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Authors

Rotheram-Borus, Mary Jane
Tomlinson, Mark
Worthman, Carol M
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Maternal depression, alcohol use, and transient effects of perinatal paraprofessional home visiting in South Africa: Eight-year follow-up of a cluster randomized controlled trial

Mary Jane Rotheram-Borus[a,1], **Mark Tomlinson**[b,1], **Carol M. Worthman**[c,*,1], **Peter Norwood**[a], **Ingrid le Roux**[d], **Mary J. O'Connor**[e]

[a.]Semel Institute Department of Psychiatry and Biobehavioral Sciences, University of California at Los Angeles, 10920 Wilshire Blvd. Suite 350, Los Angeles, CA, 90024, USA.

[b.]Institute for Life Course Health Research, Department of Global Health, Education Building, Francie Van Zijl Drive, Stellenbosch University, Tygerberg 7505, South Africa.

[c.]Department of Anthropology, Emory University, 1557 Dickey Dr., Atlanta, GA, 30307, USA.

[d.]Philani Maternal, Child Health and Nutrition Trust, P.O. Box 40188, Elonwabeni 7791, Cape Town, South Africa.

[e.]Semel Institute Department of Psychiatry and Biobehavioral Sciences, University of California at Los Angeles, 760 Westwood Plaza, Los Angeles, CA 90095, USA.

Abstract

Background: South African mothers confront synergistic challenges from depression, alcohol use, and HIV/AIDS. The importance of maternal functioning for child development motivates interventions, yet long-term outcomes seldom are tracked. Furthermore, little is known about trajectories and the role of social-cultural factors in maternal depression and alcohol use across parenthood in low- and middle-income countries.

Methods: We examined maternal outcomes at 5- and 8-years' post-birth, from the Philani Intervention Program (PIP), a randomized controlled trial of a prenatally-initiated home visiting

[*]Corresponding author: Carol Worthman, Department of Anthropology, Emory University, 1557 Dickey Dr., Atlanta, GA, 30307, USA; worthman@emory.edu; phone +1 404-368-7767; FAX +1 404-659-3822.
[1]These three authors contributed equally to the work and are listed alphabetically.

intervention lasting through 6 months' post-birth which yielded some benefits for children and mothers through 3 years. Longitudinal Bayesian mixed-effects models assessed intervention effects for maternal depression and alcohol use from pre-birth through 8 years' post-birth. We plotted trajectories of depression and alcohol use and analyzed their relationship over time.

Results: Maternal benefits appeared limited and intervention outcomes differed at 5 and 8 years. Reduced depression in PIP versus standard care (SC) mothers at 3 years disappeared by 5 and 8 years. Depression prevalence declined from 35.1% prenatally to 5.5% at 8 years, independent of intervention or alcohol use. Alcohol use in both groups rebounded from a post-birth nadir; fewer PIP than SC mothers drank alcohol and reported problematic use at 5 but not 8 years. HIV+ prevalence did not differ by condition and increased from 26% to 45% over the reported period.

Conclusions: Dissipation of early child benefits from home visiting by age 8 years likely reflects lack of durable change in maternal behaviors compounded by social-cultural factors and cumulative effects of community deprivation. High prenatal rates warrant screening and treatment for depression in standard antenatal care. Low-and-middle income countries may need sustained interventions, including alcohol use reduction, to capitalize on initial gains from targeted interventions and address community social-cultural factors. HIV/AIDS continues to spread in this population.

Keywords

Maternal depression; alcohol use; problematic alcohol abuse; HIV/AIDS; home visiting; community health worker; cultural beliefs; cultural values

1.   Introduction

Maternal well-being is a cornerstone of family and community health, strongly associated with a range of positive outcomes for children across the life course. Accordingly, intervention efforts have turned to supporting children's primary caretakers, principally mothers (Tomlinson et al., 2014). Yet interventions to improve maternal health in sub-Saharan Africa face significant co-occurring and interrelated public health and social challenges. One is maternal mental health. Depression alone engenders over 3.5% of the global burden of disease for persons aged 10–49 years (GBD 2019 Diseases and Injuries Collaborators, 2020) and is more prevalent among women, for whom it ranks as the second largest source of disability (GBD 2019 Mental Disorders Collaborators, 2022). Furthermore, perinatal depression is more common in low- and middle-income countries (LMICs) where prevalence ranges around 20% and afflicts 35% of mothers in informal settlements near Cape Town (Cooper et al., 1999; Dadi et al., 2020; Fisher et al., 2012). The burden of depression for women is compounded when considering their children (Stein et al., 2014), including effects on cognitive and socioemotional development (Parsons et al., 2011).

A second and related challenge, alcohol mis/use, also contributes substantially to the global burden of disease, particularly among people living in LMICs (Shield et al., 2020). Maternal alcohol use during pregnancy has been associated with significant long-term neurodevelopmental deficits including fetal alcohol spectrum disorder (FASD)(Wozniak et al., 2019). Moreover, maternal alcohol use after birth is associated with serious outcomes

for child functioning and behavior (May et al., 2016). Although most South Africans abstain from drink, national rates of alcohol consumption are among the highest globally (Vellios & Van Walbeek, 2017; WHO, 2018). High prevalence of maternal alcohol use during pregnancy in South Africa, particularly in the Western Cape Province, fuels FASD rates that rank among the world's highest (Olivier et al., 2016).

Risk and protective factors associated with depression and alcohol use tend to overlap. Situational factors including high rates of single parenthood, resource scarcity, and partner and neighborhood violence both add to risks for maternal depression and alcohol use, and are more prevalent and damaging under conditions of poverty (Lund et al., 2010). Food insecurity, for example, is associated with maternal depression as well as alcohol use (Rochat et al., 2019). Poor social support, depression, and anxiety contribute to the risk for alcohol use during pregnancy (Wubetu et al., 2019). Moreover, depression may fuel or be exacerbated by alcohol use and is also associated with poor social support and aversive social relationships (Sullivan et al., 2005). By contrast, higher maternal age, more education, and a stable relationship with the child's father may protect against maternal depression (Fisher et al., 2012), and also are associated with absence of maternal alcohol use (Rochat et al., 2019).

The impact of maternal depression and alcohol use on children highlights the importance of intervening to reduce both. Yet mothers in South Africa face a third challenge, from HIV/AIDS. South Africa has experienced the largest HIV/AIDS epidemic globally, with as many as a third of children being born to women living with HIV (Wubetu et al., 2019). Both depression (Kagee et al., 2018) and alcohol use (Bryant, 2006) reportedly disinhibit sexual behavior and hence increase the likelihood of HIV acquistion as well as reduce adherance to antiretroviral therapy (ARV)(Hendershot et al., 2009). Furthermore, depression is strongly associated with both maternal alcohol use and HIV, as well as intimate partner violence (Davis et al., 2017), contributing to a cycle of risk.

Consequently, South African women living in poverty face syndemic conditions that synergistically drive depression, alcohol use, and HIV (Mendenhall et al., 2022). Interventions are sorely needed to address the impacts of concurrent adversities on maternal mental health over time. Addressing this need encounters yet another challenge, namely lack of resources to diagnose or treat depression or alcohol misuse in LMIC (Thornicroft et al., 2017). Stigma along with underinvestment in treatment further contribute to a paucity of mental health care providers (Greene et al., 2021), which has stimulated work to fill the gap (Lund et al., 2012). Task shifting to community health workers CHW) has been a leading strategy to meet this need (Barnett et al., 2018). Additionally, the potential value of brief interventions (BI) targeting maternal alcohol use at key transition points such as pregnancy has fueled interest in their applications (Popova et al., 2023), including a BI shown to reduce prenatal alcohol use (O'Connor & Whaley, 2007). However, few studies examine community-level interventions using CHWs designed to reduce concurrent maternal risks in LMIC; moreover, data on durability of their impact are thin (Casillas et al., 2016; Jensen et al., 2021).

Here we assess long-term results from a cluster randomized controlled trial (RCT) in Cape Town townships to evaluate the effectiveness of a generalist paraprofessional home-visiting intervention, the Philani Intervention Program (PIP)(Rotheram-Borus et al., 2011). The PIP aimed to improve maternal and child health outcomes by addressing multiple health challenges concurrently. We posited that providing structured in-home support to pregnant young women would buffer and empower them during a stressful life transition, leading to decreased depression, alcohol use, and HIV risk behaviors with benefits for child outcomes that would, in turn, reduce maternal burden. The CHWs were women with healthy children selected from the townships for their good communication and problem-solving skills. CHWs received a month's integrated training on maternal and child health, common principles of effective evidence-based interventions, and coping with possibly difficult situations during home visits (Tomlinson et al., 2018).

Previous analyses of PIP intervention outcomes at post-birth, 6-month, 18-month, and 36-month assessments found scant maternal benefit in alcohol use, depression, or HIV status, although PIP mothers reported fewer depressive symptoms than SC at 36 months. Nonetheless, significant benefits were observed in other maternal behaviors and in children, as detailed in Supplemental Table 1.[1–6] The areas of improvement varied over time; some lasted across two time points, while others were observed only once. Home visits were associated with benefits in early child growth and cognitive development among PIP compared to Standard Care (SC) condition (le Roux et al., 2013). Children of depressed PIP mothers showed better growth and cognitive outcomes (less undernourished or stunted; better Bayley and vocabulary scores) than those of depressed SC mothers at 18 and 36 months (Tomlinson et al., 2016), yet no benefits accrued to children after 3 years of age (Gordon et al., 2021).

This report examines the effects of the intervention on mothers five to eight years after the target birth. We also probe long-term patterns in depression and alcohol use and consider local beliefs and values to interpret our findings.

2. Methods

2.1 Participants

The study team has reported details of study formation, sampling strategy and recruitment (le Roux et al., 2013; Rotheram-Borus et al., 2014). Briefly, 24 similarly sized non-contiguous Cape Town neighborhoods were identified and sorted into 12 matched pairs having one assigned to PIP and the other to SC. Nearly all (98%) pregnant women aged 18 years, <34 weeks pregnant, able to give informed consent, and living in these neighborhoods were recruited between 5/2009 and 9/2010. Figure 1 charts the participants' ($N = 1238$) engagement in the study over time. Since recruitment, 137 mothers or children have died; these dyads were removed after death. Follow-up rates are high (81.9% through 8 years). Only 22 mothers were lost to follow-up after pregnancy and never reassessed; all other participants were assessed at least twice. All available observations are included in the analyses.

2.2 Standard Care (SC) and Philani Intervention Program (PIP) conditions

The intervention and control conditions are detailed elsewhere (Rotheram-Borus et al., 2014). The SC condition received standard of care comprising a range of clinical services, including lifelong antiretroviral therapy for mothers living with HIV (MLH). The PIP condition additionally received antenatal and post-natal home visits by CHWs. Home visits were designed to promote foundational skills (cognitive: set goals, problem solve, self-monitor; behavioral: praise, be assertive, attend to others; emotional: awareness of feelings, relaxation) and key messages (e.g., stop/limit alcohol use; monitor self and child's nutrition and growth; breastfeed exclusively; get HIV testing; follow steps to Prevent Maternal to Child Transmission (PMTCT) if HIV+; prioritize care for child; bond with the baby). PIP mothers also received a brief antenatal intervention on alcohol prevention adapted from O'Conner and Whaley (2007), which included learning to calculate alcohol consumption relative to target quantities, reviewing life-long consequences of alcohol on babies, and showing realistic Black dolls with and without FASD. Depression was not a targeted message; when mothers expressed feeling depressed, CHW encouraged them to continue caring for their children, despite their feelings. Intervention materials are available at http:// chipts.ucla.edu/research/philani-pregnant-women-cape-town/. CHWs averaged 6 antenatal and 5 postnatal visits between birth and 6 months post-birth per participant. Thereafter, CHWs made biannual visits until 6 years post-birth, primarily to monitor mother-child outcomes and reinforce core intervention messages. The 8-year follow-up was conducted between 1/8/2017 and 12/10/2018.

All procedures were approved by the Institutional Review Boards of Stellenbosch and UCLA. Each mother provided informed consent and assent for their and their child's participation. Trial registration number is # NCT00996528. Mothers were compensated for the assessments only.

3. Measures and protocol

Interviewers were recruited from nearby neighborhoods, trained, certified as competent on each measure, and monitored weekly throughout the study. The interviewer team was highly consistent over time from recruitment through the 8-year assessment.

3.1 Maternal demographic characteristics

Maternal demographic characteristics represented in analyses include age (years), education, employment status, partnership status, household income, type of housing (formal or informal), food insecurity, and the presence of on-site water, flushable toilet, and electricity.

Depressive symptoms.—The Edinburgh Postnatal Depression Scale (EPDS) comprises 10 items rated on a severity scale of 0–3 to yield scores from 0 to 30 (Cox et al., 1987) and was administered at each assessment. It has been validated and used extensively in South Africa (Lawrie et al., 1998; Tsai et al., 2013), and its factor structure has been assessed in Khayelitsa (de Bruin et al., 2004). EPDS scale scores were skewed; therefore, we used log(EPDS scale score + 1) for analyses involving symptoms of depression. Depressed mood was defined as present if EPDS >13 (Lawrie et al., 1998).

Alcohol use.—At each assessment, mothers reported alcohol use as present (any drinking) or absent, and usage if present. The reporting time frame varied by visit. At recruitment, participants reported alcohol use before discovery of pregnancy and current alcohol use, after pregnancy recognition. At the post-birth assessment, alcohol use in the month before birth was reported. At six months, women reported alcohol use since the baby was born. Lastly, at the 18-month, 3-year, 5-year, and 8-year assessments, alcohol use in the month before assessment was reported. Any problematic drinking (APD) was defined as having reported heavy episodic drinking (four or more drinks in a single day) at least once a month and answering yes to any one of three questions adapted from the TWEAK (Russell, 1994): (1) Have close friends or relatives worried or complained about your drinking?; (2) Do you sometimes take a drink in the morning when you first get up?; (3) Has a friend or family member ever told you about things you said or did while you were drinking that you could not remember? At each assessment, alcohol use was scored as absent, present but no APD, and APD.

HIV status.—As detailed elsewhere, maternal HIV status was self-reported and validated at each wave on the Government Road to Health card, and directly tested in two-thirds of mothers at 8 years (Rotheram-Borus et al., 2020).

4. Data Analysis

The first aim was to test for long-term intervention outcomes in maternal depression and alcohol mis/use. Outcomes were the log(EPDS + 1), depressed mood, any alcohol, and APD. Primary interest was comparison of PIP and SC conditions on these measures at 5 and 8 years. Secondary interest concerned the trend in outcomes from pregnancy to 8 years. We calculated the fraction of participants with each outcome at each time point and plotted the proportion of assessments where a specific outcome was present for each participant (Supplemental Figure 1). Although APD was assessed at baseline and post-birth, it was minimal during pregnancy and non-existent post-birth; therefore, APD analyses started with the 6-month visit.

We addressed this aim with models fit in a Bayesian framework in R with vague priors for the fixed effects (R Core Team, 2020). We used a Bayesian longitudinal random effects model with random intercepts for neighborhoods and participants and normal errors for analyses of the log(EPDS + 1) and a logistic generalized linear mixed model (GLMM) to analyze depressed mood. We specified a single effect for baseline and separate effects for PIP and SC at each follow-up assessment. We used inverse gamma priors for the random effect variances with a mean and standard deviation of 1 for the logistic models. We applied normal errors for analyses of the log(EPDS + 1) and a logistic generalized linear mixed model (GLMM) to analyze depressed mood and used mean and standard deviation of s^2 for log(EPDS + 1) where s^2 is the marginal variance of log(EPDS + 1) over all observations. Depressed mood was fit in package MCMCglmm (Hadfield, 2010), and log(EPDS + 1) was fit in package JAGS (R Core Team, 2020).

Most mothers (61%) never reported drinking; therefore, we used a mixture model with two components to analyze any alcohol use and APD. One component comprised mothers

who never reported drinking, the other comprised mothers who were potential drinkers and potential APD. The first component (never drinkers and never APD) was a logistic random effects model with random effects for neighborhood and a single effect comparing PIP to SC. This model tests whether PIP or SC mothers were more likely to be never drinkers or never have APD and had no longitudinal component because mothers never drank or had an APD. The second component was a longitudinal logistic GLMM that was the same as the model for depressed mood.

In Bayesian analyses comparing two conditions, a result is significant if the probability that the effect is negative (or positive) is at least .975, equivalent to a one-sided p-value of 0.025 or less.

Our second aim queried the relationship of depressed symptoms and alcohol use. To examine this, we fit two longitudinal mixed-effects models with log(EPDS+1) as the outcome. The reduced model included fixed effects for time (treated as a categorical variable), intervention, alcohol use, and interactions between time and intervention, and time and alcohol use. The larger model also included interactions between intervention and alcohol use and a three-way interaction among time, alcohol use, and intervention. We then did the same with a logistic mixed-effects model using EPDS>13 as the outcome. All were frequentist models fit using the lme4 package and included subject-specific random intercepts nested in a random baseline neighborhood effect (Bates et al., 2015). Again, we removed the post-birth time point from the model because APD cases were lacking. For both outcomes, the null hypothesis testing whether the intervention affects the relationship of alcohol use to depression posited no effect from any two- or three-way interactions between alcohol use and intervention. We used a full-versus-reduced chi-square test between the larger (with all interactions) and the reduced models. To examine the relationship between depression symptoms and alcohol use, we conducted additional full-versus-reduced tests with and without alcohol use effects. Covariates were assessed at baseline and had no missing data. For outcomes, the likelihood and Bayesian methods we used assume missing at random, given the other observations from a participant and the covariates (typically time, neighborhood, intervention), and do not require complete data and multiple imputation (Sidi & Harel, 2018).

5. Results

5.1 Sample characteristics

Baseline characteristics of mothers in the PIP and SC conditions did not differ significantly at recruitment: typically, mothers were in their mid-20s, had left school at 10th grade, were unemployed (80%), and lived in informal housing (69%); half had experienced food insecurity in the last week (Supplemental Table 2). Most women (57%) reported a recent sexual partner, yet most did not live with that partner. A third (35%) met criteria for depression. Although 25% of mothers drank alcohol of whom 19% reported problematic drinking before recognizing they were pregnant, alcohol use and APD plummeted to 9% and 6%, respectively, after attending an antenatal care visit.

Eight years later, mothers were in their early to mid-thirties, most (52%) were employed, lived in formal housing (57%), and cohabited with a partner (54%) (Supplemental Table 3). Initially, 26% were mothers living with HIV (MLH). Almost all women were tested for HIV during pregnancy and many discovered their status then. By 8 years post-birth, 45% were MLH. Most mothers (70%) had completed all assessments. Sample retention to 5 and 8 years was high (82.7% and 80.9%, respectively; Figure 1) and composition closely resembled that recruited at baseline, although mothers retained at 5 years were slightly older and less educated; slightly more in formal housing at 8 years; and much more likely to report child food insecurity at both time points (Supplemental Tables 4 and 5).

5.2   Maternal outcomes

Trajectories in mean EPDS symptoms and proportions of mothers with depressed mood, any alcohol use, and APD are plotted by intervention condition at each time point in Figure 2. Systematic declines in EPDS scores and depressed mood are evident in both study conditions from baseline onwards, whereas reported alcohol use (any use and APD) showed a dramatic post-birth dip and subsequent rebound. Specifically, prevalence of APD resurged in the first year and alcohol use approached or exceeded pre-pregnancy levels by 8 years.

We probed for longer-term intervention effects by comparing PIP and SC mothers on each of the four outcomes (Table 1). Although log(EPDS + 1) scores did not differ by condition at any time point, odds of having depressed mood at 3 years among women in the PIP condition were 0.60 times that of women in the SC condition (95% CI (0.38,1.00), one-sided $p = 0.020$). However, the difference was absent at both years 5 and 8.

Notably, depressed mood had decreased significantly among both SC and PIP at the 8-year assessment, compared to the prenatal baseline (OR = 0.06 (95% CI 0.04,0.09 p <0.001) for SC and OR = 0.04 (95% CI 0.02,0.07 p <0.001) for PIP). Similarly, the log(EPDS + 1) score at 8 years was lower than at baseline: 1.43 (95% CI 1.32, 1.54, $p < 0.001$) versus 2.30 in the SC condition and 1.46 (95% CI 1.36, 1.56, $p < 0.001$) versus 2.30 in the PIP condition.

The odds were significantly lower in the PIP compared to SC condition both for ever using alcohol and for APD at the 5-year assessment (OR= 0.52; 95% CI 0.31,0.84) (OR=0.30; 95% CI 0.13,0.67)(Table 1). This effect was absent at 8 years. Indeed, the odds of reporting any alcohol consumption increased from post-birth to 8 years for both PIP and SC. Post-birth, only 8.2% of SC and 6.5% of PIP groups reported any drinking. Compared to post-birth, the odds ratio of any drinking at 8 years among SC was 5.66 (95% CI 3.45, 9.42 $p < 0.001$) and 7.81 (95% CI 4.77, 12.92 $p < 0.001$) among PIP. The odds of APD increased significantly from 6 months to 8 years in the SC but not the PIP condition, although the difference between SC and PIP is not significant. Specifically, the odds of APD at 8 years in the SC condition is 1.91 (95% CI 1.04, 3.51 $p = 0.0352$) times that at 6 months and 1.87 (0.84, 4.22) for PIP.

As shown in Figure 3, both any and problematic alcohol use are associated with higher levels of depressive symptoms at most time points, as is most evident at higher rates of depressive-like symptoms. Unsurprisingly, we find significant effects of alcohol use and APD for both depression outcomes (p<0.001 each). Also suggested by Figure 3

and given small treatment effects on alcohol or depression, tests yielded no evidence of interactions between alcohol and the intervention for log(EPDS+1) (p=0.859) or for EPDS>13 (p=0.423).

Prevalence of HIV+ status was 26% at recruitment and 45% at 8 years (M. J. Rotheram-Borus et al., 2020). Although adherence to PMTCT was greater and HIV risk behavior was lower in PIP than SC mothers to 6 months (Supplemental Table 1), maternal HIV+ rates did not differ by condition at any point. Hence, the present analyses did not include HIV status as a covariate.

6. Discussion

This report evaluates effects of a perinatal home visiting intervention on maternal depression and alcohol use in a population with high HIV prevalence at 5–8 years post-birth. Our findings add to previous reports of the program's earlier impact on both mothers and their children (summarized in Supplemental Table 1). Long-term evaluations of early intervention programs remain rare in LMICs, where most RCTs simply conduct an immediate post-intervention assessment, and few follow participants for as much as 12 months (Tomlinson et al., 2020). The PIP home visiting program for pregnant South African women significantly reduced the prevalence of depressed mood at 3 years, though not before. By 5 years after birth, however, depressive symptom scores were similar for both study conditions and remained so at 8 years. Indeed, both study conditions underwent systematic declines in depressive symptoms and reached very low levels by 8 years. Reported alcohol mis/use was slightly lower among PIP than SC at 3 years, significantly lower at 5 years, and again no different at 8 years, largely because PIP mothers returned more slowly to pre-pregnancy consumption patterns. Note that although the odds of problematic drinking at 8 years was nearly 8- and 6-fold higher than post-birth in PIP and SC respectively, and roughly twice that at 6 months for both groups, alcohol use and APD prevalence at 8 years approached or exceeded that before pregnancy.

Although we set out to evaluate impact of the PIP intervention on depression and alcohol use at 5 and 8 years, our findings also shed light on maternal depression itself. Antenatal prevalence in this population was high (35%) yet declined systematically over time to 6% at 8 years. The pattern replicated across study conditions and regardless of alcohol use or misuse despite a strong association of depression with alcohol use. Moreover, the intervention did not affect the relationship of alcohol use (any or problematic) with the depression measure over time. Likewise, alcohol use did not change the effect of the intervention on the depression measure over time. These findings suggest that the pattern of maternal depression is grounded in prevailing factors in this population that were not affected by the PIP (Lund et al., 2020).

6.1 Transient intervention effects

Global health experts have focused on the First 1000 Days to deliver developmental gains for children that buffer against later life adversities (Black et al., 2008). This report focuses on the benefits of early interventions for mothers as key agents for child welfare, rather than on their children. Previous findings revealed that the intervention did indeed benefit children

early in life despite limited measurable impact on maternal outcomes. The present analyses track changes in mothers' alcohol use and depression across an 8-year period and detect no intervention effects at the 8-year follow-up. An earlier report found that intervention benefits were undetectable among children at five years (Gordon et al., 2021). How do we understand the shifts in outcome and 'fade-out' of early impacts for children (Bailey et al., 2017)? We suggest that eroded child benefits may relate to the lack of durable change in maternal behavior allied with the challenging conditions that families experience. Given high levels of chronic adversity and a culture of alcohol use, the transient effects on alcohol use may not be surprising, yet the declines in depression are.

Early interventions are not a vaccine against adverse environments, particularly in contexts of endemic poverty, violence, unemployment, fragile health systems, and lack of basic services. Bailey and colleagues (2017) have outlined a 'sustaining environments perspective', arguing that unless early investments are reinforced by access to high quality services and environments across time, benefits will fade and the investments essentially will be unproductive. In LMICs, early intervention and building the foundation for future success is key, but interventions that continue across time in a targeted manner and/or provide other contextual supports are essential. For mothers, safe living conditions and ongoing support for them and their children are necessary to fully realize and build on early child benefits.

6.2 Local beliefs and values

An understanding that mothers should not drink during pregnancy may be widely shared in our study population. Note that reported rates of APD in both groups were lower after pregnancy recognition and minimal after birth, then rebounded by 18 months. Any intervention operates in a context rich with prevailing beliefs, values, and social and power dynamics that may or may not align with assumptions built into the intervention itself. This context frequently is overlooked in intervention design and implementation, as well as interpretation of intervention outcomes. The pronounced shifts in reported alcohol use by both groups at the post-birth assessment may be a case in point. Attitudes about alcohol use during pregnancy and lactation were not directly assessed, yet these behavior shifts may reflect effective communication about alcohol cessation by the extensive public health and prenatal services available to mothers. Conversely, some reports suggest that South African mothers who use alcohol may not adhere to health messages about use, receive conflicting messages from peers and others, and may not change consumption rates during and after pregnancy (Brittain et al., 2017; Onah et al., 2016; Watt et al., 2016). Against this background, the minimal reports of alcohol use post-birth are notable and merit probing to discern whether social desirability was a strong factor in how women responded to the questions about alcohol use, or whether and why mothers actually did change behavior around pregnancy.

Ethnographic findings from a separate ethnographic study of parenting attitudes conducted among Khayelitsa residents by the same study team capture prevalent beliefs and values in the study area and provide evidence that maternal alcohol use is widely stigmatized, viewed as poor parenting detrimental to child welfare. The study involved a structured freelist protocol with 38 caregiving mothers and grandmothers not participating in the Philani study

(Worthman et al., 2016). Mothers were asked to write spontaneous responses to questions about early child developmental needs and parenting practices which included a question about characteristics of poor parenting. Drinking during pregnancy or breastfeeding was not directly probed. Upon completing the freelists, participants were engaged in group discussion of their responses and the logics behind them.

Spontaneous freelist responses yielded 34 characteristics of bad parenting. The five most frequently endorsed indicators were: dirty child (50%), hungry child (47%), lack of care (45%), maltreatment (39%), and drinking (34%). In turn, respondents directly associated maternal drinking, especially alcohol misuse, with poor childcare reflected in a dirty, hungry, uncared-for child at risk for abuse or victimization inside or outside the home. The marks of poor care furthermore stigmatize a child. As one mother observed: "A child who is neglected and not well cared for is different from other children and anyone can see that."

By contrast, maternal depression or sadness was not nominated, although child depression and maternal stress each were listed once. Nonetheless, characteristics associated with depression, such as maternal irritability (shouts at (34%) or no time for (13%) children) and unresponsive parenting (lack of warmth/love 24%, rejecting/unempathic 21%), were nominated as features of poor parenting. Given high maternal depression rates in pregnancy and substantial albeit declining rates after birth, perhaps respondents regard this trajectory as typical.

Given widely shared norms for responsible parenting of young children, mothers may feel less constrained in drinking behavior and freer to pursue personal agendas as their children grow older, more self-sufficient, and less highly dependent for basic needs. These dynamics may contribute to the pattern of sharply curtailed drinking post-birth followed by resumption among drinkers of alcohol use with time.

6.3 Prenatal depression

Over a third of mothers in our sample met criterion for depressed mood in pregnancy. Antenatal rates of depression may match or exceed postnatal levels and vary widely among populations (Biaggi et al., 2016) yet range significantly higher in LMIC than in HIC (Woody et al., 2017), from 19 – 25% to as much as 50% in LMICs contrasted with 7 – 20% in HIC (Chae et al., 2020; Gordon et al., 2021). Associated stressors include partner lack or loss, domestic violence or history of abuse, and high perceived stress and adverse life events (Biaggi et al., 2016), all of which were widespread among the study population. Furthermore, many mothers first learned of their HIV positive status from testing in pregnancy, threatening their own and their children's future (Davies et al., 2016).

By contrast to postnatal depression, prenatal depression remains under-recognized and under-treated (Gelaye et al., 2016). Yet its high prevalence represents a significant contribution to suffering, lost human potential, and the global burden of disease through its deleterious effects on both mothers and their children. Our findings underscore the need to include diagnosis and treatment of depression in standards of prenatal as well as postnatal care.

6.4 Maternal depression

As with prenatal depression, prevalence of postpartum maternal depression varies widely and is significantly lower in HIC than in LMIC (Parsons et al., 2011; Woody et al., 2017), averaging roughly 10% in the former and over 20% in the latter (Chae et al., 2020; Gordon et al., 2021). Few reports provide extended longitudinal data on maternal depression in an LMIC setting (Chae et al., 2020), although they are available for HIC (e.g., Bailey et al., 2021).

Mothers in our sample experienced high rates of depression both before and after pregnancy which declined to much lower levels by 8 years. Dramatic decreases in depression through time are good news for mothers and others; maternal depression in early-mid childhood *per se* also has been associated with child emotional-behavioural difficulties (Woolhouse et al., 2016). Nevertheless, such improvements may palliate, but not obviate, the child developmental impact of maternal depression during pregnancy and early childhood (Bluett-Duncan et al., 2021). Reasons for steady declines in prevalence of maternal depression are unclear. Existing studies of maternal depression across the childrearing years report different trajectories (Bailey et al., 2021; Chae et al., 2020). In our sample, HIV-related fears may have abated as mothers and their children survived the years following diagnosis. Furthermore, while stress of pregnancy, birth, and early childcare in an LMIC is particularly onerous, especially so in the volatile, risky, and challenging township settings where study participants lived, these mothers' lives generally improved and childcare burdens may have lightened as children aged and became increasingly independent, as well as aids for childcare and household tasks (Lancy, 2015).

Social and cultural factors may contribute decisively to depression risk before and after pregnancy. In the qualitative study of parenting attitudes cited earlier, mothers were asked to list what young children need to grow up properly. Mothers nominated priority needs as love (79%), food (66%), care (58%), and cleanliness (45%). Reciprocally, they identified good caregivers as meeting these needs (gives love 47%, feeds child 45%, keeps child clean 42%, and takes good care 38%).

Yet mothers in the PIP study were migrants living in arduous circumstances who reported recent food insecurity (50% of mothers; 29% of their children), were single parents (56%), and experienced settings that challenged cleanliness (68% lived in informal housing; 46% lacked on-site water; 44% lacked indoor sanitation). Consequently, these women were faced with parenting under conditions that made provision of each element of normative good parenting difficult and uncertain. Difficulty or inability to achieve the shared values for good mothering may have contributed to maternal distress during and after pregnancy, particularly in the early period of infancy and toddlerhood when the child's needs are most intense and urgent. Indeed, diverse reports link attainment of shared cultural norms with psychological well-being, and tie depression with failure to achieve valued norms (e.g., Dressler et al., 2017).

Although the underlying mechanisms are uncertain, steady declines in depression in this sample of mothers including those with alcohol mis/use suggests powerful sources of resilience that merit future investigation. Such sources may explain the lack of impact by the

intervention on depressed mood at 5 and 8 years, when the paucity of women experiencing depressed mood in both study conditions may have precluded detection of any intervention effect. Overall, our findings underscore the need for longitudinal information on maternal depression in LMIC and the possible situational factors that determine which interventions will be effective and when.

6.5 Alcohol use patterns

Drinking declined dramatically in this sample after pregnancy recognition regardless of intervention status. Alcohol use and problematic drinking increased from nearly non-existent immediately following birth, rising to approach or exceed pre-pregnancy levels at 8 years. The intervention merely slowed the return to alcohol mis/use. Possible explanations include, first, that situational factors related to alcohol use among the minority of women who drank (~25%) were not addressed by the intervention and played a role in resumption of use after birth. Alcohol use saturates many social settings in the neighborhoods where mothers lived, and culturally established patterns may be difficult to avoid if not mothering young children. Consequently, the observation that PIP mothers returned to pre-pregnancy levels more slowly than controls is notable. Second, most mentoring home visits occurred during pregnancy and the first six months after birth, tapering to biannual visits thereafter. Although CHWs included alcohol screening and training among messages delivered at each visit, these appeared insufficient to counter contextual and personal conditions although they may have contributed to a slower return to alcohol ab/use among PIP mothers.

6.6 Strengths and limitations

We note strengths and limitations of this report. The PIP program differs from many CHW programs in terms of selection, training, and supervision components to enhance local appropriateness, sustainability, and efficacy of the intervention (Tomlinson et al., 2018). The original intervention study design, sample recruitment, and follow-up are strong, domains that were assessed were relatively broad, retention is very good, and post-intervention follow-up of participants was both prolonged and rather frequent (every 2–3 years) although intervention ceased at 6 months post-birth.

Our results indicate limitations to address in future data analyses. In particular, if cessation of alcohol mis/use is indeed normative once pregnancy is discovered and during the early postnatal period, then childbearing patterns would need to be incorporated into analysis and interpretation of the alcohol use patterns. Whether mother was pregnant or post-birth at the later points (3, 5, 8) may contribute to inconsistent results. Moreover, inclusion of ongoing childbearing and rearing activity may help to parse the trajectory of depression through time. For instance, among UK mothers, having 3 or more children under age 5 was associated with increased risk of depression that was exacerbated by stress and adversity (Mulvaney & Kendrick, 2005). Such analyses also may help to clarify relationships of depression and alcohol use in this sample, whose diametric trends through time form an intriguing contrast to a substantial literature documenting synergistic interactions between them and point to sources of intra-population variation (Khan et al., 2020). Finally, interactions among intervention, alcohol use, depression, and HIV status merit investigation.

7. Conclusions

This analysis has yielded insights about both interventions, and maternal depression and alcohol use over time. Focusing interventions on the first 1000 days as a critical developmental period (Martorell, 2017) for establishing durable lifetime benefits may be unduly optimistic given the ongoing and cumulative stressors of chronic poverty and adversity. The notion that a short intervention of 11 home visits would somehow inoculate families against later adversities and poor long-term outcomes may be overly confident at best and ineffective use of resources at worst (Kuzawa & Thayer, 2011). A 'one size fits all' approach, coupled with reliance on brief, infrequent early interventions, is not a viable research or policy approach. Many families, even those living in poverty under considerable adversity, may simply need universal interventions and a 'light touch', while others will require substantially more.

More nuanced tactics for delivery and targeting of support are needed. We suggest any intervention study would benefit from parallel qualitative data on community values and priorities in targeted domains. As shown in our discussion, such data provide grounded bases to interpret quantitative results and identify salient yet overlooked factors. For instance, perhaps a better understanding of life stressors and frequent booster interventions might produce positive benefits for mothers and more durable effects for their children. Such benefits might better be achieved by addressing community social and cultural factors such as those identified here which foster or compound adversity and limited life choices for mothers and their children. We note that, on another level, structural change promoting economic, educational, and health equity would yield broadest durable impact.

Our findings further highlight the potential value of early, sustained alcohol interventions for pregnant women. We observed dramatic reduction of alcohol mis/use in pregnancy and childbirth, yet rates began to rebound soon after birth and attained pre-pregnancy rates by 3–5 years in controls, while intervention slowed the rebound to 8 years. For a developing child, several years is a considerable period. Sustained alcohol interventions with community support may be critically important to enhance children's long-term outcomes. Concurrently, maternal depression incurs negative consequences for both mothers and their children. Aligned with elevated rates in LMIC, over a third of pregnant mothers' reports indicated depression in this sample. Correspondingly, maternal depression in pregnancy and postpartum is associated with less favorable outcomes for child physical and psychosocial development in these as well as high-income settings. Hence, programs targeting the first 1000 days must address maternal depression, particularly the common yet commonly overlooked problem of prenatal depression and the conditions that provoke it.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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> ## Highlights
>
> - Home visiting yields early mother-child benefits that erode without sustained intervention.
>
> - High rates of maternal depression in pregnancy decline systematically over time.
>
> - Pregnancy appears a teachable moment for reducing alcohol mis/use but risk recurs with time.
>
> - Perinatal alcohol intervention can slow resumption of use but benefits disappear by 8 years.
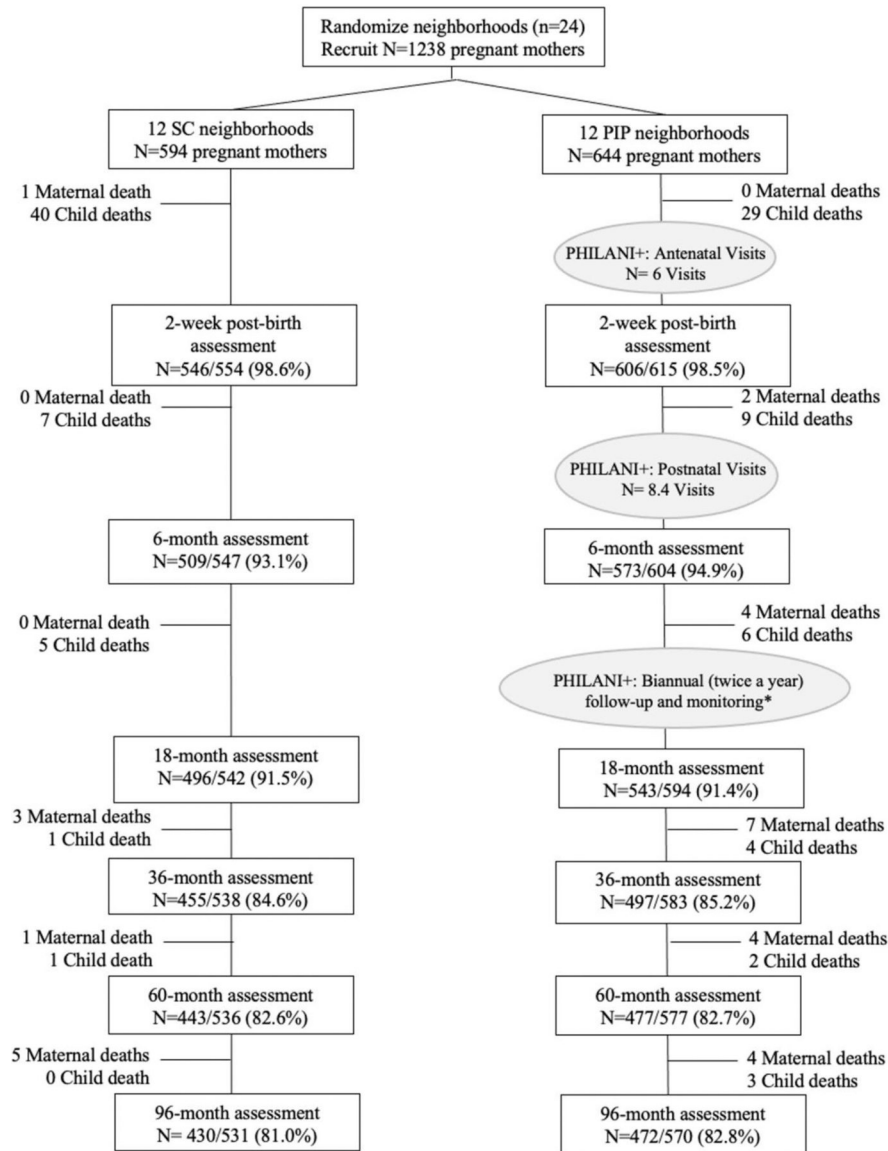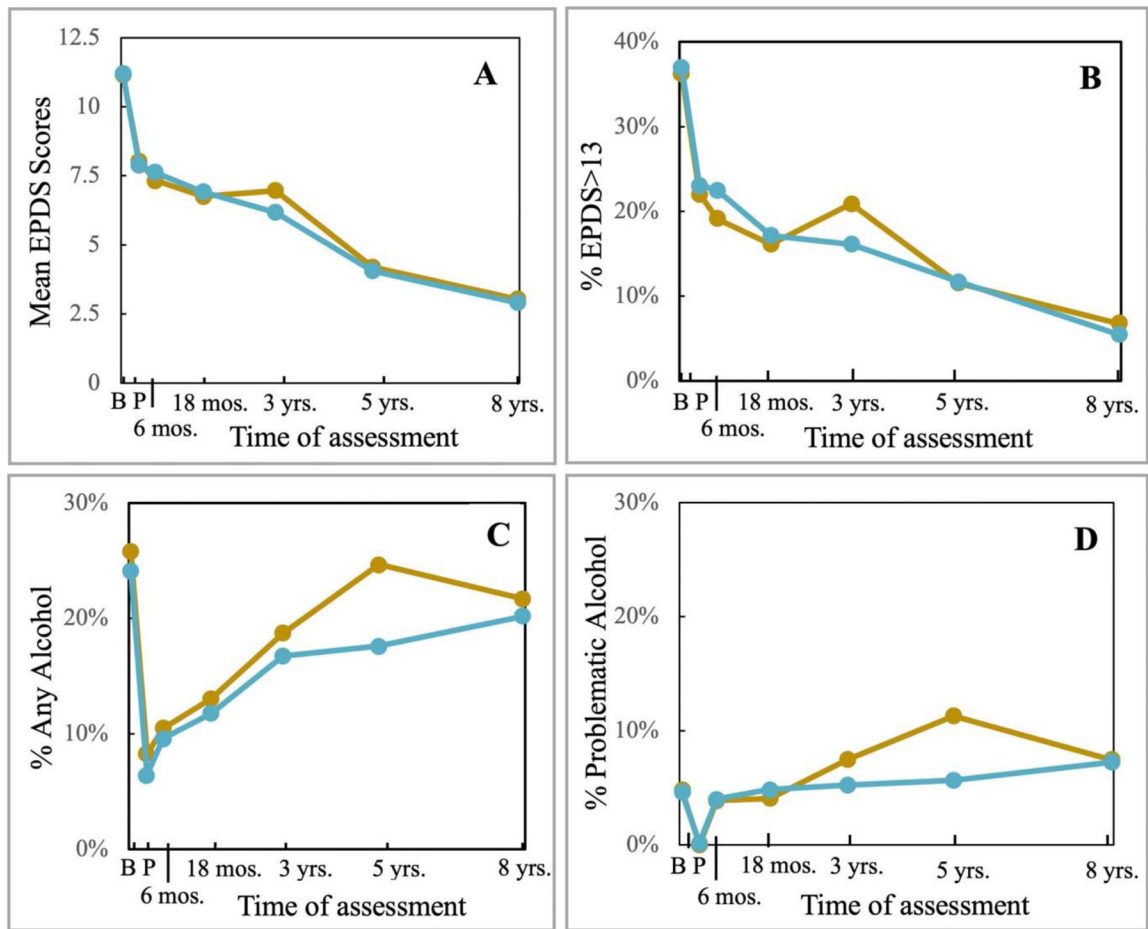
Fig. 1.
Participant flow chart.

Fig. 2.
Mean EPDS scores (A) and proportion of mothers reporting depressed mood (EPDS >13) (B), any alcohol use (C), or problematic alcohol use (D) by time post-birth. (blue = intervention (PIP); gold = control (SC)). (B = baseline; *p* = post-birth)
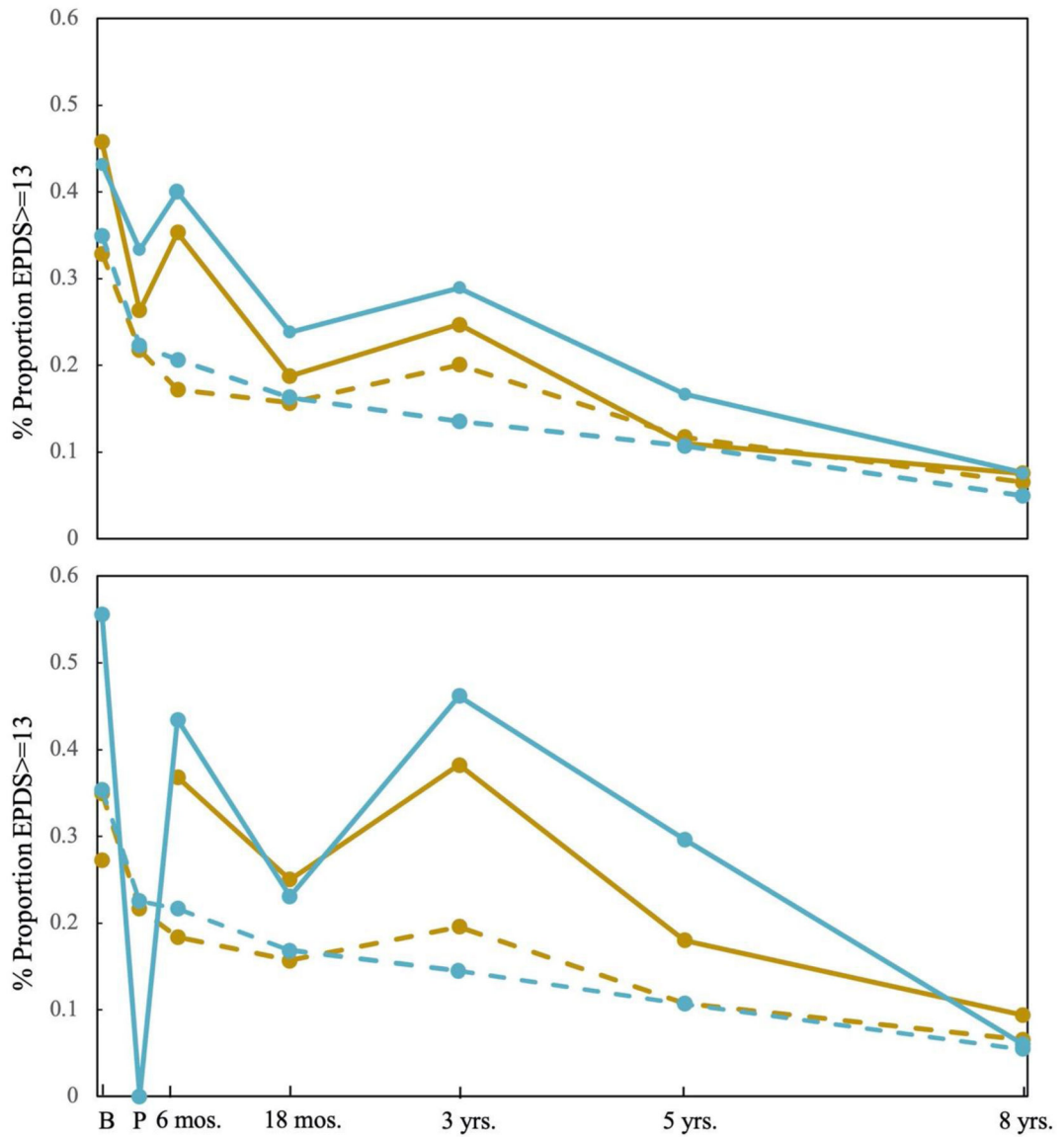
Fig. 3.
Proportions of mothers reporting depressed mood (EPDS >13) by whether they reported any alcohol use (upper panel) or APD (lower panel), by intervention condition and time post-birth. (Upper panel: dashed gold line: SC, no alcohol; solid gold line: SC, any alcohol; dashed blue line: PIP, no alcohol; solid blue line: PIP, any alcohol. Lower panel: dashed gold line= SC, no APD; solid gold line: SC, APD; dashed blue line: PIP, no APD; solid blue line = PIP, APD). (B = baseline; *p* = post-birth)

Table 1.

Differences (95% CI) of average log (EPDS + 1) scores PIP minus SC condition (row 1) and Odds ratios (95% CI) for EPDS >13 in PIP vs. SC condition (row 2). Odds ratio (95% confidence intervals) for drinking comparing PIP to SC among ever drinkers (row 3). OR < 1 indicates more drinking in SC compared to PIP (row 4).

	Post-birth	6 months	18 months	3 years	5 years	8 years
Depressed mood scores	−0.04 (−0.17,0.10)	0.01 (−0.13,0.15)	−0.02 (−0.15,0.12)	−0.09 (−0.23,0.05)	−0.04 (−0.19,0.10)	−0.03 (−0.18,0.12)
Odds ratio EPDS >13	1.02 (0.65,1.61)	1.24 (0.79,1.97)	1.06 (0.66,1.77)	0.60 (0.38,1.00) [*]	1.00 (0.58,1.71)	0.74 (0.37,1.55)
Odds ratio, any drinking	0.66 (0.37,1.21)	0.83 (0.48,1.42)	0.78 (0.46,1.34)	0.79 (0.48,1.30)	0.52 (0.31,0.84) [*]	0.92 (0.55,1.51)
Odds ratio, problematic drinking	NA	0.69 (0.31,1.53)	1.01 (0.44,2.30)	0.53 (0.24,1.21)	0.30 (0.13,0.67) [*]	0.98 (0.44,2.23)

[*] indicates one-way significance < 0.025. EPDS >13 at 3-year p=0.02. Any drinking at 5-year p=0.003. Problematic drinking at 5-year p = 0.02.