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Solutions and the Algorithm of Screening Indicating the Presence of FASD in Preschool Aged Children in the System of Early Care

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Abstract

Fetal alcohol spectrum disorder is an overarching term that describes the extent of effects of prenatal alcohol exposure. It includes the range of neurodevelopmental findings and other medical findings specific for FAS. Measurability of characteristics depends on several factors, such as diagnostic instruments, multidisciplinary focus, etc. The objective of the contribution is to provide the primary early care givers with recommendations for FASD screening. It involves suggestions that deal with recognition, protection and intervention of children with FASD in the most elaborate and unbiased manner. Results of the study offer selective intention of screening in preschool-aged children. The research was conducted with 173 children aged from 3 to 7 years. The authors used their own concept of selected domains indicating the occurrence of impairments in FASD domains. Specific quantitative and qualitative research methods were assigned to them. The impairments relate to anthropometric deviations determining early occurrence of FASD. The authors have selected the domain of basic anthropometry: head circumference, height and weight and philtrum and the obtained results from domains: auditory processing, selected cognitive components, motor system, speech and sensory processing. Conclusions define basic criteria for FASD screening in general population and basic algorithm of distribution of recognized child in a system of early care in the SR. They rely on the fact that there is urgent demand in Slovakia to involve participants in active FASD care.

Keywords: *Fetal Alcohol Spectrum Disorder (FASD), children, screening, early care, algorithm*

What is FASD?

Alcohol effect during pregnancy can lead to permanent brain damage and damage of other important organs, functions and structures of the fetus. The spectrum of FASD is an overarching term coined to indicate a wide range of various effects that can emerge from alcohol exposition. Some of these effects incorporate visible abnormalities: damage of the body, important organs and skeleton. However, the most serious damage is usually “hidden” in the brain. In the case of FASD, it is often found in the brain areas responsible for communication, behaviour and sensory issues and it can be mistaken for other disorders or impairments. The problems manifest themselves along developmental trajectory and they do not have to be apparent unless the important developmental milestones, affected by retardation or absence of required developmental skills, are reached. It does not have to be recognized as a consequence of alcohol exposure. Some of the measured deviations are not always typical of the FASD profile (Gibbard 2013: 26, as cited in: the Ministry of Health, New Zealand, 2015). However, common problems that can be visible are at the CNS level. These manifest themselves by structural, neurological or functional abnormalities.

Structural abnormalities

Small head circumference at birth (at or below the 10th percentile, for FAS usually around 33 cm and less) or other measurable developmental deviations during the first year. During the prenatal development, not only the size of the brain, but also the size of its individual parts is reduced. Retarded growth may occur regardless of facial anomalies presence. The selection of the research that deals with structural brain imaging of children from 3 to 7 years with alcohol exposition before birth, and investigates its extent using MRI in comparison with control sample is shown in Table 1.

Children with FASD usually have difficulty in transmitting information between particular brain parts, they cannot process the information about self-control or abstract thinking. They have trouble receiving new information and retaining it. Disorders can also occur in other parts of the brain. Disruption of the child’s ability to make intentional motor movement can cause clumsy and abrupt movements. Reduction of the cerebellum size can cause sleep disorder and difficulties with

Table 1. Comparison between studies that also dealt with structural brain imaging of children with prenatal alcohol exposure, aged from 3 to 7 years and investigated their extent using MRI in comparison with control sample

The author of the study	Age	N CS	N EA	Phenotype	Structural abnormalities
Swayze et al. 1997 c	4–29	119 (65)	10 (4)	FAS, FASD	Microcephalies, minor anomalies
Riikonen et al. 2005 Riikonen et al. 1999	3–23	10 (5)	12 (7)	FAS, FASD	Reduced hippocampal volume in FAS (L<R)
Lebel et al. 2008	5–13	95 (45)	24 (11)	FASD	Reduced total brain volume
Johnson et al. 1996 c	4–20	–	6 (3)	FAS	Microcephaly, hypoplasia and agenesis corpus callosum
Bhatara et al. 2002 c	6–35	2 (1)	5 (1)	FAS	Hypoplasia and agenesis corpus callosum
Archibald et al. 2001	7–24	41 (20)	26 (12)	FAS, FASD	Reduced cerebral and cerebellar vault, parietal lobe, caudate nucleus in FAS
Bookstein et al. 2007	new-born	21 (16)	23 (10)	FASD	Bigger splenium angle

b – prospective study, c – case study, CS – control sample, EA – sample of alcohol exposition. Compiled according to Dev Disabil Res Rev. the author of manuscript, available in PMC 2012, 14th of September, published in final version as: Dev Disabil Res Rev. 2009; 15(3): 209–217.

balance control. These disorders can also appear among normal looking children without FAS facial abnormalities.

The structural abnormalities in MRI images are elaborately described in Dev Disabil Res Rev (2009; 15(3): 209–217, as cited in: Norman, A.L., Crocker, N., Mattson, S.N., Riley, E.P.), with citation of the first original studies that confirm significant damage of corpus callosum and cerebellum (Jones and Smith, 1973, 1975; Clarren and Smith, 1978; Clarren, 1986; Coulter et al., 1993). A well-known FASD study (Mattson et al., 1997), proves the occurrence of structural abnormalities without facial dysmorphism.

Neurological abnormalities

Seizures, problems with coordination, motor difficulties or another less severe neurological disorders.

Functional abnormalities

The average IQ of children with FAS is about 68, compared to general population with an average IQ of 100. When facial anomalies and retarded growth are absent, we talk about a border zone or children with “normal IQ” with behavioural problems, such as impulsiveness, social disorders, misjudgement, mental retardation, inability to learn, poor study results, lowered executive functions, clumsiness, difficulties with balance control, difficulties in writing and drawing, problems with concentration and hyperactivity (Chasnoff, 2016).

The latest studies, published between 2012 and 2017, are also worth noticing, as they have differentially defined the functional abnormalities mistaken for similar inaccurate diagnosis using research instruments.

Lange, S., Rovet, J., Rehm, J., and Popova, S. (as cited in: *BMC Psychol.* 2017; 5: 22, published online 2017, June 23. doi: 10.1186/s40359-017-0191-2) elaborately analysed similarity between ADHD and FASD. Their findings reveal ten specific characteristics of behaviour recognised by the CBCL instrument, which potentially distinguished children with FASD from children with ADHD, simultaneously with a control group from 6 to 16 years of age.

The study was completed by Breiner, Nulman and Coren (2013) and later by LaFrance et al. (2014).

- They confirmed 94% sensitivity and 96% specificity in identifying children with FASD. However, it is unclear from which group children with FASD were discriminated (if the non-diagnosed group was combined with the control children), as the methods and results sections that describe it are inadequate. Further, this study retrospectively extracted items from CBCL in its entirety.
- This study also assessed possible age and sex-related differences, by comparing 11-year-old children with 12–17-year-old adolescent and boys versus girls.
- The NST showed higher sensitivity among adolescents in comparison with children, for the FASD group and the group of children prenatally exposed to alcohol. For the FASD group only, the NST showed higher sensitivity among boys when compared with girls.
- This study is not only the first to administer the NST as a stand-alone instrument, but it is also the first to differentiate children prenatally exposed to alcohol, who do not meet the criteria for FASD diagnosis, from typically developing control children (LaFrance et al., 2014).

FASD Screening in a common population

There is not any conceptually managed prevention and recognition of children with alcohol exposure in the departments of neurology and paediatrics. Many injured children come to specialists who specialise, within MKCH 10, in types of diagnosis in P, Q, R, G, Z categories, with numbers in more detail. Children up to one year are monitored 9 times in the SR (medical examination by a paediatrician). Screening of the diagnostics of congenital hyperthyroidism, hyperphenylalaninemia, congenital hyperplasia of the adrenal gland (screening of congenital metabolic diseases), obstructive uropathy and limbal dysplasia with the use of ultrasound, was extended by implementation of universal auditory screening and retina reflex examination, which can reveal congenital retinal cataract. That is not enough in the case of FASD, though. According to our findings, many children with FASD are put into medical system along with other diagnoses, e.g. autism, diagnosis of auditory disorders, speech disorders, motor disorders, mixed developmental disorders, etc. Children up to 3 years of age stay at home because of the increased demands on care and therefore their school adaptation fails. Hence, their identification is necessary.

Based on our previously published studies of children diagnosed with FASD spectrum, we are able to measure impairment of domains, such as *cognitive skills/IQ, organicity, speech/social communication, development, motor activity and oral motor activity* at the age up to 36 months.

At the age from 37 months to 70 months, apart from the above-mentioned domains, we are able to measure impairments of domains, *such as adaptive/social behaviour, psychiatric diagnosis, behaviour/concentration/activity, control of behaviour/sensorimotor integration, abstract thinking, memory/learning/information processing, social skills and adaptive behaviour*.

Primary non-medical screening of FASD

The objective of the study was mapping of selected screening data in children aged from 3 to 7 years in general population and identification of impaired domains with the domains indicating FASD. There were 173 children, 3 to 7 years of age, 74 of whom were boys.

The research was conducted by our facility in cooperation with partners, mainly with the specialized employees of the Health Prevention consulting facility.

The hypothesis was focused on answering whether it is possible to recognize children with FASD in general population by non-medical facilities that work in the field of early care and intervention. In the monitored children, we found out moderate and significant deviations in the domains connected with FASD symptoms (visual perception, speech, hearing, sociability, attitude to work, gross and fine motor skills, height, weights, head circumference, philtrum and sensory behaviour).

Research Methodology

Cognitive screening was implemented in a questionnaire for elementary school teachers (Gerbová, 2017). It includes items such as visual perception, speech, hearing, sociability, attitude to work and concentration. It ranges from 0 to 3, where 0 represents norm, 1 represents mild impairment, 2 represents impairment and 3 represents danger.

For anthropometric measurements (height, weight, head circumference, philtrum), the standardized charts for Slovak population of boys and girls at the age of 3 to 18 years were used. In the case of philtrum, we used the scale assessing lips and philtrum typical of the white race, based on Susan Astley's manual from 2004. The above-mentioned self-administered cognitive screening questionnaire was used to compare visual perception, speech, sociability, attitude towards work and concentration (Gerbová, 2017).

Hearing was examined by two instruments:

- Audiometric calibrated audiometer. It is a portable diagnostic instrument, Senti from Path Medical Company, which measures an audiogram of a child up to 3 years of age, by means of the so-called interactive psycho-acoustical test MAGIC (Multiple-Choice Auditory Graphical Interactive Check). During this test, a child plays with the tool and it successively assesses the hearing thresholds of the child. Various images (symbols) of animals representing different frequencies are displayed on the touch screen of the device. In younger children aged 3 to 4, we measured frequencies of 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz and in older children aged from 5, we measured 8 frequencies of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz, 8000 Hz, taking the disturbing surroundings into account.
- Self-administered cognitive screening as a questionnaire for elementary school teachers (Gerbová, 2017).

Gross and fine motor skills were measured by the physiotherapeutic tests: T-239 test of specific learning disabilities (Novák), subtests: A subtest – spatial orientation, B subtest – body schema orientation, C subtest – sideways orientation at the opposite plane, fine motor skill test.

Ozeret's test – ball throwing, hand circles, putting matches into the box.

Sensory Profile, Pearson Clinical measured sensory processing from the age of 3.

Study Results

Cognitivity: we measured mild impairment – impairment of visual perception in 10.983% (19 children), speech in 45.665% (79 children), sociability 39.306% (68 children), attitude towards work in 23.121% (40 children), concentration in 6.3584% (11 children).

Anthropometry: we measured 29 children (16.763%) with height delay ranging from 3 to 25‰, 34 children with weight delay 19.653% ranging from 3 to 25‰, 19 children 10.983% with developmental delay of head circumference ranging from 3 to 25‰. 52 children (30.058%) with philtrum established by value 3 and 4.

Hearing:

- audiometric – as many as 58.382% of the children (101) met the criteria of risk registered in the right ear at the frequency of 2000 Hz with 8.6705% risk and in the left ear at the frequency of 500 Hz with 19.075% risk.
- 34.104% of the children (59) met the criteria of mild impairment to impairment with values 1 to 2 in self-administered cognitive screening for elementary school teachers (Gerbová, 2017).

In the case of the gross and fine motor skills test, 57 children met the criteria of impairment (value 2) in gross motor skills and 29 children in fine motor skills. It amounts to 49.711%, which means almost a half of the total number.

Sensory processing shows norm values in 165 children. Values with deviation of +1SD and +2SD were found only in 8 children in the areas of emotional answer, motor and touch processing and oral processing.

The use of study results for multidisciplinary screening

In the screening of the study we recorded 16.763% of children with height delay, 19.653% of children with weight delay and 10.983% of children with delay

of head circumference. As much as 30.058% of the total number of children had the values of philtrum ranged between 3 and 4. From the FASD prospective, these children met the criteria for risk, concerning the anthropometric data. Since many Canadian and American studies have described numerous diagnostic criteria for FASD in the multidisciplinary process, we can confirm, based on our results and literature mentioned above, that FASD could be diagnosed also in children without facial anomalies. In our sample, impaired cognitvity range was 6.3584% (concentration), visual perception (10.983%), attitude towards work (23.121%), sociability (39.306%), speech (45.665%). Based on the audiometric measurements, hearing was impaired in 58.382% of the children, mainly at 2000 Hz frequency for the right ear and 500 Hz frequency for the left ear, prevailing in the left ear. Only 34.104% of the children were impaired in the cognitive questionnaire.

Gross and fine motor skills were impaired in 49.711% of the children. Only 8 children had their sensory processing impaired in the areas of emotional answer, motor and touch processing and oral processing.

In the case of auditory impairment, we continued to implement control measurement, which did not confirmed auditory processing disorder under laboratory conditions. Activities such as an assessment of the severity of alcohol exposure were examined in the sample.

For further implementation of the study results, we suggest creating multidisciplinary teams in regional towns. They can differ depending on community infrastructure, usually consisting of a coordinator, a doctor, a psychologist, a logopaedist, a special pedagogue and a social worker. The team collects information about the child and their family, monitors their specific needs and assesses the objectives. Coordinators at the regional level should focus on finding out the child's current needs and coordinate supporting interventional and community services. Early care givers could provide not only the important diagnostic support, but also the objectivity of data collection during diagnostics and intervention.

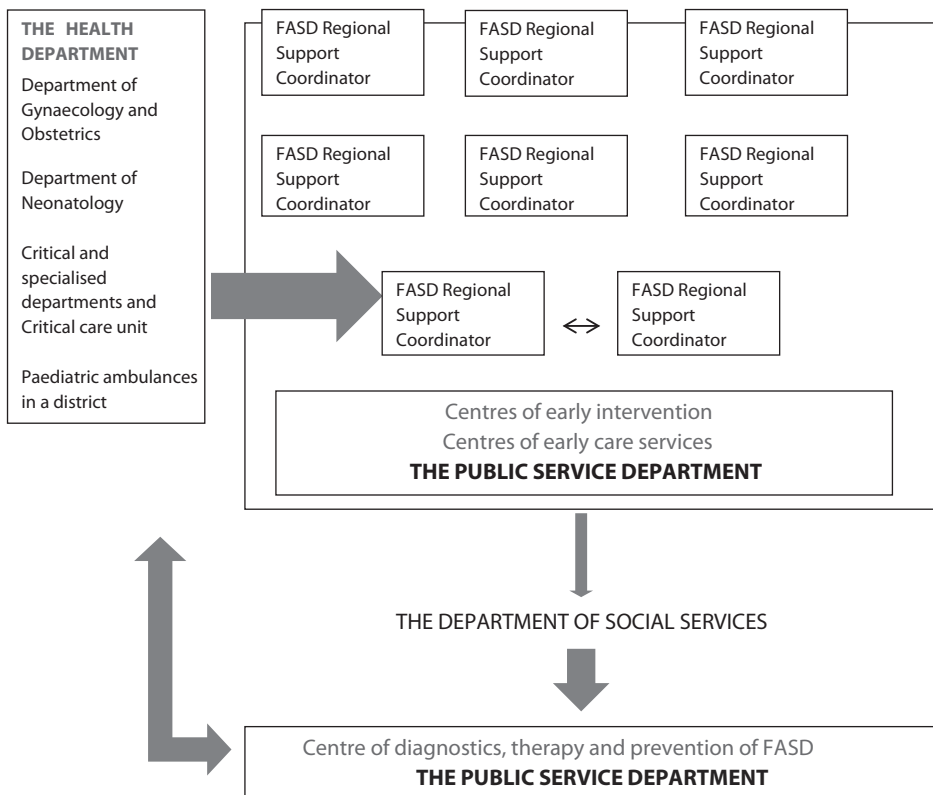
Prenatal alcohol exposure confirmation is a complicated process, which includes reliable resources, ideally during pregnancy. Multidisciplinary assessment offers data about predictors and prognosis of cognitive and adaptive functioning of multiple domains and brain functions that are significant and dynamically developing in children up to 7 years of age. Screening (Hanlon-Dearman, A.; Green, H.R.; Andrew, G.; LeBlanc, N.; Cook, J.L., 2015) is considered to be a proper way of the naming of functional strong points and children's needs. They could be taken into consideration in the inclusive educational or therapeutical intentions of the child

in the community and subsequently specified in further differential diagnostics. At their early age, these children can be stabilised and inserted into supporting inclusive systems that create supporting networks of early services.

Crucial solutions and strategies recommended for FASD in the system of early care in the SR

The algorithm

According to the above-mentioned recommendations of instruments and strategies, we suggest the following algorithm of early care in the case of FASD spectrum:



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