Neurotoxicology and Teratology 51 (2015) 52–60

Contents lists available at ScienceDirect

Neurotoxicology and Teratology

journal homepage: www.elsevier.com/locate/neutera

Prenatal alcohol exposure, adaptive function, and entry into adult roles in a prospective study of young adults

Mary Ellen Lynch *, Julie A. Kable, Claire D. Coles

Center for Maternal Substance Abuse and Child Development, Department of Psychiatry and Behavioral Sciences, Emory University School of Medicine, 12 Executive Park Drive NE, Suite 200, Atlanta, GA 30329, United States

ARTICLE INFO

Article history:
Received 24 March 2015
Received in revised form 27 July 2015
Accepted 31 July 2015
Available online 4 August 2015

Keywords:
Prenatal alcohol exposure
Adaptive function
Role entry
Transition to adulthood

ABSTRACT

Introduction: Although many studies have demonstrated effects of prenatal alcohol exposure (PAE) on physical, cognitive, and behavioral development in children, few have focused on the long term effects on adults. In this study, data are presented on adaptive function and entry into adult roles in a community sample of young adults with PAE. The expectation was that prenatally exposed adults would show lower adaptive functioning and more difficulty with entry into adult roles than the non-exposed control group and that these effects would be related to the severity of PAE effects.

Method: The predominantly African-American, low income sample included adults with a wide range of prenatal exposure (n = 123) as well as control groups for socioeconomic (SES) (n = 59) and disability (n = 54) status. The mothers of the alcohol-exposed and SES-control group participants were recruited before birth and offspring have been followed up periodically. The disability control group was recruited in adolescence. The adults were interviewed about adaptive function in day-to-day life and adult role entry. Collateral adults who were well-acquainted with each participant were interviewed concerning adaptive function.

Results: Results showed that adults who were dysmorphic and/or cognitively affected by PAE had difficulty with adaptive function and entry into adult roles. Males showing cognitive effects with no physical effects were the most severely affected. Results for exposed adults not showing physical or cognitive effects were similar to or more positive than those of the control group for most outcomes.

Conclusion: PAE has long-term effects on adaptive outcomes in early adulthood. Additional research should focus on possible interventions at this transition and on factors contributing to the adjustment of the exposed, but unaffected participants.

1. Introduction

Exposure to alcohol prenatally has documented long-term effects on physical, cognitive, and behavioral aspects of development (e.g., Riley et al., 2011; Streissguth et al., 2004; Mattson et al., 2011). Fetal alcohol syndrome (FAS), the most severe result of prenatal alcohol exposure (PAE), was first defined in the early 1970s (Jones and Smith, 1973). Diagnostic criteria include a characteristic pattern of dysmorphic facial features, deficiency in physical growth, and effects on the central nervous system that frequently present as deficits in neurocognitive functioning (e.g., Bertrand et al., 2005; Riley et al., 2011). In the past forty years, less severe and more limited effects of PAE have been identified and the umbrella term, fetal alcohol spectrum disorders (FASDs), is now used to describe the full range of outcomes related to alcohol use during pregnancy. According to the National Task Force on Fetal Alcohol Syndrome and Fetal Alcohol Effects (Olson et al., 2009), FASDs are among the most common developmental disabilities. Prevalence for FAS has been estimated at .5–2 cases per 1000 in the United States; for the full spectrum of FASD effects, prevalence is often estimated to be as high as 1 per 100 (May and Gossage, 2001). More recently, estimates based on a study of a Midwestern community sample in the U.S. were higher at 2.4–4.8% for the full spectrum of FASDs (May et al., 2014).

Although research on effects of PAE on physical, cognitive and behavioral aspects of development in children is extensive (e.g., Coles, 2006; Jones et al., 2010; Kodituwakku, 2007; Mattson et al., 2011; Riley et al., 2011), little research is available on adults. With the exception of work by Day et al. (2013) on behavior problems in young adults, the transition from adolescence to adulthood, a critical period affecting future adjustment, has received little attention in the literature on effects of FASDs. While this transition is a challenging developmental period for many young people, Osgood et al. (2005) have emphasized that it is especially difficult for those who are vulnerable due to disabilities. These young adults are likely to have limitations on their skills and abilities, which decrease opportunities to obtain employment, to complete

* Corresponding author.
E-mail address: mlynch@emory.edu (M.E. Lynch).

http://dx.doi.org/10.1016/j.ntt.2015.07.008
0892-0362/

educational programs, or to become independent in other ways. Although some may have been eligible for special services as children, these supports are no longer available.

Osgood et al. (2005) structured the challenges of this period into two categories: 1) entering adult roles in work, educational, and family spheres of life; and 2) managing adult life, including avoidance of problem behaviors. Young adults with FASDs are particularly vulnerable due to cognitive and behavioral deficits that make it difficult to meet expectations for adult adaptive function and for work or educational achievement. In addition, young adults with FASDs are thought to be vulnerable to involvement in problem behavior, including substance use, legal difficulties, and mental health problems (e.g. Streissguth et al., 1996, 2004; Fast et al., 1999; Famy et al., 1998), although not all studies have been consistent on involvement with legal problems (e.g., Rangmar et al., 2015; Lynch et al., 2003). The analyses in the present paper focus on prenatal alcohol exposure and the development of adaptive competence during the transition to adulthood with 1) general adaptive skills and 2) entry into adult roles in work, educational, and family settings as outcome variables.

1.1. Adaptive function in adulthood

While several studies suggest that adaptive function, or ability to deal with tasks of everyday life, is affected in childhood, there are few studies of adults (e.g., Streissguth et al., 1996). Several researchers suggest that deficits in adaptive functioning *increase* with age during childhood, particularly in the realm of socialization (e.g., Crocker et al., 2009; Whaley et al., 2001).

In reports based on clinical samples (e.g., Streissguth et al., 1996; Spohr et al., 2007), high percentages of adults were living in dependent circumstances, either requiring care or supervision of daily life activities such as money management. Streissguth et al. (2004) reported scores on the Adaptive Behavior Composite of the Vineland Adaptive Behavior Scales (Sparrow et al., 1984) that were substantially lower than the population norms; the mean scores on adaptive scales were 1–1.5 standard deviations below mean IQ scores, suggesting an adaptive dysfunction beyond what would be expected due to an IQ deficit alone. Temple et al. (2011) compared adults with FASD to a contrast group of clinically-referred adults matched for IQ who were not prenatally exposed. Using the Adaptive Behavior Assessment System-II (ABAS-II) (Harrison and Oakland, 2003), they found that the FASD group scored significantly lower on the General Adaptive Composite score and the Conceptual subscore than the contrast group. The authors suggest that adults with FASD have difficulty beyond what might be predicted by IQ in applying problem-solving skills to situations in everyday experience. While studies of children suggest that social functioning is impaired by PAE, Temple et al. did not report such differences. It is possible that these will be more apparent in the community sample where adults are faced each day with social challenges.

1.2. Entry into adult roles

Prior studies based on clinical samples suggest that adults with FASDs have difficulty transitioning to adult work and life roles (e.g., Streissguth et al., 2004; Spohr and Steinhausen, 2008; Spohr et al., 2007; Freunscht and Feldmann, 2011). Streissguth et al. (1996, 2004) followed a clinic sample of adolescents and adults diagnosed with either FAS or Fetal Alcohol Effects (FAE). Those diagnosed with FAE were exposed to alcohol prenatally and met some of the diagnostic criteria for FAS. Based on informant interviews, about 60% had disrupted school experiences (dropped out, expelled, or suspended) and 79% of the adults in this sample had problems with employment. Both Spohr et al. (2007) and Freunscht and Feldmann (2011) also reported limited education and vocational achievement in their German clinical samples of adults with FAS or FAE. As all three studies are based on clinical samples, they include severely affected individuals on the FASD spectrum.

On the other hand, Rangmar et al. (2015) examined employment status in a sample of Swedish adults with FAS based on data from national registers available in that country. Although adults with FAS were more likely to be unemployed and receiving disability payments than the control group, a large percentage (49%) were employed. The authors did note that they were employed in disproportionately lower-paying positions.

In summary, there have been few studies of adults with FASDs and the existing literature is based heavily on clinical samples; unexposed control groups are seldom included for comparison. While FASD is defined as a spectrum disorder, most data for adults are based on those who are severely affected, leaving outcomes for less affected adults largely unknown.

The present study provides the opportunity to refine understanding of PAE by examining adult development in a prospective community sample. The sample age range is relatively narrow (age 19–27, mean age = 22.78), so developmentally appropriate adaptive issues can be examined. The sample includes exposed and unexposed participants as well as a range of prenatal alcohol effects. Please note that, as the sample is drawn from the community, it includes many exposed participants who have not been clinically referred. Exposed participants are grouped by level of impact of PAE on physical and cognitive development; the group names are labels for area of impact and do not imply clinical diagnosis. Exposed groups range from 1) severely affected (showing dysmorphic features (DYSM)) to 2) exposed with cognitive effects only (COG-AFF), to 3) exposed, but not cognitively or physically affected (COG-UNAFF). In addition, a Special Education contrast group (SPEC) recruited at adolescence is included to explore how FASD groups compare to a disability control group. Additional details on all groups are included in the Method section.

These hypotheses will be examined:

Hypothesis 1. a) Adults with PAE will show lower general adaptive functioning than adults in the unexposed Control group.

b) The severity of prenatal alcohol effects (DYSM > COG-AFF > COG-UNAFF) will be related to the severity of adaptive deficits experienced.

Hypothesis 2. a) Adults with PAE will show lower entry into adult work, education, and family roles than adults in the unexposed Control group.

b) The severity of prenatal alcohol effects (DYSM > COG-AFF > COG UNAFF) will be related to the level of adaptation to adult roles.

2. Method

2.1. Participants

The participants were 236 young adults enrolled in a prospective, longitudinal study of effects of PAE on adaptive and neurocognitive outcomes. The study and all procedures were approved by the Emory University Institutional Review Board. Recruitment of alcohol-exposed (n = 123) and unexposed (n = 59) participants took place between 1980 and 1986 at an urban hospital in Atlanta serving a population that was primarily African-American and of low socioeconomic status (SES) (Coles et al., 1985, 1987). Exposure status of children was defined based on maternal responses to a prenatal interview concerning alcohol use during pregnancy. Mothers who reported drinking were asked about the quantity and frequency of alcohol use during pregnancy; participants whose mothers reported consuming at least 1 oz of absolute alcohol (AA) per week (about two drinks) were included in the alcohol-exposed group: however, most mothers reported drinking much larger amounts of alcohol. Means for the exposed groups ranged from 7.95 to 13.33 oz of absolute alcohol per week (see Table 1). Participants whose mothers reported abstaining make up the unexposed control group. Mothers were asked about use of other substances (tobacco,

Table 1
Background and prenatal exposure characteristics for young adults (N = 236).[a]

Variables	Groups						
	Control CONT (n = 59) (1)	Dysmorphic DYSM (n = 48) (2)	Exposed, cognitively affected COG-AFF (n = 37) (3)	Exposed, not cognitively affected COG-UNAFF (n = 38) (4)	Special education contrast SPEC (n = 54) (5)	Statistical test	p-value[b]
Ethnicity (% African-American)	100	97.9	100	97.4	85.2	$X^2_{(8)} = 23.52$	p = .003
Gender (% male)	39.0	47.9	29.7	36.8	53.7	$X^2_{(4)} = 6.62$	ns[c]
Age at follow-up (years) M (SD)	22.80 (1.75)	22.65 (2.08)	22.59 (1.64)	22.32 (1.93)	23.31 (1.39)	$F_{(4,231)} = 2.08$	p = .085
Current monthly income (total $), M (SD) (n = 229)	1191 (1453)	1011 (967)	570 (437)	946 (920)	1293 (1596)	$F_{(4,224)} = 2.17$	p = .074
Adult dysmorphia score[d] M (SD), (n = 226)	3.12 (3.30)	9.72 (7.64)	5.24 (3.63)	3.73 (3.14)	4.67 (4.22)	$F_{(4,221)} = 14.63$	p = .000; 2 > 1,3,4&5
WASI FSIQ[e] M (SD), (n = 233)	86.07 (11.56)	75.66 (13.02)	73.62 (8.37)	95.00 (9.27)	84.94 (13.90)	$F_{(4,228)} = 21.62$	p = .000; 2,3 < 1,4,&5; 4 > 1,2,3&5
Negative life events T-score (LISRES)[f] (n = 231)	58.08(11.92)	56.32 (10.90)	60.09 (10.62)	58.57 (10.80)	59.15(10.54)	$F_{(4,226)} = .696$	ns[c]
Birthweight (g) M (SD), (n = 182)	3216.14 (490.25)	2505.58 (631.28)	3245.14 (556.00)	3113.95 (578.43)	NA	$F_{(3,178)} = 18.14$	p = .000; 2 < 1,3&4
AA/oz/week[g] in pregnancy M (SD), (n = 182)	0 (0)	13.33 (13.01)	8.09 (13.11)	7.95 (7.55)	NA	$F_{(3,178)} = 17.84$	p = .000; 1 < 2,3,4;4 < 2
Cigarette use in pregnancy (% yes) (n = 174)	31	86.4	61.1	66.7	NA	$X^2_{(3)} = 33.21$	p < .001
Marijuana use in pregnancy (% yes) (n = 174)	12.1	29.5	36.1	52.8	NA	$X^2_{(3)} = 18.46$	p < .001
Cocaine use in pregnancy (% yes) (n = 173)	0	4.8	5.4	20.0	NA	$X^2_{(3)} = 15.18$	p = .002

[a] If data are not available for some participants, the n used for the analysis is noted next to the variable name.
[b] Post-hoc comparisons were completed with Tukey HSD test.
[c] ns = not significant.
[d] Dysmorphia score is based on 25% percentile, African-American norms.
[e] WASI FSIQ = Wechsler Abbreviated Scale of Intelligence — Full Scale IQ.
[f] LISRES = Life Stressors and Social Resources Inventory.
[g] Ounces of absolute alcohol per week.

marijuana, and cocaine) as well at the prenatal interview. Percent using during pregnancy is shown for each group in Table 1.

Children were evaluated after birth and follow-up studies were completed at age 7 and in mid-adolescence. At each of these three points, children were rated for growth characteristics and dysmorphic facial features characteristic of prenatal alcohol exposure by using the Dysmorphia Checklist (Coles et al., 1997a). Participants from the original sample were grouped for the present analyses into *four* groups based on prenatal alcohol exposure, dysmorphia scores, and intelligence test scores (IQ) (Wechsler, 1999). Those whose mothers abstained from alcohol use during pregnancy are in the *Control group* (CONT) (n = 59); this group is similar to the exposed group in background and will be used to control for socioeconomic status. The *Dysmorphic group* (DYSM) (n = 48) participants, the most severely affected, were exposed prenatally and received a dysmorphia score that was one standard deviation or more above the mean of the full sample at one of three previous follow-up points: birth, age 7, or adolescence. Higher dysmorphia scores have been related to more severe cognitive deficits as well (Coles et al., 1997b). The Nondysmorphic Exposed participants (dysmorphia scores less than one standard deviation above the mean of the full sample) were divided into two groups by a median split of full-scale IQ scores obtained during the adult assessment and based on performance on the Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 1999). The *Exposed-Cognitively Affected group* (COG-AFF) (IQ < 84) was defined to focus on participants with alcohol-related cognitive, but *not* physical effects of prenatal exposure (e.g., Riley et al., 2011; Stratton et al., 1996); the COG-AFF group includes 37 participants. At the same time, the *Exposed-Cognitively Unaffected* (IQ ≥ 84) or COG-UNAFF group (n = 38) was included to examine heretofore unexplored outcomes for participants who were prenatally exposed, but seem to be unaffected physically or cognitively.

A fifth group, the *Special Education Contrast* (SPEC) group, was recruited at the time of the adolescent follow-up (average age = 15.1 years) (Lynch et al., 2003; Coles et al., 2002) to control for disability status. This contrast group was included to compare the alcohol-affected adults to a group with learning problems or disabilities. The group includes students enrolled in public school special education classes during adolescence and who were similar to the longitudinal sample in age, ethnicity, and socioeconomic status. This group also participated in the early adult follow-up and includes 54 participants. Demographic and background characteristics of participants in all these groups are included in Table 1.

Each participant was asked for permission to interview a collateral, someone who knew them well and could rate their behavior and adaptive functioning. Of the 236 participants, 226 collaterals completed the adaptive function interview. Collaterals nominated by participants included parents (49.1%), grandparents, aunts or uncles, or other blood relatives (14.6%), siblings (11.1%), boyfriends or girlfriends (11.1%), spouses, (3.5%), and friends (10.6%).

2.2. Procedure

Participants were contacted by project outreach workers about volunteering for the study. Most adults, when located, were willing to participate. From the pool of 427 potential participants, 319 (74.7%) were located by the outreach team. Of those located, 236 (74%) completed the interview and medical sessions necessary to assess the behavioral variables. Of those who were located and did not participate, 23 (7.2%) had moved out of the area, nine (2.8%) were deceased, 19 (6%) were temporarily unavailable (college, military, prison), 31 (9.7%) were located, but refused to participate, and one participant was excluded due to mental health issues. Of note, 11 of 19 temporarily unavailable

participants (all males) were in the criminal justice system, three were in college, and five were in the military. The majority of unlocated potential participants had been exposed to alcohol prenatally; it is possible that their unavailability may have resulted in an underestimate of the effects of PAE.

Outreach workers discussed the study with potential volunteers and, if they were willing to participate, completed the IRB-approved consent procedure. Although the young adults had participated in prior follow-up waves of the study, their mothers or caregivers had consented for their participation. Outreach workers were careful to safeguard the confidentiality of the mothers by not revealing any information to the adults on the mother's prenatal use of alcohol or drugs.

Data were collected in a one-day session at the project research laboratory. Participants completed tests of neurocognitive function (including a test of ability (WASI; Wechsler, 1999), that was used in this study to define the groups), a medical session with a nurse, and a series of questionnaires and interviews on adaptive function and problem behavior. Surveys were administered verbally for young adults who were unable to read well enough to understand the questions. Each participant received lunch and $100 in compensation for their time and effort. Transportation was provided. Collaterals were interviewed separately, frequently on a different day, about the behavior and adaptive function of the adult participants; interviews took about 1½ h and collaterals received $50 in compensation.

2.3. Measures

2.3.1. Adult adaptive function

Descriptive information on independence of living arrangement, daily living activities (e.g., banking, household chores), and social participation was drawn from the modified community integration measure developed to examine transition issues in adults with developmental disabilities (Kregel, 1992; Kregel et al., 1986). Reports of whether assistance was required in daily living activities were summarized in three variables: activities related to money (summary of 3 items — depositing or withdrawing money, paying bills, making decisions on spending money), job/activity choices (2 items), and household chores (1 item). Indicators of social participation included responses to questions on frequency of participation in 11 life activities (e.g., visiting with friends, going to the supermarket), involvement in six group activities or clubs (e.g., exercise classes, religious clubs), and settings where one or more hours per week are spent (shopping facilities, homes of friends, outdoor recreation facilities, indoor recreation facilities). Possession of a driver's license, another indicator of independence, was available from the Addiction Severity Index (ASI) (McLellan et al., 1985). All above information was provided by the adults themselves. Instruments used and outcome variables drawn from them are included in Table 2.

Collaterals completed ratings of adult adaptive function with the Adaptive Behavior Assessment System (ABAS-II; Harrison and Oakland, 2003), a widely-used, standardized measure. The instrument provides an overall summary score, the General Adaptive Composite (GAC), and standard scores in three domains: Conceptual, Social, and Practical. The Conceptual domain includes Communication, Functional Academics, and Self-Direction subscales; the Social domain includes Leisure and Social subscales; and the Practical domain includes Community Use, Home Living, Health and Safety, Self-Care, and Work (if applicable). According to the authors, the distributions of the GAC and adaptive domains have a mean of 100 and a standard deviation of 15. Scores of 80–89 are described as "below average," 71–79 as "borderline," and ≤70 as "Extremely low."

2.3.2. Entry into adult roles

Variables related to educational achievement and transition to adult work and family roles were drawn from interview responses to the community integration measure and from the Employment/Support section of the ASI as well as from a medical interview where questions on family status were included (see Table 2). Adults themselves responded to these measures. Interview information from both the ASI and the community integration measure on educational and occupational status and history was used to code educational and occupational levels for the Hollingshead Index of socioeconomic status (Hollingshead, 2011). The Hollingshead (2011) measure provides a rating based on the combination of 1) highest level of education completed and 2) a 9-point rating of the level of the usual occupation of the adult. Educational level is weighted by 3 and occupational rating is weighted by 5; the possible range of combined, weighted socioeconomic status ratings is 8 to 66.

We compared mean responses or percentages (for categorical variables) for the alcohol-exposed groups to those of the control groups and reported significant differences. We did not have cut-offs for successful role entry, but described how groups compared to the unexposed control group.

Table 2
Instruments and outcome variables.

Instrument	Outcome variables
Community Integration Survey (Kregel, 1992)	*Independence*: Current living arrangement—rated for independence Independence in specific daily activities *Social participation*: Participation in 11 activities Number of settings where time is spent Involvement in clubs or group activities *Educational, occupational, and family outcomes*[a]: High school graduation or GED Further education after high school Attended 4-year college or university Current employment situation Title of current or most recent job Marital status
Addiction Severity Index, (McLellan et al., 1985)	*Independence*: Possession of a driver's license *Educational, occupational, and family outcomes*[a]: Years of school completed Usual (or last) occupation Usual employment pattern — past three years
Adaptive Behavior Assessment System-II (ABAS-II) (Harrison and Oakland, 2003)	General adaptive composite Conceptual domain Social domain Practical domain
Interview with nurse	*Family variables*: Married/living with partner Any biological children

[a] Responses concerning job titles, employment pattern, and educational history were the basis for the Hollingshead ratings.

2.3.3. Life stress

Adults themselves responded to the Life Stresses and Social Resources Inventory (Moos and Moos, 1994), which includes 16 scales measuring stresses and resources in a variety of life contexts. The T-score for negative life events, a count of negative events occurring in the past year across life contexts, was included in the analyses as a covariate. We included the measure for negative life events because, in the adolescent follow-up, a measure of negative life events predicted reports of delinquent behavior (Lynch et al., 2003). As this general measure of life stress was related to behavioral outcomes in our previous study, we included a measure of this construct again in the analysis of the adult data.

2.4. Data analysis

We initially analyzed continuous variables using the generalized linear modeling approach with Group (5) and Gender (2) as independent

variables and negative life stress as a covariate to control for the impact of environmental stress on the relation between the independent and dependent variables. If negative life stress was not significant, data were analyzed using only the two factors, Group and Gender. Multivariate analyses of variance were completed for the analyses of 1) the three adaptive domain composites from the ABAS-II and 2) two social participation variables; again, group and gender were the independent variables and negative life stress was included as a covariate if significant. Post hoc tests were completed with the Bonferroni multiple comparison method. Chi square analyses of categorical variables were completed to examine the relationship between group and outcome.

3. Results

3.1. Adaptive function in adulthood

Dependent variables included in this section are 1) the adult self-reports of independence and participation in social activities and 2) the collateral ratings of the General Adaptive Composite and the domain composites from the ABAS-II.

3.1.1. Self-ratings of independence and social participation

When independence in life activities was examined, few adults reported needing assistance with these activities. Adults in the DYSM group were more likely to require assistance than those in other groups for activities related to money. Similar analyses of the relation between group and independence of living arrangement, as well as independence in other specific life activities (household chores, choosing jobs or activities), however, showed no significant group effect. Group was significantly related to possession of a valid driver's license, another indicator of independence. Young adults in the DYSM or COG-AFF groups were less likely to have a driver's license than those in the other groups.

For assessment of social participation, a two-way multivariate analysis of variance (Group (5) × Gender (2)) was completed on 1) mean frequency rating of reported participation in activities, and 2) number of settings where one or more hours each week are spent. Negative life stress was not significant as a covariate, so it was eliminated from the analysis. The multivariate effect for group was significant. Group was significantly related to number of settings where time is spent; it was marginally related to frequency of participation in activities. For each of these dependent variables, the DYSM group had the lowest mean and the COG-UNAFF group had the highest. The post hoc test showed that the COG-UNAFF group scored significantly higher than the CONT, DYSM, and COG-AFF groups on number of settings. Gender was not significant in analyses for either variable. Because few participants (15% overall) reported involvement in clubs or group activities, a chi square analysis was completed to examine the relation between group and any participation. The result was marginal with the COG-UNAFF group having the largest percentage participating and the DYSM and COG-AFF the smallest. Results by group for independence and social participation are displayed in Table 3.

3.1.2. Collateral ratings of adaptive function (ABAS-II)

The generalized linear model was used to analyze effects of Group (5) and Gender (2) on the General Adaptive Composite (GAC) with negative life stress as a covariate. The model showed that negative life stress was a significant covariate. Significant effects for gender and the Group × Gender interaction also occurred. Young women showed higher adaptive function than young men. An examination of the group means and the post hoc tests suggest the interaction effect was driven by the lower adaptive function of the males in the COG-AFF group and the higher function of the COG-UNAFF females. Post hoc tests were significant in comparisons of COG-AFF males to CONT and COG-UNAFF females and in comparisons of UNAFF females to CONT, COG-AFF, and SPEC males. See Fig. 1 for graphic presentation.

A Group (5) × Gender (2) multivariate analysis of variance was completed with the three domain composites (conceptual, social, and practical) as the dependent variables and negative life stress as a covariate. The overall multivariate effects were significant for group and for gender. For the Conceptual domain, main effects for both group and gender were significant. For group, the COG-UNAFF group showed the highest score and the COG-AFF group the lowest. For gender, the women scored higher than the men. Similar gender effects were significant for Practical and Social composites. The patterns of means for the domain composites were similar to the pattern for the GAC composite: 1) women achieved higher adaptive functioning than men and 2) men in the COG-AFF group had the most difficulty with adaptive functioning. Estimated marginal means for males and females in each group are displayed in Table 4.

3.2. Entry into adult roles

This section is based on analyses of the adult self-reports of educational, work, and family status. For each continuous variable in this section, negative life stress was included in the initial analysis as a covariate; it was not significant for any variables in this area and is not included in the analyses reported below. For education, dependent variables included years of formal schooling, attainment of high school graduation or GED, and whether participants sought further education after high school. For years of formal schooling, the two-way analysis of variance showed a significant effect for group with the DYSM and COG-AFF groups having the lowest means and the COG-UNAFF and CONT groups the highest. The post hoc test showed that the COG-AFF group completed fewer years of schooling than the CONT, COG-UNAFF, or SPEC groups; the DYSM group completed fewer than the COG-UNAFF group. No significant effect occurred for gender.

Results of chi square analyses were marginal for high school graduation/GED completed and for whether participants received further education after high school. For both variables, the COG-AFF group had the lowest percentage and the CONT and COG-UNAFF groups had the highest. For the 123 participants who sought any education after high school, a larger percentage of those from the COG-UNAFF group (57.1%) reported attending a four-year college or university than from other groups (14.3 to 21.7%). Group means or percentages for each variable are included in Table 5.

Occupational variables include the participant's report of current employment status and usual employment status for the last three years, the Hollingshead rating of occupational level, and the overall Hollingshead rating of the young adult's socioeconomic status, a weighted coding of educational and occupational information (Hollingshead, 2011). The group patterns of these scores were similar to those for educational achievement. Chi square analyses for current employment status and report of usual employment status for the last three years showed that the COG-AFF and DYSM groups were least likely to describe themselves as employed and most likely to be unemployed. At the same time, it is important to note that a significant minority of each group (DYSM, 48.9%; COG-AFF, 37.8%) reported that they were currently employed.

Two-way analyses of variance of effects of Group (5) and Gender (2) showed significant effects for group on both the Hollingshead occupational ratings and the overall socioeconomic status rating with the COG-AFF and DYSM groups having the lowest means and the COG-UNAFF and CONT groups having the highest. Post hoc tests showed that, for the occupational rating, the COG-UNAFF group had significantly higher ratings than the DYSM or COG-AFF groups. For the overall socioeconomic status rating, the post hoc tests showed that both the CONT and COG-UNAFF groups had significantly higher ratings than the COG-AFF and DYSM groups. The gender effect and the interaction were both marginal for the occupational rating; young women in the two alcohol-affected groups (COG-AFF, DYSM) had mean scores similar to (or lower than) the young men in those groups while they had

Table 3
Adult adaptive function: self-reports of independence and social participation (N = 236).[a]

Variables	Groups						
	CONT (n = 59) (1)	DYSM (n = 48) (2)	COG-AFF (n = 37) (3)	COG-UNAFF (n = 38) (4)	SPEC (n = 54) (5)	Statistical test	p-value[b]
Males:Females within group	23:36	23:25	11:26	14:24	29:25		
Independence							
Independent living arrangement (% rated independent)	52.5	37.0	48.6	40.5	35.8	$X^2_{(4)} = 4.55$	ns[c]
Activities related to money — (summary of three items) (% yes, unassisted for all three)	94.9	80.9	94.6	97.3	94.3	$X^2_{(4)} = 11.09$	p = .026
Household chores (% yes, unassisted)	100	97.9	94.6	100	98.1	$X^2_{(4)} = 4.72$	ns
Choosing job or other activities — (summary of two items) (% yes, unassisted on both items)	100	93.6	100	100	96.2	$X^2_{(4)} = 7.60$	p = .107
Has driver's license (% yes)	65.5	44.7	37.1	71.1	66.7	$X^2_{(4)} = 15.36$	p = .004
Social participation							
Summary — mean frequency rating of participation in 11 activities M (SD)[d]	M[e] = 1.45 (.47) F[e] = 1.4 (.44) T[e] = 1.42 (.45)	M = 1.35 (.43) F = 1.08 (.42) T = 1.21 (.44)	M = 1.43 (.61) F = 1.30 (.36) T = 1.34 (.44)	M = 1.48 (.46) F = 1.47 (.50) T = 1.47 (.48)	M = 1.36 (.398) F = 1.35 (.45) T = 1.355 (.42)	$F_{(4,223)} = 2.09$	p = .083
Number of settings where >1 h/week spent[b] M (SD)[d]	M = 2.30 (1.15) F = 2.03 (1.30) T = 2.14 (1.24)	M = 2.0 (1.04) F = 1.71 (.91) T = 1.85 (.98)	M = 2.18 (1.54) F = 1.96 (1.34) T = 2.03 (1.38)	M = 3.0 (1.29) F = 2.83 (1.05) T = 2.89 (1.13)	M = 2.18 (1.19) F = 2.2 (1.12) T = 2.19 (1.14)	$F_{(4,223)} = 4.19$	p = .003 (4 > 1,2,3)
Involved in clubs or group activities (% yes)	15.3%	6.4%	8.1%	27.0%	18.9%	$X^2_{(4)} = 8.93$	p = .063

[a] For each analysis, N = 233 except for "Independent living arrangement" and "Has driver's license" where N = 232.
[b] Post-hoc comparisons were completed with Bonferroni test.
[c] ns = not significant.
[d] Gender and interaction effects were not significant for this variable.
[e] M = male, F = female, T = total.

higher scores than the men in the other three groups. For overall socioeconomic status rating, the gender effect was again marginal; the pattern of means was similar to that described above.

For family roles, there was no significant group difference in marital status. It is notable that approximately 90% of participants reported that they had never married. A larger percentage (37.5%) reported that they were currently married *or* living with a partner, but, again, there was no significant difference related to group. Group was significantly related to the adult's report of whether he or she had any biological children. The COG-AFF group reported the highest percentage (70.3%) while the SPEC and COG-UNAFF groups reported the lowest (33.3% and 35.1% respectively). Group was not related to whether biological children were living with the adult. Results by group for these variables are reported in Table 5.

To explore the unexpected finding showing higher adaptive function on some variables in the COG-UNAFF group than the CONT group, supplementary analyses were completed comparing the COG-UNAFF group with those in the CONT group with similar IQ scores (IQ ≥ 84) (CONTsimIQ) to control for cognitive status. Group (2) × Gender (2) analyses of variance and chi square analyses were completed as appropriate for variables that were significant or marginal ($p < .1$) in the prior analyses. For adaptive function variables, the COG-UNAFF group was higher than the CONTsimIQ group for number of social settings ($F_{(1,68)} = 9.50$, $p = .003$) and marginally higher for club/group activity participation. No significant group effects occurred for ABAS-II scales or independence variables. For role entry variables, a significant interaction occurred for Years of Schooling with COG-UNAFF women reporting more schooling than men and the opposite occurring in the CONTsimIQ group ($F_{(1,68)} = 4.04$, $p = .048$). Of those who sought further education after high school, 57.1% of the COG-UNAFF group reported attending a 4-year college as compared to 30.4% of the CONTSimIQ group ($X^2_{(1)} = 3.19$, $p = .074$). Those in the COG-UNAFF group were significantly less likely to report having children ($X^2_{(1)} = 5.53$, $p = .019$). Significant or marginal effects for gender showing higher adaptive function for women still occurred for the ABAS-II GAC, ABAS-II domain composites, and the Hollingshead ratings.

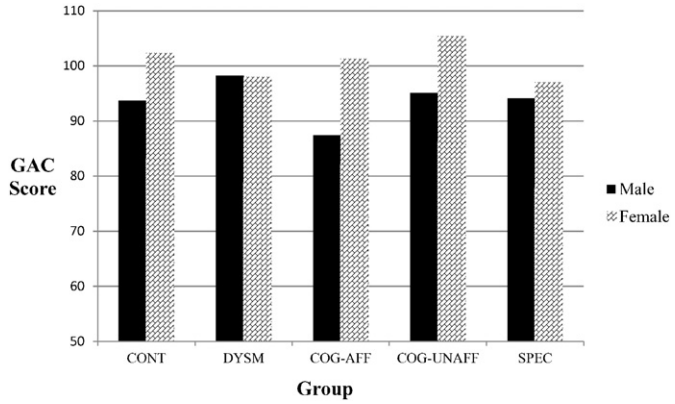

Fig. 1. Estimated Marginal Means on GAC for Gender within Group.

4. Discussion

Results suggest that PAE affected both adaptive function and entry into adult roles in this community sample. These alcohol-affected individuals, particularly males in the COG-AFF group, had more difficulty with general adaptive functioning as well as the conceptual adaptive function domain. The ability to function well in day-to-day life may provide many of the foundation skills for successful role transitions in adult life. In addition, the women in the COG-UNAFF group showed higher adaptive function than expected on a number of variables.

Both alcohol-affected (DYSM and COG-AFF) groups showed substantial difficulty with the transition to adult roles. Participants in the COG-AFF group completed less schooling, were most likely to be unemployed, and were more likely to have biological children than participants in the other groups. Both DYSM and COG-AFF groups scored significantly lower than the CONT and COG-UNAFF groups on the Hollingshead socioeconomic status rating. For independence in life

Table 4
ABAS-II scores for adaptive function: estimated marginal means, standard errors and tests (N = 222).

Variables	Groups						
	CONT (n = 57)	DYSM (n = 46)	COG-AFF (n = 34)	COG-UNAFF (n = 33)	SPEC (n = 52)	Test	p-Value
Males: females within group	23:34	23:23	8:26	12:21	28:24		
General adaptive composite (GAC), EMM (SE)	M[a] = 93.71 (2.21) F[a] = 102.34 (1.82) T[a] = 98.03 (1.43)	M = 98.23 (2.21) F = 97.98 (2.23) T = 98.10 (1.57)	M = 87.36 (3.76) F = 101.32 (2.08) T = 94.34 (2.15)	M = 95.13 (3.06) F = 105.44 (2.31) T = 100.29 (1.92)	M = 94.09 (2.01) F = 96.98 (2.18) T = 95.54 (1.48)	Group Wald $X^2_{(4)} = 6.21$ Gender Wald $X^2_{(1)} = 21.09$ Life stress Wald $X^2_{(1)} = 5.35$ Interaction Wald $X^2_{(4)} = 10.66$	ns[b] p = .000 p = .021 p = .031
Domain composites							
Conceptual composite, EMM (SE)	M = 94.06 (2.17) F = 100.83 (1.79) T = 97.44 (1.4)	M = 96.06 (2.17) F = 96.0 (2.18) T = 96.03 (1.54)	M = 87.49 (3.69) F = 98.67 (2.04) T = 93.08 (2.11)	M = 96.2 (3.0) F = 105.03 (2.27) T = 100.62 (1.88)	M = 93.05 (1.97) F = 95.77 (2.14) T = 94.4 (1.45)	Group $F_{(4,211)} = 2.49$ Gender $F_{(1,211)} = 15.02$ Life stress $F_{(1,211)} = 3.63$ Interaction $F_{(4,211)} = 1.73$	p = .045 p = .000 p = .058 ns
Social composite, EMM (SE)	M = 96.27 (1.95) F = 100.02 (1.6) T = 98.14 (1.26)	M = 100.33 (1.95) F = 98.07 (1.96) T = 99.2 (1.38)	M = 92.88 (3.3) F = 99.55 (1.83) T = 96.22 (1.9)	M = 98.02 (2.7) F = 105.0 (2.04) T = 101.51 (1.69)	M = 97.65 (1.77) F = 100.27 (2.29) T = 96.93 (1.30)	Group $F_{(4,211)} = 1.58$ Gender $F_{(1,211)} = 4.05$ Life stress $F_{(1,211)} = 2.67$ Interaction $F_{(4,211)} = 2.08$	ns p = .045 ns p = .085
Practical composite EMM (SE)	M = 94.88 (2.32) F = 104.93 (1.9) T = 99.9 (1.5)	M = 100.27 (2.32) F = 102.16 (2.33) T = 101.22 (1.64)	M = 92.64 (3.94) F = 105.52 (2.18) T = 99.08 (2.25)	M = 94.95 (3.21) F = 105.88 (2.43) T = 100.41 (2.01)	M = 96.25 (2.11) F = 100.27 (2.29) T = 98.26 (1.55)	Group $F_{(4,211)} = .48$ Gender $F_{(1,211)} = 24.08$ Life stress $F_{(1,211)} = 5.44$ Interaction $F_{(4,211)} = 1.76$	ns p = .000 p = .021 ns

[a] M = male, F = female, T = total.
[b] ns = not significant.

activities, the DYSM group reported needing more assistance with activities related to money; both groups were less likely to have a driver's license than participants from the other groups. On the other hand, when social variables were examined, the scores for the DYSM and COG-AFF groups were similar to those of the CONT group on the social composite for the ABAS. The DYSM and COG-AFF groups had lower scores on the social participation variables, but the group effects were either not significant or significant and due to the higher score of the COG-UNAFF group (number of settings). This result is in contrast to studies of social development in children showing an increase in social problems with age in alcohol-affected groups (Crocker et al., 2009; Whaley et al., 2001), but consistent with the results of Temple et al. (2011) in their study of adults with PAE. It is likely that social difficulties increase from childhood into the adolescent years as a part of that transition. Additional social challenges in adulthood were expected, however, so this result may be due to rather low levels of social involvement overall in most groups in this sample.

Most study findings are consistent with expectations, but the hypotheses were only partially supported. While both the DYSM and COG-AFF groups had difficulty with the transition to adulthood, the DYSM group did not show the most serious adaptive difficulties. The COG-AFF group, while less affected physically, showed the most difficulty in measures of adaptive function and entry into adult roles. This result is consistent with the work of prior researchers such as Streissguth et al. (1996) who have suggested that less physically affected individuals are particularly at risk because they are less likely than those who are dysmorphic to be diagnosed early or to receive special services; both these factors can function to protect individuals with PAE from negative outcomes. Difficulty with adaptation to expectations for adult behavior has also been shown in samples of adults with other disabilities such as ADHD (see Barkley and Fischer, 2010).

In contrast, participants in the COG-UNAFF group had high scores on social participation and adult role entry variables. In many instances, the mean scores for this group exceeded those of the CONT group, which was not predicted. Although the higher cognitive capabilities of this group may have impacted school and work outcomes, the supplementary analyses showed that this pattern persisted for some educational and social participation variables even when IQ was controlled. To our knowledge, this is the first time an exposed, but cognitively unaffected group has been defined and their outcomes characterized. Additional research is necessary to examine other possible factors (e.g., environmental context, family influences, genetic variables) to explain their higher adaptive functioning.

The SPEC group was included to provide the opportunity to compare the alcohol-affected groups to a disability group. In general, the scores for this group were similar to those of the alcohol-affected groups but, for some variables (e.g., social participation, some role entry variables), they were similar to the control group. These results suggest that, although the alcohol-affected groups did experience some negative outcomes, their early adult experience is similar to that of other young adults who have required special education services during high school.

While we had no hypotheses concerning a gender difference, we found consistent effects favoring young women in adaptive function and marginal differences on some role entry variables. It is notable

Table 5
Entry into adult roles: educational, occupational, and family outcomes (N = 236).[a]

Variables	Groups						
	Control (n = 59) (1)	DYSM (n = 48) (2)	COG-AFF (n = 37) (3)	COG-UNAFF (n = 38) (4)	SPEC (n = 54) (5)	Statistical test	p-Value[b]
Males: females Within group	23:36	23:25	11:26	14:24	29:25		
Educational outcomes							
Years of formal schooling[c] (N = 233) (# of years), M (SD)	M[d] = 12.49 (2.15)	M = 11.76 (1.43)	M = 11.6 (1.5)	M = 12.0 (1.04)	M = 11.98 (1.33)	Group[c]	p = .003
	F [d] = 12.21 (1.34)	F = 11.72 (1.38)	F = 10.97 (1.27)	F = 13.23 (1.88)	F = 12.2 (1.63)	$F_{(4,223)} = 4.09$	3 < 1,4,5
	T [d] = 12.32 (1.68)	T = 11.73 (1.39)	T = 11.15 (1.34)	T = 12.77 (1.71)	T = 12.08 (1.47)		2 < 4
High school graduation/(N = 230) (% yes)	76.3	62.2	52.8	81.1	66.0	$X^2_{(4)} = 9.42$	p = .052
Further education after high school? (N = 233) (% yes)	66.1	48.9	37.8	56.8	49.1	$X^2_{(4)} = 8.32$	p = .08
Attended 4-year college or university (of those who sought further education) (N = 123) (% yes)	20.5	21.7	14.3	57.1	19.2	$X^2_{(4)} = 13.03$	p = .011
Occupational outcomes							
Current employment status (N = 233) (% — each category)						$X^2_{(12)} = 24.23$	p = .019
Employed	59.3	48.9	37.8	59.5	73.6		
Student/training	15.3	12.8	5.4	10.8	3.8		
Homemaker	0	2.1	5.4	5.4	0		
Unemployed	25.4	36.2	51.4	24.3	22.6		
Employment status (past three years) (N = 232) (% each category)						$X^2_{(16)} = 41.89$	p = .000
Employed — ful l— time	58.6	36.2	42.9	44.7	31.5		
Employed — art — time	20.7	31.9	20.0	28.9	48.1		
Student	6.9	2.1	0	18.4	3.7		
Ret/Disabl/ContEnv[f]	0	2.1	2.9	2.6	3.7		
Unemployed	13.8	27.7	34.3	5.3	13.0		
Hollingshead occupational rating (N = 233), M (SD)	M = 3.0 (1.54)	M = 2.83 (1.83)	M = 2.636 (1.91)	M = 3.07 (1.59)	M = 2.276 (1.25)	Group	p = .025
	F = 3.64 (1.69)	F = 2.33 (1.69)	F = 2.46 (1.58)	F = 3.917 (1.69)	F = 3.375 (1.58)	$F_{(4,223)} = 2.85$	4 > 2,3
	T = 3.4 (1.65)	T = 2.57 (1.75)	T = 2.513 (1.66)	T = 3.605 (1.69)	T = 2.77 (1.5)	Gender $F_{(1,223)}$ = 2.92	p = .089
						Interaction $F_{(4,223)}$ = 1.97	p = .099
Hollingshead – weighted overall rating of socioeconomic status (N = 232), M (SD)	M = 27.14 (10.18)	M = 24.52 (10.7)	M = 24.0 (10.58)	M = 27.14 (8.07)	M = 23.5 (7.03)	Group	p = .003
	F = 31.03 (9.66)	F = 23.29 (10.62)	F = 22.58 (8.43)	F = 32.92 (9.74)	F = 28.87 (8.56)	$F_{(4,222)} = 4.1$	1,4 > 2,3
	T = 29.55 (9.953)	T = 23.89 (10.57)	T = 23.0 (8.997)	T = 30.79 (9.476)	T = 25.98 (8.16)	Gender	p = .057
						$F_{(1,222)} = 3.65$	
						Interaction$F_{(4,222)}$ = 1.45	ns[e]
Family status							
Marital status (N = 233)						$X^2_{(12)} = 12.39$	ns
Never married	86.4	91.5	97.3	89.2	88.7		
Married	10.2	4.3	2.7	10.8	7.5		
Separated	1.7	0	0	0	3.8		
Divorced	1.7	4.3	0	0	0		
Currently married or living with partner (% yes) (N = 232)	35.6	31.9	47.2	47.4	30.8	$X^2_{(4)} = 4.75$	ns
Any biological children? (N = 231) (% yes)	61.0	46.8	70.3	35.1	33.3	$X^2_{(4)} = 18.04$	p = .001
If adult has biological children, do any live with participant? (N = 112) (% yes)	86.1	68.2	83.3	69.2	76.5	$X^2_{(4)} = 3.67$	ns

[a] If data are not available for some participants, the n used for the analysis is noted next to the variable name.
[b] Post-hoc comparisons were completed with Bonferroni test.
[c] Gender and interaction effects were not significant for this variable.
[d] M = male, F = female, T = total.
[e] ns = not significant.
[f] Retired/disabled/controlled environment

that, for the role entry variables, the young women in the alcohol-affected (DYSM and COG-AFF) groups did not achieve at the same level as women in the other groups. PAE may moderate abilities and behavior so that successful role transitions are less likely for them than for women in the other groups. Another potentially relevant factor may be that participants have been drawn from a population that is economically disadvantaged. The impact of low SES may be particularly important in the outcomes of the affected males in our sample. It is possible that the low SES environment may be more conducive to developing risky behavior in males than females, resulting in less emphasis on traditional avenues of achievement and more involvement in problem behavior. As noted above, we were unable to contact a number of males in the study pool due to involvement with the criminal justice system.

The mothers of the adults reported more use of tobacco and marijuana in pregnancy than the mothers in the control group. This is consistent with expectations concerning substance use patterns. Cocaine use was

generally quite low during this time period (1980–1986 — prior to the crack cocaine epidemic), and, overall, the percentage using cocaine in this sample was 6.4%. It is notable, however, that mothers of participants in the COG-UNAFF group reported a much higher level of use (20.0%). This result was unexpected given the positive outcomes for offspring from this group. As prenatal cocaine exposure is often associated with behavior dysregulation and behavior problems (e.g., Min et al., 2014; Ackerman et al., 2010; Buckingham-Howes et al., 2013), it may predict to behavior not considered in the current report.

This study presents initial data on PAE and adaptive function in a community sample of young adults. Future directions for research may focus on determining environmental factors that increase or decrease the effect of PAE on young adults' chances for success. Does access to special education intervention increase adult work opportunities? Would vocational services during the transition to adulthood aid in entry to adult educational and work roles? In addition, further examination of the COG-UNAFF group would also contribute to our knowledge of development during this time period. In particular, it would be beneficial to know what factors, given that they have experienced similar levels of prenatal exposure to alcohol, contribute to their more successful adult functioning.

Conflict of interest

None.

Acknowledgments

The authors would like to thank the young adults who participated in this study. We also acknowledge the contributions of the Maternal Substance Abuse and Child Development staff to this project, especially Sharron Paige, Chris Foster, Valerie Jones Pritchett, Tuesday Means, and Jonathan Cook.

This work was supported by grant R01 AA 014373 from the National Institute on Alcohol Abuse and Alcoholism and by the State of Georgia, Department of Behavioral Health and Developmental Disabilities Fetal Alcohol and Drug Screening Project, GA DBHDD 44100-906-0000042796.

References

Ackerman, J.P., Riggins, T., Black, M.M., 2010. A review of the effects of prenatal cocaine exposure among school-aged children. Pediatrics 125, 554–565.

Barkley, R.A., Fischer, M., 2010. The unique contribution of emotional impulsiveness to impairment in major life activities in hyperactive children as adults. J. Am. Acad. Child Adolesc. Psychiatry 49 (5), 503–513.

Bertrand, J., Floyd, L.L., Weber, M.K., 2005. Guidelines for identifying and referring persons with fetal alcohol syndrome. MMWR Recomm. Rep. 54 (RR-11), 1–14.

Buckingham-Howes, S., Berger, S.S., Scaletti, L.A., Black, M.M., 2013. Systematic review of prenatal cocaine exposure and adolescent development. Pediatrics 131, e1917–e1936.

Coles, C.D., 2006. Prenatal alcohol exposure and human development. In: Miller, M. (Ed.), Brain Development: Normal Processes and the Effects of Alcohol and Nicotine. Oxford University Press, Oxford, pp. 123–142.

Coles, C.D., Smith, I., Fernhoff, P.M., Falek, A., 1985. Neonatal neurobehavioral characteristics as correlates of maternal alcohol use during gestation. Alcohol. Clin. Exp. Res. 9 (5), 454–460.

Coles, C.D., Smith, I.E., Falek, A., 1987. Prenatal alcohol exposure and infant behavior: immediate effects and implications for later development. Adv. Alcohol Subst. Abuse 6 (4), 87–104.

Coles, C.D., Fernhoff, P., Lynch, M.E., Falek, A., & Dellis, E. (1997a). *Manual for scoring the Dysmorphia Checklist: newborn version.* Unpublished manuscript.

Coles, C.D., Platzman, K.A., Raskind-Hood, C.L., Brown, R.T., Falek, A., Smith, I.E., 1997b. A comparison of children affected by prenatal alcohol exposure and attention deficit, hyperactivity disorder. Alcohol. Clin. Exp. Res. 21 (1), 150–161.

Coles, C.D., Platzman, K.A., Lynch, M.E., Freides, D., 2002. Auditory and visual sustained attention in adolescents prenatally exposed to alcohol. Alcohol. Clin. Exp. Res. 26 (2), 263–271.

Crocker, N., Vaurio, L., Riley, E.P., Mattson, S.N., 2009. Comparison of adaptive behavior in children with heavy prenatal alcohol exposure or attention-deficit/hyperactivity disorder. Alcohol. Clin. Exp. Res. 33 (11), 2015–2023. http://dx.doi.org/10.1111/j.1530-0277.2009.01040.x.

Day, N.L., Helsel, A., Sonon, K., Goldschmidt, L., 2013. The association between prenatal alcohol exposure and behavior at 22 years of age. Alcohol. Clin. Exp. Res. 37 (7), 1171–1178. http://dx.doi.org/10.1111/acer.12073.

Famy, C., Streissguth, A.P., Unis, A.S., 1998. Mental illness in adults with fetal alcohol syndrome or fetal alcohol effects. Am. J. Psychiatry 155, 552–554.

Fast, D.K., Conry, J.L., Loock, C.A., 1999. Identifying fetal alcohol syndrome (FAS) among youth in the criminal justice system. J. Dev. Behav. Pediatr. 20 (5), 370–372.

Freunscht, I., Feldmann, R., 2011. Young adults with Fetal Alcohol Syndrome (FAS): social, emotional and occupational development. Klin. Padiatr. 223 (1), 33–37. http://dx.doi.org/10.1055/s-0030-1261927.

Harrison, P.L., Oakland, T., 2003. Adaptive Behavior Assessment System, Second Edition (ABAS-II): Manual. The Psychological Corporation, San Antonio, TX.

Hollingshead, A.B., 2011. Four factor index of social status. Yale J. Sociol. 8, 21–51.

Jones, K.L., Smith, D.W., 1973. Recognition of the fetal alcohol syndrome in early infancy. Lancet 302 (7836), 999–1001.

Jones, K.L., Hoyme, H.E., Robinson, L.K., Del Campo, M., Manning, M.A., Prewitt, L.M., Chambers, C.D., 2010. Fetal alcohol spectrum disorders: extending the range of structural defects. Am. J. Med. Genet. A 152A (11), 2731–2735. http://dx.doi.org/10.1002/ajmg.a.33675.

Kodituwakku, P.W., 2007. Defining the behavioral phenotype in children with fetal alcohol spectrum disorders: a review. Neurosci. Biobehav. Rev. 31 (2), 192–201. http://dx.doi.org/10.1016/j.neubiorev.2006.06.020.

Kregel, J. (1992). *Results of a follow-up study of special education graduates. Region VI education service center. Follow-up interview.* Unpublished copy from the author.

Kregel, J., Wehman, P., Seyfarth, J., Marshall, K., 1986. Community integration of young adults with mental retardation: transition from school to adulthood. Educ. Train. Mentally Retarded 21 (1), 35–42.

Lynch, M.E., Coles, C.D., Corley, T., Falek, A., 2003. Examining delinquency in adolescents differentially prenatally exposed to alcohol: the role of proximal and distal risk factors. J. Stud. Alcohol 64 (5), 678–686.

Mattson, S.N., Crocker, N., Nguyen, T.T., 2011. Fetal alcohol spectrum disorders: neuropsychological and behavioral features. Neuropsychol. Rev. 21 (2), 81–101. http://dx.doi.org/10.1007/s11065-011-9167-9.

May, P.A., Gossage, J.P., 2001. Estimating the prevalence of fetal alcohol syndrome. A summary. Alcohol Res. Health 25 (3), 159–167.

May, P.A., Baete, A., Russo, J., Elliott, A., Blankenship, J., Kalberg, W., et al., 2014. Prevalence and characteristics of fetal alcohol spectrum disorders. Pediatrics 134, 855–866. http://dx.doi.org/10.152/peds.2013-3319.

McLellan, A.T., Luborsky, L., Cacciola, J., Griffith, J., Evans, F., Barr, H.L., O'Brien, C.P., 1985. New data from the Addiction Severity Index: reliability and validity in three centers. J. Nerv. Ment. Dis. 173, 412–423.

Min, M.O., Minnes, S., Lang, A., Weishampel, P., Short, E.J., Yoon, S., Singer, L.T., 2014. Externalizing behavior and substance use related problems at 15 years in prenatally cocaine exposed adolescents. J. Adolesc. 37, 269–279.

Moos, R.H., Moos, B.S., 1994. LISRES-A: life stressors and social resources inventory—adult form. Professional manual. Psychological Assessment Resources, Inc., Lutz, FL.

Olson, H.C., Ohlemiller, M.M., O'Connor, M.J., Brown, C.W., Morris, C.A., Damus, K., National Task Force on Fetal Alcohol Syndrome and Fetal Alcohol Effect, 2009. A call to action: advancing essential services and research on fetal alcohol spectrum disorders — a report of the National Task Force on Fetal Alcohol Syndrome and Fetal Alcohol Effect (March).

Osgood, D.W., Foster, E.M., Flanagan, C., Ruth, G.R., 2005. Introduction: why focus on the transition to adulthood for vulnerable populations? In: Osgood, D.W., Foster, E.M., Flanagan, C., Ruth, G.R. (Eds.), On your own without a net: The transition to adulthood for vulnerable populations. The University of Chicago Press, Chicago, pp. 1–26

Rangmar, J., Hjern, A., Vinnerljung, B., Stromland, K., Aronson, M., Fahlke, C., 2015. Psychological outcomes of fetal alcohol syndrome in adulthood. Pediatrics 135 (1), e52–e58.

Riley, E.P., Infante, M.A., Warren, K.R., 2011. Fetal alcohol spectrum disorders: an overview. Neuropsychol. Rev. 21 (2), 73–80. http://dx.doi.org/10.1007/s11065-011-9166-x.

Sparrow, S.S., Balla, D.A., Cicchetti, D.V., 1984. Vineland Adaptive Behavior Scales: Interview Edition Survey Form Manual. American Guidance Service, Circle Pines, MN.

Spohr, H.L., Steinhausen, H.C., 2008. Fetal alcohol spectrum disorders and their persisting sequelae in adult life. Dtsch. Arztebl. Int. 105 (41), 693–698. http://dx.doi.org/10.3238/arztebl.2008.0693.

Spohr, H.L., Willms, J., Steinhausen, H.C., 2007. Fetal alcohol spectrum disorders in young adulthood. J. Pediatr. 150 (2), 175–179. http://dx.doi.org/10.1016/j.jpeds.2006.11.044 (179 e171).

Stratton, K., Howe, C., Battaglia, F., 1996. Fetal Alcohol Syndrome: Diagnosis, Epidemiology, Prevention, and Treatment. National Academy, Washington, DC.

Streissguth, A.P., Barr, H.M., Kogan, J., Bookstein, F.L., 1996. Understanding the occurrence of secondary disabilities in clients with fetal alcohol syndrome (FAS) and fetal alcohol effects (FAE). Fetal Alcohol and Drug Unit, University of Washington School of Medicine, Seattle, WA.

Streissguth, A.P., Bookstein, F.L., Barr, H.M., Sampson, P.D., O'Malley, K., Young, J.K., 2004. Risk factors for adverse life outcomes in fetal alcohol syndrome and fetal alcohol effects. J. Dev. Behav. Pediatr. 25 (4), 228–238.

Temple, V., Shewfelt, L., Tao, L., Casati, J., Klevnick, L., 2011. Comparing daily living skills in adults with fetal alcohol spectrum disorder (FASD) to an IQ matched clinical sample. J. Popul. Ther. Clin. Pharm. 18 (2), e397–e402.

Wechsler, D., 1999. Wechsler Abbreviated Scale of Intelligence (WASI). The Psychological Corporation, Harcourt Brace & Co., San Antonio, TX.

Whaley, S.E., O'Connor, M.J., Gunderson, B., 2001. Comparison of the adaptive functioning of children prenatally exposed to alcohol to a nonexposed clinical sample. Alcohol. Clin. Exp. Res. 25 (7), 1018–1024.