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Impact of maternal common mental disorders on child educational outcomes at 7 and 9 years: a population-based cohort study in Ethiopia

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Manuscripts

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3 **Impact of maternal common mental disorders on child educational outcomes at 7 and 9**
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5 **years: a population-based cohort study in Ethiopia**
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ABSTRACT

Objectives: To examine the association between maternal common mental disorders (CMD) and child educational outcomes. We hypothesised that children exposed to higher maternal CMD symptoms would have increased absenteeism and drop-out and poorer academic achievement over 24 months.

Design: A population-based cohort study (the CMAmIE study: child outcomes in relation to maternal mental health).

Setting: the study was undertaken in the Butajira Health and Demographic Surveillance Site, a predominantly rural area of Ethiopia, located 135 km south to the capital Addis Ababa.

Participants: Inclusion criteria were: aged between 15 and 49 years, able to speak Amharic, third trimester of pregnancy and resident of the Health and Demographic Surveillance site. Out of 1234 eligible women, 1065 women were recruited between July 2005 and February 2006 and followed up. When the child was 6.5 years old, the size of the cohort was expanded to include an additional 1345 mothers and children who had been born in the 12 months preceding and following the recruitment of the original cohort.

Primary and secondary outcome measures: Maternal CMD was measured using the Self-Reporting Questionnaire, validated for the setting. Educational outcomes (academic achievement, absenteeism, drop-out) of the child were obtained from school records when the children were aged 8 to 9 years and from the mother at the age of 7 to 8 years.

Result: After adjusting for potential confounders, maternal CMD at 7 to 8 years was associated significantly with school drop-out (Odds Ratio 1.07; 95% Confidence Interval (CI): 1.00, 1.13, P=

0.043) and absenteeism (Incidence Rate Ratio 1.01; 95% CI: 1.00, 1.02 P=0.026) at 8 to 9 years.

There was no significant association between maternal CMD and child academic achievement.

Conclusion: Our findings are consistent with the expanding body of evidence indicating that interventions to improve maternal mental health may have benefits for child education.

Keywords: Child Education, Absenteeism, Maternal Mental Health, Depression, sub-Saharan Africa

Article summary: strengths and limitations of this study

- To the best of our knowledge this is the first study from a low-income country to investigate prospectively the association between maternal mental health and school absenteeism, drop-out and academic performance in the child.
- Methodological strengths include the representative, population-based sample and large sample size.
- We relied on non-standardised tests of child academic achievement and on routinely collected data to measure absenteeism, which may have led to non-differential misclassification and under-estimation of the strength of association.

What is already known on this subject?

Maternal common mental disorder (CMD), particularly depression, is associated with poorer child growth, health, development and survival during early childhood. The effect of exposure to maternal CMD during pre-and early school years upon the subsequent educational outcomes of the child has been little investigated in low-income country settings.

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3 *What this study adds?*

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5 This prospective study has shown that children who exposed to maternal CMD during pre- and
6
7 early school years have higher school absenteeism and drop-out in the subsequent year.
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10 Current global efforts to scale-up mental health care provide an opportunity to integrate
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12 mental health interventions into community programmes to improve child retention in
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14 education.
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INTRODUCTION

Child education is a crucial component of holistic child development;^[1] however, even when children have access to schooling, they may not fully use their potential. An early nurturing environment is integral to establishing the solid foundations essential for child development, wellbeing and later academic success. In a systematic review of studies from low- and middle-income countries (LMICs), common mental disorders (CMD: clinically significant depressive and anxiety symptoms) affected 15.6% of women during pregnancy and 19.8% during the postnatal period.^[2] Evidence is accumulating from middle-income^[3-5] and low-income^[6-8] countries that the children of mothers with CMD have less optimal growth, cognitive and language development, even when taking social adversity into account. This association may be mediated through disruption of mother-child interactions^[7, 9] as has been seen in high-income country settings.^[10] In LMICs, maternal CMD has also been associated with low birth weight,^[11] prolonged labour,^[12] child ill-health^[13] and child under-nutrition,^[14, 15] all of which are established risk factors for poor child development.^[16, 17] Despite this emerging evidence base, to the best of our knowledge, there have been just two previous studies investigating the impact of maternal CMD on child educational outcomes, both of which were conducted in Barbados, at the time an upper middle income country.^[18, 19] There have been no published studies from rural LMIC settings or low-income countries.

In the current study, we examined the association between preschool and early school age exposure to maternal CMD and child educational outcomes in an ongoing population-based

1
2 cohort study of mothers and children in rural Ethiopia. We hypothesised that children exposed
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4 to high symptoms of maternal CMD would have poorer school attendance, higher school drop-
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6 out and poor academic achievement over 24 months of follow-up.
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10 **METHODOLOGY**

11 **Study Design**

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15 The C-MaMiE study (child outcomes in relation to maternal mental health in Ethiopia) is a
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17 population-based cohort study.[12]
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22 **Study Setting**

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25 This study was undertaken in Butajira, Gurage Zone, Southern Nations Nationalities and Peoples'
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27 Region of Ethiopia. Butajira is a predominantly rural area, located 135 km south of the capital
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29 Addis Ababa, within a Health and Demographic Surveillance Site (HDSS). The HDSS was
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31 established in 1986 under the Butajira Rural Health Programme,[20] with one urban and nine
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33 rural administrative sub-districts from different ecological zones. In each sub-district, there is an
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35 easily accessible health post (frontline primary care) and an elementary school. Mixed farming
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37 of cash crops like Khat (*Catha edulis Forsk*) and chilli peppers, and production of staples, like
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39 maize, "false banana" or Ensete (*Ensete ventricosun*), form the basis of the economy.
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48 *Context for Education*

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50 In Ethiopia, primary education lasts for eight years (age group 7-14 years) with two cycles: basic
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52 (grades 1-4) and general education (grades 5-8). In the first cycle, children are taught and
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54 evaluated by a single teacher following the 'self-contained class' concept.[21] Ethiopia is working
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2 towards complete coverage of primary education, yet only 85.5% has been achieved with 9.9%
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4 drop-out and 7.3 % grade repetition nationally.[22] The official age for school enrolment is
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6 seven years, [21]. All government schools are, in principle, free for all Ethiopians; however,
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8 families are expected to cover the costs of school uniforms, food and exercise books.[21] Except
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10 for two national examinations (at the completion of grades 10 and 12) and one regional
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12 examination (at the completion of grade 8), the academic performance of students is assessed
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14 by the class teacher using non-standardized tests.
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20 **Study Participants**

21 The C-MaMiE birth cohort was established in the Butajira HDSS between July 2005 and February
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23 2006 to investigate the public health impact of perinatal CMD.[12] A population-based sample
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25 of 1065 women was recruited out of 1234 eligible women (86.3%) with inclusion criteria of ages
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27 between 15 and 49 years, ability to speak Amharic, resident of the HDSS and in the third
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29 trimester of pregnancy. The cohort of women and the child born from the index pregnancy have
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31 been assessed repeatedly over time. When the C-MaMiE project children were six and a half
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33 years of age, the cohort size was augmented by 1345 children and their mothers, (the 'expanded
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35 C-MaMiE cohort') who were identified by records in the HDSS as having been born in the 12
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37 months preceding (n=572) and following (n=773) the recruitment of the C-MaMiE cohort.
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45 **Assessment time-points**

46 Two assessments were conducted 12 months apart within the expanded C-MaMiE cohort;
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48 exposures were assessed when the children were aged 6 to 7 (6/7) years and 7 to 8 (7/8) years
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50 and educational outcomes when children were 7/8 years and 8/9 years old.
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Measures

Outcomes

School drop-out: this was operationalised as the proportion of students who had enrolled at the beginning of the academic year (September) but who had dropped out of school before the end of the academic year (June) and was obtained from school records and each mother. Children who drop out of school can be re-enrolled for the subsequent academic year.

Academic Achievement: was assessed using the child's grade point averaged over the two semesters of the Ethiopian school year. Grade repetition occurs when the averaged grade point is <50%.

Absenteeism: was defined as the student missing school for a minimum of one day, irrespective of the reason given for the absence. In Ethiopia, each school keeps a daily attendance record for each student. For this study, the total number of days of absence from school was obtained from the school attendance sheet for the 2014/2015 academic year.

Primary exposure

Maternal CMD: was measured when the child was aged 6/7 and 7/8 years, using the World Health Organization (WHO) 20-item version of the Self-Reporting Questionnaire (SRQ-20).[23] The SRQ-20 asks about the existence or absence of depressive, anxiety and somatic symptoms in the preceding one month (answered 'yes' or 'no'). The SRQ-20 has been validated for perinatal women in this rural Ethiopian population.[24]

Potential confounding factors

The following potential confounding factors were measured at both the 6/7 and 7/8 year exposure time points:

Stressful life events: List of Threatening Experiences (LTE) measures 12 stressful life events over the preceding six months.[25] The LTE was translated into Amharic, adapted to local conditions and has been used in the C-MaMiE cohort study at all points of assessment.

Socio-economic status: was measured using self-report of current roof material, the experience of hunger in the preceding month due to lack of food or money, and the existence of emergency resources for times of crisis.

Paternal substance use: maternal report of frequency of alcohol or khat use by the father.

Demographic characteristics: age of the mother, marital status, literacy level, birth order and sex of the child were obtained from self-report of the mother when the children were 6/7. The updated marital status of the woman was also recorded when the children were 7/8 years. The HDSS records were used to calculate the age of the child.

Potential mediators

Child nutritional status: anthropometric measures were carried out by trained project data collectors. Weight was measured with digital floor scales. A stadiometer with a movable head piece was used for height. Using the WHO reference population,[26] height-for-age z scores were calculated using WHO Anthro software.[27]

Data Management

Data Collection Procedure: Interviews with the women and anthropometric measures of the child were carried out in the woman's home, or surrounding area, according to the woman's

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2 preference, to ensure privacy and confidentiality. Anthropometric measures were also
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4 conducted in school, when convenient. The project data collectors have all completed diploma
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6 level education and have been employed by the C-MaMiE project for the last 11 years. They are
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8 experienced in conducting interviews and in the use of the study measures. All data collectors
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10 received an additional three days of intensive training on the use of the instruments. The
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12 questionnaires were piloted before commencing data collection and discrepancies in ratings
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14 were discussed to ensure that the data collectors had a common understanding.
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19 **Maintaining data quality:** Supervisors and a field coordinator monitored the data collection
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21 process and performed quality checks on a random sample of evaluations. Data were double
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23 entered with EpiData[28] by experienced data entry clerks on the day of data collection, where
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25 possible. Any identifiable information about the respondent was kept securely and separately
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27 detached from the assessment data and a code number was used to ensure confidentiality.
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31 32 33 **Statistical Analyses**

34 The analysis was conducted using Stata software version 12.[29] A hypothesis-driven analysis
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36 was conducted to examine the association between maternal CMD (total score on the SRQ-20)
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38 and educational outcomes, guided by the conceptual model shown in Figure 1. Initially,
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40 univariate analyses were conducted: logistic regression for school drop-out and repetition of the
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42 year (binary), poisson regression for absenteeism (continuous, count data) and linear regression
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44 for academic achievement (continuous, normally distributed). Multivariable analyses were then
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46 conducted, adjusted for all potential confounders identified *a priori*. Child nutritional status was
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48 modelled separately to explore mediation of the association between maternal CMD and child
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50 educational outcomes. Estimates of association were presented with their corresponding 95%
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2 confidence intervals. Complete case analysis was used. The study has been reported according
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5 to the STROBE reporting checklist.
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8 **ETHICAL CONSIDERATIONS**

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10 Ethical approval was obtained from the Institutional Review Board of the College of Health
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12 Sciences, Addis Ababa University, Ethiopia (reference number 082/13/psy) and the Research
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14 Ethics Committee of King's College London, UK (reference number PNM/13/14-92). Consent
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16 from each woman and assent from the child were obtained. Any woman who presented with
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18 high symptoms of mental health problems and suicidal ideation was advised to seek care at the
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20 psychiatric unit at Butajira Hospital, with the project covering treatment and transportation
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22 costs.
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28 **RESULTS**

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31 A total of 2090 mother-child dyads were assessed at 6/7 years, and 1957 were assessed at 7/8
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33 years. Those who were lost to follow-up did not differ in terms of demographic,
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35 socioeconomic and other background characteristics. There was no significant difference
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37 between those children who did and who did not have educational information available
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39 regarding maternal CMD, socioeconomic status, nutritional status or other background
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41 characteristics. See Figure 2.
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48 See Tables 1 and 2 for the distribution of maternal and child characteristics across educational
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50 outcomes.
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Table 1: Characteristics of participants in relation to drop-out from school

Characteristics		Child school drop-out by 7/8 years		Child school drop-out by 8/9 years	
		Dropped out	Attending School	Dropped out	Attending school
		N (%)	N (%)	N (%)	N (%)
		336 (20.2)	1326 (79.8)	153 (11.8)	1140 (88.2)
Primary exposure					
Maternal CMD	High SRQ-20 (6 or more)	19 (5.7)	54 (4.1)	20 (13.7)	117 (10.3)
Parental characteristics					
Maternal Age in years (Mean, Standard Deviation)		35 (6.00)	34 (6.00)	35 (6.00)	34 (6.00)
Literacy (mother)	Non-literate	307 (91.6)	1100 (83.3)	142 (93.4)	997 (88.0)
Literacy (father)	Non-literate	148 (46.7)	423 (33.3)	62 (42.5)	400 (36.8)
Maternal marital status	Monogamous	263 (78.5)	1089 (82.4)	116 (76.8)	908 (81.0)
	Polygamous	54 (16.1)	182 (13.8)	28 (18.5)	160 (14.3)
	Divorced, widowed, separated	18 (5.4)	50 (3.8)	7 (4.6)	53 (4.7)
Socioeconomic status					
Current hunger	Had hunger	42 (12.5)	80 (6.1)	12 (7.8)	50 (4.4)
Emergency resources	No emergency resources	164 (48.9)	485 (36.7)	49 (32.2)	322 (28.4)
Roof material	Thatched roof	242 (72.2)	810 (61.3)	94 (61.8)	601 (53.0)
Psychosocial characteristics					
Paternal substance use	Weekly khat use	264 (83.5)	976 (76.9)	104 (72.2)	880 (82.7)
	Weekly alcohol use	55 (17.4)	185 (14.6)	30 (20.8)	173 (16.2)
Negative life event in the last 6 months	No life event	272 (81.9)	1065 (81.2)	108 (71.1)	860 (75.9)
	1 life event	48 (14.5)	184 (14.0)	31 (20.4)	196 (17.3)
	2 or more	12 (3.6)	63 (4.8)	13 (8.6)	77 (6.8)
Child characteristics					
Childbirth order	First	26 (7.7)	212 (16.0)	16 (10.5)	156 (13.7)
	Middle or last	310 (92.3)	1114 (84.0)	136 (89.5)	977 (86.2)
Sex of the child	Boy	201 (59.8)	670 (50.6)	85 (55.4)	590 (52.0)
Child nutritional status	Stunted (Height-for-age z-score < -2)	111 (33.4)	297 (22.6)	46 (30.3)	261 (23.2)

CMD = Common mental disorders; SRQ = Self-Reporting Questionnaire;

Table 2: Characteristics of participants and child absenteeism, academic achievement and repetition of the school year

Characteristics		Child School absenteeism by the age of 8/9 years	Child Academic achievement by the age of 8/9 years	Child grade repetition status by the age of 8/9 years	
				Class Repeated	Promoted to next grade
		Median (25 th , 75 th percentiles)	Mean (SD)	N (%)	N (%)
		5 (2, 11)	62.5 (9.21)	25 (2.4)	1029 (97.6)
Primary exposure					
Maternal CMD	High SRQ-20 (≥ 6)	2 (5, 11)	62.0 (9.54)	3 (12.0)	107 (10.5)
Parental characteristics					
Maternal age in years (mean (SD))			-	34 (6.00)	34 (6.00)
Literacy (mother)	Non-literate	2 (5, 12)	62.5 (9.29)	22 (88.0)	900 (87.9)
Literacy (father)	Non-literate	3 (6, 14)	61.3 (9.23)	13 (54.2)	351 (35.8)
Maternal marital status	Monogamous	2 (5, 12)	62.8 (9.34)	19 (76.0)	824 (81.4)
	Polygamous	2 (4, 9)	61.1 (8.91)	5 (20.0)	140 (13.8)
	Divorced, widowed, separated	1 (4, 6)	62.1 (8.13)	1 (4.0)	48 (4.7)
Socioeconomic status					
Current hunger	Had hunger	2 (5, 11)	62.1 (7.75)	1 (4.0)	44 (4.3)
Emergency resource	Had no emergency resource	2 (5, 11)	62.1 (9.07)	9 (36.0)	288 (28.1)
Roof materials	Thatched	3 (6, 14)	62.8 (9.65)	17 (68.0)	524 (51.2)
Psychosocial characteristics					
Paternal substance use	Weekly khat use	2 (5, 12)	62.3 (9.24)	16 (66.7)	791 (82.4)
	Weekly alcohol use	1 (3.5, 7)	64.6 (9.42)	6 (25.0)	150 (15.6)
Negative life event in the last six months	No life event	2 (5, 12)	62.5 (9.14)	20 (80.0)	775 (75.6)
	1 life event	2 (4, 9)	62.8 (9.84)	3 (12.5)	180 (17.6)
	2 or more	2 (3, 8)	61.2 (8.21)	2 (8.0)	68 (6.6)
Child characteristics					
Childbirth order	First	2 (4.5, 14)	62.8 (8.87)	5 (20.0)	136 (13.3)
	Middle or last	2 (5, 11)	62.5 (9.26)	20 (80.0)	887 (86.7)
Sex of the child	Boy	2 (5, 12)	62.6 (9.23)	15 (60.0)	528 (51.6)
Child nutritional status	Stunted (Height-for-age z-score < -2)	2 (5, 12)	62.5 (9.20)	6 (24.0)	233 (23.0)

CMD = Common mental disorders; SRQ = Self-Reporting Questionnaire; SD= standard deviation

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3 The prevalence of maternal CMD was 5.2% when the children were 6/7 years and 10.9% when
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5 7/8 years of age. The difference was statistically significant. School drop-out was 20.2% (n=336)
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7 at the 7/8 years and 11.8% (n=153) at the 8/9 years. At the 8/9 years, the median number of
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9 days of absence was 5 (interquartile range 2 - 11), the mean average grade point was 62.5 out of
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11 100 (Standard Deviation 9.21) and 2.4 % of the children had repeated the year.
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15 Controlling for potential confounders, maternal CMD at 7/8 years was associated significantly
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17 with child school drop-out (OR 1.07, 95% CI: 1.00, 1.13) at 8/9 years, but the significant
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19 univariate association between maternal CMD at 6/7 years and school drop-out by 7/8 years
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21 became non-significant (adjusted OR 1.05, 95% CI: 0.99, 1.12). In the fully adjusted
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23 multivariable model, parent non-literacy, low socioeconomic status, male gender, not being
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25 first in the birth order and lower height-for-age were associated significantly with school drop-
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27 out by the age of 7/8 years. At 8/9 years follow-up, paternal khat use and lower child height-
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29 for-age were associated significantly with school drop-out. Maternal CMD at 7/8 years was
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31 associated with absenteeism by 8/9 years (adjusted Incidence Rate Ratio 1.01, 95% CI: 1.00,
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33 1.02). Absenteeism was also associated significantly with maternal age, parent non-literacy,
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35 widowed or separated marital status, low socioeconomic status, mother experiencing negative
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37 life event, child male gender, and being first in the birth order. See Tables 3 and 4.
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Table 3: Factors associated with child school dropout by 7/8 and 8/9 years

Explanatory variables	Explanatory variables at 6/7 years and school drop-out as an outcome by age 7/8 years Odds Ratio (95% Confidence Interval)		Explanatory variables at 7/8 years and school drop-out as an outcome by age 8/9 years Odds Ratio (95% Confidence Interval)	
	Crude	Adjusted [§]	Crude	Adjusted [§]
Primary exposure				
Maternal CMD (SRQ-20 total score)	1.07 (1.02, 1.13)	1.05 (0.99, 1.12)	1.07 (1.01, 1.13)	1.07 (1.00, 1.13)
Other explanatory variables				
Maternal age (years)	1.03 (1.01, 1.05)	1.02 (0.99, 1.03)	1.01 (0.98, 1.04)	1.01 (0.97, 1.05)
Non-literate mother	2.20 (1.46, 3.33)	1.77 (1.13, 2.77)	1.94 (0.99, 3.76)	1.64 (0.82, 3.27)
Non-literate father	1.75 (1.37, 2.25)	1.53 (1.17, 2.01)	1.26 (0.89, 1.78)	1.19 (0.82, 1.74)
Maternal marital status (polygamous, divorced and widowed)	1.08 (0.99, 1.18)	1.07 (0.82, 1.43)	1.03 (0.91, 1.18)	1.18 (0.78, 1.78)
Experienced hunger due to lack of resources	2.22 (1.50, 3.29)	1.74 (1.10, 2.77)	1.85 (0.96, 3.56)	1.78 (0.82, 3.84)
No emergency resources	1.65 (1.30, 2.11)	1.43 (1.10, 1.89)	1.20 (0.83, 1.72)	1.05 (0.69, 1.60)
Thatched roof	1.65 (1.27, 2.14)	1.30 (0.96, 1.74)	1.43 (1.01, 2.03)	1.33 (0.91, 1.96)
Paternal khat use at least weekly	1.52 (1.10, 2.11)	1.38 (0.98, 1.95)	0.54 (0.37, 0.81)	0.52 (0.34, 0.79)
Paternal alcohol use at least weekly	1.23 (0.89, 1.71)	1.35 (0.95, 1.93)	1.35 (0.88, 2.09)	1.18 (0.73, 1.89)
Negative life event (≥1 in the last 6 months)	0.99 (0.84, 1.16)	0.85 (0.69, 1.03)	1.04 (0.98, 1.89)	1.00 (0.77, 1.29)
Male child	1.45 (1.14, 1.85)	1.50 (1.15, 1.96)	1.15 (0.82, 1.62)	1.13 (0.78, 1.63)
Child first in birth order	0.44 (0.29, 0.67)	0.59 (0.36, 0.95)	0.73 (0.43, 1.27)	0.82 (0.45, 1.51)
Height for age z score	0.73 (0.65, 0.83)	0.80 (0.70, 0.91)	0.75 (0.62, 0.89)	0.73 (0.60, 0.89)

CMD = common mental disorder; SRQ = Self-Reporting Questionnaire;

[§] Parental characteristics including (maternal age, marital status, maternal and paternal level of literacy), Socio-economic status (hunger due to lack of resources, emergency resources, roof material), paternal substance use, negative life event, child sex, birth order and child nutritional status

Table 4: Association of factors by 7/8 years with child school absenteeism at 8/9 years

Explanatory variables	School absenteeism by 8/9years Incidence Rate Ratio (95% Confidence Interval)	
	Crude	Adjusted [§]
Primary exposure		
Maternal CMD (SRQ-20 total score)	1.00 (0.99, 1.01)	1.01 (1.00, 1.02)
Other explanatory variables		
Increasing maternal age (years)	1.00 (0.99, 1.01)	1.01 (1.01, 1.02)
Mother non literate	1.60 (1.48, 1.74)	1.57 (1.44, 1.72)
Father non literate	1.18 (1.13, 1.23)	1.07 (1.02, 1.12)
Marital status (polygamous, divorced, widowed)	0.92 (0.89, 0.94)	0.88 (0.83, 0.93)
Experienced hunger due to lack of resources	1.06 (0.96, 1.17)	1.06 (0.94, 1.19)
No emergency resources	1.03 (0.99, 1.08)	0.98 (0.94, 1.04)
Thatched roof (vs. corrugated iron)	1.46 (1.40, 1.53)	1.36 (1.30, 1.42)
Father uses khat at least weekly	1.10 (1.03, 1.17)	1.04 (0.97, 1.11)
Father uses alcohol at least weekly	0.90 (0.85, 0.96)	0.92 (0.86, 0.98)
Negative life event (≥1 in the last 6 months)	0.98 (0.97, 0.99)	0.90 (0.87, 0.94)
Male child	1.04 (1.00, 1.09)	1.05 (1.00, 1.09)
Child first in birth order	1.14 (1.08, 1.21)	1.17 (1.10, 1.25)
Height for age z score	1.00 (0.97, 1.01)	1.00 (0.97, 1.02)

CMD = common mental disorder; SRQ = Self-Reporting Questionnaire;

[§] Parental characteristics including (maternal age, marital status, maternal and paternal level of literacy), Socio-economic status (hunger due to lack of resources, emergency resources, roof material), paternal substance use, negative life event, child sex, birth order and child nutritional status

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2
3 There was no significant association between maternal CMD and academic achievement or
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5 grade repetition. Paternal non-literacy, alcohol use and widowed or separated maternal marital
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7 status were significantly associated independently with these outcomes. See Table 5.
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Table 5: Association of other factors at 7/8 years with child educational outcomes by 8/9 years

Explanatory variables	Academic achievement by 8/9 years β coefficient (95% Confidence Interval)		Grade repetition by 8/9 years Odds Ratio (95% Confidence Interval)	
	Crude	Adjusted [§]	Crude	Adjusted [§]
Primary exposure				
Maternal CMD (SRQ-20 total score)	-0.07 (-0.27, 0.13)	0.01 (-0.22, 0.23)	1.01 (0.87, 1.16)	0.99 (0.85, 1.16)
Other explanatory variables				
Maternal age	-0.03 (-0.13, 0.08)	0.01 (-0.11, 0.13)	1.01 (0.94, 1.09)	1.05 (0.96, 1.14)
Mother non-literate	0.21 (-1.51, 1.92)	0.46 (-1.42, 2.34)	1.00 (0.29, 0.97)	0.87 (0.24, 3.17)
Father non- literate	-1.88 (-3.06, -0.69)	-1.90 (-3.16, -0.64)	2.12 (0.93, 4.78)	1.89 (0.80, 4.44)
Marital status (polygamous, divorced and widowed)	-0.21 (-0.67, 0.26)	-2.02 (-3.48, -0.55)	0.96 (0.67, 1.38)	1.31 (0.54, 3.16)
Experienced hunger due to lack of resources	-0.42 (-3.18, 2.33)	-0.79 (-4.14, 2.56)	0.93 (0.12, 7.00)	0.97 (0.11, 8.74)
No emergency resources	-0.59 (-1.83, 0.64)	-0.59 (-2.00, 0.80)	1.43 (0.63, 3.28)	1.50 (0.60, 3.74)
Thatched roof	0.54 (-0.57, 1.66)	0.78 (-0.46, 2.00)	2.02 (0.86, 4.73)	1.55 (0.62, 3.89)
Father uses khat at least weekly	-1.31 (-2.82, 0.21)	-0.57 (-2.15, 1.00)	0.43 (0.18, 1.01)	0.44 (0.18, 1.12)
Father uses alcohol at least weekly	2.47 (0.88, 4.05)	2.35 (0.65, 4.04)	1.80 (0.70, 4.62)	1.26 (0.45, 3.51)
Negative life event in the last six months	-0.07 (-0.33, 0.18)	-0.24 (-1.09, 0.61)	1.04 (0.90, 1.18)	0.76 (0.34, 1.72)
Male child	0.16 (-0.95, 1.28)	-0.09 (-1.10, 1.27)	1.41 (0.63, 3.16)	1.45 (0.61, 3.42)
Child first in birth order	0.34 (-1.30, 1.97)	0.33 (-1.50, 2.17)	1.63 (0.60, 4.41)	2.09 (0.66, 6.60)
Height for age z score	0.62 (0.00, 1.23)	0.59 (-0.07, 1.25)	1.08 (0.69, 1.67)	1.12 (0.69, 1.81)

CMD = common mental disorder; SRQ = Self-Reporting Questionnaire;

[§] Parental characteristics including (maternal age, marital status, maternal and paternal level of literacy), Socio-economic status (hunger due to lack of resources, emergency resources, roof material), paternal substance use, negative life event, child sex, birth order and child nutritional status

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2 When child nutritional status was removed from the multivariable model, the association
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4 between maternal CMD and child educational outcomes was not strengthened at either time
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6 point, indicating the absence of mediation.
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11 **DISCUSSION**

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14 We found a significant prospective association between maternal CMD and school drop-out
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16 and absenteeism. The association did not appear to be mediated by nutritional status of the
17
18 child. Parental low socioeconomic status, non-literacy and substance use were associated
19
20 significantly with adverse educational outcomes of children. There was no association between
21
22 maternal CMD and child academic achievement or grade repetition.
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29 As far as we are aware, our study is the first of its kind from a low-income country to report the
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31 association between exposure to preschool maternal CMD and subsequent adverse educational
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33 outcomes. Strengths of the study included the population-based design, large sample size, high
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35 follow-up rates and use of culturally validated measures. Nonetheless, there were limitations of
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37 our study. We assessed academic achievement using a composite and non-standardised
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39 measure (individual teacher assessment). Although this approach increased measurement
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41 error, composite measures which include participation, homework, attendance and tests given
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43 by teachers may be more ecologically valid and tied to day-to-day routine of teaching and
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45 learning than narrowly focused assessments of content mastery. Absenteeism was extracted
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47 from data collected routinely by schools, which is likely to have led to underestimation of
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49 absences, but this would have led to a non-differential error which would be expected to
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2 reduce the chance of finding a significant association and would not be expected to have led to
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4 bias. We relied on proxy indicators of socioeconomic status. Although these indicators have
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6 been developed for the population under study, they relied on self-report from the women and
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8 may not have been sufficiently comprehensive, thus raising the possibility of residual
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10 confounding.
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17 Maternal CMD was more prevalent at the 7/8 year time point compared to 6/7 years. This
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19 difference might have arisen because the 7/8 years time point was measured during the rainy
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21 season, a time of hardship and food shortage, while the 6/7 time point was distributed over the
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23 year according to the birth date of the child. The non significant association between maternal
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25 CMD and academic achievement and grade repetition in our study is in contrast to the study
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27 from Barbados, where postpartum depression was associated with poorer academic
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29 achievement at 11 years of age.[19] This difference may have arisen due to the measures of
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31 academic achievement used (standardized in Barbados vs. subjective/composite measure in
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33 Ethiopia) and the timing of the CMD exposure (postpartum vs. pre- and early school years).
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35 Furthermore, the broader context for learning also differs substantially between Barbados and
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37 Ethiopia. In Ethiopia, the majority of women are non-literate and there is limited availability of
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39 learning resources (e.g. books, games) within the home. Given the critical importance of these
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41 factors for child learning, any additional effect of maternal CMD may have been too small to
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43 detect, unlike in Barbados.
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2 On the other hand, the deficits in the home learning environment mean that regular
3 attendance at school becomes the most important way for a child to learn and is likely to have
4 greater influence on child educational performance. Our findings were in keeping with the
5 Barbados study, where depressive symptoms in mothers of a child with an early history of
6 malnutrition were associated with school absences between 5 and 11 years of age. Irregular
7 school attendance is likely to be on the pathway to poorer educational attainment and to
8 identify a group of children who are at risk of fully dropping out from school.
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22 In studies from HICs, erratic school attendance and drop-out from school have been associated
23 with an adverse early home environment, living with smokers, the quality of early care-giving,
24 socioeconomic status, cognitive development, behavior problems, academic achievement, peer
25 relations and parent involvement.[30, 31] In LMICs, food insecurity and death of parents[32,
26 33] are associated with irregular school attendance and dropping out entirely. In both HIC and
27 LMIC studies, maternal CMD could be an important unmeasured mediator of the effects of
28 adverse home environment on school attendance. For children under the age of ten years,
29 absenteeism and drop-out are unlikely to happen without the knowledge of the family, and in
30 particular the mother.
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School absenteeism and drop-out have important economic implications, particularly in a low-
income country like Ethiopia. Repeating years of education or students taking longer to
complete their education bring inefficiency into the school system, financial burden on the
household and may adversely affect the motivation of the child to pursue their education. For

1
2 those students who drop out of school altogether, there are economic losses from negative
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4 impacts on future productivity. Every additional year of schooling has a substantial positive
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6 effect on adult wages.[34] Achieving high coverage of primary school enrolment is undermined
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8 by subsequent early drop-out from schooling, which will limit Ethiopia's ability to deliver on the
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10 Sustainable Development Goal (SDG) target to ensure that all girls and boys complete free,
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12 equitable and quality primary and secondary education by 2030.
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19 School-based interventions targeting specific predictors of absenteeism and drop-out in LMICs,
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21 e.g. deworming,[35] hand wash campaigns, safe water and hygiene,[36] and school feeding
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23 programmes,[37] have been found to be effective in reducing absenteeism and drop-out. Our
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25 study indicates that interventions (at family, school or community level) focusing on the
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27 reduction of absenteeism and drop-out need also to incorporate maternal CMD. There is a
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29 global impetus to improve access to primary care-based mental health care in LMICs through
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31 the World Health Organisation's mental health Gap Action Programme.[38] Evidence-based
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33 treatment packages for maternal depression that can be delivered by general health workers
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35 (assessment and prescription of medication) and lay workers (psychosocial approaches) have
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37 been shown to be effective, feasible and acceptable to communities across LMIC settings.[39]
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39 Effective care for maternal depression has been shown to have beneficial effects on child health
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41 in Pakistan[40] but further studies are needed to evaluate the impact on child educational
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43 outcomes.
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CONCLUSION

In this population-based cohort study in rural Ethiopia, children of mothers with symptoms of common mental disorders were at greater risk of school drop-out and absenteeism. Future studies are needed to understand the mechanisms underlying this association. Current global efforts to expand access to mental health care offer an opportunity to address maternal CMD as a key component of programmes to increase school attendance.

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Contributors

HM, CH, AA and MP conceptualised the study. HM led data collection with oversight from CH, AA and GM. HM led data analysis, with input from CH, AA, MP, MT and GM. HM drafted the manuscript and all other co-authors revised it critically. All authors approved the final version of the paper and agree to be accountable for all aspects of the work.

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Competing interests

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Ethical approval

Ethical approval was obtained from the Institutional Review Board of the College of Health Sciences, Addis Ababa University, Ethiopia (reference number 082/13/psy) and the Research Ethics Committee of King's College London, UK (reference number PNM/13/14-92).

Data sharing statement

The data are being used for a PhD student (HM) for their thesis and are not, therefore, available at the present time to the general public. The data may be requested from the corresponding author for verification of the analyses in this paper.

Figure 1: Conceptual framework

Figure 2: Follow-up chart for child educational outcomes

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2090 children alive and under follow-up by 6 to 7 years of age

- 68 mothers migrated out of country
- 47 mothers changed address
- 4 mothers with severe mental disorder
- 8 children deceased
- 5 mothers refusals
- 1 mother hearing impairment

1957 children alive by 7 to 8 years and expected to enrol in school

247 non enrolled

48 children not living with mothers

1662 enrolled in school by 7 to 8 years (2013/2014 academic year)

336 dropped out by 7 to 8 years

1326 attended school by 7 to 8 years

1415 enrolled in school by 8 to 9 years (2014/2015 academic year)

122 missing (unable to trace)

153 dropped out by 8 to 9 years

1140 attended school by 8 to 9 years

10 of zero graders had no attendance record

1130 had attendance record (absenteeism) by 8 to 9 years

76 zero graders had no average grade point

1054 had average grade point (academic assessment) by 8 to 9 years

BMJ Open

Impact of maternal common mental disorders on child educational outcomes at 7 and 9 years: a population-based cohort study in Ethiopia

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Primary Subject Heading:	Mental health
Secondary Subject Heading:	Epidemiology, Global health
Keywords:	MENTAL HEALTH, EPIDEMIOLOGY, Community child health < PAEDIATRICS

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2 **Impact of maternal common mental disorders on child educational outcomes at 7 and 9**
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4 **years: a population-based cohort study in Ethiopia**
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ABSTRACT

Objectives: To examine the association between exposure to maternal common mental disorders (CMD) in pre- and early school age children and subsequent child educational outcomes.

Design: A population-based cohort study.

Setting: the study was undertaken in the Butajira Health and Demographic Surveillance Site (HDSS), a predominantly rural area of south central Ethiopia.

Participants: Inclusion criteria: women aged between 15 and 49 years, able to speak Amharic, in the third trimester of pregnancy and resident of the HDSS. 1065 women were recruited between July 2005 and February 2006 and followed up. When the average age of children was 6.5 years old, the cohort was expanded to include an additional 1345 mothers and children who had been born in the 12 months preceding and following the recruitment of the original cohort, identified from the HDSS records. Data from a total of 2090 mother-child dyads was included in the current analysis.

Measures: Maternal CMD was measured when the children were 6 to 7 ("6/7") and 7 to 8 ("7/8") years old using the Self-Reporting Questionnaire, validated for the setting. Educational outcome (drop-out) of the children at age 7/8 years (end of 2013/14 academic year) were obtained from maternal report. At age 8/9 years (end of 2014/15 academic year) educational outcomes (academic achievement, absenteeism, and drop-out) of the children were obtained from school records.

Result: After adjusting for potential confounders, exposure to maternal CMD at 7/8 years was associated significantly with school drop-out (Odds Ratio 1.07; 95% Confidence Interval (CI):

1 1.00, 1.13, P= 0.043) and absenteeism (Incidence Rate Ratio 1.01; 95% CI: 1.00, 1.02 P=0.026) at
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4 the end of 2014/15 academic year. There was no association between maternal CMD and child
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6 academic achievement.
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9 **Conclusion:** Future studies are needed to evaluate whether interventions to improve maternal
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11 mental health can reduce child school absenteeism and drop-out.
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19 **Keywords:** Child Education, Absenteeism, Maternal Mental Health, Depression, sub-Saharan
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Article summary: strengths and limitations of this study

- To the best of our knowledge this is the first study from a low-income country to investigate prospectively the association between maternal mental health and school absenteeism, drop-out and academic performance in the child.
- Methodological strengths include the representative, population-based sample and large sample size.
- We relied on non-standardised tests of child academic achievement and on routinely collected data to measure absenteeism, which may have led to non-differential misclassification and under-estimation of the strength of association.
- Diagnostic measures of common mental disorders would have been preferable to use of a screening scale.
- Chronic physical health problems in the child were not measured.

INTRODUCTION

Child education is a crucial component of holistic child development;^[1] however, even when children have access to schooling, they may not fully use their potential. An early nurturing environment is integral to establishing the solid foundations essential for child development, wellbeing and later academic success. Maternal common mental disorders (CMD), characterized by depressive, anxiety and somatic symptoms, may compromise early child development.^[2] In a systematic review of studies from low- and middle-income countries (LMICs), maternal CMD affected 15.6% of women during pregnancy and 19.8% during the postnatal period.^[3] Evidence is accumulating from middle-income^[4-6] and low-income^[7-9] countries that the children of mothers with CMD have less optimal growth, cognitive and language development, even when taking social adversity into account. This association may be mediated through disruption of mother-child interactions^[8, 10] as has been seen in high-income country settings.^[11] In LMICs, maternal CMD has also been associated with low birth weight,^[12] prolonged labour,^[13] child ill-health^[14] and child under-nutrition,^[15, 16] all of which are established risk factors for poor child development.^[17, 18] Despite this emerging evidence base, to the best of our knowledge, there have been just two previous studies investigating the impact of maternal CMD on child educational outcomes, both of which were conducted in Barbados, at the time an upper middle income country.^[19, 20] There have been no published studies from rural LMIC settings or low-income countries.

In the current study, we examined the association between preschool and early school age exposure to maternal CMD and child educational outcomes in an ongoing population-based

1 cohort study of mothers and children in rural Ethiopia. We hypothesised that children exposed
2 to high symptoms of maternal CMD would have poorer school attendance, higher school drop-
3 out and poor academic achievement over 24 months of follow-up.
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10 **METHODOLOGY**

11 **Study Design**

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16 The C-MaMiE study (child outcomes in relation to maternal mental health in Ethiopia) is a
17 population-based cohort study.[13]
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22 **Study Setting**

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25 This study was undertaken in Butajira, Gurage Zone, Southern Nations Nationalities and Peoples'
26 Region of Ethiopia. Butajira is a predominantly rural area, located 135 km south of the capital
27 Addis Ababa, within an HDSS. The HDSS was established in 1986 under the Butajira Rural Health
28 Programme,[21] with one urban and nine rural administrative sub-districts from different
29 ecological zones. In each sub-district, there is an easily accessible health post (frontline primary
30 care) and an elementary school. Mixed farming of cash crops like Khat (*Catha edulis Forsk*) and
31 chilli peppers, and production of staples, like maize, "false banana" or Ensete (*Ensete*
32 *ventricosum*), form the basis of the economy.
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47 *Context for Education*

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49 In Ethiopia, primary education lasts for eight years (age group 7-14 years) with two cycles: basic
50 (grades 1-4) and general education (grades 5-8). In the first cycle, children are taught and
51 evaluated by a single teacher following the 'self-contained class' concept.[22] Ethiopia is working
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1 towards complete coverage of primary education, yet only 85.5% has been achieved with 9.9%
2 drop-out and 7.3 % grade repetition nationally.[23] The official age for school enrolment is
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4 seven years, [22]. All government schools are, in principle, free for all Ethiopians; however,
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6 families are expected to cover the costs of school uniforms, food and exercise books.[22] In the
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8 study area private schools are only found in the urban (Butajira town) district, with fewer than
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10 0.3% of study children enrolled in these schools. Except for two national examinations (at the
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12 completion of grades 10 and 12) and one regional examination (at the completion of grade 8),
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14 the academic performance of students is assessed by the class teacher using non-standardized
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16 tests.
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25 **Study Participants**

26 The C-MaMiE birth cohort was established in the Butajira HDSS between July 2005 and February
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28 2006 to investigate the public health impact of perinatal CMD.[13] A population-based sample
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30 of 1065 women was recruited out of 1234 eligible women (86.3%) with inclusion criteria of ages
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32 between 15 and 49 years, ability to speak Amharic, resident of the HDSS and in the third
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34 trimester of pregnancy. Fewer than 3% of women were excluded on the basis of language at
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36 baseline. The cohort of women and the child born from the index pregnancy have been assessed
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38 repeatedly over time. When the average age of the C-MaMiE project children was six and a half
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40 years, the cohort size was augmented by 1345 children and their mothers, (the 'expanded C-
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42 MaMiE cohort') who were identified by records in the HDSS as having been born in the 12
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44 months preceding (n=572) and following (n=773) the recruitment of the C-MaMiE cohort. The
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46 same eligibility criteria were applied to the expanded cohort participants. In the current study,
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48 2090 mother-child dyads remain under follow-up and participated in the study.
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Assessment time-points

Two assessments were conducted 12 months apart within the expanded C-MaMiE cohort; exposures were assessed first when the children were aged 6/7 years and repeated at age 7/8 years. Drop-out of the children at age 7/8 years (end of 2013/14 academic year) was obtained from maternal report, while at age 8/9 years (end of 2014/15 academic year) the educational outcomes of absenteeism, drop-out and academic achievement were obtained from school records.

Measures

Outcomes

School drop-out: this was operationalised as the proportion of students who had enrolled at the beginning of the academic year (September) but who had dropped out of school before the end of the academic year (June) and was obtained from school records and each mother. Children who drop out of school can be re-enrolled for the subsequent academic year.

Academic Achievement: was assessed using the child's grade point averaged over the two semesters of the Ethiopian school year. Grade repetition occurs when the averaged grade point is <50%.

Absenteeism: was defined as the student missing school for a minimum of one day, irrespective of the reason given for the absence. In Ethiopia, each school keeps a daily attendance record for each student. For this study, the total number of days of absence from school was obtained from the school attendance sheet for the 2014/2015 academic year.

Primary exposure

Maternal CMD: was measured when the child was aged 6/7 and 7/8 years, using the World Health Organization (WHO) 20-item version of the Self-Reporting Questionnaire (SRQ-20).[24] The SRQ-20 is a screening tool which asks about the existence or absence of depressive, anxiety and somatic symptoms in the preceding one month (answered 'yes' or 'no'). The SRQ-20 has been validated for perinatal women in this rural Ethiopian population.[25]

Potential confounding factors

The following potential confounding factors were measured at both the 6/7 and 7/8 year exposure time points:

Stressful life events: List of Threatening Experiences (LTE) measures 12 stressful life events over the preceding six months.[26] The LTE was translated into Amharic, adapted to local conditions and has been used in the C-MaMiE cohort study at all points of assessment.

Socio-economic status: was measured using self-report of current roof material (corrugated iron vs. thatch), the experience of hunger in the preceding month due to lack of food or money, and the existence of emergency resources for times of crisis.

Paternal substance use: maternal report of frequency of alcohol or khat use by the father.

Demographic characteristics: age of the mother, marital status, literacy level, birth order and sex of the child were obtained from self-report of the mother when the children were 6/7. The updated marital status of the woman was also recorded when the children were 7/8 years. The HDSS records were used to calculate the age of the child.

Child nutritional status: anthropometric measures were carried out by trained project data collectors. Weight was measured with digital floor scales. A stadiometer with a movable head piece was used for height. Using the WHO reference population,[27] weight-for-age z scores

1 (underweight) and height-for-age z scores (stunting) were calculated using WHO Anthro
2 software.[28] However, there was collinearity between height and weight and, therefore,
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6 height-for-age was included in the final model as it has been argued that it is a better summary
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9 measure of cumulative undernutrition [29].
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11 **Data Management**

12 **Data Collection Procedure:** Interviews with the women and anthropometric measures of the
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14 child were carried out in the woman's home, or surrounding area, according to the woman's
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16 preference, to ensure privacy and confidentiality. Anthropometric measures were also
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18 conducted in school, when convenient. The project data collectors have all completed diploma
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20 level education and have been employed by the C-MaMiE project for the last 11 years. They are
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22 experienced in conducting interviews and in the use of the study measures. All data collectors
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24 received an additional three days of intensive training on the use of the instruments. Data
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26 collectors were not aware of the objectives of the study and interpretation of the score on the
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28 measures. Furthermore, they were randomly selected to carry out follow-up visits to specific
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30 households and time-points were separated by at least six months, so the chance of bias due to
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32 recall of maternal CMD status was very low. The questionnaires were piloted before
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34 commencing data collection and discrepancies in ratings were discussed to ensure that the data
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36 collectors had a common understanding.
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45 **Maintaining data quality:** Supervisors and a field coordinator monitored the data collection
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47 process and performed quality checks on a random sample of evaluations. Data were double
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49 entered with EpiData[30] by experienced data entry clerks on the day of data collection, where
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1 possible. Any identifiable information about the respondent was kept securely and separately
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3 detached from the assessment data and a code number was used to ensure confidentiality.
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6 7 **Statistical Analyses**

8 The analysis was conducted using Stata software version 12.[31] The data were summarized
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10 using mean, median and percentage. A hypothesis-driven analysis was conducted to examine
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12 the association between maternal CMD (total score on the SRQ-20) and educational outcomes,
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14 guided by the conceptual model shown in Figure 1. Initially, unadjusted analyses were
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16 conducted: logistic regression for school drop-out and repetition of the year (binary), Poisson
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18 regression for absenteeism (continuous, count data) and linear regression for academic
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20 achievement (continuous, normally distributed). Multivariable analyses were then conducted,
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22 adjusted for all potential confounders identified *a priori*. Estimates of association were
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24 presented with their corresponding 95% confidence intervals. Complete case analysis was used.
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31 The study has been reported according to the STROBE reporting checklist.
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34 **ETHICAL CONSIDERATIONS**

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36 Ethical approval was obtained from the Institutional Review Board of the College of Health
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38 Sciences, Addis Ababa University, Ethiopia (reference number 082/13/psy) and the Research
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40 Ethics Committee of King's College London, UK (reference number PNM/13/14-92). Consent
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42 from each woman and assent from the child were obtained. Any woman who presented with
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44 high symptoms of mental health problems and suicidal ideation was advised to seek care at the
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46 psychiatric unit at Butajira Hospital, with the project covering treatment and transportation
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48 costs.
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RESULTS

A total of 2090 mother-child dyads were assessed at 6/7 years, and 1957 were assessed at 7/8 years. See Figure 2. Those who were lost to follow-up did not differ in terms of age, marital status, level of literacy, negative life event, socioeconomic, substance use or on their mental health status. There was no significant difference between those children who did and who did not have educational information available regarding maternal CMD, socioeconomic status, parental literacy, substance use, negative life event, nutritional status, gender and their birth order. .

See Tables 1 and 2 for the distribution of maternal and child characteristics across educational outcomes.

Table 1: Characteristics of participants in relation to child school drop-out

Exposure variables		Exposure variables at age of 6/7 years Child school drop-out at end of 2013/14 academic year		Exposure variables at age of 7/8 years and Child school drop-out at end of 2014/15 academic year	
		Dropped out	Attending School	Dropped out	Attending school
		N (%)	N (%)	N (%)	N (%)
		336 (20.2)	1326 (79.8)	153 (11.8)	1140 (88.2)
Parental characteristics					
Maternal Age in years (Mean, Standard Deviation)		35 (6.00)	34 (6.00)	35 (6.00)	34 (6.00)
Literacy (mother)	Non-literate	307 (91.6)	1100 (83.3)	142 (93.4)	997 (88.0)
Literacy (father)	Non-literate	148 (46.7)	423 (33.3)	62 (42.5)	400 (36.8)
Maternal marital status	Monogamous	263 (78.5)	1089 (82.4)	116 (76.8)	908 (81.0)
	Polygamous	54 (16.1)	182 (13.8)	28 (18.5)	160 (14.3)
	Divorced, widowed, separated	18 (5.4)	50 (3.8)	7 (4.6)	53 (4.7)
Socioeconomic status					
Current hunger	Had hunger	42 (12.5)	80 (6.1)	12 (7.8)	50 (4.4)
Emergency resources	No emergency resources	164 (48.9)	485 (36.7)	49 (32.2)	322 (28.4)
Roof material	Thatched roof	242 (72.2)	810 (61.3)	94 (61.8)	601 (53.0)
Psychosocial characteristics					
Paternal substance use	Weekly khat use	264 (83.5)	976 (76.9)	104 (72.2)	880 (82.7)
	Weekly alcohol use	55 (17.4)	185 (14.6)	30 (20.8)	173 (16.2)
Negative life event in the last 6 months	No life event	272 (81.9)	1065 (81.2)	108 (71.1)	860 (75.9)
	1 life event	48 (14.5)	184 (14.0)	31 (20.4)	196 (17.3)
	2 or more	12 (3.6)	63 (4.8)	13 (8.6)	77 (6.8)
Child characteristics					
Childbirth order	First	26 (7.7)	212 (16.0)	16 (10.5)	156 (13.7)
	Middle or last	310 (92.3)	1114 (84.0)	136 (89.5)	977 (86.2)
Sex of the child	Boy	201 (59.8)	670 (50.6)	85 (55.4)	590 (52.0)
Child nutritional status	Stunted (Height-for-age z-score < -2)	111 (33.4)	297 (22.6)	46 (30.3)	261 (23.2)

Table 2: Characteristics of participants and child absenteeism, academic achievement and repetition of the school year

Exposure variables at age of 7/8 years		Child School absenteeism at end of 2014/15 academic year	Child Academic achievement at end of 2014/15 academic year	Child grade repetition status at end of 2014/15 academic year	
		Median (25 th , 75 th percentiles)	Mean (SD)	Class Repeated	Promoted to next grade
		5 (2, 11)	62.5 (9.21)	N (%)	N (%)
Parental characteristics					
Maternal age in years (mean (SD))			-	34 (6.00)	34 (6.00)
Literacy (mother)	Non-literate	2 (5, 12)	62.5 (9.29)	22 (88.0)	900 (87.9)
Literacy (father)	Non-literate	3 (6, 14)	61.3 (9.23)	13 (54.2)	351 (35.8)
Maternal marital status	Monogamous	2 (5, 12)	62.8 (9.34)	19 (76.0)	824 (81.4)
	Polygamous	2 (4, 9)	61.1 (8.91)	5 (20.0)	140 (13.8)
	Divorced, widowed, separated	1 (4, 6)	62.1 (8.13)	1 (4.0)	48 (4.7)
Socioeconomic status					
Current hunger	Had hunger	2 (5, 11)	62.1 (7.75)	1 (4.0)	44 (4.3)
Emergency resource	Had no emergency resource	2 (5, 11)	62.1 (9.07)	9 (36.0)	288 (28.1)
Roof materials	Thatched	3 (6, 14)	62.8 (9.65)	17 (68.0)	524 (51.2)
Psychosocial characteristics					
Paternal substance use	Weekly khat use	2 (5, 12)	62.3 (9.24)	16 (66.7)	791 (82.4)
	Weekly alcohol use	1 (3.5, 7)	64.6 (9.42)	6 (25.0)	150 (15.6)
Negative life event in the last six months	No life event	2 (5, 12)	62.5 (9.14)	20 (80.0)	775 (75.6)
	1 life event	2 (4, 9)	62.8 (9.84)	3 (12.5)	180 (17.6)
	2 or more	2 (3, 8)	61.2 (8.21)	2 (8.0)	68 (6.6)
Child characteristics					
Childbirth order	First	2 (4.5, 14)	62.8 (8.87)	5 (20.0)	136 (13.3)
	Middle or last	2 (5, 11)	62.5 (9.26)	20 (80.0)	887 (86.7)
Sex of the child	Boy	2 (5, 12)	62.6 (9.23)	15 (60.0)	528 (51.6)
Child nutritional status	Stunted (Height-for-age z-score < -2)	2 (5, 12)	62.5 (9.20)	6 (24.0)	233 (23.0)

SD= standard deviation

School drop-out was 20.2% (n=336) at the end of the 2013/14 academic year. At the end of the 2014/15 academic year, drop-out was 11.8% (n=153), the median number of days of absence

1 was 5 (interquartile range 2 - 11), and the mean average grade point was 62.5 out of 100
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4 (Standard Deviation 9.21). The correlation of SRQ20 score with absenteeism (Spearman's rank
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6 correlation coefficient = 0.008; $p=0.777$) and averaged grade point ($r=-0.039$; $p=0.208$) was not
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8 significant. In the 2013/14 academic year the median score of SRQ20 was 1, (interquartile range
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10 0 – 2) in children who dropped out versus 0, (interquartile range 0- 1) in those who stayed in
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12 school ($p=0.003$; Mann-Whitney test). Similarly, in 2014/15 academic year, for in-school children
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14 the median SRQ20 score was 0, (interquartile range 0 – 2) versus 1, (interquartile range 0 – 3.5)
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16 in those dropped out children ($p=0.02$; Mann-Whitney test).
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24 Controlling for potential confounders, maternal CMD at 7/8 years was associated significantly
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26 with school drop-out (OR 1.07, 95% CI: 1.00, 1.13) by the end of the 2014/15 academic year ,
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28 but the significant unadjusted association between maternal CMD at 6/7 years and school drop-
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30 out by the end of the 2013/14 academic year became non-significant (adjusted OR 1.05, 95% CI:
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32 0.99, 1.12). In the fully adjusted multivariable model, parent non-literacy, low socioeconomic
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34 status, male gender, not being first in the birth order and lower height-for-age were associated
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36 significantly with school drop-out by the end of the 2013/14 academic year. Paternal khat use
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38 and lower child height-for-age were associated significantly with 2014/15 academic year school
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40 drop-out. Maternal CMD at 7/8 years was associated with 2014/15 academic year school
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42 absenteeism (adjusted Incidence Rate Ratio 1.01, 95% CI: 1.00, 1.02). Absenteeism was also
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44 associated significantly with maternal age, parent non-literacy, widowed or separated marital
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46 status, low socioeconomic status, mother experiencing negative life event, child male gender,
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48 and being first in the birth order. See Tables 3 and 4.
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Table 3: Factors associated with child school drop-out

Exposure variables	Exposure variables at age of 6/7 years and school drop-out at end of 2013/14 academic year		Exposure variables at age of 7/8 years and school drop-out at 2014/15 academic years	
	Odds Ratio (95% Confidence Interval)		Odds Ratio (95% Confidence Interval)	
	Crude	Adjusted [§]	Crude	Adjusted [§]
Primary exposure				
Maternal CMD (SRQ-20 total score)	1.07 (1.02, 1.13)	1.05 (0.99, 1.12)	1.07 (1.01, 1.13)	1.07 (1.00, 1.13)
Other explanatory variables				
Maternal age (years)	1.03 (1.01, 1.05)	1.02 (0.99, 1.03)	1.01 (0.98, 1.04)	1.01 (0.97, 1.05)
Non-literate mother	2.20 (1.46, 3.33)	1.77 (1.13, 2.77)	1.94 (0.99, 3.76)	1.64 (0.82, 3.27)
Non-literate father	1.75 (1.37, 2.25)	1.53 (1.17, 2.01)	1.26 (0.89, 1.78)	1.19 (0.82, 1.74)
Maternal marital status (polygamous, divorced and widowed)	1.08 (0.99, 1.18)	1.07 (0.82, 1.43)	1.03 (0.91, 1.18)	1.18 (0.78, 1.78)
Experienced hunger due to lack of resources	2.22 (1.50, 3.29)	1.74 (1.10, 2.77)	1.85 (0.96, 3.56)	1.78 (0.82, 3.84)
No emergency resources	1.65 (1.30, 2.11)	1.43 (1.10, 1.89)	1.20 (0.83, 1.72)	1.05 (0.69, 1.60)
Thatched roof	1.65 (1.27, 2.14)	1.30 (0.96, 1.74)	1.43 (1.01, 2.03)	1.33 (0.91, 1.96)
Paternal khat use at least weekly	1.52 (1.10, 2.11)	1.38 (0.98, 1.95)	0.54 (0.37, 0.81)	0.52 (0.34, 0.79)
Paternal alcohol use at least weekly	1.23 (0.89, 1.71)	1.35 (0.95, 1.93)	1.35 (0.88, 2.09)	1.18 (0.73, 1.89)
Negative life event (≥1 in the last 6 months)	0.99 (0.84, 1.16)	0.85 (0.69, 1.03)	1.04 (0.98, 1.89)	1.00 (0.77, 1.29)
Male child	1.45 (1.14, 1.85)	1.50 (1.15, 1.96)	1.15 (0.82, 1.62)	1.13 (0.78, 1.63)
Child first in birth order	0.44 (0.29, 0.67)	0.59 (0.36, 0.95)	0.73 (0.43, 1.27)	0.82 (0.45, 1.51)
Height for age z score	0.73 (0.65, 0.83)	0.80 (0.70, 0.91)	0.75 (0.62, 0.89)	0.73 (0.60, 0.89)

CMD = common mental disorder; SRQ = Self-Reporting Questionnaire;

[§] Parental characteristics including (maternal age, marital status, maternal and paternal level of literacy), Socio-economic status (hunger due to lack of resources, emergency resources, roof material), paternal substance use, negative life event, child sex, birth order and child nutritional status

Table 4: Factors associated with child school absenteeism

Exposure variables at age 7/8 years of the child	School absenteeism at the end of 2014/15 academic years Incidence Rate Ratio (95% Confidence Interval)	
	Crude	Adjusted [§]
Primary exposure		
Maternal CMD (SRQ-20 total score)	1.00 (0.99, 1.01)	1.01 (1.00, 1.02)
Other explanatory variables		
Increasing maternal age (years)	1.00 (0.99, 1.01)	1.01 (1.01, 1.02)
Mother non literate	1.60 (1.48, 1.74)	1.57 (1.44, 1.72)
Father non literate	1.18 (1.13, 1.23)	1.07 (1.02, 1.12)
Marital status (polygamous, divorced, widowed)	0.92 (0.89, 0.94)	0.88 (0.83, 0.93)
Experienced hunger due to lack of resources	1.06 (0.96, 1.17)	1.06 (0.94, 1.19)
No emergency resources	1.03 (0.99, 1.08)	0.98 (0.94, 1.04)
Thatched roof (vs. corrugated iron)	1.46 (1.40, 1.53)	1.36 (1.30, 1.42)
Father uses khat at least weekly	1.10 (1.03, 1.17)	1.04 (0.97, 1.11)
Father uses alcohol at least weekly	0.90 (0.85, 0.96)	0.92 (0.86, 0.98)
Negative life event (≥ 1 in the last 6 months)	0.98 (0.97, 0.99)	0.90 (0.87, 0.94)
Male child	1.04 (1.00, 1.09)	1.05 (1.00, 1.09)
Child first in birth order	1.14 (1.08, 1.21)	1.17 (1.10, 1.25)
Height for age z score	1.00 (0.97, 1.01)	1.00 (0.97, 1.02)

CMD = common mental disorder; SRQ = Self-Reporting Questionnaire;

[§] Parental characteristics including (maternal age, marital status, maternal and paternal level of literacy), Socio-economic status (hunger due to lack of resources, emergency resources, roof material), paternal substance use, negative life event, child sex, birth order and child nutritional status

There was no significant association between maternal CMD and academic achievement or grade repetition. Paternal non-literacy, alcohol use and widowed or separated maternal marital status were significantly associated independently with these outcomes. See Table 5.

Table 5: Factors associated with child academic achievement

CMD = common mental disorder; SRQ = Self-Reporting Questionnaire;

Exposure variables at age of 7/8 years of the child	Academic achievement by end of 2014/15 academic year β coefficient (95% Confidence Interval)		Grade repetition by end of 2014/15 academic year Odds Ratio (95% Confidence Interval)	
	Crude	Adjusted [§]	Crude	Adjusted [§]
Primary exposure				
Maternal CMD (SRQ-20 total score)	-0.07 (-0.27, 0.13)	0.01 (-0.22, 0.23)	1.01 (0.87, 1.16)	0.99 (0.85, 1.16)
Other explanatory variables				
Maternal age	-0.03 (-0.13, 0.08)	0.01 (-0.11, 0.13)	1.01 (0.94, 1.09)	1.05 (0.96, 1.14)
Mother non-literate	0.21 (-1.51, 1.92)	0.46 (-1.42, 2.34)	1.00 (0.29, 0.97)	0.87 (0.24, 3.17)
Father non-literate	-1.88 (-3.06, -0.69)	-1.90 (-3.16, -0.64)	2.12 (0.93, 4.78)	1.89 (0.80, 4.44)
Marital status (polygamous, divorced and widowed)	-0.21 (-0.67, 0.26)	-2.02 (-3.48, -0.55)	0.96 (0.67, 1.38)	1.31 (0.54, 3.16)
Experienced hunger due to lack of resources	-0.42 (-3.18, 2.33)	-0.79 (-4.14, 2.56)	0.93 (0.12, 7.00)	0.97 (0.11, 8.74)
No emergency resources	-0.59 (-1.83, 0.64)	-0.59 (-2.00, 0.80)	1.43 (0.63, 3.28)	1.50 (0.60, 3.74)
Thatched roof	0.54 (-0.57, 1.66)	0.78 (-0.46, 2.00)	2.02 (0.86, 4.73)	1.55 (0.62, 3.89)
Father uses khat at least weekly	-1.31 (-2.82, 0.21)	-0.57 (-2.15, 1.00)	0.43 (0.18, 1.01)	0.44 (0.18, 1.12)
Father uses alcohol at least weekly	2.47 (0.88, 4.05)	2.35 (0.65, 4.04)	1.80 (0.70, 4.62)	1.26 (0.45, 3.51)
Negative life event in the last six months	-0.07 (-0.33, 0.18)	-0.24 (-1.09, 0.61)	1.04 (0.90, 1.18)	0.76 (0.34, 1.72)
Male child	0.16 (-0.95, 1.28)	-0.09 (-1.10, 1.27)	1.41 (0.63, 3.16)	1.45 (0.61, 3.42)
Child first in birth order	0.34 (-1.30, 1.97)	0.33 (-1.50, 2.17)	1.63 (0.60, 4.41)	2.09 (0.66, 6.60)
Height for age z score	0.62 (0.00, 1.23)	0.59 (-0.07, 1.25)	1.08 (0.69, 1.67)	1.12 (0.69, 1.81)

[§] Parental characteristics including (maternal age, marital status, maternal and paternal level of literacy), Socio-economic status (hunger due to lack of resources, emergency resources, roof material), paternal substance use, negative life event, child sex, birth order and child nutritional status

DISCUSSION

We found a significant prospective association between maternal CMD and child school drop-out and absenteeism. The unadjusted association between exposure to maternal CMD at age 6/7 years and drop-out by the end of the 2013/14 academic year became non-significant when adjusted for potential confounding variables. Parental low socioeconomic status, non-literacy and substance use were associated significantly with adverse educational outcomes of children. There was no association between maternal CMD and child academic achievement or grade repetition.

As far as we are aware, our study is the first of its kind from a low-income country to report the association between exposure to preschool maternal CMD and subsequent adverse educational outcomes. Strengths of the study included the population-based design, large sample size, high follow-up rates and use of culturally validated measures. Nonetheless, there were limitations of our study. Maternal CMD was assessed using a symptom screening scale rather than a diagnostic measure. We assessed academic achievement using a composite and non-standardised measure (individual teacher assessment). Although this approach increased measurement error, composite measures which include participation, homework, attendance and tests given by teachers may be more ecologically valid and tied to day-to-day routine of teaching and learning than narrowly focused assessments of content mastery. Absenteeism was extracted from data collected routinely by schools, which is likely to have led to underestimation of absences, but this would have led to a non-differential error which would be expected to reduce the chance of finding a significant association and would not be

1 expected to have led to bias. We relied on proxy indicators of socioeconomic status. Although
2 these indicators have been developed for the population under study, they relied on self-report
3 from the women and may not have been sufficiently comprehensive, thus raising the possibility
4 of residual confounding. Physical ill-health of the child may also have confounded the
5 association.
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16 The higher school drop-out rate at the end of 2013/14 academic year over the subsequent year
17 is in keeping with existing evidence. The non-significant association between maternal CMD and
18 academic achievement and grade repetition in our study is in contrast to the study from
19 Barbados, where postpartum depression was associated with poorer academic achievement at
20 11 years of age.[20] This difference may have arisen due to the measures of academic
21 achievement used (standardized in Barbados vs. subjective/composite measure in Ethiopia) and
22 the timing of the CMD exposure (postpartum vs. pre- and early school years). Furthermore, the
23 broader context for learning also differs substantially between Barbados and Ethiopia. In
24 Ethiopia, the majority of women are non-literate and there is limited availability of learning
25 resources (e.g. books, games) within the home. Given the critical importance of these factors
26 for child learning, any additional effect of maternal CMD may have been too small to detect,
27 unlike in Barbados.
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48 On the other hand, the deficits in the home learning environment mean that regular
49 attendance at school becomes the most important way for a child to learn and is likely to have
50 greater influence on child educational performance. Our findings were in keeping with the
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2 Barbados study, where depressive symptoms in mothers of a child with an early history of
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4 malnutrition were associated with school absences between 5 and 11 years of age. Irregular
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6 school attendance is likely to be on the pathway to poorer educational attainment and to
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8 identify a group of children who are at risk of fully dropping out from school.
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14 In studies from HICs, erratic school attendance and drop-out from school have been associated
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16 with an adverse early home environment, living with smokers, the quality of early care-giving,
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18 socioeconomic status, cognitive development, behavior problems, academic achievement, peer
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20 relations and parent involvement.[32, 33] In LMICs, food insecurity and death of parents[34,
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22 35] are associated with irregular school attendance and dropping out entirely. In both HIC and
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24 LMIC studies, maternal CMD could be an important unmeasured mediator of the effects of
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26 adverse home environment on school attendance. For children under the age of ten years,
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28 absenteeism and drop-out are unlikely to happen without the knowledge of the family, and in
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30 particular the mother.
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38 School absenteeism and drop-out have important economic implications, particularly in a low-
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40 income country like Ethiopia. Repeating years of education or students taking longer to
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42 complete their education bring inefficiency into the school system, financial burden on the
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44 household and may adversely affect the motivation of the child to pursue their education. For
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46 those students who drop-out of school altogether, there are economic losses from negative
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48 impacts on future productivity. Every additional year of schooling has a substantial positive
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50 effect on adult wages.[36] Achieving high coverage of primary school enrolment is undermined
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2 by subsequent early drop-out from schooling, which will limit Ethiopia's ability to deliver on the
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4 Sustainable Development Goal (SDG) target to ensure that all girls and boys complete free,
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6 equitable and quality primary and secondary education by 2030.
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11 School-based interventions targeting specific predictors of absenteeism and drop-out in LMICs,
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13 e.g. deworming,[37] hand wash campaigns, safe water and hygiene,[38] and school feeding
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15 programmes,[39] have been found to be effective in reducing absenteeism and drop-out. Our
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17 study indicates that interventions (at family, school or community level) focusing on the
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19 reduction of absenteeism and drop-out need also to incorporate maternal CMD. There is a
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21 global impetus to improve access to primary care-based mental health care in LMICs through
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23 the World Health Organisation's mental health Gap Action Programme.[40] Evidence-based
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25 treatment packages for maternal depression that can be delivered by general health workers
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27 (assessment and prescription of medication) and lay workers (psychosocial approaches) have
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29 been shown to be effective, feasible and acceptable to communities across LMIC settings.[41]
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31 Effective care for maternal depression has been shown to have beneficial effects on child health
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33 in Pakistan[42] but further studies are needed to evaluate the impact on child educational
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35 outcomes.
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44 **CONCLUSION**

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47 In this population-based cohort study in rural Ethiopia, children exposed to mothers with
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49 symptoms of common mental disorders during pre and early school age were at greater risk of
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51 school drop-out and absenteeism. Future studies are needed to understand the mechanisms
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53 underlying this association. Current global efforts to expand access to mental health care offer
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1 an opportunity to address maternal CMD as a key component of programmes to increase
2 school attendance.
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9
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12
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21 **Contributors**

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24 HM, CH, AA and MP conceptualised the study. HM led data collection with oversight from CH,
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26 AA and GM. HM led data analysis, with input from CH, AA, MP, MT and GM. HM drafted the
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28 manuscript and all other co-authors revised it critically. All authors approved the final version of
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30 the paper and agree to be accountable for all aspects of the work.
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46 **Competing interests**

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49 The funding for the study came from the Wellcome Trust.
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Ethical approval

Ethical approval was obtained from the Institutional Review Board of the College of Health Sciences, Addis Ababa University, Ethiopia (reference number 082/13/psy) and the Research Ethics Committee of King's College London, UK (reference number PNM/13/14-92).

Data sharing statement

The data are being used for a PhD student (HM) for his thesis and are not, therefore, available at the present time to the general public. The data may be requested from the corresponding author for verification of the analyses in this paper.

Figure 1: Conceptual framework

Figure 2: Follow-up chart for child educational outcomes

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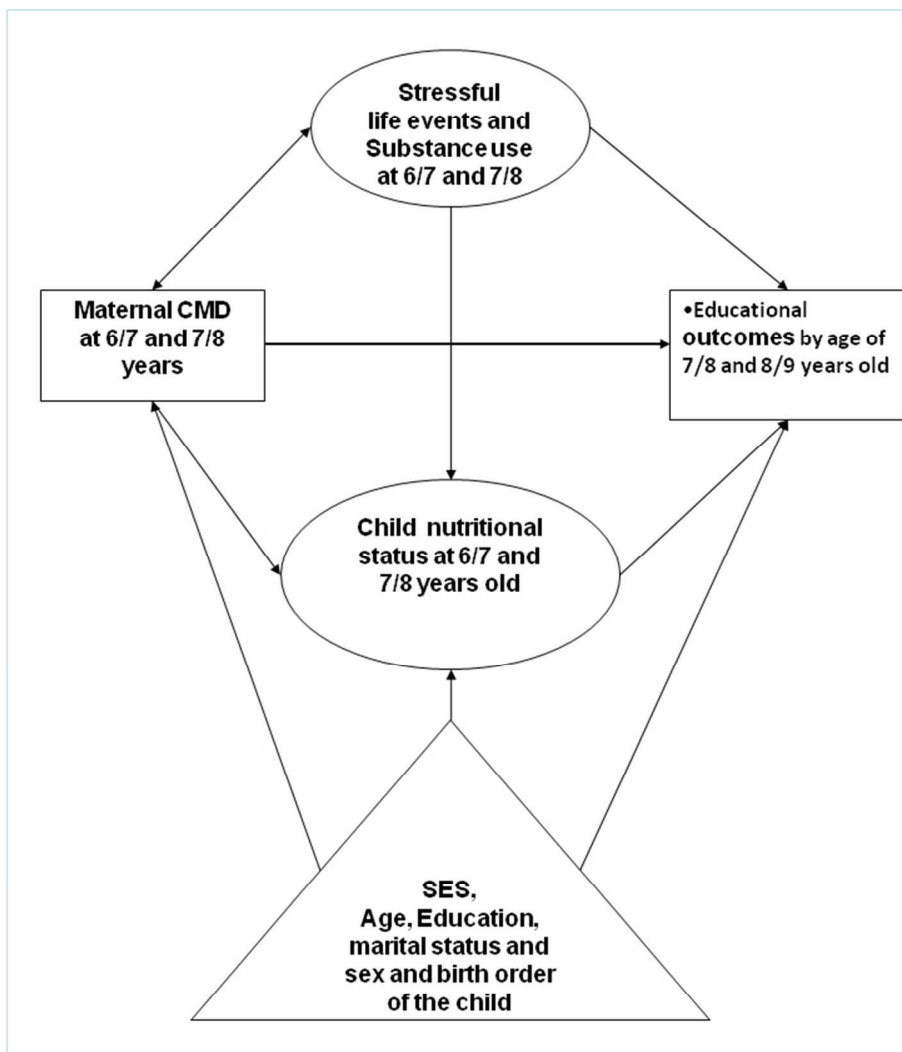


Figure 1: Conceptual framework

65x81mm (300 x 300 DPI)

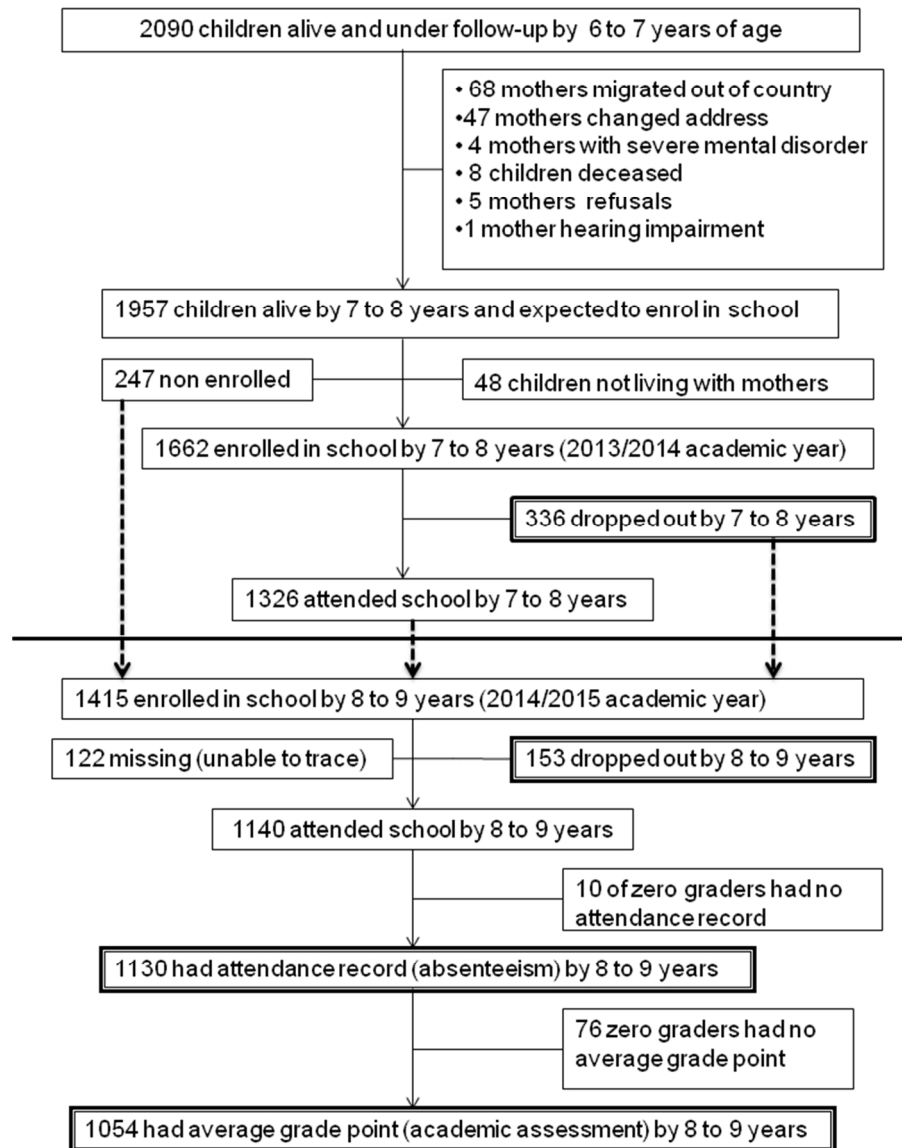


Figure 2: Flow chart of study participants

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