AIDSImpact SPECIAL ISSUE

The impact of common mental disorders among caregivers living with HIV on child cognitive development in Zimbabwe

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ABSTRACT

Common mental disorders (CMD) among caregivers living with HIV may affect their young children. The aim of this paper is to analyse the impact of maternal CMD among caregivers living with HIV on the cognitive functioning of their child.

Data were collected at baseline and 12 months follow-up from mother-child dyads recruited as part of an ongoing trial among participants on the HIV-exposed infant register from 2 rural districts in Zimbabwe. Symptoms of CMD were assessed using the Shona Symptom Questionnaire (SSQ-8), with a cut-off point of $\geq$6. Mixed-effects linear regression was used to assess child cognitive scores at follow-up (assessed using the Mullen Scales of Early Learning) in relation to caregiver CMD prevalence over 12 months.

Of the 574 caregivers enrolled in the trial, 514 (90.1%) were followed-up at 12 months. At baseline, caregivers reporting CMD (n=230; 40.1%) were less likely to have completed higher education (46.9% vs. 56.9%; p=0.02), more likely to be unmarried (27.8% vs. 16.0%; p<0.01), and experience food insecurity (50.0% vs. 29.4%; p<0.01) compared to the group without CMD (n=344).

There were 4 CMD patterns over time: i) Emerging CMD (n=101; 19.7% of caregivers) defined as those who were below the cut-off at baseline, and above it at 12 months; ii) Improving CMD (n=76; 14.8%) defined as those who reported CMD at baseline, and were below the cut-off by follow-up; iii) No CMD (n=206; 40.1%) defined as those who did not report CMD symptoms at either time point; and iv) Chronic CMD (n=131; 25.5%) defined as those who reported CMD above the cut-off at both time points. There was no evidence of a difference in the overall cognitive score of the children by caregiver CMD categories. However, children of caregivers with chronic CMD (n=131, 25.5%) had lower receptive language scores (aMD:-2.81, 95%CI -5.1 to -0.6; p=0.05) compared to the reference group with no CMD (n=206, 40.1%).

Exposure to caregiver CMD over a prolonged period may affect child receptive vocabulary skills. This highlights the importance of the maternal mental health inclusion in HIV management as well as in child intervention programmes especially in environments compounded with adversities.

Word count: 351

Keywords: Common mental disorders; Maternal depression; Child cognitive development; HIV positive; Sub-Saharan Africa

Introduction

Maternal mental health is an important factor in healthy child development (Bennett, Schott, Krutikova, & Behrman, 2016; Hadley, Tegegn, Tessema, Asefa, & Galea, 2008). There is substantial evidence that maternal mental health can affect children in many domains, including cognitive and socio-emotional development as well as their nutritional status (Bennett et al., 2016; Stein et al., 2014; Surkan, Kennedy, Hurley, & Black, 2011).

Common mental disorder (CMD) is a term widely used to describe disorders such as depression, anxiety, and somatic symptoms (Goldberg, 1992). Evidence from low-and middle-income countries (LMIC) show that the children of mothers with CMD tend to have worse growth, cognitive and language development, even when taking social adversity into account (Cooper et al., 2009; Harpham, Huttly, De Silva, & Abramsky, 2005; Mekonnen et al., 2018). The relationship between maternal anxiety-mood disorders and poor childhood development is often exacerbated by low socioeconomic status (Bradley & Corwyn, 2002; Hadley et al., 2008). A systematic review examining the link between poverty and CMD in adults in LMIC reported that CMD is strongly associated with lower levels of education and socio-economic status, rapid social change, violence and insecurity, particularly among women in low resource settings (Lund et al., 2010). However, most studies in the review were cross-sectional, thus making it difficult to draw clear conclusions regarding the direction of the poverty-CMD relationship (Lund et al., 2010). This was supported by other studies from Africa which highlight the association of CMD with caregiver income and level of education (Chhagan et al., 2014) as well as child development (Hadley et al., 2008). The likely mechanism is that poverty and food insecurity influence maternal anxiety and depression and that these factors can be thought of as indirect contributors to children's development, with the effect mediated by maternal mental health status (Hadley et al., 2008).

Persistence of maternal CMD over time seems to be particularly important in relation to child cognitive development, especially in terms of language development (Quevedo et al., 2012). A study in Brazil found that children of mothers who experienced chronic depression (post-partum and 12 months later) had on average poorer language skills than the children who were exposed to depression only at one time-point or not at all (Quevedo et al., 2012). Other studies report the impact of maternal CMD on child development is influenced by the amount of time the child is exposed to the adult with the disorder, the severity of maternal symptoms and the time of exposure (Brennan et al., 2000; Sohr-Preston & Scaramella, 2006). Mothers with chronic depression may compromise the level of care and quality of stimulation given to

their child, particularly in verbal interactions (Brennan et al., 2000). However, some studies report no evidence of an association between infant developmental outcomes and the presence of high levels of maternal CMD symptoms at more than one time-point (i.e. chronic) even after adjusting for confounding variables such as infant undernutrition, birth weight, prolonged labour and illness episodes (Servili et al., 2010).

Cross-sectional studies in LMIC show that maternal CMD such as depression are associated with child language development in HIV-affected populations (Mebrahtu et al., 2018; Tse, Rich-Edwards, Rifas-Shiman, Gillman, & Oken, 2010). There is also good evidence that HIV is associated with an elevated mental health burden (Bernatsky, Souza, & Jong, 2007; Brandt, 2009; Egbe et al., 2017). However scant attention is paid to the mental health burden of the mother living with HIV and the impact of prolonged exposure on child developmental domains, especially during the early stages of development. There is also a need for more evidence from LMIC settings investigating the impact of maternal CMD using locally developed and validated assessment tools for such population. The association of maternal CMD and child cognitive scores will be investigated in this longitudinal study.

Methods

Study sample

Data for this study were collected as part of a cluster-randomized controlled trial (The Child Health Initiative for Developmental Outcomes-CHIDO [PACTR201701001387209]). Details of the trial methods and outcome have been published previously (Chingono et al., 2018; Mebrahtu et al., 2019).

In brief, mother-child dyads were recruited from catchment areas surrounding 30 clinics in 2 rural districts in Zimbabwe. All mothers with confirmed HIV positive status during pregnancy who lived locally and had singleton births aged 0-24 months with no other chronic illness were invited to enrol in the trial. All participants were provided with full information and gave consent to participate in the study as well as consent for child participation.

Trial participants were assessed at baseline upon enrolment and followed up for 12 months for re-assessment. This analysis includes all primary caregivers (i.e. biological mothers and other caregivers) that completed mental health assessments at both time points as well as their children. Given that the intervention of the trial had no significant effect on child cognitive development (Mebrahtu et al., 2019) the data from all arms of the trial were pooled.

Measures

I) *Maternal measures*

Socio-demographic information were collected on participant characteristics (age, marital status), and socioeconomic factors (educational level, employment status, asset index score, and number of adults living in the household). A subset of questions from the Household Food Insecurity Access Scale (Coates, Swindale, & Bilinsky, 2007) was used to assess household food insecurity in the study. These were used to categorize households as: food secure, moderately insecure or severely insecure.

II) *Mental health measures*

Common mental disorder (CMD) symptoms were assessed using the locally developed and validated Shona Symptom Questionnaire (SSQ)-8 (Patel, Simunyu E Fau - Gwanzura, Gwanzura F Fau - Lewis, Lewis G Fau - Mann, & Mann, 1997). The short form is derived from the longer SSQ-14 version. Scores range from 0-8, and scores 6 and above were used a cut-off point for identifying those diagnosed as suffering from CMD symptoms (Patel et al., 1997). The longitudinal data was used to generate four groupings: i) caregivers with Emerging CMD defined as those who were below the cut-off at baseline, and above it at 12 months; ii) Improving CMD defined as those who reported CMD at baseline, and were below the cut-off by follow-up; iii) No CMD defined as those who did not report CMD at either time point; and iv) Chronic CMD defined as those who reported CMD above the cut-off at both time points.

The EPDS, a postpartum depression-screening questionnaire (with scores ranging from 0-30), which has also been validated in Zimbabwe (Chibanda et al., 2010) was administered to participating mothers (Chibanda et al., 2010; Cox, Holden, & Sagovsky, 1987). A cut-off point ($\geq$12) was used for identifying participants with high depressive symptoms. The Parental Stress Index-Short Form (PSI-SF), a self-completed screening tool was used for identifying different types of stress associated with parenting (Abidin, 1995). This index comprises 3 subscales which combine to give a Total Stress Score ranging from 40-149.

III) *Child assessment measures*

Child cognitive development was assessed using the Mullen Scales of Early Learning (M. J. Boivin, Nakasujja, Sikorskii, Opoka, & Giordani, 2016; Mullen, 1995). The Mullen scale assesses child abilities in different developmental domains including gross motor skills, visual reception, fine motor skills, receptive language, and expressive language (Mullen,

1995). The Mullen scales were administered to all children in the standardized format at enrolment and 12 months later. The test scores obtained by the children for each Mullen scale were transformed into an age-standardized T-score, using a US reference population as there was no local Zimbabwean reference population on this index. The Mullen scales have been used in several settings in Africa (Bass et al., 2016; Michael J. Boivin et al., 2013a, 2013b; Bornman et al., 2018; Brahmbhatt et al., 2017; Mireku et al., 2016; Ruiseñor-Escudero et al., 2016). The standardized T-scores of four components - the fine motor, expressive language, receptive language, and visual perception scales are combined to produce the Early Learning Composite (ELC) score. Composite scores were used in this analysis to measure general cognitive functioning. Gross motor scale was not included in the ELC score and was used separately as an indicator concentrating on their motor skills (Akshoomoff, 2006; Mullen, 1995).

Statistical analysis

Student's t-test, and Pearson's chi square were used to compare characteristics of participants by CMD symptoms. Characteristics of the sample were described using means, standard deviations (SD), frequencies and percentages.

Mixed-effects linear regression was used to compare child cognitive outcomes by caregiver CMD over 12 months. Data were pooled for this analysis as there was no evidence of differences in child cognitive outcomes by trial arm. Adjusted mean differences were reported comparing the mean children's cognitive scores at follow-up by caregiver's CMD categories. Models were adjusted for baseline Mullen scores and tested confounding variables (household food insecurity and the code for the person conducting Mullen assessments). Clustering within study sites was accounted for by incorporating a random effect for cluster in all models. All analysis was conducted using STATA v.15.1 (StataCorp LP, College Station, Texas, USA).

Ethical approval

The study was approved by the Medical Research Council of Zimbabwe (MRCZ/A/1943), University College London (6789/002) and the London School of Hygiene and Tropical Medicine (9912). All participants were provided with full information and gave consent to participate in the study as well as consent for child participation.

Results

Sample characteristics at baseline

At baseline, all 574 caregivers enrolled in the trial completed the assessments, with 230 (40.1%) caregivers scoring above the cut-off for CMD on the SSQ-8 scale (Table 1).

The mean age of the mothers (n=562) was 31.9 years (SD=6.9), 52.9% had completed secondary level of education and above, over three quarters were married (79.3%), and 36.6% reported being formally or informally employed. The mean household size was 5.2 (SD=1.8), and 37.6% reported moderate to severe hunger in the household. Over half the women (53.0%) were diagnosed with HIV before their pregnancy and were aware of their status prior to conception with the remainder diagnosed during antenatal care.

There was no evidence of differences by trial arm allocation in baseline prevalence of CMD among the caregivers (48.7% reported CMD in the intervention arm vs. 51.3% control arm; p=0.92). However, CMD symptoms were associated with caregivers' education level, marital status, food insecurity, child cognitive scores, and parental stress and depression symptoms (Table 1). Caregivers with CMD were less likely to have completed higher education (46.9% vs. 56.9%; p=0.02), more likely to be unmarried (27.8% vs. 16.0%; p<0.01), and more likely to live in households with moderate to severe hunger (50.0% vs. 29.4%; p<0.01) compared to the group with no CMD. Caregivers with CMD also experienced elevated parental stress (PSI-SF mean- 93.1 vs. 79.4; p<0.01) and post-natal depression symptoms (EPDS mean- 16.2 vs. 8.3; p<0.01).

Insert Table 1 here

Caregiver CMD symptoms change over 12 months

Of the 574 caregivers who completed the baseline assessments, 90.1% (n= 514) completed a follow-up survey after 12 months. Of the 514 caregivers, the largest proportion (n=206; 40.1%) did not report CMD at baseline or 12 months follow-up. However, 131 (25.5%) caregivers reported chronic CMD. There were 101 (19.7%) caregivers reporting emerging CMD and 76 (14.8%) reporting improvement in CMD symptoms (Figure 1).

Insert Figure 1 here

Caregiver CMD symptoms and child outcome

The mean Mullen scores of the children by caregiver CMD categories are shown in Figure 2. Children of the chronic group tend to have lower scores across the developmental sub-scales. Results of the multivariable regression models show no evidence of a difference in the overall cognitive score of the children by caregiver CMD categories (Tables 2 and 3). However, there was evidence of a difference in receptive language comparing children of caregivers with chronic CMD (adjusted mean difference (aMD) -2.81, 95%CI: -5.1 to -0.6; p=0.05) to the children of caregivers without CMD at either time point.

Insert Figure 2 here

Insert Tables 2 and 3 here

Discussion

The prevalence of CMD symptoms at baseline was high (40%) in the study sample, and was associated with lower education level, marital status, and food insecurity. CMD scores above the cut-off were also negatively associated with child receptive vocabulary. The findings of this study are consistent with previous studies that show caregivers who report mental disorders were more likely to have no source of income (from informal employment or social services) and have less formal education than other caregivers (Chhagan et al., 2014; Tomlinson, Grimsrud At Fau - Stein, Stein Dj Fau - Williams, Williams Dr Fau - Myer, & Myer, 2009; Williams et al., 2008), leading to household food insecurity. It is unclear whether these harsh living conditions drive poor mental health, or whether those with poor mental health gravitate towards social deprivation such as unemployment, school dropout and food insecurity. For all these mothers HIV was an additional factor which may contribute to the complex cycle of poor mental health and social deprivation. It is well established that there is a profound mental health burden of HIV (Myer et al., 2008; Tomlinson et al., 2009). Those with mental health problems are more likely to become infected in the first place, and the demands of living with a life threatening health condition, often stigma bound, may negatively affect mental health (Sherr, Cluver, et al., 2014; Whetten, Reif, Whetten, & Murphy-McMillan, 2008). Poor maternal mental health such as chronic or recurrent maternal depression may affect child development and especially when it occurs in the context of adversity such as poverty and dealing with HIV illness as experienced by this study population (Grace, Evindar, & Stewart, 2003); this was evident in the results of this study.

There is further evidence in the literature on the effect of chronic maternal depression on child development (McLearn, Minkovitz, Strobino, Marks, & Hou, 2006). Mothers suffering

from chronic CMDs might be engaging less in early child stimulation practices and verbally interacting less with their children compared to the reference group (Brennan et al., 2000). This could explain the low language scores reported by the children of the chronic CMD group. However, contrary to the findings here, a cross-sectional study examining maternal CMD in rural Ethiopia reported that maternal symptoms of CMD were associated with both child global development and most developmental sub-scales except for language domain (Hadley et al., 2008). Another study reported mothers with chronic depressive symptoms were more likely to engage in parenting behaviours associated with child health and development than mothers with depressive symptoms at only 1 time or not at all (McLennan & Kotelchuck, 2000).

Of importance, it is difficult to disentangle anxiety and depression symptoms in patients experiencing CMDs. A study in Ethiopia reported that when symptoms of mental disorders were separated into high symptoms of depression and anxiety, depression was responsible for the association observed between overall child developmental scores and maternal symptoms of CMD (Hadley et al., 2008). There is usually an overlap between the two categories (i.e. depression and anxiety symptoms), with symptoms reported by patients in each category being highly related. Nonetheless, this is important to help tailor mental health care for HIV positive mothers and ensure their children reach their potential. Of note, the SSQ-8 tool used in this study measures the risk of CMD and is not diagnostic. Additionally, when being used in HIV positive individuals, the items in the SSQ-14 (Patel et al., 1997) (longer version of SSQ-8) identify many somatic symptoms which can be associated with HIV infection rather than CMD– although it has also been validated in HIV positives.

Strengths of the study include the large sample size which was representative of the study population and the high follow-up rate over 12 months. The majority of studies of maternal mental health and child development use cross-sectional data, are based in high-income countries and focus specifically on maternal depressive symptoms. The use of locally validated CMD assessment tool and longitudinal data allowed for an in-depth examination of CMD over time for this group of women living with HIV. This study highlights the effect of prolonged maternal CMD (over 12 months) exposure on a child's language acquisition skills. The findings here also provide valuable information on the characteristics of HIV positive mothers at risk of common mental disorders in rural settings.

Limitations include that the data for this analysis were collected as part of a trial. Although the trial did not show differences in cognitive development over time which allowed us to pool the data, there may have been some intervention exposure considerations that were missed. It was not possible to differentiate depression symptoms and anxiety when assessing caregiver's mental health using the SSQ-8 scale. Additionally, it was difficult to separate the reciprocal impact of maternal mental disorders and child development and establish a direct causal pathway. It is well documented that both HIV infected, and HIV exposed uninfected children may experience cognitive delay (Blanchette, Smith, Fernandes-Penney, King, & Read, 2001; Gay et al., 1995; Hutchings & Potterton, 2013; Sherr, Croome, Parra Castaneda, Bradshaw, & Herrero Romero, 2014; Van Rie, Mupuala, & Dow, 2008). Although HIV status was controlled for in the analysis, the direction of the CMD cannot be categorically ascertained. It may well be that observing a child with developmental challenges affects the mood of a mother – herself diagnosed with HIV either before conception or during pregnancy. Future studies would benefit from a longer follow-up period to assess child development over time.

In settings of high HIV prevalence and poverty, the concurrent common mental health burden needs urgent recognition and prioritization, given what is known about the impact of maternal depression on child language development. When considering public health policy and interventions in other LMIC with similar resource constraints the social or contextual factors contributing to caregiver mental health should be of high relevance (Chhagan et al., 2014). Interventions should be tailored to address such mental health challenges. This study aimed to examine the impact of duration, and severity of CMDs on child cognition. The consistent association between chronic CMD and child development observed here serves to strengthen the case for the inclusion of maternal mental health on the agenda of child intervention programmes and centre of postnatal care, especially in environments compounded with adversities.

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Declaration of interest statement

The authors declare that they have no competing interests.

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490 *Table 1: Caregiver demographic, socioeconomic, reproductive, mental health characteristics*
491 *and child cognitive development by CMD groups at baseline*

	No CMD (n=344)	**CMD (n=230)**	**Total (n=574)**	**P value**
Trial arm, n (%)				0.92
Intervention	169 (49.1)	112 (48.7)	281 (49.0)	
Control	175 (50.9)	118 (51.3)	293 (51.0)	
Age (Years), mean (SD)	31.6 (6.5)	32.3 (7.6)	31.9 (6.9)	0.22
Education level (Completed secondary school and above), n (%)	196 (56.9)	108 (46.9)	304 (52.9)	0.02
Marital status, n (%)				<0.01
Yes	289 (84.0)	166 (72.2)	455 (79.3)	
No	55 (16.0)	64 (27.8)	119 (20.7)	
Relationship status^, n (%)				0.01
Married	289 (84.0)	166 (72.2)	455 (79.3)	
Divorced/separated	32 (9.3)	42 (18.3)	74 (12.9)	
Widowed	15 (4.4)	16 (7.0)	31 (5.4)	
Never been married	8 (2.3)	5 (2.2)	13 (2.3)	
Employment status (Yes-employed), n (%)	116 (33.7)	94 (40.9)	210 (36.6)	0.08
Household size (number of people living under the same roof) , mean (SD)	5.2 (1.7)	5.3 (1.9)	5.2 (1.8)	0.31
Hunger scales, n (%)				<0.01

Little to no hunger	243 (70.6)	115 (50.0)	358 (62.4)	
Moderate to severe hunger	101 (29.4)	115 (50.0)	216 (37.6)	
Asset Index score (terciles), n (%)				0.08
Low	108 (31.4)	84 (36.5)	192 (33.5)	
Middle	109 (31.7)	82 (35.7)	191 (33.3)	
High	127 (36.9)	64 (27.8)	191 (33.3)	
Tested for HIV, n (%)				0.36
Before pregnancy	186 (54.6)	116 (50.7)	302 (53.0)	
During or following pregnancy	155 (45.5)	113 (49.3)	268 (47.0)	
Child cognitive development at baseline (Mullen scales), mean (SD)				
Expressive Language	53.8 (11.0)	51.2 (10.4)	52.8 (10.8)	<0.01
Fine Motor	52.0 (11.2)	48.6 (11.7)	50.7 (11.5)	<0.01
Gross Motor	51.0 (10.6)	49.6 (11.3)	50.5 (10.9)	0.13
Receptive Language	48.8 (11.3)	45.7 (11.8)	47.6 (11.6)	<0.01
Visual reception	55.0 (12.4)	50.2 (12.8)	53.1 (12.7)	<0.01
Early Learning Composite Score	104.9 (17.2)	98.3 (18.6)	102.3 (18.0)	<0.01
Parental Stress Index at baseline, mean (SD)				
Parental distress	29.2 (6.5)	36.2 (7.1)	32.0 (7.6)	<0.01
Difficult child	26.6 (5.8)	30.8 (6.8)	28.2 (6.6)	<0.01
Parent-child dysfunction	23.6 (5.5)	26.0 (6.6)	24.6 (6.0)	<0.01
Total Stress score	79.4 (13.8)	93.1 (16.2)	84.9 (16.2)	<0.01

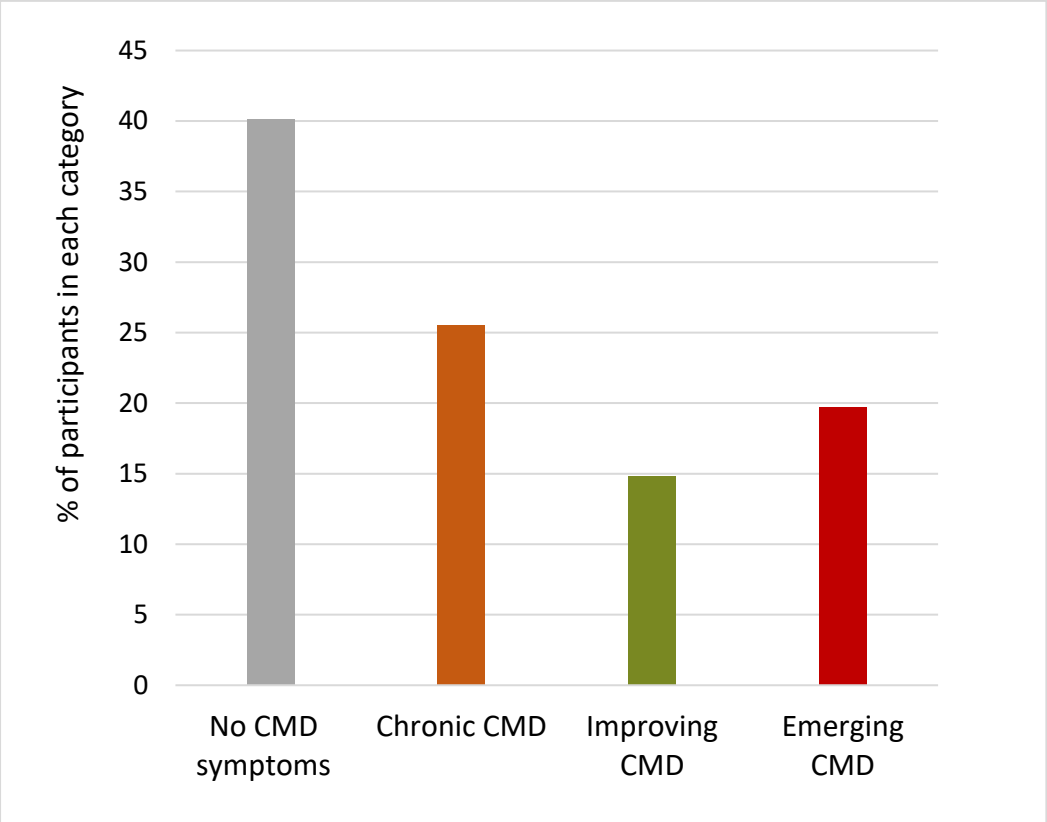
EPDS at baseline, mean (SD)	8.3 (5.4)	16.2 (5.0)	11.5 (6.5)	<0.01

EPDS: The Edinburgh postnatal depression scale| SSQ-8: Shona Symptom Questionnaire| CMD: common mental health disorder

^ *Relationship status variable was recoded to married/not married during analysis*

SSQ-8 cut-off points (No CMD=scores 0-5| CMD = 6-8 scores)

Figure 1: Categories of change in CMD symptoms reported using the SSQ-8 from enrolment to 12 months



501 *Table 2: Mullen T-scores of children at 12 months follow-up by caregiver CMD categories*

Mullen Scales (T-scores)	**No CMD symptoms (n=206)**	**Chronic CMD (n=131)**	**Improving CMD (n=76)**	**Emerging CMD (n=101)**
	Mean (SD)			
Expressive language	45.8 (9.1)	44.4 (10.5)	43.6 (8.8)	45.8 (8.9)
Receptive language	47.2 (10.1)	43.8 (11.1)	45.9 (9.2)	43.9 (9.4)
Fine Motor	42.4 (11.3)	39.6 (9.8)	40.9 (11.5)	42.1 (10.9)
Gross Motor ^	50.4 (11.0)	47.7 (13.2)	47.1 (11.5)	50.0 (9.2)
Visual reception	43.4 (10.8)	40.5 (10.7)	42.2 (12.3)	41.7 (10.7)
Early learning composite score	90.0 (15.4)	85.2 (16.0)	87.1 (15.0)	87.5 (14.6)

502 *^Only measured in children aged <36 months at follow-up (n=397)*

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Figure 2: Child Mullen scores at 12 months by caregiver common mental disorder categories

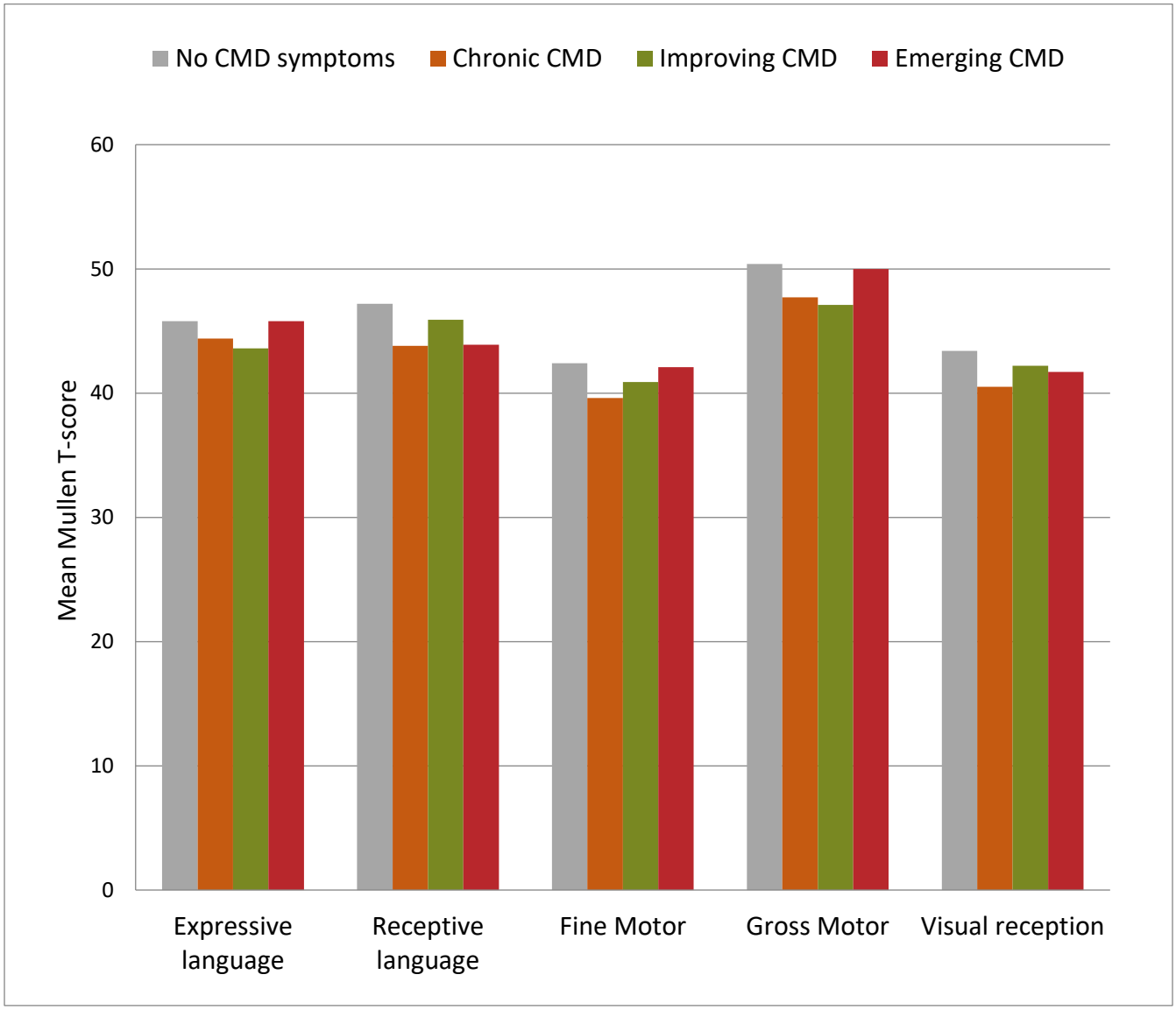

Table 3: Association of caregiver CMD over time with child Mullen scores at 12 months

Mullen Scales (T-scores)	**No CMD symptoms (n=206)**	**Chronic CMD (n=131)**	**Improving CMD (n=76)**	**Emerging CMD (n=101)**	**P value ***
		Adjusted mean difference (95% CI)			
Expressive Language	Ref	-0.48 (-2.99 to 1.28)	-0.71 (-3.32 to 1.90)	1.60 (-0.72 to 3.92)	0.33
Receptive Language	Ref	-2.81 (-5.07 to -0.56)	0.24 (-2.45 to 2.92)	-1.66 (-4.05 to 0.74)	0.05
Fine Motor	Ref	-0.87 (-3.40 to 1.67)	1.40 (-1.58 to 4.38)	1.82 (-0.83 to 4.48)	0.24
Gross Motor^	Ref	-0.77 (-3.83 to 2.30)	-1.40 (-4.86 to 2.08)	0.30 (-2.98 to 3.58)	0.81
Visual reception	Ref	-0.96 (-3.49 to 1.57)	1.85 (-1.05 to 4.75)	-0.06 (-2.55 to 2.67)	0.35
Early Learning Composite Score	Ref	-2.86 (-6.34 to 0.62)	1.13 (-2.87 to 5.12)	0.09 (-3.46 to 3.63)	0.23

***Model adjusted for baseline Mullen scores, household food insecurity, clustering of trial sites and examiner*

^Only measured in children aged <36 months at follow-up (n=397)