PHYSICAL AND NEURODEVELOPMENTAL EVALUATION OF CHILDREN ADOPTED FROM EASTERN EUROPE

Monique Robert[1], Ana Carceller[1], Valérie Domken[1], Félix Ramos[2], Otilia Dobrescu[1], Marie-Noëlle Simard [3], Julie Gosselin[3]

[1]Department of Pediatrics; [2]Psychology; [3]Research Center; CHU Sainte-Justine, Université de Montréal, Canada

Presented in part at: The Canadian Pediatric Society's 83rd Annual Meeting, June 2006, St-John's, Newfoundland, Canada

ABSTRACT

Background
Children adopted from Eastern Europe are at risk of prenatal alcohol exposure, consequently at risk of Fetal Alcohol Spectrum Disorders (FASD). To our knowledge, a systematic complete assessment of these disabilities among adoptees from Eastern Europe has not yet been reported.

Objective
To assess physical and neurodevelopmental status to identify FASD in children adopted from Eastern Europe.

Method
Cross sectional study at International Adoption Clinic of a paediatric academic hospital. This evaluation was realized according to the 4-Digit Diagnostic Code (4-DDC).

Results
Twenty-nine children were evaluated. Five years after adoption, 7% (N=2) still presented growth delay and 24% (N=7) microcephaly. Facial evaluation demonstrated moderate Fetal Alcohol Syndrome (FAS) features in 7% (N=2) of children. Amiel-Tison Neurological Assessment was non optimal in 46% (N=13/28) of children. Visual-motor perception skills were mainly normal, but 14% (N=4) showed distal somatopraxic problems. Cognition, executive functioning, abstract reasoning and memory were normal. Full scale IQ was 105.5 ± 13.3; verbal IQ < performance IQ ($p<0.005$), work memory < short memory ($p<0.0001$), receptive <expressive language ($p<0.0001$). Attention-deficit hyperactive disorder was presented in 31% (N=9). Concerning adaptive behaviour, social skills and social communication, 29% (N=8) performed <-2 SD and 33% (N=5/15) needed school assistance. According to 4-DDC, 7% (N=2) of children were normal, 21% (N=6) of children were known exposed to alcohol, one of these was classified as Partial FAS and five others presented neurological damage, or neurobehavioral disorders with or without sentinel physical findings. Three percent (N=1) were classified FAS although alcohol exposure was unknown. Sixty-nine percent (N=20) of children presented physical findings alone or neurological anomalies with or without physical findings.

Conclusion
In our cohort, the 4-DDC was useful. Systematic and multidisciplinary neurodevelopmental assessment is needed in these adopted children, for an early intervention to prevent secondary disabilities and therefore optimize children's outcome.

Keywords: *Fetal Alcohol Spectrum Disorder; Fetal Alcohol Syndrome; international adoption; Eastern Europe; 4-Digit Diagnostic Code; 4-DDC*

In Quebec (Canada), more than one thousand children were adopted from Eastern Europe between the years of 1990 and 2005. In Russia, one third of women in childbearing age drink alcohol on a regular basis.[1] Children adopted from these countries are at risk of

prenatal alcohol exposure and consequently at risk of Fetal Alcohol Spectrum Disorders (FASD).[2] FASD is a term that encompasses a wide range of physical, mental, behavioural and learning disabilities that can occur when a person is exposed to alcohol during pregnancy.[3] The most visible presentation is Fetal Alcohol Syndrome (FAS). To establish the clinical diagnosis of FAS, in the context of prenatal exposure to alcohol, we must document a growth deficit, specific facial features, and CNS abnormalities with neurodevelopmental impairment.[4] The rate of FASD among institutionalized children in Eastern Europe is high, even though the exact prevalence remains presently unknown.[5,6]

The identification of these disorders when maternal history of alcohol abuse is not available is difficult. The 4-Digit Diagnostic Code (4-DDC)[7], standardized and validated by the University of Washington (Seattle), provide categorizations according to the severity of signs, even if the gestational alcohol exposure is unknown. To our knowledge, a systematic and complete assessment of these disabilities among adoptees from Eastern Europe has not yet been reported. This evaluation may be essential in order to better inform adoptive families.

Our objective was to assess physical and neurodevelopmental status to identify FASD in children adopted from Eastern Europe.

METHODS

Design Study and Study Sample

This observational descriptive cross-sectional study (between 2005/04 and 2006/06) was approved by the Scientific and the Ethical Committees of the Tertiary Centre Hospitalier Universitaire (CHU) Sainte-Justine of Montreal in Canada. The patients were retrieved from the computerized database of the International Adoption Clinic. From 780 adoptees evaluated between 1998/01 and 2004/06, 69 (8.8%) children came from Eastern Europe. Selection criteria: between 4 and 8 years at the time of the study and a minimum of one year elapsed post adoption. Exclusion criteria were:

1. Prenatal infection or maternal drug consumption other than alcohol during the pregnancy (Cf. medical records),
2. Neurological, genetic or metabolic diseases,
3. Child and parents inability to communicate in French, and
4. Refusal to participate in the study. Patients were recruited by letters and phone calls.

Two separate sessions of evaluation of 2.5 hours each were performed by a pediatrician (VD), occupational therapist (JG) and psychologist (FR). Several questionnaires were also completed by parents.

4-Digit Diagnostic Code[7]

Every child received a 4-Digit quotation. Ranking of each Digit was expressed from 1 (no trouble) to 4 (severe trouble) according to a 4-point Likert-type scale.

1ST Digit of the Code: weight and height growth

Anthropometric parameters were obtained at birth, upon arrival in Canada, and at the start of the study. All the measurements were converted in z-scores using the US CDC 2000 Growth Charts.

2ND Digit of the Code: facial features

Three main facial features of FAS[8] were analyzed: palpebral fissure length, upper lip thinness and philtrum smoothness. Computerized measurements of these parameters were performed with the FAS Facial Photographic Analysis Software.[9]

3RD Digit of the Code: neurodevelopmental assessment

Based on the 4-DDC[7] and the FASD-Canadian Guidelines for diagnosis[10], the following domains were assessed:

Neurological status was first evaluated with the *Amiel-Tison Neurological Assessment (ATNA).*[11] This standardized neurological evaluation takes into account passive tone, deep tendon reflexes, primitive reflexes, motor activity, and cranial suture examination. Results of this assessment were classified: optimal status, when either one isolated abnormal sign was found or none; and non-optimal status, when severe or moderate neuromotor impairment was present, resulting in the diagnosis of cerebral palsy or milder signs compatible with independent walk.

The visuo-motor skills were evaluated with the *Developmental Test of Visual Perception-2*[12] (*DTVP-2*) consisting of four strictly visual and four visual and motor subtests. Four types of ability were noted:
1. Form constancy: recognition of dominant features of figures or shapes
2. Figure-ground: recognition of figures embedded within a general sensory background
3. Position in space: discrimination of reversals and rotations of figures, and
4. Spatial relations: analysis of forms and patterns in relation to one's body and space.

Ideomotor praxic abilities were appraised with the *Bergès-Lézine's Imitation of Gestures test.*[13] The child was asked to imitate, in the mirror, simple distal and complex digital gestures. Performances were scored according to recent normative data (*Vaivre-Douret*).[14] **Sensory processing abilities** were assessed with the *Sensory profile*[15], a questionnaire completed by the parents. This allowed identifying poor responsiveness by habituation, over responsiveness by sensitization, sensation seeking or avoidance, and if sensorial peculiarities interfered with functional performance in daily life. Results were expressed in cut-offs: typical performance, probable or definite difference. **Brain structure** was estimated by head circumference measurement, which was converted in *z-scores* according to Nellhaus curves.[16] **Cognitive performances, executive functioning, abstract reasoning and memory** were assessed by the psychologist. The French version of *Wechsler Preschool and Primary Scale of Intelligence - Revised (WPPSI-R)*[17], was used for children aged 4 to 5 years 11 months, while the French version of *Wechsler Intelligence Scale for Children – III Edition (WISC-III)*[18] was used for children aged 6 to 8 years 9 months. In addition to the usual scales (full, verbal and performance), subscales were selected to assess long term memory (information), short term memory (arithmetic index), work memory (digit span), executive functions (mazes in W*PPSI-R* and picture arrangement in *WISC-III*), verbal abstract reasoning (similarities) and non verbal abstract reasoning (block design). **Communication** was evaluated with the *Communication Subscale of the Vineland Adaptive Behavior Scale, interview edition.*[19] Expressive (vocabulary) and receptive (comprehension) skills were also evaluated by *WISC-III* subscales. **Attention and activity level** were mainly assessed with the questionnaire *Conners' Parent Rating Scale Revised Long Version*[20] filled up by the parents in order to determine the risk of Attention-Deficit Hyperactivity Disorder (ADHD). In our study, indexes were selected on the basis of DSM-IV criteria[21] and *IQ subscales* were also studied**. Adaptive behaviours and social skills** were measured with the *Vineland Adaptive Behavior Scale, interview edition*[19] while the *Pediatric Symptom Checklist (PSC)*[22] was completed by the parents. The scores were expressed by cut-offs. **Academic achievement** was appraised according to special education needs and failure to promote to a regular school level.

To score the 3RD Digit, a classification was developed according to the number of neurodevelopmental domains situated <-2 SD. *Rank 1:* absence of neurological damage, no domain <-2 SD; *Rank 2:* possible neurological damage, with 1 or 2 domains <-2 SD; *Rank 3:* probable neurological damage, with ≥3 domains <-2 SD but without microcephaly; *Rank 4:* definite neurological damage, with ≥3 domains <-2 SD and microcephaly.

4TH Digit of the Code: Fetal Alcohol Exposure

According to the 4-DDC[7], Rank 1 was attributed to no risk of prenatal alcohol exposure, Rank 2 for unknown, Rank 3 for some risk and Rank 4 for high risk exposure.

Categorization

The diagnostic code was established for each patient, that were grouped into categories following the 4-DDC.[7]

Statistical Analysis

Statistical analyses were performed with SPSS 13.0 for Windows (SPSS, Inc, Chicago, IL). As needed, χ^2 and *t* test were performed.

RESULTS

Among 69 children adopted from Eastern Europe during the study period, 51 met the inclusion criteria. Two children were lost in follow-up and

twenty were excluded: chromosomal anomaly (1), incapacity to communicate in French (1), or refusal to participate (18). The reasons for refusal were: child in good health (6), already FAS diagnosed (1), living too far (1), and no comment (10). Therefore, 29 children completed the study. There was no difference according to age and sex between participants and non-participants. In our cohort, 17 (59%) were male. Children came from Russia (42%, N=12), Belarus (35%, N=10), Romania (10%, N=3), Poland (7%, N=2), Georgia (3%, N=1), and Yugoslavia (3%, N=1). Limited perinatal information was available. One third of the children were institutionalized from birth while one third lived at home between 1 and 30 months. Information for the remaining children is unknown. Socio-demographic characteristics are presented in Table 1.

TABLE 1 Socio-demographic characteristics of the cohort

Children (N = 29)	**Mean± SD**	**Range**
Age at the admission in orphanage (months)	6 ± 8	[0-30]
Time spent in orphanage (months)	16 ± 10	[8-52]
Age at the arrival in Canada (months)	22 ± 12	[9-53]
Age at the first medical evaluation (months)	23 ± 11	[9-53]
Time elapsed after adoption (years)	4.7 ± 2.0	[1.7-7.3]
Age at the time of the study (years)	6.5 ± 1.4	[4.2-8.9]
Adoptive parents	**Mothers N (%)**	**Fathers N (%)**
Level of education		
University	14 (48%)	18 (64%)
College	12 (42%)	6 (22%)
High school	3 (10%)	4 (14%)
Mean age at the moment of adoption (years ± SD) [range]	36 ± 4 [27-45]	38 ± 5 [30-49]
Family income > 50 000 $ CAD, N (%)	27 (93%)	

1ST Digit of the Code: Weight and Height Growth

Anthropometric birth data were available for only 8 adoptees. Birth weight was < 3rd percentile in 38% (N=3) of children. On their arrival in Canada, the mean weight expressed in *z-score* was -1.6 ± 1.3 and the mean height -1.4 ± 1.0. Weight and height were < -2SD in 52% (N=15) and 38% (N=11), respectively. These parameters were together < -2SD in 21% (N=6) of the cohort. Nearly five years later, the mean weight (*z-score*) was -0.4 ±1.3 and the mean height -0.3 ±1.2. Weight and height persisted < -2 SD in 7% (N=2) and 3% (N=1) of patients, respectively.

2ND Digit of the Code: Facial Features

Moderate FAS features were present in 7% children (N=2), but no severe case was found.

3RD Digit of the Code: Neurodevelopmental Assessment

Neurodevelopmental performances are presented in Table 2. Neurological status evaluated with *ATNA* was non optimal in 46% (N=13) children, but none had cerebral palsy. Forty-six percent (N=13/28) of adoptees had microcephaly on arrival in Canada; 24% (N=7) still had it at the time of the study ($p<0.0001$). All IQs were within normal limits, however, performance IQ was significantly higher than verbal IQ ($p<0.005$). Executive functioning and abstract reasoning tested with similarities (verbal) and block design (non-verbal) were normal. Short memory index was significantly higher than working memory index ($p<0.0001$). Children assessed with subscales of verbal IQ performed significantly better on expressive than on receptive language scale ($p<0.0001$). Thirty-one percent of the children (N=9) had

global ADHD with no significant difference between attention deficit and hyperactivity-impulsivity scores. Moreover, 29% (N=8) of the children performed < -2 SD on the *Vineland Adaptive Behaviour Scale* and 15% (N=4/26) on the *Pediatric Symptom Checklist.* According to parents' information, 1/3 (N=5/15) children required some school assistance.

4TH Digit of the Code: Fetal Alcohol Exposure

Fetal alcohol exposure was known for only 6 children. Ranking is found in Table 3.

TABLE 2 Neurodevelopmental Assessment

Evaluated Domains	Test	Unit	Value	Over (1SD)		(- 1 to -1.9 SD)		Below (- 2 SD)	
			Mean (SD)	N	%	N	%	N	%
Neurological and sensory-motor signs	Visual perception (*DTVP-2*)	Standard score (mean 100±15)	101.8 (± 13.5)	26	90	2	7	1	3
	Praxis (*Bergès-Lézine*)								
	Distal test		89.6 (± 20.2)	19	65	6	21	4	14
	Digital test		94.1 (± 17.1)	23	80	3	10	3	10
Brain structure	Head circumference								
	At arrival	z-score	-1.8 (± 1.4)†	10	39	4	15	12	46
	4.7 years later	(mean 0)	-0.8 (± 1.4)†	20	69	2	7	7	24
Cognition	*WPPSI-R or WISC-III*								
	Full scale IQ	Standard score	105.5 (± 13.3)	28	97	1	3	0	0
	Verbal IQ	(mean 100±15)	102.5 (±11.8)*	28	97	1	3	0	0
	Performance IQ		108.5 (±13.9)*	28	97	1	3	0	0
Executive functioning and Abstract reasoning	IQ sub-scales	Scaled score							
	Picture arrangement (*WISC-III*)	(mean 10±1)	10.9 (±12.7)	25	86	4	14	0	0
	Mazes (*WPPSI-R*)			28	97	1	3	0	0
Memory	IQ sub-scales:								
	Information	Scaled score	9.8 (± 11.8)						
	Arithmetic	(mean 10±1)	11.3 (±13.0)†	25	86	4	14	0	0
	Digit span		7.9 (±19.8)†						
Communication	*Vineland Adaptive Behavior Scale*	Standard score	87.8 (± 19.0)						
	Verbal IQ *(WISC-III)*	(mean100±15)		28	97	0	0	1	3
	Vocabulary	Scaled score	10.7 (±12.4)†						
	Comprehension	(mean 10±1)	9.0 (±12.5)†						
Attention and Activity Level	Conners	T score							
	DSM-IV inattentive	(mean 50±10)	57.0 (± 11.6)						
	hyperactive-impulsive		57.0 (± 13.7)						
	DSM-IV global		56.9 (± 12.1)	14	48	6	21	9	31
	IQ Freedom	Standard score	98.9 (± 15.7)						
	from distractibility	(mean 100±15)							
Adaptive behaviour	*Vineland Adaptive Behavior Scale*	Standard score (mean 100± 15)	85.7 (±17.1)	14	48	7	24	8	29
Academic achievement	Questionnaire			**Normal course**		**School assistance**		**Resumed school year**	
				10	67	3	20	2	13

* $p < 0.005$ † $p < 0.0001$

TABLE 3 Ranking in accordance with the 4-Digit Diagnostic Code[7]

	Rank 1	Rank 2	Rank 3	Rank 4
	No trouble N (%)	Mild N (%)	Moderate N (%)	Severe trouble N (%)
1st Digit				
Growth deficiency At the time of study (4.7 years later)	21 (72)	6 (21)	1 (3)	1 (3)
2nd Digit				
FAS facial Phenotype	20 (69)	7 (24)	2 (7)	0 (0)
3rd Digit				
Neurological Damage	6 (21)	11 (38)	9 (31)	3 (10)
4th Digit				
Prenatal alcohol exposure	0 (0)	23 (79)	0 (0)	6 (21)

Categorization

According to 4-DDC[7], 7% (N=2) of children were normal, 21% (N=6) of children were known exposed to alcohol, one of these was classified as Partial FAS (normal weight and height) and five others presented neurological damage, or neurobehavioral disorders with or without sentinel physical findings. Three percent (N=1) of children were classified FAS although alcohol exposure was unknown. Sixty-nine percent (N=20) of children presented physical findings alone or neurological anomalies with or without physical findings.

Other Results

Visual perception (*DTVP-2)* was better with younger age (<6 months) at admission in orphanage (p=0.029), younger age at arrival (<18 months) in Canada (p=0.003) and higher level of education (University) of adoptive mother (p=0.002). **Visual contact** *(Sensory Profile)* was also better with younger age at admission in orphanage (p=0.012) and younger age at arrival in Canada *(*p=0.046). **Verbal IQ** was higher with younger age at arrival in Canada (p=0.041), normal mean head circumference (>-2SD) at the time of the study (p=0.013) and younger adoptive mother (<36 years) (p=0.004). **Performance IQ** was higher with normal mean head circumference at the time of the study (p=0.021), younger adoptive mother (p=0.036), and younger mean age (<6 years) at the time of the study *(*p=0.048). **Global IQ** was higher with normal mean head circumference at the time of the study (p=0.022) and younger adoptive mother (p=0.005). **Adaptation** (*Vineland)* was better with younger adoptive mother (p= 0.020).

DISCUSSION

Adopted children are at risk for physical and neuropsychological disabilities and it is difficult to attribute the outcomes observed only by alcohol exposure. In our study 21% of the biological mothers consumed alcohol during pregnancy. The validity of this information could not be confirmed. Landgren et al[23] reported that 33% of the biological mothers of the adopted children from Eastern Europe were alcoholic. The use of 4-DDC[7], although not intended to be the gold standard to identify FASD, could be useful when alcohol exposure is unknown.

Upon arrival in Canada, half of the adopted children had weight or height deficiency, caused by illness, nutritional, emotional, or sensorial deprivation, genetic or environmental factors such as prenatal alcohol exposure. Most of our children

presented a significant catch up growth, however, 7% of them still had weight and 3% height below -2SD as already described.[23] Despite this improvement, microcephaly may still persist - twenty-four percent of patients still presented microcephaly, as in another study.[23] Since the catch up of head circumferences after adoption mainly occurs in the first two years of life and with the mean age of children studied here was 6.5 years old, we believe that this permanent microcephaly may indicate an early important insult. Furthermore, relative microcephaly - disproportionate to height and weight- as we have noted in 6 out of 7 patients, is more likely to represent serious underlying brain damage. However, it is impossible to differentiate the deleterious effect of alcohol from that of the neglectful orphanage environment with regards to head growth.

In Russian orphanages, Miller et al[5] reported that 45% of children had intermediate facial phenotype scores compatible with prenatal alcohol exposure. In our study, using computerized analysis of facial features of FAS, only 7% of children had moderate features and none had severe ones. It is our belief that children in orphanages with suspected FAS are not selected for adoption. Also, among the children who did not participate in our study, one case had confirmed FAS and there may have been others in the refusals.

It was difficult to score the third digit, to decide which test to administer, to determine the relative power of each test, to define domain abnormality in the same manner and to eliminate the bias of interpretation of a specific test. To resolve this problem, we used several tests - all administered by the same professionals, and we developed a classification consistent to the results.

The authors have noticed the association between maternal drinking and neurocognitive impairment on child leading to neurobehavioral dysfunctions reflected in attention, cognition, memory, and school performances problems.[24] In our study, children mainly performed within normal limits in cognition, executive function, abstract reasoning and memory. However, there were some neurological findings - nearly half of children had a non optimal status according to ATNA. It has been shown, that in children younger than six years of age, that ATNA status was related to intellectual performances.[11] Therefore, this assessment could be used in the medical evaluation of adopted children. In addition, structural and functional neurological alterations were described in FAS subjects, as abnormalities in size and location of the corpus callosum and cortical thickness.[25] Thus, we question the possible link between these anatomical anomalies and the abnormal ideomotor praxic tests results found in our study. This finding may be partially explained by the fact that the fine motor skills in FAS are significantly more delayed than gross motor skills.[26]

Verbal IQ scores were significantly lower than performance IQ scores. Unfavourable environment may reduce cognitive capacities and in particular, verbal capacities. Lower verbal scores in recently adopted children could be related to exposition to a new language. In our study, receptive language was significantly lower than expressive one; this problem has been previously reported, with prenatal alcohol exposure.[27] Also, school-aged children with prenatal alcohol exposure often exhibit language deficits leading to adverse social interactive experiences.[27]

Global memory was found to be normal, but children performed significantly better in short memory than in work memory. Kulaga, et al[28] demonstrated that slower processing in specific cognitive tasks amongst children with prenatal exposure to alcohol could result in a reduced working memory.

There is an obvious neuropsychological and neurochemical link between ADHD and FASD.[27] Children with FASD have greater ADHD incidence and present a defect resulting in ADHD of early expression. In our cohort, 1/3 of children had an abnormal Conners' test. No differences were found between inattention and hyperactive/impulsivity. The most frequent neurobehavioral characteristic in children exposed to alcohol was inattention followed by hyperactivity.[27] Abnormalities in adaptive behaviour, social skills and academic achievement were found in 1/3 of our patients. Behaviours - cruelty, lack of guilt, lying, cheating, stealing- and psychiatric disorders significantly associated with heavy prenatal alcohol exposure[29], were not described in our cohort. Neurodevelopmental abnormalities found in our patients could result

from prenatal alcohol exposure - however these neurobehavioral impairments are not unique to FASD. Other factors could be associated with these findings such as child age at adoption and quality of orphanage environment.[30]

Finally, despite no facial features of FAS in 93% of children, normal IQ, normal executive functioning, abstract reasoning and memory for all in the cohort - still 24% of the cohort had microcephaly, nearly half had a non optimal ATNA status. Also, several children had difficulties in verbal communication, work memory combined with a high prevalence of ADHD leading to difficult psychosocial adaptation and complicated academic achievement.

Considering cardinal neurodevelopmental features usually altered in FAS[7,10] - cognition, executive function, abstract reasoning, and memory are not largely affected in our cohort. We would like to keep certain optimism for the long term neurodevelopmental function of our patients. Nevertheless, we are certainly concerned that number of children may present some brain / injury dysfunction. In fact, 7% of our cohort, had FAS / Partial FAS and 86% presented physical findings alone or neurological anomalies with or without physical findings. We may have found even more severe categories of 4-DDC if children had been tested at an older age, since the neurodevelopmental disabilities frequently appear later around 9-12 years of age. Certainly, the 4-DDC categories identified in our cohort are of unequal importance in clinical settings, "physical signs" alone being are not as serious as severe neurological damage. We reaffirm again that findings can only be ascribed to in utero alcohol exposure, in whole or in part, when there is a confirmed history of alcohol exposure or when the facial features are found to be at the rank 4. More studies are needed. Due to the limited size of this cohort, our findings according to 4-DDC, could not be generalised to all children adopted from Eastern Europe. However, this study could contribute to a better evaluation of adopted children along with better guidance for adoptive families with stimulation programs in preventing additional disabilities.[31]

In conclusion, children adopted from Eastern Europe should be evaluated with a systematic and multidisciplinary neurodevelopment assessment. The 4-DDC is useful in order to categorize disabilities, but the most important point is to arrange early educational and environmental interventions, and therefore optimize children's outcome.

Corresponding Author:
monique.robert.hsj@ssss.gouv.qc.ca

REFERENCES

1. World Health Organization Global Database on alcohol use. Accessed on December 8, 2008 at: http://www3.who.int/whosis/alcohol.
2. Barr HM, Streissguth AP. Identifying maternal self-reported alcohol use associated with fetal alcohol spectrum disorders. Alcohol Clin Exp Res.2001;25: 283-7.
3. Loock C, Conry J, Cook JL. Guidelines for Diagnosis. Identifying fetal alcohol spectrum disorder in primary care. JAMC 2005;172 (5): 628-30.
4. Bertrand J, Floyd LL, Weber MK; Fetal Alcohol Syndrome Prevention Team, Division of Birth Defects and Developmental Disabilities, National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention. Guidelines for identifying and referring persons with fetal alcohol syndrome. MMWR Recomm Rep. 2005; 54 (RR-11):1-14.
5. Miller LC, Chan W, Litvinova A, et al; Boston-Murmansk Orphanage Research Team. Fetal Alcohol Spectrum Disorders in children residing in Russian orphanages: a phenotypic survey. Alcohol Clin Exp Res 2006;30:531-8.
6. Aronson J. Evan B. Donaldson Adoption Institute Conference. Alcohol and Drug Exposure of Infants and Children: Research and Public Policy. October 24-25 1997. Alexandria, Virginia. Alcohol Exposure in Internationally Adopted Children: Russia.
7. Fetal alcohol syndrome Diagnostic and Prevention Network. University of Washington, Seattle. The 4-Digit Diagnostic Code. Accessed on December 8, 2008 at: http://depts.washington.edu/fasdpn
8. Smith DW. The fetal alcohol syndrome. Hosp Pract. 1979;14:121-8.
9. Astley S. FAS Facial Photographic Analysis Software version 1.0.0. FAS Diagnostic and Prevention Network, University of Washington, Seattle, Washington. 2003.
10. Chudley AE, Conry J, Cook JL, et al. Public Health Agency of Canada's National

Advisory Committee on Fetal Alcohol Spectrum Disorder. Fetal alcohol spectrum disorder: Canadian guidelines for diagnosis. CMAJ 2005; 172(5 Suppl):S1-21.
11. Gosselin J, Amiel-Tison C. Le développement neurologique de la naissance à 6 ans. Ed.CHU Sainte-Justine, Elsevier Masson. 2007. 208 pages.
12. Hammill DD, Voress JK, Pearson NA. Developmental Test of Visual Perception, second edition. 1993. PRO-ED Inc.
13. Bergès J, Lézine I. Test d'imitation de gestes, 2ème éd. Paris : Masson, 1972.
14. Vaivre-Douret L. Évaluation de la motricité gnoso-praxique distale chez l'enfant. Une adaptation du test d'imitation de gestes de Bergès-Lézine. Approche Neuropsychologique des Apprentissages. 1999;51 :13-20.
15. Dunn W. Infant-Toddler Sensory Profile. User's manual. Therapy Skill Builders Psychological Corporation; 2002. Free French translation.
16. Nellhaus G. Head circumference from birth to eighteen years. Practical composite international and interracial graphs. Pediatrics 1968;41:106-14.
17. Wechsler D. Manual for the Wechsler Preschool and Primary Scale of Intelligence–Revised. (WPPSI-R) New York, NY: Psychological Corporation; 1990.
18. Wechsler D. Manual for the Wechsler Intelligence Scale for Children (WPPSI-R). 3rd ed. San Antonio, TX: Psychological Corporation; 1991.
19. Sparrow SS, Balla DA, Cicchetti DV. 1984. Vineland Adaptive Behavior Scales. A revision of the Vineland Social Maturity Scale developed by the psychologist Doll and originally published in 1936.
20. Conners CK, Sitarenios G, Parker JD, et al. The revised Conners' Parent Rating Scale (CPRS-R); factor structure, reliability, and criterion validity. J Abnorm Child Psychol. 1998;26:257-68.
21. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (DSM). 2000.
22. Jellinek MS, Murphy JM, Robinson J, et al. Pediatric Symptom Checklist: screening school-age children for psychosocial dysfunction. J Pediatr. 1988;112:201-9.
23. Landgren M, Andersson Grönlund M, Elfstrand PO, et al. Health before and after adoption from Eastern Europe. Acta Paediatr. 2006;95:720-5.
24. Streissguth AP, Barr HM, Bookstein FL, et al. The long-term neurocognitive consequences of prenatal alcohol exposure: A 14-year Study. Psychol. Sci. 1999;10:186-90.
25. Sowell ER, Mattson SN, Thompson PM, et al. Mapping callosal morphology and cognitive correlates: effects of heavy prenatal alcohol exposure. Neurology. 2001;57:235-44.
26. Kalberg WO, Provost B, Tollison SJ, et al. Comparison of motor delays in young children with fetal alcohol syndrome to those with prenatal alcohol exposure and with no prenatal alcohol exposure. Alcohol Clin Exp Res. 2006;30:2037-45.
27. Coggins TE, Timler GR, Olswang LB. A state of double jeopardy: impact of prenatal alcohol exposure and adverse environments on the social communicative abilities of school-age children with fetal alcohol spectrum disorder. Lang Speech Hear Serv Sch 2007;38:117-27.
28. Kulaga V. Cognitive processing speed among children exposed to fetal alcohol. JFAS Int 2006; 4; e3-Feb 2006:1-4.
29. Fryer SL, McGee CL, Matt GE, et al. Evaluation of psychopathological conditions in children with heavy prenatal alcohol exposure. Pediatrics. 2007; 119:e733-41.
30. O'Connor TG, Rutter M, Beckett C, et al. The effects of global severe privation on cognitive competence: extension and longitudinal follow-up. English and Romanian Adoptees Study Team. Child Dev. 2000;71:376-90.
31. Loomes C, Rasmussen C, Pei J, et al. The effect of rehearsal training on working memory span of children with fetal alcohol spectrum disorder. Res Dev Disab. 2008;29:113-24.