Adverse Childhood Experiences and Later-Life Cognitive Function: Evidence from a Population-Based Study of Older Men and Women in Post-Apartheid Rural South Africa

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Short Abstract

Adverse childhood experiences are associated with negative health outcomes throughout the life course, but their relationships with later-life cognitive outcomes are understudied, especially in low- and middle-income countries. We investigated the associations between four adverse childhood experiences (parent unemployed for >6 months, parents drank or used drugs, parents argued/fought often, physical abuse by parents) and cognitive function domains measured on a novel tablet designed for low-literacy settings. Data were from a population-based study of 2,497 adults aged 40+ in rural South Africa ("Health and Aging in Africa: Longitudinal Study of an INDEPTH Community in South Africa"). The adverse experiences were relatively common (e.g. 35% physical abuse), and were not associated with measures of executive function, language, visuospatial abilities, or memory in multivariable modelling. These early results from a low-income, post-Apartheid setting raise several questions, and should be corroborated in other studies in South Africa and other global contexts.

BACKGROUND

Adverse childhood experiences are documented to have a range of long-lasting negative effects on health throughout the life course, including poor mental health, greater engagement in risky behaviors, increased risks of chronic conditions including diabetes and asthma, acute conditions including stroke and myocardial infarction, and risk of mortality (S. Dube, Felliti, Dong, Giles, & Anda, 2003; S. R. Dube, 2001; Edwards, George W Holden, Vincent J Felitti, & Robert F Anda, 2003; Felliti et al., 1998; Geoffroy, Pereira, Li, & Power, 2016; Gilbert et al., 2015; Nikulina, Spatz Widom, & Brzustowicz, 2012). Adverse childhood experiences are stressful or traumatic events that are experienced during childhood, here, defined as prior to age 16, and the most commonly studied examples are physical, social, and emotional abuse, substance use or mental illness in the household, parental divorce, and exposure to parental violence (Felliti et al., 1998). These experiences are thought to affect health throughout the life course via adverse effects on social, emotional, and cognitive development in childhood and adolescence, and some research suggests that adulthood mental health, risk behaviors, and socioeconomic status mediate effects on later-life health outcomes (Cahall Young & Spatz Widom, 2014; Edwards et al., 2003; Richards & Hatch, 2011). Adverse childhood experiences tend to cluster within households, and previous research has observed dose-response relationships between the cumulative number of adverse childhood experiences and the likelihood of several health outcomes in later-life (Dong et al., 2004; S. Dube et al., 2003; Edwards et al., 2003; Gilbert et al., 2015).

Despite this strong body of research on adverse childhood experiences in high-income countries, mainly in the United States, very little research has investigated the adult health consequences of adverse childhood experiences in low- and middle-income countries (LMICs). This is a major gap in the literature, as the types, number, and severity of adverse childhood experiences may differ from those observed in higher-income settings. Further, the broader social, political, and economic structures which shape individuals' risks of these experiences and their abilities to recover from them also vary widely. In particular, South Africa is a country where a long period of Apartheid from 1948 to 1994 exposed non-white members of the population to forced migration to rural areas, exclusion from quality education and employment, and regular violence and racism (Abdi, 2002; United Nations, 1963). In rural northeast South Africa, the region of interest in the present study, a sizable proportion of the population came to the region as refugees from a civil war in neighboring Mozambique between 1975 and 1992 (Kahn et al., 2012; Sartorius et al., 2013). Together, these two long-running and traumatic events have likely shaped the range of early-life course exposures to adverse and traumatic events experienced by the current middle-aged and older population of rural northeast South Africa.

As the population of South Africa is rapidly aging, advancing the body of scientific evidence on the life course drivers of chronic conditions in this country becomes increasingly important (Tollman,

Norris, & Berkman, 2016). Here, we are interested in the relationships between adverse childhood experiences and cognitive function in later-life. A small body of literature demonstrates direct neurobiological effects of childhood trauma, which impede cognitive development (Bremner & Narayan, 1998; Perry, Pollard, Blakley, Baker, & Vigilante, 1995; van der Kolk, 2003), but it is surprisingly unclear whether this relationship persists into affecting cognitive function in later-life. Longitudinal evidence from the 1958 British Birth Cohort study demonstrates that exposure to neglect or sexual, emotional, or psychological abuse in childhood are negatively associated with a range of domain-specific cognitive functions through adolescence and at age 50 (Geoffroy et al., 2016), while other evidence is limited to studies of small, cross-sectional designs (Burri, Maercker, Krammer, & Simmen-Janevska, 2013; Gould et al., 2012; Radford et al., 2017). In addition to direct neurobiological effects, traumatic events in childhood may shape exposure to risk factors for cognitive decline and dementia in later-life (Metzler, Merrick, Klevens, Ports, & Ford, 2017; Richards & Hatch, 2011). For example, educational attainment and other indicators of socioeconomic advantage are strongly associated with cognitive function trajectory in later-life (Clouston, Glymour, & Terrera, 2015; Kaplan et al., 2001; Nguyen et al., 2015; Zahodne, Manly, Azar, Brickman, & Glymour, 2016). If adverse childhood experiences contribute to subsequent educational attainment and socioeconomic position, then these factors could mediate any indirect effects of adverse childhood experiences on later-life cognitive function through shaping one's level of cumulative cognitive development as well as risk for cognitive decline during aging.

We aimed to assess the relationships between four adverse childhood experiences and domain-specific cognitive function in a population-based study of older men and women in rural South Africa. A methodological innovation of this analysis is our use of a novel tablet-based assessment of domain-specific cognitive function, designed for use in low-literacy and low-income settings to minimize educational bias in assessments of cognitive function (Humphreys et al., 2017). Specifically, using data from a population-based study of older men and women in rural northeast South Africa, we aimed to: 1) estimate the associations between individual and cumulative adverse childhood experiences and domain-specific cognitive function, and 2) examine whether these associations could be mediated by educational attainment. Our hypotheses were as follows: 1) there will be direct effects of adverse childhood experiences on multiple domains of cognitive function in later-life, potentially reflecting direct neurobiological effects of trauma that impede cognitive development in earlier-life, and 2) there will be indirect effects of adverse childhood experiencse on multiple domains of cognitive function in later-life mediated by low educational attainment.

DATA AND METHODS

Sample

Data were from in-person interviews in the 2015 baseline wave of "Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa" (HAALSI), a population-based cohort of 5,059 men and women aged ≥40 years (Gómez-Olivé et al., 2018). With an 86% response rate, HAALSI is representative of the underlying census sampling frame of about 110,000 people in Agincourt sub-district, northeast South Africa. This area is part of a former "homeland" region of forced racial segregation during South African Apartheid, where black population members were resettled according to their ethnic group affiliation (United Nations, 1963). The racial and ethnic composition of this region has remained predominantly Shaangan since the end of Apartheid in 1994 (Kahn et al., 2012). Due to its location near the Mozambique border, Agincourt sub-district is also home to a sizeable number of people, also of the Shaangan ethnic group, who were refugees from a civil war in Mozambique from 1975 to 1992 (Kahn et al., 2012; Sartorius et al., 2013). Here, we use data from a sub-sample aged 40-79 years of the HAALSI study who were randomly selected within age- and sex-strata to complete an additional in-depth interview with biomarker assessments and administration of the Oxford Cognitive Screen (OCS-Plus): a novel tablet measure to screen for domains of cognitive function designed for low-literacy settings in LMICs (N=2,497) (Humphreys et al., 2017). Due to the nature of the adverse childhood experiences assessed in HAALSI, which depended on parental behavior and circumstances, we excluded respondents who reported that one or both of their parents died before they were aged 16 (N=91/2,497), for a total of 2,406 eligible study participants.

Measures

All study measures were assessed during in-person interviews with local, trained fieldworkers. HAALSI is harmonized with the US Health and Retirement Study (HRS) and other international sister studies of aging (Gómez-Olivé et al., 2018). Most of the study measures in HAALSI are harmonized with those in the HRS, and have been adapted where appropriated for cultural and linguistic relevance. All study materials were translated and back-translated from English to the Shaangan language to ensure reliability. Pilot interviews were conducted with a random sample of adults who did not become part of the HAALSI sample to ensure appropriateness and comprehension of the interview questions.

Adverse Childhood Experiences

Four adverse childhood experiences were assessed during a life history module in the in-person study interview. Participants were asked whether they experienced each of the following situations prior to age 16: 1) having either parent unemployed for six months or more; 2) having parents who fought or argued often; 3) having parents who drank excessively, used drugs, or had mental health problems; 4) physical abuse by parents. All four items had binary response options (yes; no), and were adapted from a

life history module in the English Longitudinal Study of Ageing (ELSA) (Scholes et al., 2009). Each item was examined individually, and in summation to create a cumulative measure of adverse childhood experiences.

Cognitive Function

Domain-specific cognitive function was assessed with OCS-Plus, a tablet-based measure designed for use in low-literacy and low-income settings, such as Agincourt sub-district (Humphreys et al., 2017). The OCS-Plus tablet uses image-based and verbal assessments to minimize testing bias that may be introduced when literacy and numeracy skills are required to complete cognitive tests. For example, common cognitive tests that are used in high-income countries to screen for cognitive impairment ask the respondents to, for example, count backwards from 100 in counts of 7 or to connect numbers and letters of the alphabet. Performance on these tests would be sensitive to learned literacy and numeracy skills, even after conditioning on true underlying level of cognitive function. In place of tests such as these, the OCS-Plus asks the respondents, for example, to connect circles and squares and to remember images rather than words. The OCS-Plus assesses domain-specific (language; memory; visuospatial abilities) and domain-general (executive function; auditory attention) cognitive functions. The OCS-Plus minimizes floor and ceiling effects that are common in other cognitive screening tools, such as the Mini-Mental Status Examination, and its construct validity and external validity have been established in the HAALSI study (Humphreys et al., 2017).

Covariates

Early-life variables that were thought to be common causes of adverse childhood experiences and later-life cognitive function were included in modeling as potential confounders: age group (40-49; 50-59; 60-69; 70-79), sex (male; female), and country of birth (South Africa; Mozambique or other). Educational attainment, the hypothesized mediating variable, was categorized as no formal education (0 years), some primary (1-7 years), some secondary (8-11 years), and secondary or more (12+ years).

Statistical analysis

Characteristics of the sample were described according to the above covariates and other important sociodemographic and health-related factors, overall and according to adverse childhood experiences. Guided by the neuropsychological theory underlying the domains measured in the OCS-Plus tablet, latent variables were derived for each cognitive function domain assessed in the OCS-Plus using confirmatory factor analysis. These domains were executive function, language, visuospatial ability, and memory. Residual error variances on closely related individual cognitive tests (e.g. immediate and delayed recall)

were allowed to correlate. A multiple indicator multiple cause (MIMIC) model was then specified within a structural equation modeling framework using maximum likelihood estimation to estimate the direct effects of adverse childhood experiences on each z-standardized latent cognitive domain, adjusting for age group, sex, and country of birth. All available data were utilized in estimating the four latent cognitive function domains, even if some observations for the individual cognitive tests were missing (Muthén & Muthén, 2017). Model fit was iteratively assessed using the standard thresholds: root mean square error of approximation (RMSEA) <0.05; comparative fit index (CFI) >0.95, and Tucker-Lewis index (TLI) >0.95 (Hu & Bentler, 1999). Two secondary analyses were conducted: the first was with cumulative adverse childhood experiences as the exposure variable, to assess dose-response relationships between the number of adverse experiences and cognitive function; the second was with an indicator of cognitive impairment as the outcome variable, defined as scoring <=1.5 SD below the mean on a composite indicator of time orientation and immediate and delayed recall or requiring a proxy interview with proxy-reported memory being "fair" or "poor". All analyses were conducted using MPlus 7.2 and the 'runmplus' package in Stata 15.1.

RESULTS

After excluding those missing all cognitive function data (368/2,406), the analytical sample size was 2,038. Just over half the sample were female (1196/2038; 58%), reflecting the demographic composition of the older population of Agincourt, and the mean age was 58 years (SD: 11 years). Just under one-third of the sample was born in Mozambique (579/2034; 28%), half were married, just over one-third were illiterate (759/2034; 37%), and one-quarter were HIV positive among those who consented to HIV testing (487/1921; 25%; Table 1). The adverse childhood experiences were relatively common: 15% reported having at least one parent unemployed for 6 months or more, 24% reported that at least one of their parents drank, used drugs, or had a mental health problem, 24% reported that their parents fought or argued often, and 35% reported physical abuse by their parents, all before the age of 16 years (Table 1). Forty-five percent of the sample reported experiencing no adverse childhood events, 30% reported one adverse event, 13% reported two events, 9% reported three events, and 2% reported four events. The frequencies of the adverse childhood experiences were similar across sociodemographic factors including sex, education, country of birth, household wealth, and marital status (Table 1).

The factor structure of the z-standardized latent variables for executive function, visuospatial ability, language, and memory are shown in Figure 1, omitting all covariate paths for simplicity of presentation. The final factor structure was derived in a MIMIC model, which was of good fit to the data with RMSEA = 0.026 (95% CI: 0.023-0.30), CFI = 0.974, and TLI = 0.966. The standardized factor loadings, which represent the strength of relationship between each individual cognitive test and the

underlying latent cognitive factor, ranged from 0.412 (semantics on language factor) to 0.818 (delayed recall – recognition of target words from a multiple choice list, if the respondent did not identify them during a free recall trial). The mean values for each cognitive domain were very similar and close to the grand mean of zero across all study participants who did and did not report experiencing each of the four adverse childhood experiences (Table 2).

Older age, female sex, and being born in Mozambique were associated with worse performance in each cognitive domain, except females had a slight advantage over males in memory performance (Table 3). The standardized parameter estimates for each of the four adverse childhood experiences in relation to each cognitive domain were close to the null, with one exception – respondents who reported that their parents drank or did drugs or had mental health problems had memory scores that were, on average, 0.11 SD lower than those not reporting this adverse experience (Table 3). However, this finding could be a type I error, especially given the number of parameter estimates generated from the MIMIC model. In a separate model using a single cumulative measure of adverse childhood experiences as the exposure variable, there was no evidence of increasingly lower or higher cognitive domain scores according to the number of reported adverse childhood experiences. Because no associations were apparent between the adverse childhood experiences and cognitive domain scores, we did not investigate the mediating role of educational attainment in the MIMIC model.

There were no apparent associations between the adverse childhood experiences and cognitive impairment (yes vs. no) as the outcome in logistic regression models adjusted for age group, sex, and country of birth. The effect estimates were in the positive direction but imprecise: OR=1.09 (95% CI: 0.59, 2.02) for having a parent unemployed for >6 months; OR=1.32 (95% CI: 0.84, 2.06) for parents who drink, did drugs, or had mental health problems, OR=1.15 (95% CI: 0.70, 1.89) for having parents who argued or fought often, and OR=1.45 (95% CI: 0.97, 2.17) for being physically abused by parents. There was no linear trend in the relationship between cumulative number of adverse childhood experiences and odds of cognitive impairment (OR=1.03; 95% CI: 0.84, 1.26, per event reported).

DISCUSSION

In this population-based study of men and women aged 40 and over in rural northeast South Africa, we demonstrated no association between four adverse childhood experiences and domain-specific cognitive function in later-life, as measured by a tablet assessment designed for use in low-income and low-literacy settings. The population included in this study have lived through the trauma of institutionalized racism and segregation during Apartheid, as well as a civil war in Mozambique for about one-third of the study population. The four adverse childhood experiences were relatively common, ranging from between 15% (parental employment for at least 6 months) to 35% (physical abuse by

parents) of the study sample. We expected that worse later-life cognitive function across all domains would be associated with reporting adverse childhood experiences, given the growing body of life course epidemiological literature on the 'long arm' of childhood for later-life cognitive health, and especially given the specific social, economic, and political context in which the study population grew up in during Apartheid in South Africa (Tollman et al., 2016). However, this association was null across domains of cognitive function, and in association with a separate indicator of cognitive impairment. As an early investigation into the long-run associations between adverse childhood experiences and later-life cognitive health in rural South Africa, this paper raises many questions and the results should be corroborated in other studies in this context and others.

A body of literature demonstrates that exposure to traumatic events during childhood is associated with impaired cognitive development, which is thought to be through direct neurobiological effects of trauma during this critical life course period (Pears, Kim, & Fisher, 2008; Perry et al., 1995; Roos, Kim, Schnabler, & Fisher, 2016; Sherr et al., 2016). However, little research in any country context has examined the associations between traumatic childhood events and later-life cognitive function, cognitive decline, or dementia risk. The strongest evidence comes from the 1958 British Birth Cohort, whereby childhood neglect and sexual, physical, or psychological abuse (both experienced and witnessed) were associated with worse performance on tests of math, reading, and general cognitive ability at ages 7, 11, and 16, and on tests of immediate and delayed recall, verbal fluency, and processing speed at age 50; these associations were independent of childhood socioeconomic confounding variables and mental health status (Geoffroy et al., 2016). A recent study of urban and rural Aboriginal and Torres Strait Islander Australians found that higher scores on a Childhood Trauma Questionnaire covering experiences such as separation from family, poor childhood health, and frequent relocations were associated with higher prevalence of Alzheimer's disease, as well as depression, anxiety, and suicide attempts (Radford et al., 2017). Using the Cambridge Neuropsychological Test Automated Battery (CANTAB), Gould and colleagues observed that experiences of physical abuse, sexual abuse, and neglect in childhood were associated with worse memory and executive functioning in early adulthood, in a sample of 93 men and women aged 18-45 years in Atlanta, Georgia (Gould et al., 2012). With the exception of the British Birth Cohort study, these studies were cross-sectional with small samples, and their results are subject to selective survival bias and recall error or bias. Although our study was of also cross-sectional design, we aimed to test our postulated mechanisms via direct effects of childhood experiences, inferred to be through cognitive development in early-life, and indirect effects via low educational attainment. We ultimately did not test these pathways, as no overall relationship between adverse childhood experiences and later-life cognitive function was apparent.

We did not expect to see no association between the four adverse childhood experiences and cognitive function in this older, rural South African population. There are several possible explanations for these findings, each of which deserves investigation in its own right. First, there may truly be no association between the adverse childhood experiences that we measured and adulthood cognitive function. If this sharp null association is truly the case, then other evidence demonstrating direct neurobiological effects of similarly traumatic events during childhood on cognitive development should be interpreted as having no long-lasting effect on cognitive health in later-life. A second, and strong possibility is selective survival patterning according to childhood trauma and cognitive function. In 2017, the average life expectancy at birth for South African men was 61.2 years, and for women was 66.7 years; these figures are an improvement from those in the 20th century and especially following a dip in life expectancy during the peak of the HIV epidemic in the late 1990s and early 2000s (Statistics South Africa, 2018). This means that a substantial proportion of the HAALSI cohort have outlived their life expectancy, and HAALSI should be understood as predominantly a cohort of survivors. If individuals who experienced childhood trauma and had poor cognitive function differentially died prior to the time of study entry, then no association may be apparent in the surviving population, even if there is a truly causal relationship. This would be true whether poor cognitive function was caused by poor cognitive development in early-life or rapid cognitive decline in later-life.

Finally, we had relatively crude measures of childhood trauma, with binary response options that reduced a range of important dimensions of trauma such as frequency, severity, duration, ages when it occurred, and degree of psychological effects at the time. There could be inter-individual variation in interpretation of the interview questions, as well as recall error, which would add noise to the exposure measures and bias our results towards the null. There may also have been social desirability bias in responding to these highly personal and sensitive questions about adverse childhood experiences. It is difficult to validate self-reports of childhood trauma reported in older age, but previous efforts to validate such measures indicated a substantial degree of measurement error and false negative reporting; with speculation of false positive reporting being much less common (Hardt & Rutter, 2004). If the adverse childhood experiences were under-reported by those who experienced severe trauma and if these individuals had worse cognitive function than those who did not experience adverse childhood events, our results would again be biased towards the null. Improvement of the measurement of childhood trauma in low-literacy and low-income contexts is an important area where in-depth qualitative research could inform the development of measures for use in epidemiological studies.

CONCLUSIONS

In conclusion, we found no association between four brief measures of adverse childhood experiences and cognitive function in middle- and older-aged adults in a population-based study of rural men and women living in rural South Africa. There was a suggestive yet imprecise association observed between reporting of physical abuse by parents and odds of cognitive impairment. This study makes a novel contribution to research on childhood trauma and later-life cognitive function in low-literacy and low-income settings, with the added methodological contribution of presenting data from a novel tablet assessment of cognitive function designed for such settings. This study seems to raise more questions than it answers, and represents a challenging area of investigation due to the strong potential for selective survival bias and error or bias in reporting of early-life trauma according to later-life cognitive status. This area of inquiry is relevant for the younger generation of South Africans growing up in rural regions of the country today, where economic inequality and adverse childhood conditions have persisted despite the end of Apartheid in 1994 (Badat & Sayed, 2014; Ndimande, 2016; Said-Mohamed, Micklesfield, Pettifor, & Norris, 2015). Future research should refine measures of adverse childhood experiences for use in low-income settings, quantify the role of selective survival in research on adverse childhood experiences and later-life cognitive function, decline, and dementia risk, and corroborate the current findings in a variety of settings and study designs.

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Table 1. Sample characteristics according to four adverse childhood experiences, "Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa" (HAALSI), Agincourt, South Africa, 2015

Characteristic	Total*	Parent unemployed for 6+ months	Parent drank, did drugs, or mental health problems	Parents argued or fought often	Physical abuse by parents
	2,038/2,038 (100%)	284/1881 (15%)	475/1944 (24%)	460/1907 (24%)	718/2023 (35%)
Age					
40-49	457 (22%)	67 (15%)	101 (23%)	98 (23%)	178 (39%)
50-59	656 (32%)	112 (18%)	163 (25%)	175 (27%)	224 (35%)
60-69	456 (22%)	60 (14%)	84 (18%)	82 (19%)	72 (16%)
70-79	466 (23%)	45 (11%)	127 (31%)	104 (26%)	244 (53%)
Sex					
Male	842 (41%)	112 (14%)	205 (23%)	186 (23%)	344 (41%)
Female	1196 (59%)	172 (15%)	270 (25%)	274 (25%)	374 (32%)
Country of birth					
South Africa	1455 (72%)	202 (15%)	345 (26%)	347 (25%)	504 (35%)
Mozambique or other	579 (29%)	82 (15%)	130 (24%)	112 (22%)	214 (37%)
Educational attainment					
No education	945 (39%)	116 (14%)	232 (27%)	198 (24%)	352 (38%)
Some primary (1-7 years)	845 (35%)	123 (16%)	202 (25%)	209 (26%)	291 (35%)
Some secondary (8-11 years)	300 (13%)	35 (12%)	70 (24%)	59 (21%)	124 (42%)
Secondary or more (12+ years)	306 (13%)	44 (15%)	76 (26%)	84 (29%)	140 (47%)
Household wealth quintile					
1 (poorest)	425 (21%)	56 (15%)	104 (27%)	93 (25%)	160 (38%)
2	404 (20%)	65 (18%)	104 (27%)	83 (22%)	149 (37%)
3	404 (19%)	57 (15%)	85 (22%)	89 (23%)	130 (32%)
4	397 (20%)	53 (14%)	102 (27%)	103 (27%)	144 (37%)
5 (richest)	405 (20%)	53 (14%)	80 (20%)	91 (23%)	135 (34%)
Employment status					
Employed part- or full-time	304 (15%)	46 (16%)	70 (24%)	74 (25%)	131 (44%)
Not working	1488 (73%)	210 (15%)	353 (25%)	330 (24%)	512 (35%)
Homemaker	238 (12%)	27 (12%)	50 (22%)	54 (24%)	73 (31%)
Marital status					
Married	1058 (52%)	151 (15%)	220 (21%)	241 (24%)	370 (35%)
Unmarried	977 (48%)	133 (15%)	255 (28%)	218 (24%)	348 (36%)
Ability to read or write					
Yes	1275 (63%)	97 (14%)	191 (27%)	163 (24%)	267 (35%)
No	759 (37%)	187 (16%)	284 (23%)	296 (24%)	451 (36%)
HIV status					
HIV positive	487 (25%)	198 (15%)	318 (23%)	319 (24%)	479 (34%)
HIV negative	1434 (75%)	80 (17%)	115 (25%)	111 (24%)	165 (34%)

*Numbers for some covariates may not sum to 2,038, due to missing observations

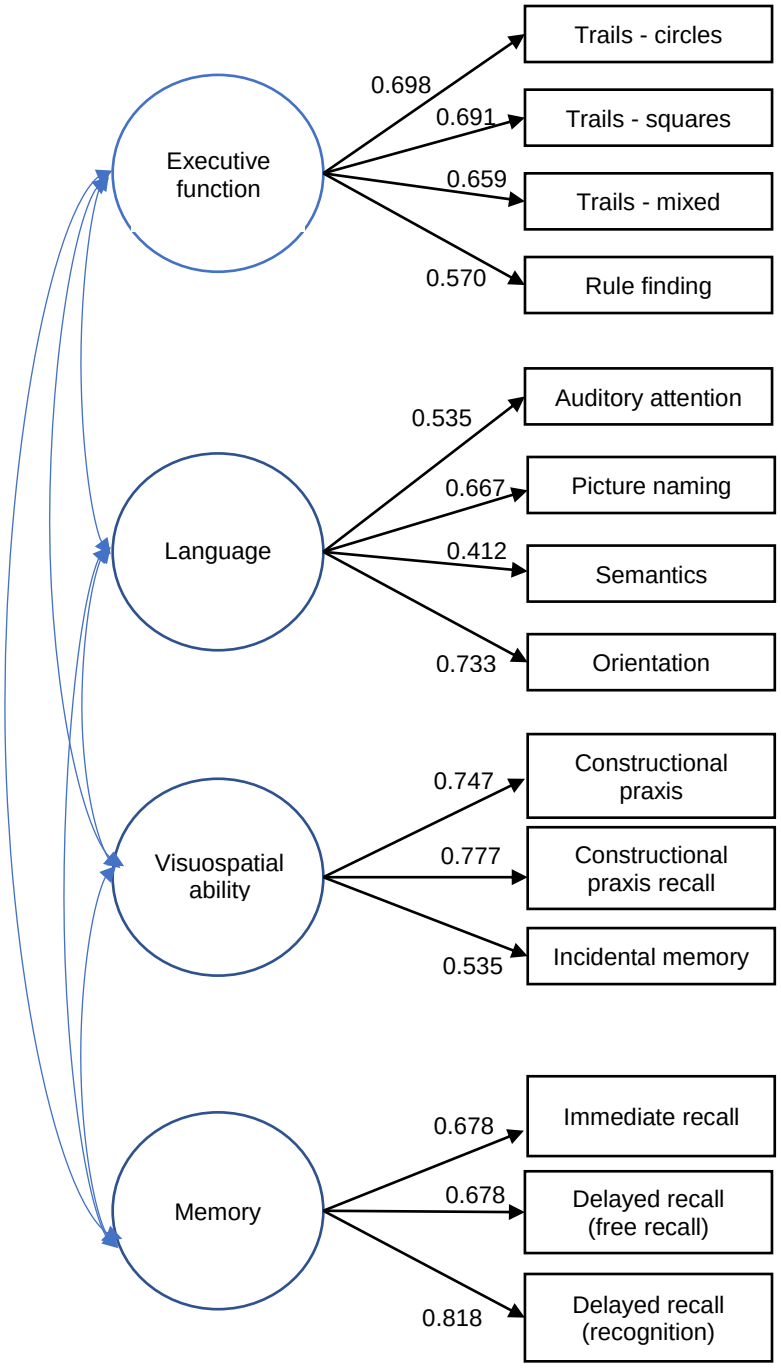

Figure 1. Factor structure of the OCS-Plus tablet assessment of cognitive function. Individual cognitive items are depicted within rectangles on the right-hand side of the figure, and the latent cognitive domains which they reflect are depicted within circles on the left-hand side of the figure. The values along the paths from the latent domains to the individual items are the factor loadings from a MIMIC model, which regresses the cognitive domains on the four adverse childhood events, adjusting for age, sex, and country of birth (paths not shown for simplicity). The model fit statistics are: RMSEA = 0.026 (95% CI: 0.023-0.30); CFI = 0.974; TLI = 0.966.

Table 2. Mean (SD) performance in four cognitive function domains according to each adverse childhood experience, "Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa" (HAALSI), Agincourt, South Africa, 2015

Adverse childhood experience	Executive function	Language	Visuospatial ability	Memory
	Mean (SD) 0.0 (1.0)	Mean (SD) 0.0 (1.0)	Mean (SD) 0.0 (1.0)	Mean (SD) 0.0 (1.0)
Parent unemployed for 6+ months				
No (n=1,597)	0.03 (0.86)	0.04 (0.87)	0.03 (0.88)	0.02 (0.86)
Yes (n=284)	0.07 (0.88)	007 (0.90)	0.06 (0.90)	0.03 (0.91)
Parents drank or took drugs				
No (n=1,469)	0.05 (0.86)	0.07 (0.86)	0.07 (0.86)	0.06 (0.84)
Yes (n=475)	-0.03 (0.85)	-0.05 (0.88)	-0.07 (0.90)	-0.11 (0.93)
Parents argued or fought often				
No (n=1,447)	0.02 (0.86)	0.05 (0.76)	0.05 (0.86)	0.05 (0.83)
Yes (n=460)	0.05 (0.88)	0.03 (0.88)	0.02 (0.90)	-0.02 (0.92)
Physically abused by parents				
No (n=1,305)	0.01 (0.86)	0.01 (0.87)	0.02 (0.88)	0.01 (0.86)
Yes (n=718)	-0.02 (0.89)	-0.02 (0.93)	-0.03 (0.94)	-0.03 (0.91)

Table 3. Standardized parameter estimates from multiple indicator multiple cause (MIMIC) structural equation model, "Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa" (HAALSI), South Africa, 2015

Characteristic	Executive function	Language	Visuospatial ability	Memory
	Beta (SE)	Beta (SE)	Beta (SE)	Beta (SE)
Age (per decade)	-0.40 (0.02) ***	-0.45 (0.02) ***	-0.58 (0.02) ***	-0.45 (0.02) ***
Female sex	-0.13 (0.02) ***	-0.18 (0.02) ***	-0.13 (0.03) ***	0.06 (0.02) **
Born in Mozambique	-0.26 (0.02) ***	-0.42 (0.02) ***	-0.29 (0.03) ***	-0.13 (0.02) ***
Parent unemployed for 6+ months	0.01 (0.03)	0.00 (0.02)	0.01 (0.03)	-0.01 (0.03)
Parents drank or took drugs	-0.04 (0.02)	-0.04 (0.03)	-0.02 (0.03)	-0.08 (0.03) ***
Parents argued or fought often	0.05 (0.03)	-0.01 (0.03)	-0.05 (0.03)	0.00 (0.03)
Abuse by parents	0.00 (0.03)	0.01 (0.02)	0.00 (0.03)	0.03 (0.03)

***p < .01; **p < .05; *p < .10; Note: All variables in the table were mutually adjusted for. The model was of good fit to the data, with RMSEA = 0.026 (95% CI: 0.023-0.30); CFI = 0.974; TLI = 0.966.