members beaten by police/soldiers or gangs), and (4) sexual abuse. When the internal

structure of the factors was examined (Table 8), only factor 1 (physical abuse) and factor 4 (sexual abuse) had acceptable internal reliabilities (.80 and .79, respectively). On the other hand, factors 2 (domestic neglect) and 3 (systemic violence) had notably lower reliability at .66 and .68, respectively. The correlations among the WHO-ACE-IQ factors were all statistically significant and ranged from .31 to .44.

Table 6. Descriptive information for scale factors and factor correlations-CTQ Measure.

	Factor I-Family Dysfunction	Factor II-Sexual abuse	Factor III-Physical abuse	Factor IV-Neglect
Mean	0.13	0.22	0.2	0.04
SD	0.23	0.36	0.26	0.16
Internal reliability (KR-20)	0.9	0.92	0.79	0.63
Factor I Correlation	-	0.47	0.56	0.23
Factor II Correlation		-	0.54	0.17
Factor III Correlation			-	0.27
Factor IV Correlation				-
Note: All correlations are significant at $p < .001$, except for the correlation between Factor II and IV, which is significant at $p < .01$.				

Table 7. Factor analytic results forced to 4 factors-WHO-ACE-IQ Measure.

Item #	Content	Factor I-Physical abuse	Factor II-Domestic neglect	Factor III-Systemic violence	Factor IV-Sexual abuse
% Variance; Total=27.15%		7.3	7.02	6.62	6.21
73c	Punch/ slap/ kick you	0.76			
73d	Cut you with an object	0.91			
73a	Yell at/ scream/ humiliate you	0.65			
73b	Threaten or kick you out	0.51			

72f	Unwanted sexual touch of other	0.53			
72g	Witness other beaten/kicked	0.59			
72h	Witness another cut w. object	0.91			
74a	Bullied	0.43			
72b	Parent mentally ill/suicidal	0.43	0.49		
76b	Destruction of home	-0.55		0.75	
71d	Parents too drunk/high		0.78		
72a	Lived w. problem drinker		0.87		
72c	Household member in jail		0.67		
72d	Parental separation/divorce		0.78		
71br	Parents knew where you were		0.82		
71e	Not sent to school			0.43	
72e	Parent/ guardian died			0.42	
74c	In physical fight			0.6	
75a	Heard/ saw other beaten up			0.54	
75b	Heard/ saw someone shot			0.65	
75c	Heard/ saw someone threatened			0.8	
76a	Forced to live elsewhere			0.73	
76c	Beaten by police/soldiers			0.77	
76d	Family member beaten by police/soldiers/gangs			0.87	
73e	Touched/ fondled sexually				0.87
73f	Made to touch other sexually				0.81
73g	Attempted intercourse				0.93
73h	Actual intercourse				0.92

Note: Only factor loadings of $\geq .40$ are reported. The factor analysis was forced to four factors, using Pro-max rotation which permits correlated factors.

Table 8. Descriptive information for scale factors and factor correlations-WHO-ACE-IQ Measure.

	Factor I-Physical abuse	Factor II-Domestic neglect	Factor III-Systemic violence	Factor IV-Sexual abuse
Mean	.41	.19	.14	.14
SD	.29	.24	.16	.25
Internal reliability (KR-20)	.80	.66	.68	.79
Factor I Correlation	-	.44	.36	.43
Factor II Correlation		-	.31	.42
Factor III Correlation			-	.31
Factor IV Correlation				-

Note: All correlations are significant at $p < .001$.

Table 9. Total scale correlations and reliabilities.

Scale	ACES	CTQ	CATS	WHO-ACE-IQ
ACES	(0.95)	.88	.88	.82
CTQ		(0.92)	.89	.75
CATS			(0.94)	.80
WHO-ACE-IQ				(0.85)

Note: Scale reliabilities using Cronbach's alpha coefficient are on the diagonal. All correlations are significant at $p < .001$.

Correlations among ACE scales

While the above analyses make it clear that the four examined scales each had somewhat unique factor structures and item relationships, another question was the overall functioning of each scale. To address this question, scores were composed for each scale, using the original scoring proposed by each scales' authors. These scores were examined with respect to internal reliability, using Cronbach's alpha coefficient (Table 9). These results indicated that each scale had an acceptable to highly acceptable internal reliability, ranging from .85 for the WHO ACE-IQ to .95 for the ACES measure. Further, correlations among the total scale scores ranged from .75 to .89 and were all statistically significant. These results indicate that these scales all have significant amounts of shared variance, as would be expected for an underlying construct such as childhood adversity.

Discussion

The current study examined the psychometric characteristics of four commonly employed measures of childhood adversity. As these scales all purport to assess the same construct, it was expected that they would demonstrate a high degree of internal reli-

ability and that there would be strong correlations amongst the four measures. When the results were examined in this light, it was the case that the internal reliabilities did range from acceptable to highly acceptable levels. The lowest internal reliability was found for the World Health Organization ACE - IQ, but the other three scales all had reliabilities in the .9 range. When correlations amongst the scales were examined, they again demonstrated strong convergent validity, although the scale that had the lowest correlations among the other scales was again the World Health Organization ACE - IQ. In some respects, the fact that the World Health Organization ACE-IQ measure was somewhat weaker in its psychometric characteristics is not too surprising, however, as the scale incorporates both the assessment of personal and family adversity, as well as the challenges and potential traumas associated with war, military victimization, displacement and refugeeism.

When the scales were examined at an individual level, more focused strengths and limitations emerged. None of the four measures demonstrated the factor structure that was proposed by the authors. The 29 items of the Adverse Childhood Experiences Questionnaire [1] yielded a six-factor solution, while the

38 items of the Child Abuse and Trauma Scale [9,10] generated eight factors. The 30 items of the World Health Organization's Adverse Childhood Experience International Questionnaire [12] yielded an original 8-factor solution when first factor analysed. Only the 25 items of The Child Trauma Questionnaire [11] approximated what the authors had proposed as a factor structure, in that a four factor solution was obtained, wherein one factor encompassed two of the previously proposed factors by the authors. More specifically, whereas the authors of the CTQ proposed that emotional abuse and emotional neglect were distinct factors, the current factor solution placed these items on a single larger dimension.

A second set of factor analyses constrained the factor solutions to a maximum of four factors, in order to simplify the factor structure and to aid interpretability. These solutions were generally highly interpretable, and for the most part yielded factors that were consistent across the various measures. For example, a unique factor for sexual abuse items emerged in all factor solutions, and this factor had a reasonably high degree of internal liability in each instance. This result alone suggests that sexual abuse needs to be assessed as an independent construct in the context of childhood adversity. Physical abuse also emerged as a relatively consistent factor across the various measures, with the exception of the CATS. Even in the CATS, however, a broader factor was identified that incorporated both items related to physical abuse of children as well as broader domestic violence and stress. A general conclusion is that both sexual and physical abuse are consistent elements of the construct of adverse childhood experiences.

Contemporary views of adverse childhood experiences often propose that there are three broad aspects, including sexual and physical abuse, as noted above, but also a broader notion of household dysfunction/neglect/emotional abuse. Items that are sometimes incorporated in these dimensions include living with family members who have mental illness or have been incarcerated or having caregivers who are emotionally unavailable to sustain the needs of the child. In the current analyses, a factor related to family dysfunction and domestic neglect did emerge with the original ACEs questionnaire. The CATS, CTQ and WHO ACE-IQ had similar factors, although the specific items that were included in these various factor solutions varied, dependent upon the actual items incorporated into the scales.

In addition to the relatively consistent results across the four ACE measures, several inconsistencies also emerged. For example, the CATS yielded a relatively less important factor related to punishment. As not-

ed above, this was largely uninterpretable, and likely should not be used in future studies of ACES and their impacts. As a second example, the WHO ACE-IQ yielded a factor that was entitled systemic violence, which incorporated both items related to witnessing or being the direct victim of family violence, but also having these experiences from social authority figures (e.g. police, military figures) or gang members. Systemic violence is likely to be most relevant to social minority groups, or victims of war and displacement, and this scale likely should be reserved for studies within these populations.

One of the issues with the current research was that items were in some instances modified from the original dimensional formats to dichotomous variables, in order to utilize the same correlational and factor analytic methods across scales. One of the consequences of this statistical framework was that the relative incidence of various types of childhood adversity's can be examined across the four scales that were included in the study. For example, when the construct of sexual abuse is reviewed in Tables 2, 4, 6, and 8, it can be observed that the average mean endorsement of these items ranges from between .14 and .22. This result suggests that between 14 and 22% of patients in primary care will endorse an experience of sexual abuse, dependent upon the specific measure that is employed. This result can be contrasted with that of physical abuse. Across the four measures, the average reported rates of physical abuse ranged from .19 (the domestic violence factor from the CATS), to .41. It should be noted, however, that three of the scales had scores that ranged between .19 and .22 and that the WHO ACES - IQ measure was a distinct outlier with a higher average endorsement. It is possible that this higher endorsement resulted from a larger number of items on this factor for the WHO ACE-IQ than for the other measures, but it is also possible that there are items in that factor that yielded a relative over endorsement of physical abuse.

Based on the overall pattern of results, it appears that two measures primarily recommend themselves for further use in studies related to childhood adversity. One of these is the original Adverse Childhood Experiences Questionnaire [1], although it appears that three of the factors likely should be the focus of future study (family dysfunction, sexual abuse, and physical abuse), while the factor of family support may potentially be able to be studied independently. If this recommendation was followed, the scale could be abbreviated to the 20 unique items for the above three factors, although the stability and replicability of these factors needs to be examined in future research. The second scale that recommends itself from the

current analyses is the Child Trauma Questionnaire [11], although again only with respect to the three clear and interpretable factors of family dysfunction, sexual abuse, and physical abuse. The fourth factor observed in the current analysis is likely not replicable, as it included a single item, and the other three items all loaded on the other factors. In contrast, the Child Abuse and Trauma Scale [9,10] did not yield a relatively interpretable factor structure in the current data set. Research should be conducted to determine if the scale might work better in other samples, or if a modification of the scale is needed to yield consistently interpretable factor structure. Finally, the World Health Organization's Adverse Childhood Experience International Questionnaire [12] is less recommended based on the current results. This said, this was the only scale among the four that were examined which incorporates items related to systemic violence. As such, the current factor analytic results likely reflect the very low rate of such childhood experiences in the current sample. If researchers are interested in this domain, the WHO ACE-IQ is the only available measure, and so it should be used in this context, or at least the items related to systemic violence should be adopted in some form. Further comparative research amongst various ACEs measures in samples of individuals who have experienced civil strife, war and/or refugeeism would also be a contribution to the literature.

One final issue with respect to the current results is how they relate to other methods that assess adverse childhood experiences. For example, it has become a relatively common convention to ask 10 items that span the dimensions of sexual abuse, physical abuse, emotional abuse, neglect, and family dysfunction, and to calculate a score that ranges from 0 to 10, as an index of the severity of childhood adversity. For example, there is now an easy on-line ACE calculator comprised of 10 dichotomous items. Such an approach to the measurement of childhood adversity assumes that these 10 items capture the construct adequately, and that a dichotomous (yes/no) format is sufficient to evaluate the occurrence of adversity in childhood. Such an assumption may or may not be valid. For example, repeated parental sexual exploitation over a period of years may have a distinctly different psychological effect on the child than a single sexual assault from a stranger, and yet both experiences would be counted as a single endorsement on one of the ACE calculators. While the current study cannot directly address the correspondence between more detailed assessments of childhood adversity and abbreviated ACE calculators, this is an issue that requires further study and potential validation.

This study had a number of significant strengths. These included a relatively large sample of patients in primary care settings, the use of a series of commonly used measures, and consistent methods to evaluate the factor structure of the measures that were studied. The results provide an important comparative assessment of four commonly employed measures of childhood adversity. This said, some of the limitations of the current study included the fact that the factor analytic methodology had to be adapted to ensure comparable item properties across the four measures. While the use of tetrachoric correlations as the basis for factor analysis is not problematic in its own right [25,26], the study could have yielded stronger results had all of the scales had similar scale properties. Second, while the overall sample size was adequate for factor analysis, there were insufficient numbers of participants to permit subgroup comparisons (e.g., gender comparisons). As noted in other research [21], factor analytical results can differ between males and females, and so sub-group differences should be a focus of continued investigation. Third, the analyses did not provide an evaluation of concurrent validity of the studied measures with potential outcomes of childhood adversity, such as mental and physical health disorders. Future research is needed to examine the extent to which various ACE measures are associated with either concurrent problems or can predict future dysfunction and disorder. Finally, the current study was not able to provide a direct comparison between the four studied measures and abbreviated ACE calculators. Until such an investigation has been conducted, researchers and clinicians should be cognizant that 10 item dichotomous ACE scores have yet to be validated as an assessment strategy. From a psychometric perspective, it is highly likely that such calculators will overestimate the frequency of childhood adversity, and as such they should be used with caution [27].

Conclusion

While much is known about the long-term impact of childhood adversity, much yet remains to be studied. One challenging but compelling area of research would be to collect documented instances of childhood adversity, of the types that are typically captured on ACEs self-report scales, while a child is in development. These documented instances of ACEs could then be compared with adult memories of these events, both at various stages of life and in the face of various adult adversities and difficulties. This type of study would require consistent and longitudinal evaluation of childhood adversity, but has the potential to generate the most sound and compelling evaluation of the retrospective recall of adverse childhood experience.

riences, as was studied here.

Author Notes

Appreciation is express to Dr. Tak Fung, for his statistical assistance with the factor analyses. This project was funded by the Palix Foundation (<https://www.palixfoundation.org/>), then entitled the Norlien Foundation), through a grant to the first author.

References

- [1] Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) study. *Ameri J of Preve Medi.* 1998; 144: 245-258.
- [2] Bernstein DP, Ahluvalia T, Pogge D, Handelsman L. Validity of the childhood trauma questionnaire in an adolescent psychiatric population. *J Ameri Acade of Chil and Adol Psychia* 1997; 36: 340-346.
- [3] Lindert J, von Ehrenstein OS, Grashow R, Gal G, Braehler E, et al. Sexual and physical abuse in childhood is associated with depression and anxiety over the life course: Systematic review and meta-analysis. *Intern J of Publi Heal* 2014; 59: 359-372.
- [4] Felitti VJ, Anda RF. The relationship of adverse childhood experiences to adult medical disease, psychiatric disorders, and sexual behavior: Implications for healthcare. In R. Lanius & E. Vermetten (Eds.) *The Hidden Epidemic: The Impact of Early Life Trauma on Health and Disease*. Cambridge, England: Cambridge University Press 2009.
- [5] Chartier MJ, Walker JR, Naimark B. Separate and cumulative effects of adverse childhood experiences in predicting adult health and health care utilization. *Child Abuse and Neglect* 2010; 346: 454-464.
- [6] Currie J, Spatz Widom C. Long-term consequences of child abuse and neglect on adult economic well-being. *Child Maltreatment* 2010; 15: 111-120.
- [7] Dobson K S, Allan L, Marandola G, Pusch D. The long shadow of adverse childhood events: 1. Mental health outcomes in an adult community sample. *Ame J Prev Medicine and Publi Health* 2020; 6 (5): 119- 129.
- [8] Dobson KS, Pusch D, Allan L, Gonzalez S, Poole J. The long shadow of adverse childhood events: 2. Physical health outcomes in an adult community sample. *Ame J Prev Medicine and Public Health* 2020; 6 (2): 39-49.
- [9] Sanders B, Becker- Lausen E. The measurement of psychological maltreatment: Early data on the child abuse and trauma scale. *Chil Abus and Negl* 1995; 19: 315-323.
- [10] Sanders B, Giolas M. Dissociation and childhood trauma in psychologically disturbed adolescents. *Ameri Jof Psychia* 1991; 148: 50-53.
- [11] Bernstein DP, Fink L. *The childhood trauma questionnaire: A retrospective self-report*. San Antonio, TX: The Psychological Corporation 1998
- [12] World Health Organization. Report of the Pilot study review and finalization meeting for the Adverse Childhood Experiences International Questionnaire (ACE-IQ), May 4 -5, 2011, WHO Headquarters, Geneva, Switzerland.
- [13] McGee RA, Wolfe DA, Yuen SA, Wilson SK, Carnochan J. The measurement of maltreatment: A comparison of approaches. *Chil Abus and Negl* 1995; 19: 233-392.
- [14] Fergusson DM, Horwood LJ, Woodward LJ. The stability of child abuse reports: A longitudinal study of the reporting behaviour of young adults. *Psycholog Medic* 2000; 303: 529-544.
- [15] Kent A, Waller G. The impact of childhood emotional abuse: An extension of the Child Abuse and Trauma Scale. *Chil Abu and Neglect* 1998; 22 (5): 393-399.
- [16] Bernstein DP, Fink L, Handelsman L, Foote J, Lovejoy M. Initial reliability and validity of a new retrospective measure of child abuse and neglect. *Ameri J Psych* 1994; 151: 1132-1136.
- [17] Raab PA, Claypoole KH, Hayashi K, Baker C. The association between trauma and chronic medical conditions in individuals with severe mental illness. *The J Nervou and Men Disea* 2012; 200 (10): 897- 903.
- [18] Winje D, Øverland SN, Breivik K, Arefjord

- K. Psychometric properties of the Norwegian version of the childhood trauma questionnaire in high-risk groups. *Scandina J of Psycho* 2013; 54: 286–291.
- [19] Dudeck M, Vasic N, Otte S, Streb J, Wingefeld K. Factorial validity of the short form of the Childhood Trauma Questionnaire (CTQ-SF) in German psychiatric patients, inmates and university students. *Psychological Reports: Disability & Trauma* 2015; 116 (3): 685-703.
- [20] Cecen-Erogul A , Ayse R. Psychometric properties of Turkish version of Childhood Trauma Questionnaire among adolescents with gender differences. *Psychology* 2012; 3: 916-922.
- [21] Wright KD, Asmundson GDJ, McCreary DR, Scher C, Hami S. Factorial validity of the Childhood Trauma Questionnaire in men and women. *Depressi and Anxie* 2001; 13: 179-183.
- [22] Araya M, Chotai J, Komproe IH, de Jong JTVM. Effect of trauma on quality of life as mediated by mental distress and moderated by coping and social support among postconflict displaced Ethiopians. *Quality of Life Research* 2007; 16: 915-927.
- [23] Opaas M, Varvin S. Relationships of childhood adverse experiences with mental health and quality of life at treatment start for adult refugees traumatized by pre-flight experiences of war and human rights violations. *J Nerv and Men Diseases* 2015; 203(9): 684-695.
- [24] Kuder GF, Richardson MW. The theory of the estimation of test reliability. *Psychometrika* 1937;2(3): 151-160.
- [25] Cristoffersson A. Factor analysis of dichotomized variables. *Psychometrika* 1975; 40: 5-32.
- [26] McDonald RP. *Test theory: A unified treatment*. Mahwah, New Jersey: Erlbaum 1999.
- [27] Lanius R, Vermetten E. *The hidden epidemic: The impact of early life trauma on health and disease*. Cambridge, England: Cambridge University Press 2009