

Alcohol Use in Primiparous Women Older Than 30 Years of Age: Relation to Infant Development

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ABSTRACT. The effects of maternal alcohol use on mental development, growth, and dysmorphogenesis was studied in a sample of 1-year-old infants born to elderly primiparous mothers. Alcohol intake was measured using Jessor's AA score and a simple count of maximum number of drinks consumed in one day. Infant cognition was assessed using the Bayley Scale of Mental Development. Alcohol levels prior to, during, and following pregnancy were obtained. Alcohol intake was greatly reduced during pregnancy, returning to prepregnancy levels following birth. A significant linear relationship between drinking prior to pregnancy and infant mental development was found. The average mental development score of infants whose mothers consumed ≤ 3 , 3.3 to 29.7, or ≥ 30 mL (≤ 0.10 , 0.11 to 0.99, or ≥ 1.0 average fluid ounces) of absolute alcohol per day was 115, 108, and 95, respectively. Maximum number of drinks consumed in a day related to physical anomalies. No alcohol measure was significantly correlated with condition at birth, postnatal illness, or growth parameters of height, weight, and head circumference at 1 year. Deficits found were less pronounced than those reported in infants with fetal alcohol syndrome. *Pediatrics* 1986;78:444-450; *alcohol consumption, older primiparous women, infant development, maternal age.*

Heavy alcohol use during pregnancy has been documented as a causal agent in a syndrome of growth deficiency, mental retardation, and abnormal morphogenesis called "fetal alcohol syndrome."¹⁻³ Results from the Seattle Longitudinal Prospective Study on Alcohol and Pregnancy suggest that even moderate consumption of alcohol or social drinking during early pregnancy may

have an adverse effect on the fetus as reflected in abnormalities in newborn physical status and behavior.⁴⁻⁷ The Seattle group has reported smaller infant size, lower Apgar scores, poorer neonatal habituation and conditioning, increased tremulousness, decreased activity and sucking, and increased minor dysmorphic features.⁷ Follow-up studies revealed lower mental and motor development at 8 months.⁸

Although there is a suggestion that older mothers are at risk for producing offspring with fetal alcohol syndrome,⁹ no study has systemically examined the drinking practice of this group of women in relation to infant outcome. The samples from most large prospective studies examining maternal alcohol use and infant development include a very small percentage of women older than 30 years of age. The population of older women is important to study because these women represent a growing percentage of mothers who are having children for the first time.

The purpose of this study was to investigate the effects of maternal drinking practices prior to and during pregnancy on infant mental development, physical growth, and morphogenesis at 1 year of age. The study population was unique in that all mothers were 30- to 41-year-old primiparous women who were highly educated, from middle-class homes, had excellent prenatal care, and, for the most part, did not smoke or abuse drugs. In addition, all mothers had undergone amniocentesis to rule out chromosomal abnormalities in their offspring. This study represents an attempt to control, through subject selection and experimental design as opposed to statistical control alone, many variables often confounded with alcohol ingestion.

MATERIALS AND METHODS

Subjects

Sample subjects were 25 first-born infants (12

Received for publication Sept 9, 1985; accepted Jan 8, 1986.
Presented before the Annual Meeting of the Western Society for Pediatric Research, February 1984, Carmel, CA.

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boys, 13 girls) whose mothers were 30 years of age or older. All mothers had been screened at the University of California at Los Angeles (UCLA) Amniocentesis Clinic to rule out chromosomal abnormalities in the fetus. Reasons for undergoing amniocentesis included advanced age (92%) or anxiety about possible abnormalities in the baby (8%).

Mothers were selected randomly and letters were mailed to them describing the study; they were requested to fill out a demographic questionnaire and to return it if they were interested in participating. The fact that the study was designed to assess maternal drinking practices was mentioned but not highlighted as the major purpose of the study. Interested mothers were then contacted by the first investigator who described the study in full and who scheduled the infants for testing. No mother refused to participate after the study was described. Return rate on mailings was about 40%. This estimate may be low because we had no information on parity; thus, we do not know what percentage of mothers failed to respond because they had latter-born children.

Maternal demographic characteristics are given in Table 1. The sample represents a highly select group of preponderantly white (88%), intelligent, highly educated (64% college or more education), middle-class (100%; determined by Hollingshead's¹⁰ index), married women (96%) older than 34 years of age (88%). The average age of women in the sample was 36.28 years (± 2.57). The average IQ of sample mothers was 117.08 (± 5.28) as measured by the Shipley Institute of Living Scale which provides a quick and valid measure of overall intellectual functioning.¹¹

TABLE 1. Demographic Characteristics of Sample Mothers

Variable	n	%
Race		
White	22	88
Black	2	8
Other	1	4
Age (yr)		
30-35	7	28
36-41	18	72
Marital status		
Married	24	96
Divorced	1	4
Education		
Graduate school	10	40
College graduate	6	24
Some college	7	28
High school graduate	1	4
Non-high school graduate	1	4
Socioeconomic status		
Upper middle	16	64
Middle	7	28
Lower middle	2	8

Procedure

Alcohol, Caffeine, Smoking, and Other Drug Consumption. When their infant was 1 year old, mothers were asked to fill out a self-report questionnaire on frequency and quantity of alcohol and caffeine ingestion prior to pregnancy and during pregnancy. Also determined was mother's smoking and drug use during those time periods.

Alcohol level was estimated using the AA score of Jessor et al¹² which yields the average daily ounces of absolute alcohol consumed. Two drinks of wine, beer, or liquor is approximately equivalent to 30 mL (1.0 fl oz) of absolute alcohol or an AA score of 1.0. In addition, we counted the maximum number of servings of beer, wine, or liquor consumed per drinking occasion. Other estimates of alcohol consumption were used which yielded comparable results; therefore, they are not reported. The mean AA score for all mothers in the sample prior to pregnancy was 21.3 mL (0.71 fl oz) \pm 23.7 (0.79) or approximately the equivalent of 1½ drinks. The mean AA score for all mothers during pregnancy was 4.8 mL (0.16 fl oz) \pm 6.0 (0.20) or approximately ⅓ of a drink. The average number of maximum drinks consumed in any one day prior to pregnancy was 4.64 (± 2.86) with a decrease of 2.32 (± 2.04) during pregnancy. Twenty-two (89%) sample mothers reduced the amount of drinking during pregnancy. Prepregnancy drinking patterns were resumed following the birth of the child for the majority of women (68%, $r_p = .69$, $P < .0001$).

Caffeine ingestion was estimated by tabulating the number of cups of coffee consumed per day. Fifteen mothers reported drinking coffee daily. The average number of cups of coffee was 2.60 (± 3.02) prior to pregnancy and 1.04 (± 1.54) during pregnancy.

Smoking was estimated by the number of cigarettes consumed per day.¹³ Seven mothers in our sample smoked prior to pregnancy (five to 35 cigarettes per day); two continued to smoke during pregnancy (ten cigarettes per day).

Drug use during pregnancy was estimated from each mother's report of the number and kinds of drugs she consumed throughout pregnancy. Eight mothers (32%) denied using any drugs at all. Eight mothers (32%) used over-the-counter preparations (including aspirin, acetaminophen, Sudafed, Dristan, and cough preparations). Fourteen (56%) used prescription drugs (including bendectin, antibiotics, thyroid, codeine, diphenhydramine hydrochloride, phenobarbital, and local cortisone injections). Four mothers (16%) used marijuana at regular intervals throughout pregnancy. Six of the mothers taking over-the-counter drugs also took prescrip-

tion drugs; three of the four mothers who smoked marijuana also took prescription drugs. None of the marijuana-using mothers took over-the-counter drugs. All mothers denied taking heroin, amphetamines, PCP, LSD, cocaine, morphine, and mescaline. The average number of different drugs consumed by sample mothers was 1.20 (± 1.08).

Obstetrical Complications and Postnatal Illness. The Obstetric Complications Questionnaire (OCS), a 41-item scale of the mother's medical history, pregnancy, labor, and delivery, including events known to be associated with increased infant risk, was used by the study pediatrician in a 20-minute interview with each mother. This scale has been used extensively at UCLA to quantify prenatal and interpartum events for medically high-risk infants.¹⁴ Raw scores were converted to standard scores with a mean of 100 and an SD of 20.

The Postnatal Complications Scale (PCS) is a ten-item scale used to assess the occurrence of medical complications during the first month of life. Scale items include questions about respiratory distress, infection, metabolic abnormalities, convulsions, hyperbilirubinemia or exchange transfusion, temperature disturbance, surgery, noninfectious illness (hemorrhage, etc), and feeding difficulties. Items in the scale reflect medical events associated with increased risk of infant mortality and morbidity. This scale yields standard scores with a mean of 100 and an SD of 20. A higher score reflects less severe postnatal illness.

One-Year Infant Outcome. All infants were scheduled for the 12-month evaluation within 1 week of their 1-year birthdays. The Bayley Scales of Infant Development was administered by one of three experienced examiners who was unaware of the mother's drinking history. Only the Bayley mental scale was administered. The Mental Development Index (MDI), which is a standardized score with a mean of 100 and an SD of 15, was used as the estimate of 1-year mental outcome.

Following the Bayley assessment, all infants were examined by a pediatrician who was unaware of the mother's drinking history. A health history was taken and a physical examination was done. The infant's general appearance, height, weight, head circumference, and neurologic integrity were assessed. In addition, infants were evaluated for abnormalities of morphogenesis using a standard procedure. Particular attention was paid to major and minor physical anomalies ascribed to fetal alcohol syndrome. Thus, the focus of the physical examination was on the assessment of CNS dysfunction, growth deficiency, dysmorphic facial characteristics, and the wide range of anomalies that have

been reported in children of mothers who drink alcohol.^{3,15}

RESULTS

Alcohol, Caffeine, Smoking, and Other Drug Use in Relation to Obstetrical Complications, Infant Status at Birth, and Postnatal Illness

There was no statistical relation between alcohol, caffeine, smoking, or other drug use and obstetrical complications (OCS) or infant status at birth. Only one mother had a pregnancy with complications great enough to place her 1 SD below the mean on the OCS because of premature labor requiring prolonged bed rest and a complicated labor with fetal distress. The infant was full term, did well at birth, and had no anomalies. The mother was in the abstinent-light alcohol group. She used three prescription and over-the-counter drugs during pregnancy, drank a moderate amount of coffee, but did not smoke.

Caffeine use was unrelated to birth weight and height. However, those mothers who admitted to smoking prior to pregnancy had smaller infants ($r = -.40$, $P < .05$). All infants were within the normal range for birth weight.

There were no infants with postnatal complication scores greater than 1 SD below the mean. All infants had Apgar scores of greater than 7 at five minutes. Two infants had Apgar scores of less than 6 at one minute. One of these infants had no anomalies. The infant's mother took no drugs, was in the light-moderate alcohol group, and did not smoke or drink coffee. The other infant had meconium aspiration and had to be intubated. This was the infant with facial features suggestive of fetal alcohol syndrome, tracheomalacia, tremulousness, and hypotonia. Her mother was in the moderate-heavy alcohol group, took antibiotics, and did not drink coffee or smoke during pregnancy.

Alcohol, Caffeine, Smoking, and Other Drug Ingestion and 1-Year Infant Outcome

Correlational analyses examining the relation between alcohol consumption variables and 1-year infant outcome variables of mental development (MDI), physical growth (height, weight, and head circumference), and anomalies revealed some alcohol-associated effects. These correlations are shown in Table 2. Reported alcohol consumption during pregnancy was not significantly related to infant mental development at 1 year. There was, however, a significant relation between self-reported alcohol consumption prior to pregnancy and infant development. A correlation of $-.64$ ($P < .001$) was found

TABLE 2. Correlation Between Alcohol Consumption Prior to and During Pregnancy and Infant Outcome at 1 Year of Age

Drinking Patterns	Bayley Mental Development Index	Height (Percentile)	Wt (Percentile)	Head Circumference	Physical Anomalies
Average absolute alcohol consumed daily prior to pregnancy	-.59*	.25	.15	.35	.20
Average absolute alcohol consumed daily during pregnancy	.06	.07	.18	.26	.09
Maximum drinks prior to pregnancy	-.64†	.19	-.07	.26	.53*
Maximum drinks during pregnancy	-.20	.19	-.03	.23	.64†

* $P < .01$.† $P < .001$.**TABLE 3.** Relation Between Maternal Alcohol Consumption and Physical Anomalies

Alcohol Consumption	Maximum Drinks		
	0-2	3-4	≥5
Prior to pregnancy			
No. of anomalies	0	4	6
No. of infants with anomalies	0	3	3
%	0	38	30
N	7	8	10
During pregnancy			
No. of anomalies	1	2	6
No. of infants with anomalies	1 (Inguinal hernia)	1 (Tibial torsion, strabismus)	4 (Dysmorphic facies, tracheomalacia; scalp hemangioma; preauricular skin tags; retroorbital hemangioma, clinodactily)
%	8	20	80
N	15	5	5

between maximum drinks consumed in a day and the Bayley MDI; a correlation of $-.59$ ($P < .01$) was calculated between AA score and Bayley MDI. These findings suggest that infants with lower mental functioning had mothers who drank more prior to pregnancy.

To explore this finding further, mean Bayley mental scores were grouped according to mother's prepregnancy AA score. (AA scores were used instead of maximum number of drinks because the amount of absolute alcohol per day classification scheme is more commonly used in other studies examining maternal alcohol consumption.) The relation between amount of alcohol consumed and infant mental development appears to be linear in that infants whose mothers drank ≤ 3 mL (0.10 average fl oz) of absolute alcohol per day (abstinent-light) had an average MDI of 115 ($SD = 7.72$), infants whose mothers drank between 3.3 and 29.7 mL (0.11 and 0.99 fl oz) per day (light-moderate) had an average score of 108 ($SD = 8.48$), and infants whose mothers drank ≥ 30 mL (1.0 fl oz) per day (moderate-heavy) had an average score of 95 ($SD = 2.99$), $F(2,22) = 7.78$, $P < .01$.

Drinking prior to and during pregnancy was un-

related to infant 1-year growth parameters of height, weight, or head circumference. Furthermore, AA score during those time periods was not related to number of physical anomalies found in the infant. However, maximum number of drinks consumed on any one occasion prior to and during pregnancy was highly related to number of physical anomalies (prior, $r = .53$, $P < .01$; during, $r = .64$, $P < .001$). All anomalies were classified as minor except in one infant. The dose-related effects between anomalies and alcohol consumption were evident when infants were divided into groups based upon maximum drinks consumed. The frequency of anomalies seen when infants were divided according to those mothers' reported drinking levels is shown in Table 3.

If prepregnancy drinking history was examined, 0% of the infants of mothers drinking two or fewer drinks; 38% of the infants of mothers drinking three to four drinks; and 30% of the infants of mothers drinking five or more drinks had anomalies.

When consumption during pregnancy was examined, drinking decreased considerably but the relationship between frequency of anomalies and greater alcohol consumption was significant. Dur-

ing pregnancy, the majority of mothers reported drinking two or fewer drinks maximum per occasion. Only one infant in this group (8%) had an anomaly, an inguinal hernia. Five mothers consumed three or four drinks maximum per occasion and only one infant in the group (20%) had anomalies, internal tibial torsion and strabismus. Four of five (80%) of the infants whose mothers drank five or more drinks had anomalies, or about four times the frequency of anomalies as in the three- to four-drink group and ten times the frequency as in the zero- to two-drink group. The anomalies in this heavier drinking group included an infant with preauricular skin tags and one with a large scalp hemangioma. The two infants in the group who were most severely affected included one infant with a large retroorbital hemangioma resulting in proptosis of the eye and facial asymmetry. This infant also had clinodactyly. The other severely affected infant had tracheomalacia and facial features suggestive of fetal alcohol syndrome, with midface hypoplasia, a flat nasal bridge, and an indistinct philtrum. These two infant's mothers were the heaviest drinkers in the sample, both pre-pregnancy and during pregnancy.

Smoking and drug and caffeine ingestion were related weakly to drinking patterns and to infant mental and physical growth.

In the group of 15 children having Bayley mental scores of greater than 100, four (27%) had mothers who were heavy smokers, one mother was a moderate smoker, and ten (67%) were nonsmokers. Similarly, for the ten children with Bayley scores of 100 or less, one mother was a moderate smoker and nine were nonsmokers. There was a slightly higher percentage of maternal coffee drinkers in the lower functioning infant group in that five of ten (50%) were moderate coffee drinkers and the remainder were light coffee drinkers. In the high functioning infant group, six of 15 (40%) of the mothers were moderate or heavy coffee drinkers and ten of 15 (60%) were nondrinkers or light drinkers.

There was little relation between physical anom-

alies noted in the infants and the mothers' cigarette smoking, coffee drinking, or drug use during pregnancy. Four mothers admitted smoking marijuana occasionally throughout pregnancy. One infant in this group was noted to have anomalies (strabismus and internal tibial torsion). This mother was a light to moderate drinker before and during pregnancy.

Maternal Age, Education, and Intelligence in Relation to Infant Outcome at 1 Year

A final analysis examined the relation between other maternal variables and infant outcome. Two maternal variables, mother's education (defined as number of years) and intelligence, have been shown to be highly related to infant developmental status.¹⁶ A third variable, mother's age, was also examined in this analysis. The only significant relation found was between mother's intelligence and infant height at 1 year. More intelligent mothers had taller infants. Little relation between maternal age and infant outcome was found.

In contrast to most developmental literature, our findings revealed no relation between mother's intelligence or education and infant developmental functioning on the Bayley examination. To understand the part that mother's drinking may play in this failure to find associations among commonly associated maternal and infant variables, we divided infants into three respective groups based upon maternal AA levels prior to pregnancy. Infant Bayley scores (MDI) and mother's IQ served as dependent variables in a 3×2 (AA group \times mother IQ/infant MDI) repeated measures analysis of variance. The results of this analysis are given in Table 4. The interaction comparing mother's IQ to infant MDI within AA groups was significant, $F(2,44) = 6.40$, $P < .01$.

Planned comparisons revealed that, in the moderate-heavy drinking group (AA ≥ 1.0), mother's IQ was significantly greater than infant MDI score. The magnitude of the difference was 24 points. In the light-moderate group (AA = 0.11 to 0.99), the mother's IQ was eight points higher than the in-

TABLE 4. Relation Between Mother's Intelligence Quotient and Infant Cognitive Development as a Function of Maternal Drinking Prior to Pregnancy

Mental Score	Average Absolute Alcohol/Day			<i>F</i>	<i>df</i>	<i>P</i>
	≤ 3 mL (0.10 fl oz) (Abstinent-Light)	3.3–29.7 mL (0.11–0.99 fl oz) (Light-Moderate)	≥ 30 mL (1.0 fl oz) (Moderate-Heavy)			
Bayley Mental Development Index (mean \pm SD)	115 \pm 7.72	108 \pm 8.48	95 \pm 2.99	6.40	2, 22	.01
Mother's IQ (mean \pm SD)	118 \pm 4.13	116 \pm 5.59	119 \pm 6.13			
Difference score	3	8	24			
Planned comparisons	NS	$P < .01$	$P < .0001$			

fant's MDI score. In the abstinent-light group (AA ≤ 0.10), mothers and infants had similar levels of cognitive functioning.

Because infant development and mother's IQ are usually highly related, and in fact were highly related in the abstinent-light drinking group, the finding of a 24-point difference in the moderate-heavy group suggests a depressive effect on infant cognitive potential associated with alcohol consumption.

DISCUSSION

In this study, self-reported maternal alcohol use has been investigated in relation to infant mental and physical development at 1 year of age. Findings were that children born to older mothers who drank more prior to pregnancy had depressed mental scores and more physical anomalies than children of mothers who consumed smaller quantities of alcohol. These deficits were less pronounced than those reported in infants with fetal alcohol syndrome.

The finding of a strong relation between alcohol consumption prior to, rather than during, pregnancy and infant mental development is consistent with the current research literature in that several investigators have found stronger associations with reported drinking patterns 1 month prior to pregnancy and weaker relations during pregnancy. Many investigators who only examined maternal alcohol consumption during pregnancy report little relation between drinking and infant outcome.¹⁷⁻¹⁹ Hanson and associates⁴ have suggested the reason for this finding is that mothers may follow habitual drinking practices until they discover they are pregnant, at which time they decrease their drinking. Thus, the time prior to pregnancy is more accurately defined as the time prior to recognition of pregnancy, which may include the first few weeks after conception which is likely to be a period of high vulnerability (*Medical Bulletin*, 1982;38:48-52).

Another explanation for these findings may be that, as public awareness of the fetal risks from alcohol consumption increases, mothers may be less inclined to admit to drinking during pregnancy. In particular, mothers in our sample were all informed by their obstetricians about the possible risk to the fetus due to alcohol consumption during pregnancy. These mothers may have underreported their level of alcohol intake during pregnancy. With such minimal levels reported, significant statistical relationships were difficult to obtain.

A third explanation is that maternal characteristics and attitudes that correlate with increased

alcohol use might also relate to child-rearing practices and mother-infant interaction that would impact on the infant's development. Therefore, environmental variables might have also contributed to our results.

Nevertheless, of those mothers reporting higher consumption during pregnancy, increased incidence of anomalies in the infant was noted. Our data suggest that, in particular, mothers who had a tendency to drink large quantities of alcohol, even infrequently, had infants with a greater proportion of anomalies. Furthermore, the incidence of anomalies observed in our sample was greater than that reported in other samples (*Medical Bulletin*, 1982;38:48-52).

With regard to sample characteristics and study findings, our sample differed considerably from other samples in large prospective studies. Our mothers were older, better educated, more intelligent, and of higher social status than samples of mothers commonly reported in other alcohol studies. Furthermore, a higher percentage of mothers in our sample would be considered moderate to heavy drinkers than is commonly reported. Sixteen percent of our sample, as compared to 3% to 9% in other studies, consumed an average of at least 30 mL (1.0 fl oz) of absolute alcohol per day.^{7,18,21,22} The higher proportion of drinkers in our sample cannot be explained simply by reason of increased age because national prevalence rates are comparable across different ages up to 50 years when drinking increases.²¹ Thus, our study design and recruitment procedure may have biased our sample for mothers who may, in fact, have more significant drinking problems. Another explanation may be that, in populations of women who are more highly educated and from higher social strata, level of alcohol consumption might be higher.

ACKNOWLEDGMENT

This research was supported by Public Health Service Biomedical support grant RR 05756.

We thank Holly Hackman and Janet Miller for their assistance in infant testing.

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ERRATUM

In the article, "Aversive Taste Treatment of Finger and Thumb Sucking" by Friman et al (*Pediatrics* 1986;78:174-176), the address for reprint requests is incorrect. The correct address is Patrick C. Friman, PhD, Meyer Children's Rehabilitation Institute, 444 S 44th St, Omaha, NE 68131.

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