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The association of maternal alcohol use and paraprofessional home visiting with children's health: a randomized controlled trial

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Abstract

Objective: This study examines the effect of a home visiting intervention on maternal alcohol use, problematic drinking, and the association of home visiting and alcohol use on children's behavioral, cognitive, and health outcomes at five time points over 5 years.

Method: We analyzed 5,099 observations of 1,236 mothers and their children from pregnancy to five years post-birth, within a longitudinal cluster-randomized trial evaluating the effect of a home visiting intervention on mothers in Cape Town, South Africa. Paraprofessional home visitors coached mothers on coping with multiple risk factors, including a brief, one visit intervention on alcohol prevention in pregnancy. Changes in maternal abstinence, occasional drinking, and problem drinking and the home visiting intervention were examined on child outcomes over time.

Results: Drinking increased over the 5 years post-birth, but was significantly lower in the intervention condition. Compared to abstinence, mothers problematic drinking was associated with decreased child weight (−0.21 z-units) at all assessments, as well as increased child aggressive behavior (3 to 7 additional symptoms) and decreased child performance on an executive functioning measure (the "Silly Sounds" task; odds ratio .34) at 3 and 5 years. The intervention's effect was associated with increased child aggression (0.25–0.75 of one additional symptom), but the intervention appeared to decrease the effect of problem drinking on children's aggressive acts and executive functioning.

Conclusion: These findings support the need for sustained interventions to reduce alcohol, especially for mothers who exhibit problematic drinking. Maternal drinking influences children's health and development over time.

Trials Registration: ClinicalTrials.gov #, registered October 15, 2009.

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Keywords

maternal alcohol use; children's executive function; aggressive behavior; longitudinal data; consequences of problematic drinking

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Recent research on children's developmental cascades shows that exposure to one risk factor early in life predicts subsequent maladaptive behaviors, which then can further impair healthy development (Tomlinson et al., 2016; Masten & Cicchetti, 2010). Children living in low-and middle-income countries (LMIC) are exposed to numerous risks that undermine their developmental trajectories, beginning in utero (Tomlinson et al., 2016; O'Connor et al., 2011). In communities marked by poverty, food insecurity, and community or intimate partner violence (IPV), parental problematic drinking is common (Davis et al., 2017; O'Connor et al., 2011). The consequences on children are substantial (Henderson, Kesmodel, & Gray, 2007).

In South Africa, families chronically experience these challenges, creating ongoing risks to children's development. South African women report some of the highest rates globally of alcohol use, IPV, HIV, TB, and depression (World Bank, 2018; Davis, Rotheram-Borus, Weichle, Rezai, & Tomlinson, 2017; Karim, Churchyard, Karim, & Lawn, 2009). Existing literature on the effects of problematic drinking in South Africa focuses predominately on men, 10% of whom experience alcohol use disorders, compared to 1.5% for women (World Health Organization [WHO], 2014). However, several studies based in the Western Cape of South Africa suggest that the rate of alcohol use disorders among women is much higher, particularly among young Black women in townships (May et al., 2005; Vythilingum et al., 2012). Problematic drinking among women is of critical importance because it is associated with higher rates of unplanned pregnancy, depression, and IPV, as well as reduced adherence to health regimens such as HIV treatment (Rotheram-Borus et al., 2015; Devries et al., 2014).

Maternal alcohol use both during and after pregnancy threatens children's development (Henderson, Kesmodel, & Gray, 2007). In later life, children exposed to alcohol in utero experience increased risk for substance misuse, behavioral problems, poor physical and mental health, and diminished cognitive capacity (Johnson & Leff, 1999; Manning, Best, Faulkner, & Titherington, 2009). Most pregnant women report stopping alcohol consumption upon learning that they are pregnant (O'Connor et al., 2011). Yet, about 25% of South African women in Cape Town report drinking early on in their pregnancies prior to realizing that they are pregnant (O'Connor et al., 2011); this is almost double the national rate of alcohol use among pregnant women (13.2%; Popova, Lange, Probst, Gmel, & Rehm, 2017).

Even among women who abstain from alcohol while pregnant, retrospective reports suggest that many return to pre-pregnancy levels of alcohol consumption after the child is born (May et al., 2016; May et al., 2013). This is problematic, since perinatal alcohol use, both before and after birth, is associated with negative developmental outcomes for children (May et al., 2016). Drinking during breastfeeding is associated with lower weight, lower verbal IQ scores, and more developmental anomalies among children, even when controlling for prenatal alcohol exposure (May et al., 2016). Furthermore, mothers who drink while breastfeeding are 6.4 times more likely to have a child with fetal alcohol spectrum disorders (FASD) than mothers who abstain while breastfeeding (May et al., 2016). In high-income countries, parental problematic drinking is also associated with an increased risk of childhood depression, anxiety, behavioral disinhibition, conduct disorders, and poor academic performance (King et al., 2009; Hill, Tessner, & McDermott, 2011). Thus, drinking in the home may continue to negatively impact children's health outcomes, even after the consequences of perinatal alcohol use. However, we have few data from LMIC, especially in Africa. This study helps fill that gap.

Home visiting by community health workers may be an effective strategy to stop or reduce problematic drinking. By bringing services to women's residences, home visiting circumvents access barriers to health care (Lewin et al., 2010). The Philani Mentor Mothers Intervention Program is a home visiting intervention that shifts healthcare tasks to local township women. This program started in 2002 in the peri-urban townships settlements outside Cape Town, South Africa. Community health workers, known as Mentor Mothers (MM), are community role models who are hired because they have healthy children of their own, as well as strong communication and problem-solving skills (Marsh et al., 2004). They are trained as generalists who address the risks of HIV, malnutrition, maintaining health care, and reducing problematic alcohol use (Rotheram-Borus et al., 2011). Previous reports of the Philani Program's impact include benefits for both the mothers and children receiving home visits, including increased breastfeeding, better infant growth trajectories and recoveries from malnutrition, as well as increased adherence to a single feeding method and tasks to prevent vertical HIV transmission for mothers living with HIV (le Roux et al., 2010; le Roux et al., 2013; Rotheram et al., 2014; Tomlinson et al., 2016). The program also has benefits for children of depressed mothers, including both growth and higher IQ at 6 and 18 months post birth (Tomlinson et al., 2015).

Alcohol use and maternal and child outcomes associated with maternal alcohol use are also targeted outcomes of the intervention. This study examines the effect of the home visiting intervention on mothers' alcohol use, and the association of the intervention and alcohol use with children's behavioral, cognitive, and health outcomes over the first five years of life. Consistent with previous research (Rotheram-Borus et al., 2015; le Roux et al., 2014), we hypothesize that maternal alcohol use is associated with more negative child outcomes and that the intervention will reduce both maternal alcohol use and the associated negative child outcomes.

Methods

The Institutional Review Boards of University of California, Los Angeles (UCLA, #10–000386) approved the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments. This study was registered October 15, 2009 in ClinicalTrials.gov (NCT00996528).

Recruitment

To reduce potential bias, three separate teams led different study components: data collection (Stellenbosch University), intervention implementation (the Philani Program), and analyses (UCLA). Neighborhoods (N=24) of 450 to 600 households each were identified and matched on housing type, availability of electricity, water, sanitation, size, density, presence of child-care resources, the number of bars (shebeens), distance to health clinics within 5km, and duration of residence. The neighborhoods were chosen so that all were separated by buffer zones, to prevent cross-contamination. Neighborhoods were randomly assigned by the UCLA, organized in 6 blocked sets of 4 neighborhoods apiece, into 12 intervention neighborhoods and 12 control neighborhoods.

Recruiters (local, trained women from adjoining township neighborhoods) were trained by the Stellenbosch team to conduct house-to-house visits in each neighborhood repeatedly from May 2009 to September 2010 to invite all pregnant mothers ages 18 years or older to participate. Each recruiter worked in one intervention and one control neighborhood to ensure that recruiter competence was similar across conditions. Pregnant women were recruited at an average 26 weeks of pregnancy (range, 3–40 weeks); only 2% of women (n=25/1263) refused participation. Initially, 22% fewer pregnant women were found in the control neighborhoods (n=500 vs. n=644). Yet, the samples were highly similar in almost all other demographic, risk, and protective factors (le Roux et al., 2013). By redeploying recruiters to all study neighborhoods, an additional 94 pregnant women were found and recruited for a total of 594 mothers in the control condition. Of these late-entering mothers, 19 were recruited within two weeks post-birth, 53 before 6 months, and 22 before 18 months. Figure 1 summarizes the retention and death data for each condition. By five years, a death occurred in 8.9% of mother-child pairs and were then ineligible for the study.

Assessments

There were five follow-up time points over five years (2 weeks, and 6, 18, 36, and 60 months), each with 83%−96% follow-up; 70% completed all assessments. Yet, if any items were missing, the observation may be missing from this paper's analyses.

Standard Care Condition

Standard clinic care in Cape Town was accessible within 5 km of each study neighborhood. Each antenatal clinic provided comprehensive maternal and child health services and prevention of mother-to-child transmission (PMTCT) services, following international guidelines.

Intervention Condition (Philani Program)

In addition to the standard care services, home visits were conducted. The Philani Program, a non-governmental organization, trained township women to become MM. Many of these women had less than a high school education and had never worked outside the home. MM were selected for having good social and problem-solving skills and raising healthy children of their own. MM were identified through three rounds of interviews as well as observations by supervisory community health workers of trainees' homes (to assess organization skills) and their performance during training (MM training is described in further detail below).

Those who completed the training and were selected as MM then shadowed experienced MM and completed a three-month probationary period.

For one month, MM were trained as generalists to apply cognitive-behavioral change strategies and provide health information about HIV/TB prevention, PMTCT strategies, desired health care regimens, the consequences of problematic alcohol use, the importance of breastfeeding, and nutrition (for more details see, Rotheram-Borus et al., 2011). MM were also trained to administer a one-session-long, brief alcohol intervention adapted from O'Conner & Whaley (2007) which included: reviewing characteristics and life-long consequences of alcohol on babies, e.g., by showing a Black doll with FASD (or not) and evaluating the typical amount of alcohol being used by the pregnant woman when drinking, compared to desirable quantities. Videotaped models and role-plays depicting common challenging situations for mothers were provided. MM delivered these messages in at least four antenatal visits and four post-natal visits within the first 2 months of life. All intervention materials can be found at http://chipts.ucla.edu/research/philani-pregnant-women-cape-town/.

MM carried mobile phones to allow monitoring of the duration, content, and place of each visit, pre-programmed by Mobenzi (http://www.mobenzi.com/researcher/). MM reported the meeting content from among eight core intervention topics. The visit duration was automatically recorded based on the entry and exit survey time stamps. This information was reviewed by supervisors and discussed in case consultations during the weekly supervision meetings where they discussed why certain topics were not addressed (e.g., not applicable, or no time due to other priorities) and provided decision-making support.

Measures

Trained and certified interviewers monitored the following measures, which were all translated and back translated into the mothers' native language, Xhosa. All questions were reviewed in focus groups composed of township women prior to mounting the study.

Mothers' alcohol use.—Mothers were asked about their drinking at every assessment using the AUDIT-C (Dawson, Grant, & Stinson, 2005). The post-birth timepoint (except in Figure 2) is excluded because only three mothers reported any drinking at this assessment. At each assessment, mothers were assigned to one of three possible drinking states: a) abstinence (no drinking); b) problem drinking: drank four or more 14 g glasses in one day at least once a month and reported at least one symptom of alcohol withdrawal on the AUDIT Babor, Higgins-Biddle, Saunders, & Monteiro, 2001); or c) occasional drinking (some alcohol use, but did not meet problematic criteria).

Child Measures.

Growth.—Weights and heights were measured and converted to z-scores using the WHO's age-and sex-specific norms (http://www.who.int/childgrowth/standards/en).

Cognitive functioning.—At 18 months, interviewers administered the cognitive and motor scales of the Bayley Scales of Infant and Toddler Development, a measure found valid and reliable in South Africa (including translated versions; Baley, 2003; Potterton et al., 2009).

At 5 years, interviewers administered the Kaufman Assessment Battery for Children—Second Edition (KABC-II; Lichtenberger & Kaufman, 2010). The Mental Processing Index (MPI) of the KABC-II measured executive function and has been validated for use in LMIC (Bangirana et al., 2009).

At 3 and 5 years, the number of correct items on three tasks were reported from the Executive Function Battery, a measure validated in other LMIC (Willoughby, Piper, Kwayumba, & McCune, 2018). The Stroop-like Silly Sounds task is 36 questions and tests if children can stop themselves from associating animal sounds with pictures of animals. The Something's the Same task is 28 items at 3 years and 36 at 5 years, assessing attention-shifting by asking children to match pictures to a sample array. The Operation Span task is 16 questions at 3 years and 20 questions at 5 years, tested working memory by having children name an animal in a picture and the color and then repeat the animal name when prompted with the color.

Social behavior.—At 3 years and 5 years, mothers rated children on the Aggressive Behavior subscale of the Child Behavior Checklist (Achenbach, 1991; Ivanova et al., 2007). Mothers also rated their children on the Prosocial Behavior subscale of the Strengths and Difficulties Questionnaire, a screening questionnaire validated in South Africa (Vostanis, 2006).

Data analysis

We first examined how maternal drinking changes over time and was influenced by the intervention. We then examined how drinking alcohol (in combination with the intervention and time) was related to each child outcome. All analyses were performed as complete-case analyses; that is, all observations that were missing on a variable used by a given analysis were excluded from that analysis. The analysis code can be found at http://arfer.net/projects/philani.

Analysis of alcohol use

To characterize the effect of the intervention on drinking state over time, a mixed-effects ordinal probit-regression model was fitted, using the function clmm in the ordinal R package (Christensen, 2015). Ordinal regression allowed for the retention of the order information of the three drinking states without assuming that they are equally distant; the dependent variable (DV) in this case is ordered with abstinence < occasional drinking < problem drinking. Hence it was allowed, for example, for a larger effect to be necessary to take a participant from occasional drinking to problem drinking than from abstinence to occasional drinking. Ordinal probit regression, specifically, resembled linear regression in that it modelled a quantity as a linear combination of several predictors plus normally distributed random error. Unlike linear regression, this quantity was not observed directly. Rather, it was discretized into one of k ordered categories (three drinking states, in this study's case) on the basis of k – 1 thresholds on the real line, and what was observed was the resulting category (e.g., the drinking state). The model estimated these thresholds as well as the model coefficients. For identifiability, the model intercept was fixed at 0 and the SD of the error term was fixed at 1.

In addition to the intercept, the model included dummy-coded independent variables (IVs) for assessment and intervention condition, including all interactions. These IVs were treated as fixed effects, and a random intercept was included for each mother.

Analysis of child outcomes

To examine the effect of drinking and the intervention on child outcomes, each outcome was analyzed separately. There were two models for each outcome, distinguished by whether alcohol-related terms were present. The no-alcohol models had no terms for alcohol, whereas the alcohol models had two dummy variables for occasional drinking and problem drinking, and an interaction term for each of these dummy variables with intervention condition.

The models were compared using the Akaike information criterion (AIC; Akaike, 1973) to determine which model best trades off between maximizing the fit and minimizing the number of parameters, the model with least AIC being the one with the best tradeoff. For example, a study (Grajeda et al., 2016) considered longitudinal models of children's height that had different combinations of regression terms and selected the model with the lowest AIC.

Other features of the models differed by the DV. Mixed-effects models were used for DVs that were measured at multiple timepoints, namely, growth, prosocial behavior, and executive functioning. Similar to the model described above, these models had mother-level random intercepts. Time was treated as a categorical variable, with fixed effects for each time point (omitting a fixed intercept in favor of using a dummy variable for every time point). We also included interactions of each time point with the intervention condition. (A main effect of the intervention condition would have been unidentifiable and hence was excluded.) Models with only fixed effects, including a main effect of the intervention, were used for outcomes measured at a single timepoint, namely the Kaufman Scale for cognitive development, which was measured only at 5 years, and the Bayley Scales, which were administered at 18 months. For most DVs, normally distributed error was assumed, but for the executive-functioning scales, the DV was treated as binomial, with the number of binomial trials set to the number of items in the scale, so in this case the models used mixed-effects logistic regression. All mixed models were fit with the R package lme4 (Bates, Mächler, Bolker, & Walker, 2015), computing confidence intervals with the percentile bootstrap.

Results

Sample characteristics

Baseline and demographic characteristics of the sample were discussed in le Roux et al., 2013 and Rotheram-Borus et al., 2011. At recruitment, the mean age of the Black-African mothers was 26.4 and they had a mean of 10.3 years of education; 57% were married or living with a partner, 19% were employed, 31% lived in formal housing (vs. a backyard shack), and 47% had a monthly income of at least 2,000 Rand (about $150). Most households (90%) had electricity, 53% had water, and 55% had flush toilets.

Analysis of alcohol use

There were 4,400 mother-time point pairs at which the mothers were abstinent, 433 at which mothers were occasional drinkers, and 266 at which mothers were problem drinkers. At the 5-year time point, there were 920 mothers and of these, 77 (8.3%) were drinking problematically, 116 (13%) were drinking occasionally, and the drinking state of one mother (0.0011%) was missing. Table 1 shows the coefficients of the model that has drinking state as the DV and includes confidence intervals and p-values. We interpret all our results in terms of raw regression coefficients and confidence intervals. The boundary between abstinence and occasional drinking was estimated as 2.15, whereas the boundary between occasional drinking and problem drinking was estimated as 3.04. The coefficients showed that drinking increases over time, whereas the intervention attenuated this. However, this intervention effect only became substantial at the 5-year timepoint. Figure 2 shows that the same trends appear when comparing proportions at each timepoint. Including both intervention and control mothers, 105 of 1143 mothers (9.2%) with non-missing alcohol data were drinking at baseline and by the 5-year follow-up, 193 of 919 mothers (21%) were drinking. At the 5-year follow-up, 13% of control mothers were occasional drinkers and 11% were problem drinkers, whereas 12% of mothers receiving home visiting were occasional drinkers and 6% were problem drinkers.

Analysis of child outcomes

AICs of the models for each child outcome are shown in Table 2. In the case of height, prosocial behavior, MPI, the two Bayley scales, Operation Span, and Something's the Same, the model that did not account for alcohol outperforms the model that did (none of the AIC improvements exceeded +0.5). That is, the relationship of alcohol with these child outcomes, controlling for time and intervention condition, was not strong enough to justify the addition of alcohol information to the models. For DVs for which the no-alcohol model was selected, we had no conclusions to draw about the effects of maternal drinking, but the model coefficients were informative about time and the intervention. Children were overall shorter than average, and their performance on the executive-function tasks improved dramatically from age 3 to age 5. However, the intervention had little effect on height, the Bayley scales, MPI, prosocial behavior, the Operation Span task, or the Something's the Same task. The coefficients of the selected model for each DV are shown in Table 3. Fewer children completed the Bayley Scales because mothers did not always bring their children to the assessments located at research centers in the townships. Since the Bayley Scales could not be conducted in the home, fewer children completed this assessment.

In the case of weight, the model is depicted in Figure 3. As an example of how to interpret its coefficients, this model predicted that, at the 5-year timepoint, a child of a mother in the control condition currently drinking problematically would have a weight z-score of 0.01 – 0.21 = −.20. At 6 months, children were heavy on average, but reached normal weight by 3 years. Occasional drinking was not strongly associated with weight, whereas problem drinking was associated with a slight decrease, about a fifth of a z-unit. The intervention had little effect.

The model for aggressive behavior scores is depicted in Figure 4. Mothers reported less aggressive behavior at 5 years of age than at 3. Mothers' occasional drinking was associated with slightly more aggressive behavior, and problem drinking was associated with much more aggressive behavior. The intervention seemed to have a weak effect of increasing aggression on its own but ameliorated the effect of problem drinking.

The model for Silly Sounds scores is depicted in Figure 5. There was a dramatic effect of time, with children performing much better at 5 years of age than at 3. The intervention had little effect on its own, but problem drinking was associated with lower scores on this task of cognitive development, and the intervention undid the effect of problem drinking.

Discussion

Maternal alcohol consumption, both during and after pregnancy, is a health risk for children. This paper examines longitudinal patterns of mothers' alcohol use and child outcomes in South African townships from pregnancy to 5 years post-birth. Consistent with rates of prenatal alcohol use found previously in South Africa (Popova et al., 2017), 25% of mothers report drinking prior to recognizing pregnancy and one in ten women continue drinking during their pregnancy. It is encouraging to find that alcohol use drops substantially by two weeks after giving birth. However, by five years, one in five mothers is again drinking, similar to the rate of alcohol use before pregnancy (Davis et al., 2017). This is also supported by previous studies, which find that most women in high income countries substantially reduce their alcohol consumption upon pregnancy recognition and gradually return to pre-pregnancy drinking habits (including binge drinking) after giving birth (National Survey on Drug Use and Health, 2009). Consistent with past research (National Survey on Drug Use and Health, 2009), the most rapid rise in alcohol use occurs in the first 6 months after birth.

The Philani intervention curtails mothers' problematic drinking at 5 years. MM deliver one alcohol-specific session in their home visits during pregnancy, however they are generalists and address multiple challenges faced by township mothers concurrently, including malnutrition, HIV, and IPV (Rotheram-Borus et al., 2011). As demonstrated in previous publications from this study, intervention mothers have healthier children (le Roux et al., 2010; le Roux et al., 2013; Rotheram et al., 2014; Tomlinson et al., 2016). While the intervention includes a brief, one-day session covering the impacts of alcohol use (O'Connor & Whaley, 2007), it is also possible that childcare is easier for intervention mothers whose children are healthier. This may also contribute to intervention mothers being less likely to drink. The current findings support this generalist approach and the program's effectiveness in helping to prevent maternal problematic drinking across time, which in turn may help reduce health risks for mothers and their children.

Maternal problematic drinking is associated with a small decrease in children's weight, while occasional drinking among mothers had an even smaller effect. These effects are in the same direction but smaller than effects found in previous research linking postnatal alcohol use while breastfeeding with lower child weight-for-age (May et al., 2016).

Compared to children of occasional drinkers and abstainers, children of mothers engaged in problem drinking score lower on the Silly Sounds Stroop–like measure of inhibitory control. These findings are consistent with prior research suggesting that children of alcoholic mothers perform poorly on tests of cognitive inhibition (Nigg et al., 2004; Noland et al., 2003). However, research on maternal postpartum alcohol use – which commonly focuses on drinking during breastfeeding – shows mixed results regarding the effects on child cognitive function depending on the child's age. One study found that alcohol use during breastfeeding is predictive of lower scores among infants on motor development tasks, but not mental development tasks (Little, Anderson, Ervin, Worthington-Roberts, & Clarren, 1989). More recent findings demonstrate that drinking while breastfeeding is associated with significantly lower verbal IQ scores in first graders, even after controlling for prenatal alcohol exposure (May et al., 2016). However, of six variables related to cognitive or motor development we examined (from the Bayley scales, the Kaufman scales, and the Executive Function Battery), only one is associated with drinking strongly enough to justify inclusion of drinking in a model, even with our large sample. Thus, some consequences of pre-and postnatal maternal drinking may manifest in early childhood years, but may not necessarily be detectable during the first years of life. For the Silly Sounds tests, we find that the intervention increases scores among children of problematic drinkers. This suggests that, although the intervention aims to reduce maternal alcohol use, the program still benefits the children of mothers who continue to engage in problematic drinking.

Consistent with previous findings linking maternal drinking during pregnancy and aggressive child behavior, maternal occasional and problem drinking is associated with mothers' reports of more aggressive behavior among their children (Sood et al., 2001; Fuller et al., 2003). The intervention reduces, but does not eliminate, this increase in aggression among the children of problem drinkers.

Limitations

One limitation of this study is the exclusion of mothers under 18 years old during recruitment. Previous research shows that alcohol use among South African women is associated with younger maternal age (O'Connor et al., 2011) and is highly prevalent among adolescents (Parry et al 2004; Madu & Matla, 2003). The inclusion of adolescent mothers may have produced slightly different rates of alcohol use. However, a recent study by this team found similar rates of adolescent and adult mothers drinking in the Eastern Cape (le Roux et al., 2018).

Furthermore, it is possible that mothers in our sample underreported their drinking levels to interviewers, due to the stigma around alcohol (Viljoen, Croxford, Gossage, Kodituwakku, & May, 2002). Past data show that as many as 42% of women in Cape Town townships engage in problematic drinking, according to self-administered (as opposed to interviewer-administered) questionnaires (Wong, Huang, DiGangi, Thompson, & Smith, 2008). Thus, using biomarkers or self-administered questionnaires may reduce the effect of stigma and self-report bias. However, interviewers in this study are of the same cultural/ethnic background as participants and the rate of consent to participate is high (98%), suggesting that women are open to discussing their pre-and postnatal practices. Further, future analyses may consider family-level factors found to be associated with both parental drinking and negative child outcomes, including food insecurity, IPV, and depression (Kalichman et al., 2012; O'Connor et al., 2011).

Conclusions

Children raised in contexts of maternal pre-and postnatal alcohol use and abuse fare worse than children raised in the absence of such risks. While the existing literature on maternal alcohol use and child outcomes focuses overwhelmingly on prenatal drinking, postnatal drinking is far more prevalent and can still pose serious health risks for mothers and their children (Laborde & Mair, 2012). The current study suggests that maternal alcohol use decreases during pregnancy but then increases after pregnancy, marking an important opportunity for intervention. Mothers in the Philani home visiting program are less likely than mothers in the control condition to drink problematically post-pregnancy, and problematic drinking is associated with slightly lower weight, decreased inhibitory control, and more aggressive behavior among children. The current findings support the continued need for home visiting intervention programs in the first years after the child is born to support healthy maternal and child outcomes.

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Public Health Significance:

This study highlights the need for home visiting programs that address maternal drinking during pregnancy and early childhood. Even brief alcohol interventions, nested within a generalist home visiting intervention, result in less problematic drinking over the next 5 years. The findings demonstrate that problematic alcohol use is associated with children's increased challenge to maintain healthy growth, inhibitory control, and non-aggressive behavior overtime.

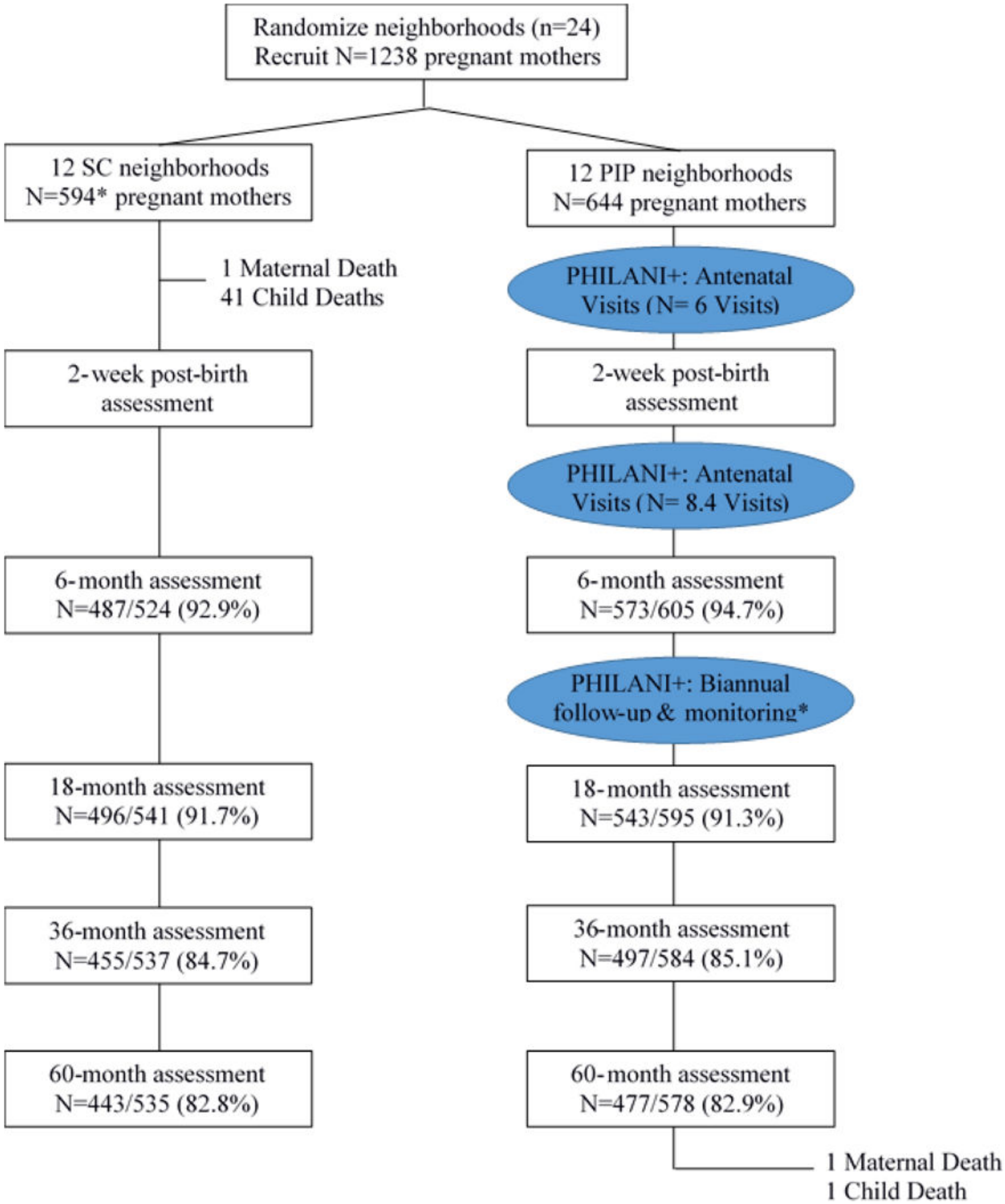

Figure 1.

Flow of mothers through the study. Proportions marked with an asterisk include late-entering mothers (see text) even when they were recruited after the indicated timepoint, and hence contributed only retrospective data to that timepoint.

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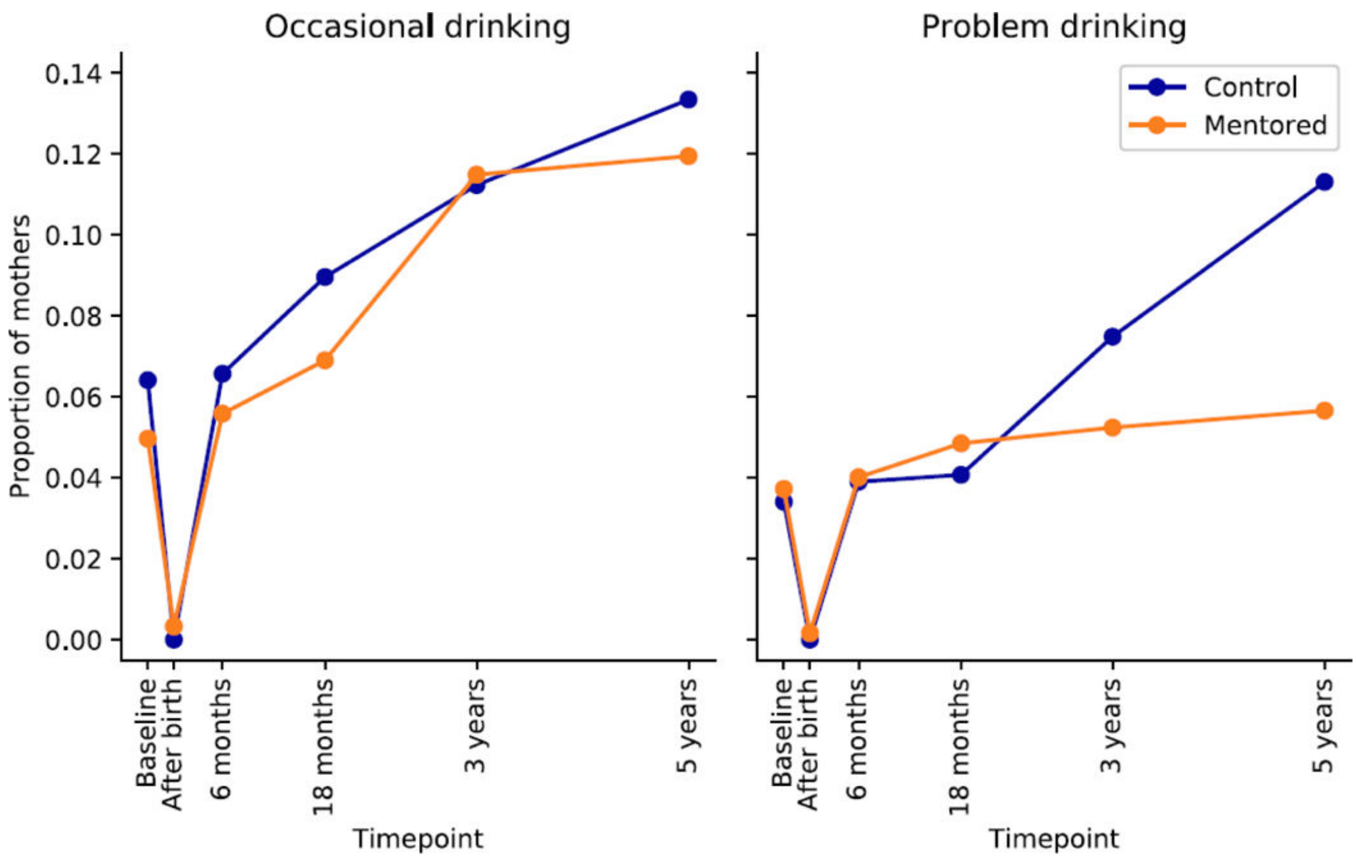

Figure 2.

The proportion of mothers who were occasional drinkers or problem drinkers at each timepoint, colored by intervention condition. The *x*-axis is spaced proportionally to the mean time elapsed between interviews

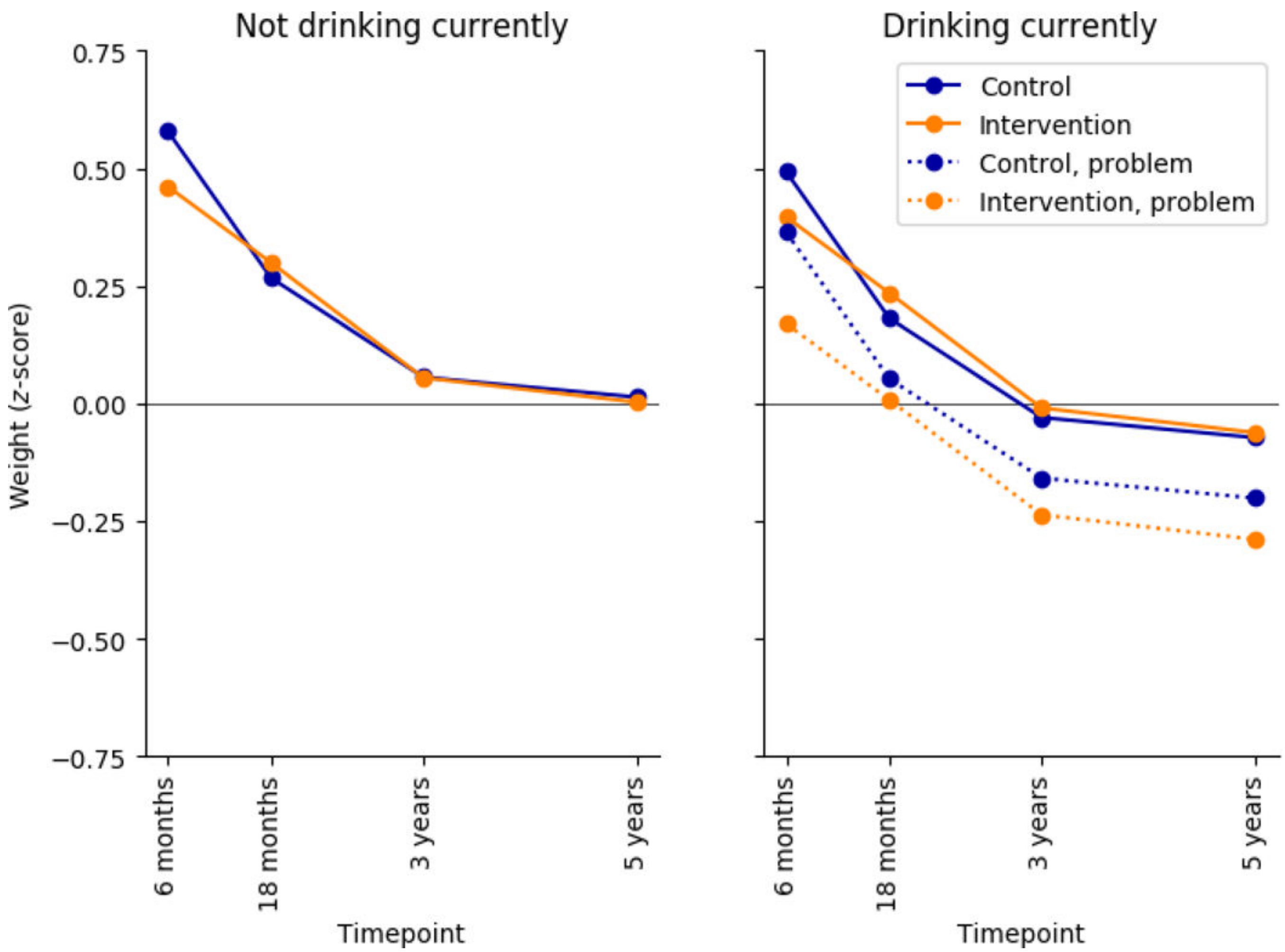

Figure 3.

Child weight-for-age *z*-score as predicted by treatment and drinking. Solid lines in the drinking panel represents occasional drinking.

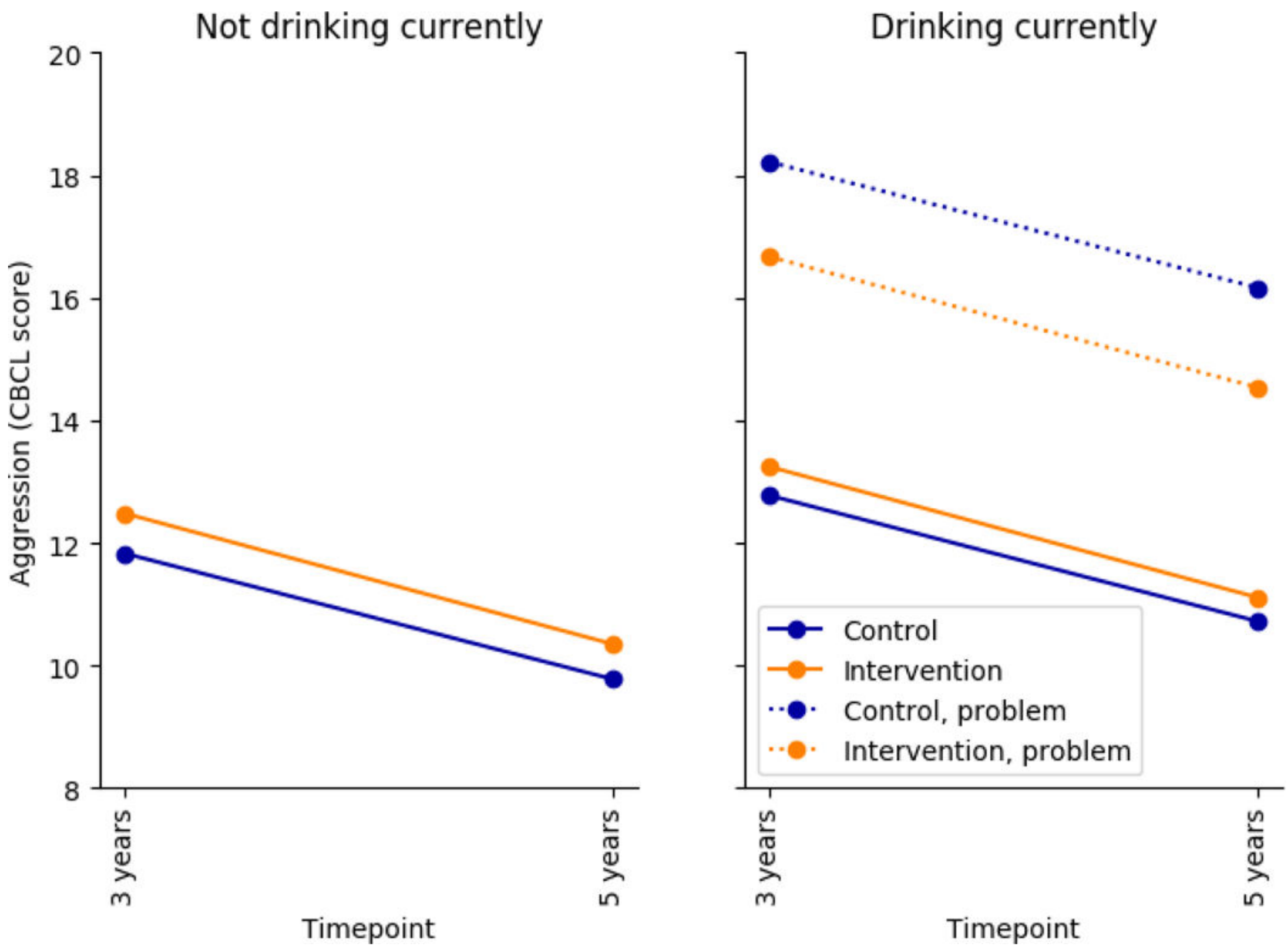

Figure 4.
Child CBCL aggression as predicted by treatment and drinking. Solid lines in the drinking panel represent occasional drinking.

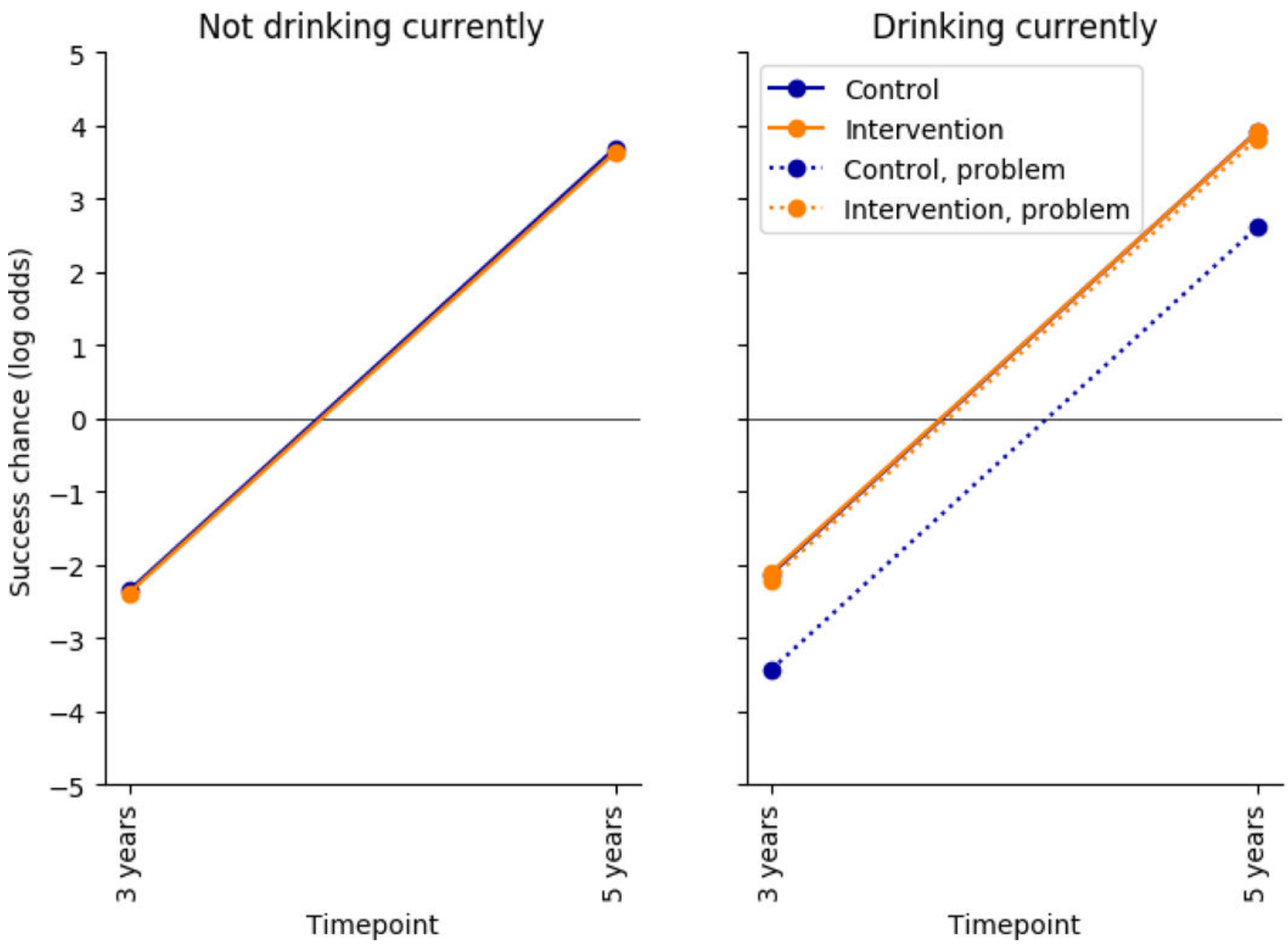

Figure 5.

Log odds of answering a Silly Sounds item correctly as predicted by treatment and drinking. Solid lines in the drinking panel represent occasional drinking.

Table 1.

Unstandardized fixed effects (with 95% confidence intervals) of the mixed-effects ordinal-regression model characterizing drinking over time.

Coefficient	Value
Main effects	
6 months	0.04 [−0.23, 0.31], p = .79
18 months	0.23 [−0.04, 0.49], p = .09
3 years	0.61 [0.36, 0.87], p < .01
5 years	0.98 [0.72, 1.23], p < .01
Intervention	−0.04 [−0.35, 0.28], p = .82
Interactions	
Intervention × 6 months	
Intervention × 18 months	−0.04 [−0.41, 0.33], p = .84
Intervention × 3 years	−0.02 [−0.38, 0.34], p = .92
Intervention × 5 years	−0.11 [−0.46, 0.24], p = .54

Table 2.

Summaries of the regression models for child outcomes. "AIC improvement" is the AIC of the No Alcohol minus the AIC of the Current Drinking model, so higher scores mean greater improvement over No Alcohol, and negative numbers mean worse models than No Alcohol. EF = executive function

I	Weight	Height	Bayley Cognitive	Bayley Motor	MPI	Aggressive Behavior	Prosocial Behavior	EF: Silly Sounds	EF: Operation Span	EF: Something's the Same
Observations	3,374	3,370	473	473	646	1,567	1,567	1,545	1,545	1,545
Mothers	1,003	1,003	473	473	646	879	879	866	866	866
Timepoints	4	4	1	1	1	2	2	2	2	2
AIC improvement: drinking	5	−5	−8	−6	−8	42	−3	18	−7	0

Table 3.

Unstandardized coefficients and 95% confidence intervals of the selected model (alcohol or no-alcohol) for each dependent variable.

I	Weight	Height	Bayley Cognitive	Bayley Motor	MPI	Aggressive Behavior	Prosoeial Behavior	EF: Silly Sounds	EF: Operation Span	EF: Something's the Same
Main effects										
(Intercept)			52.45 [51.66, 53.24], p<.01	51.14 [50.75, 51.52], p<.01	83.50 [82.18, 84.82], p<.01					
6 months	0.58 [0.47, 0.69], p<.01	−0.27 [−0.39, −0.15], p<.01								
18 months	0.27 [0.15, 0.40], p<.01	−0.62 [−0.75, −0.49], p<.01								
3 years	0.06 [−0.07, 0.17], p=.35	−1.40 [−1.51, −1.28], p<.01				11.83 [11.07, 12.64], p<.01	7.59 [7.38, 7.81], p<.01	−2.35 [−2.56, −2.13], p<.01	−3.02 [−3.20, −2.87], p<.01	−2.20 [−2.30, −2.11], p<.01
5 years	0.01 [−0.11, 0.15], p=.82	−0.60 [−0.75, −0.48], p<.01				9.77 [8.84, 10.61], p<.01	8.16 [7.94, 8.39], p<.01	3.69 [3.49, 3.92], p<.01	−0.10 [−0.23, 0.03], p=.13	−0.63 [−0.73, −0.53], p<.01
Current occasional drinking	−0.09 [− 0.23, 0.08], p=. 27					0.94 [−0.81, 2.59], p=.26		0.10, 0.58], p=. 22		
Current problem drinking	−0.21 [− 0.43, − 0.03], p=.03					6.39 [4.23, 8.34], p<.01		−1.08 [− 1.52, − 0.63], p<.01		
Intervention			−0.42 [−1.46, 0.61], p=.42	0.24 [−0.26, 0.75], p=. 35	−0.40 [−2.16, 1.37], p=.66					
Interactions										
Intervention × 6 months	−0.12 [−0.28, 0.04], p=.12	0.14 [−0.02, 0.29], p=.09								
Intervention × 18 months	0.03 [−0.12, 0.19], p=.68	0.05 [−0.11, 0.24], p=.53								
Intervention × 3 years	−0.00 [−0.16, 0.16], p=.99	0.02 [−0.14, 0.19], p=.78				0.65 [−0.43, 1.64], p=.23	−0.34 [−0.63, −0.08], p=.02	−0.03 [−0.31, 0.25], p=.83	−0.14 [−0.35, 0.11], p=.19	−0.01 [−0.14, 0.12], p=.83
Intervention × 5 years	−0.01 [−0.18, 0.15], p=.90	0.03 [−0.15, 0.21], p=.77				0.57 [−0.67, 1.81], p=.33	−0.04 [−0.33, 0.31], p=.78	−0.05 [−0.37, 0.26], p=.73	0.05 [−0.14, 0.24], p=.58	0.03 [−0.10, 0.15], p=.68
Intervention × Current occasional drinking	0.02 [−0.21, 0.23], p=.84					−0.18 [−2.43, 1.84], p=.87		0.05 [−0.44, 0.55], p=.83		
Intervention × Current problem drinking	−0.08 [−0.35, 0.22], p=.59					−2.20 [−5.14, 0.87], p=.15		1.26 [0.59, 1.98], p<.01		