



Prenatal alcohol consumption and infant and child behavior: Evidence from the Growing Up in New Zealand Cohort

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ABSTRACT

Background: High levels of alcohol exposure during pregnancy can damage developing brains and influence child behavior and learning.

Aim: To examine the effects of lower levels of alcohol and very early exposure to alcohol on infant temperament and child behavior.

Study design, subjects, and outcome measures: The Growing Up in New Zealand study involves a prospective birth cohort of 6822 pregnant women of whom 6156 provided information on their child's temperament using the Infant Behavior Questionnaire-Revised (IBQ-R VSF) at 9 months and their child's behavior using the Strengths and Difficulties Questionnaire at 2 years.

Results: A series of adjusted linear regression models controlling for socio-demographic factors found alcohol consumption during pregnancy was most consistently related to Lower Positive Affect, Affiliation/Regulation, and Orienting Capacity temperament scores. Mothers who stopped drinking after becoming aware of their pregnancy, but had an unplanned pregnancy (hence may have a baby exposed to alcohol for longer), also reported infants with lower Orienting Capacity, Affiliation/Regulation, and Fear temperament scores compared to those that did not drink. Children whose mothers drank four or more drinks per week during pregnancy were more likely to report their child as having conduct problems, with higher total difficulties scores at age 2.

Conclusions: Alcohol consumption during pregnancy has a negative effect especially on infant temperament, even if small amounts of alcohol are consumed. Our findings have implications for men and women who drink, medical professionals, and for the availability of contraception to those who drink, but do not plan to get pregnant.

1. Introduction

Parents all over the world intend to give their children the best possible start in life. Increasingly, researchers have started to look at how environmental factors very early in life (usually in utero) can influence the development of wellbeing throughout life [1–3]. This is known as the Developmental Origins of Health and Disease (DOHaD) approach.

While the detrimental effects of some exposures, such as certain infections or toxins are well known, there is a large number of other factors that are expected to have more subtle effects. Alcohol

consumption during pregnancy is one of the established factors that can cause strong negative effects on the offspring. These effects are referred to as fetal alcohol spectrum disorders (FASD) which can include growth impairments, neuro-cognitive delays and altered facial features [4]. While FASD is more likely to occur in children that have been heavily exposed to alcohol during pregnancy, only in the recent years has research started to look into the more subtle effects on the offspring, which may be associated with lower alcohol exposure [5, 6].

One area of interest is child behavior where a few studies have shown an association between high levels of alcohol consumption and later behavioral outcomes, such as conduct problems, hyperactivity,

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emotional problems as well as internalizing and externalizing behaviors [7–9]. However, less is known about whether low to moderate levels of alcohol consumption during pregnancy can affect infant and child behavior and whether the timing of alcohol consumption plays a role in this association.

Some studies provide evidence for an effect of moderate alcohol consumption (up to six drinks a week) during pregnancy on negative behavioral outcomes [10, 11]. Studies looking at mild or low alcohol consumption are sparser, and the research evidence is more contradictory. Sood and colleagues [12] looked at average levels of alcohol exposure across pregnancy and found that one drink per week increased the chance of clinically significant behavioral problems in 6–7 year-olds. They also reported a dose response of more alcohol consumption being associated with increased behavioral problems and higher delinquent scores. Similar findings were found by Sayal, Heron, and Golding [13] who looked at mothers who had less than one alcoholic drink a week during the first trimester. However, in Sayal et al.'s [14] study the associations with clinically significant behavior and emotional problems were only found in girls aged 4, although these gender specific findings were found to persist at 8 years of age and were verified by teacher reports.

In contrast, Kelly et al. [8, 15] found that low or mild alcohol consumption during pregnancy (drinking no more than 1–2 drinks per week across the pregnancy) did not increase the risk of clinically relevant behavioral or cognitive difficulties in 3–5 year-olds. A subsequent study [16] found that children born to low drinkers (no more than 1–2 units per week during pregnancy) had fewer behavioral difficulties at age 7 compared to those born to mothers who reported not drinking during pregnancy, however, these differences largely disappeared after statistical adjustment for potential confounders. These findings led the authors to conclude that exposure to low alcohol in utero does not appear to have a negative impact on subsequent child development. It is, however, worth noting that Kelly et al.'s studies [8, 15, 16] asked the mothers about their alcohol consumption retrospectively (when their infants were 9 months old), and did not include consideration of the timing of alcohol exposure.

Given that women often do not know if they are pregnant for some time, it is somewhat concerning that few studies have looked at the impact of alcohol exposure early in pregnancy, and to our knowledge, no studies have examined the differential effects of stopping drinking once the pregnancy is recognized, compared to those who drank low amounts across their pregnancy. Those that have looked at early alcohol exposure have tended to look at the effects of early binge drinking. For example, Alvik et al. [9] found that early binge drinking was associated with conduct problems, emotional problems, and hyperactivity, and O'Leary [7] found early binge drinking was associated with increased internalizing problems.

Fetal organs are most susceptible to damage during early pregnancy, when many women may not yet know they are pregnant [17]. Frequent alcohol consumption among women in reproductive age is very common. A recent Australian study found that while less than 20% of women continue drinking after they become aware of their pregnancy, the majority of women drink between conception and recognition of the pregnancy [18]. Alcohol consumption between conception and recognition of pregnancy may be partly due to unplanned pregnancies, but may also reflect the lack of awareness of possible risks for the child associated with alcohol exposure in very early pregnancy.

In this study, we used information from pregnant mothers about the amount of alcohol consumed during pregnancy and before becoming aware of the pregnancy. We then measured infant temperament at 9 months using the very short form of the Infant Behavior Questionnaire-Revised (IBQ-R VSF) and child behavioral problems at age 2 using the Strengths and Difficulties Questionnaire (SDQ).

The aim of this study is to describe the association between alcohol exposure during pregnancy and infant temperament and child behavioral outcomes using data from the Growing Up in New Zealand

prospective longitudinal study. The focus is on studying whether very early exposure and exposure to low levels of alcohol consumption can negatively affect infant and child behavior.

2. Material and methods

2.1. Participants

A total of 6822 pregnant New Zealand women were recruited from four District Health Board regions in New Zealand to complete an antenatal interview and for their child to subsequently participate in the Growing Up in New Zealand study for up to 21 years [19]. The cohort is broadly generalizable to New Zealand birth statistics with respect to ethnicity, maternal age, and socioeconomic status [20]. Children were included in the current study if their mother had antenatally provided information on maternal alcohol consumption ($N = 6822$), their infant's temperament at 9 months of age ($N = 6476$) and their child's behavioral problems at 2 years of age ($N = 6242$). This left a final sample of 6156 children with information at all three time points of which 3177 (51.6%) were male and 2979 (48.4%) were female. The mean gestational age of the children at birth was 39 weeks ($SD = 1.9$). The majority of the children in the final sample were identified by their mother as European (46%), followed by Māori (24%), Pacific Peoples (14%), Asians (14%), and Other (2%).¹

2.2. Outcome variables

Infant temperament was measured via maternal report when infants were approximately 9 months old using the Infant Behavior Questionnaire-Revised Very Short Form (IBQ-R VSF) [27]. The IBQ-R VSF uses 37 items designed to assess three broad temperament traits: Positive Affect/Surgency (PAS), Negative Emotionality (NEG) and Orienting and Regulatory Capacity (ORC). We used a five-factor model for our analysis, as it was found previously that a five-factor structure was a better statistical model fit for the Growing Up in New Zealand Cohort than the three-factor structure [21]. The five-factor model consists of NEG, PAS and a slightly altered factor Orienting Capacity, along with two new factors Affiliation/Regulation and Fear, which separated out from the broader factors of NEG and ORC respectively (see Table 1 for a brief description of these factors). In completing the IBQ-R VSF, mothers or caregivers are asked to indicate how frequently their child engaged in specific behaviors during the past week on a scale from 1 to 8.

Child behavioral problems were measured via parent report when the children were 2 years old, using the preschool version of the Strengths and Difficulties Questionnaire (SDQ) [22]. The SDQ consists of five sub-scales measuring emotional problems, peer problems, hyperactivity-inattention, conduct problems and prosocial behavior. Responses were rated on a three-point Likert scale and a score out of 10 was calculated for each subscale. For the difficulties measures, higher scores indicate greater difficulties. For the prosocial subscale, a higher score indicates more prosocial behavior. The sum of the difficulties subscales was also used to calculate a total difficulties score, where the prosocial subscale was reverse-coded to fit with the other subscales [23].

2.3. Alcohol exposure variables

Maternal alcohol consumption during pregnancy was measured via a computer assisted personal interviewing (CAPI) during the last

¹ As part of the antenatal interview, mothers were asked to describe which ethnic group(s) they expected their child to identify with. For the purpose of this analysis, data has been coded into Level 1 categories using Statistics NZ coding criteria (2005).

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