https://doi.org/10.18778/7525-795-3.18

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COGNITIVE DEVELOPMENT OF CHILDREN WITH GROWTH RETARDATION IN THE PRENATAL PERIOD – A PILOT STUDY

Introduction

Recent epidemiological studies reveal an increase in the number of children born with growth retardation in the prenatal period. Hitherto prevailing results state that intrauterine growth retardation may lead to the formation of developmental defects, weaker cognitive functioning of the child and difficulties in the course of education.

During diagnostic procedures in clinical practice one must aknowledge data concerning both the patient and their social environment. Information concerning mother's and fetus' state of health during pregnancy and delivery is vital in psychological tests evaluating a child's psychic development.

Developmental psychology determines multifactor developmental concepts which emphasise the mutual and complex influence of biological and environmental factors on the child's development, highlighting self-activity of the individual. One of the most important tasks of developmental psychologists is not only to explain the causes of changes in the growth process, but also to establish the rules governing the aforementioned changes. Family and cultural factors as well as development indicators: subject's activity, upbringing and education, are of vital importance for the child's growth (Przetacznik-Gierowska, 2000).

While analysing growth disorders in the prenatal period, which may affect child's subsequent psychic functioning, one must take into account three groups of factors: genetic, genetic-like and extra-genetic as well as the course of delivery and its potential complications. However, one must remember that harmfulness of the aforementioned factors depends on their duration, the moment they appeared,

constitutional properties of the mother and the child and other unfavourable conditions in that period of time (Kornas-Biela, 2000).

Modern medicine has considerably widened diagnostic-therapeutic posibilities of prenatal period. Thanks to ultrasound technology one may investigate fetus' growth and its potential disorders. It allows for earlier, and at the same time more effective preventive and curative actions both in the range of medical and psychological activities stimulating child's growth. One of the most frequently described irregularities of the prenatal period is the intrauterine growth retardation (IUGR). Fetus' growth retardation may be symmetrical or asymmetrical. The fetus develops more slowly or unharmoniously, it is smaller and dystrophic. Epidemiological studies indicate that the frequency of children born with reduced body mass is increased in societies of low socio-economic standing. Three groups of risk factors have been distinguished: maternal, fetal and placental. Maternal factors are among others too young or too old age, increased parity, mothers' lifestyle, e.g. improper diet, smoking, alcohol and drug use, severe stress. Fetal factors include multiple pregnancies, developmental defects, chronic infections. Placental factors are for instance placental insufficiency or arterio-venous anastomoses (Bada-Ellzey, 2001). In consequence, symmetrical growth disorders may lead to developmental defects (Bada-Ellzey, 2001). Hence, it is of great importance to diagnose the disorders early and to take preventive actions, both of medical and psychological nature.

IUGR may result in the birth of a child "small for gestational age" (SGA). SGA has numerous negative health consequences such as low height, risk of cardiovascular diseases and diabetes in adulthood. Low birth weight increases the risk of mortality in infants. It can also constitute one of the risk factors of weaker intellectual development and, consequently, learning difficulties. Some studies point to statistically lower IQ results of SGA children, however, this difference constitutes only one standard deviation. The results of these studies should be treated with caution (Geva, Eshel, Leitner, Valevski, Harel, 2006). Some authors, however, emphasise the relation between genetic and psychosocial factors in the course of intellectual development of SGA children and with intrauterine retardation.

The most important psycho-social factors include: the family's socio-economic status, school and family environment, parents' intelligence and education (Theodore,Thompson, Waldie, Becroft, Robinson, Wild, Clark, Mitchell, 2009). In the theoretical model of cognitive development of IUGR and SGA children, the following factor groups can be distinguished: characteristics of fetal and teratogens development, postnatal child growth, genetic conditions (e.g. parents' intelligence) and psycho-social factors (De Bie, Oostrom, Delemarre-van de Waal, 2010). The authors emphasise that IUGR and SGA may lead to the child's abnormal cognitive functioning, but the relations between these factors are very subtle and complex.

Children born with low birth weight and whose physical development in the prenatal period is improper often manifest a broad spectrum of developmental problems. Those children more often than others have behavioral and emotional problems, cognitive deficit and learning difficulties during school years. Weaker fetus' development and low birth weight are connected with worse school achievements and worse education in adulthood. Research results emphasise that such problems concern children brought up in families in a difficult socio-economic situation, therefore the mutual influence of environmental and biological factors must be aknowledged (Nomura, Halperin, Newcorn, Davey, Fifer, Savitz, Brooks-Gunn, 2009).

The undertaken studies are of a pilot nature and concern children aged 5 – 9, who were born with symmetric intrauterine growth retardation and a low birth weight.

The Aim of the Research

The aim of the research was to establish the level of cognitive development of children who were recognised with intrauterine growth retardation (IUGR) in the prenatal period and with low birth weight (SGA – small for gestation age).

Detailed research questions:

- What is the overall ability of proper thinking?
- What is the course of development of perception and eye-hand coordination?
- Do the children have difficulties and developmental disorders?

Study Group

31 children, who underwent specialised treatment due to IUGR and who presently had a control examination, took part in the research. The study group included children aged 5-9, 18 girls and 13 boys (Table 1).

Table 1. Group characteristic

Sex	Number of people	%
Girls	18	58
Boys	13	42
Total	31	100

Source: Own work

The examined children were diagnosed with fetus' developmental disorders in the form of symmetric intrauterine growth retardation in the prenatal period. The children were born in proper time, that is between 36th and 40th week of pregnancy, however, their birth weight was substantially lower, what confirms a weaker development of the fetus in the prenatal period. 15 children were born vaginally, 16, however, were born through a cesarean section, which was necessary due to threat to the life of the mother or child.

Parents' education is presented in Table 2 and indicates that the majority has secondary and higher education.

Table 2: Parents' education

Education	Moher	Father	total	%
Elementary	6	12	18	29
Secondary	11	10	21	33,9
Higher	14	9	23	37,1
Total	31	31	62	100

Source: Own work

The analysis of family situation indicates that 27 examined children live in a full family and only 4 children are brought up by a single parent (3 single mothers and one single father). Taking into account number of children in a family, the most numerous are families with two children (16), 12 children had no siblings and 3 live in a family with three children.

Applied Research Tools

The following research methods were used:

- Raven's Coloured Progressive Matrices Test used to measure the level of general intelligence of children aged 3 years and 11 months through 9 years and 11 months. This test measures the ability of proper thinking relatively independent of the individual's experience. Psychometric properties of this test allow for studies of screening nature,
- Marianne Frostig's Developmental Test of Visual Perception is used to evaluate visual perception of children aged 3 years and 11 months through 7 years and 11 months. In the area of visual perception there are 5 operationally defined capabilities: eye-hand coordination, perception of figure and background, perception of shape constancy, perception of figure position and spacial relationships,
- Lateralisation tests according to H. Spionek allowing to determine the lateralisation of hands, eyes, legs and ears and to establish the functioning superiority of one half of the body,

• Bender – Koppitz Test examining the level of eye-hand integration development of children aged 5 – 8 and detecting retardation of this function in children over 8 years old,

• Interview with parents concerning pregnancy and birth, current family situation, number of children in the family, parents' education, the course of child's development and possible difficulties and disorders of physical, somatic and psychic growth.

These psychological tests are used in diagnosis of child's psychic development (Frydrychowicz, Koźniewska, Sobolewska, Zwierzyńska, 1998).

The psychological examinations were conducted in Pediatric Cardiology Clinic of the Medical University of Lodz in 2011. Each test was performed individually with the child and their parents.

Research Results

On the basis of the obtained results one may state that the ability of proper thinking relatively independent of the individual's experience, measured with the use of Raven's test, falls within the limits of medium and high performance (Table 3). 48,4% of the subjects achieved the second degree, what shows children's great mental abilities in the logical analysis of non-verbal material. Only one child's results were worse than average.

Table 3. Raven test results

Global result	Girls	Boys	Total	%
I degree >95 centil	1	1	2	6,5
II degree 75-95 centile	9	6	15	**48,4**
III+ degree 50-75 centile	5	4	9	29
III degree 25-50 centile	2	2	4	12,9
IV degree 10-25 centile	1	0	1	3,2
IV - degree >10 centile	0	0	0	0
V degree >5 centile	0	0	0	0
Total	18	13	31	100

Source: Own work

The results of the developmental test of visual perception indicate that most of the children aged 5 through 7 years 11 months are characterised with correct development of visual perception (Table 4). Perception quotient in 10 subjects was average and amounted to 100-115 points, 9 children achieved a result above average in the field of visual perception. However, the ability of correct visual perception of 5 children reached the lower limit for their age.

Table 4. Results of the Developmental Test of Visual Perception – perception quotient

Perception quotient	Girls	Boys	Total
115-130	7	2	9
100-115	6	4	10
85-100	2	3	5
Total	15	9	24

Source: Own work

The results of individual subtests of the Developmental Test of Visual Perception are presented below:

- Eye-hand coordination: obtained results were calculated within the limits of 8-17 points, average score: 13,9
- Perception of figure and background: obtained results were calculated within the limits of 5-15 points, average score: 9,6
- Perception of shape constancy: obtained results were calculated within the limits of 6 - 15 points, average score: 10,4
- Perception of figure position: obtained results were calculated within the limits of 8-15 points, average score: 12
- Perception of spacial relationships: obtained results were calculated within the limits of 9-15 points, average score: 12,7

The above data indicate that the examined children achieved best results in the field of eye-hand coordination, whereas the lowest results in the field of perception of figure and background. All results fall within the standard limits for a certain age, however, in single cases subjects reached lower limits for some subtests.

The level of perception and eye-hand coordination was evaluated with the use of Bender – Koppitz test in the group of children aged 8-9 (Table 5). 5 children in this age group achieved results indicating eye-hand integration development retardation.

Table 5. Bender – Koppitz test results

Visual perception, visual-motor coordination	Girls	Boys	Total
Correct	1	1	2
Delayed	2	3	5
Total	3	4	7

Source: Own work

All children in the study group, having right-hand heterogenous lateralisation, use their right hands. 14 children had homogenous right-hand lateralisation, 15 – heterogenous and in two cases the lateralisation could not be established.

Various developmental disfunctions in the form of psycho-motor, emotional and speech disorders were found in as much as 50% of the study group. Six children had speech disorders, mostly in the form of improper articulation requiring logopedic care. Data gathered in the course of interviews indicate that five children were retarded as far as locomotion development and posture control is concerned. 4 subjects revealed emotional disorders in the form of selective mutism, nocturnal enuresis, emotional hypersensitivity and psycho-motor hyperactivity. One child revealed symptoms probably connected with Asperger's syndrome. The boy was refered to specialised examinations in order to be properly diagnosed and to undergo further treatment. The above described developmental difficulties, occuring in as much as 16 cases, are worrying because they concern half of the study group. At the same time they indicate the necessesity to broaden research diagnostics.

Discussion and Conclusions

Studies concerning psychic functioning of children, whose growth was retarded in the prenatal period, are presented in the literature on the subject. Research conducted in the group of 9-year-olds indicate a negative influence of IUGR on their subsequent neuro-cognitive development. (Puga, Puga, de Arriba, Armendariz, Labarta, Longas, 2009).

In the presented research, explicit retardation in the field of perception and eye-hand coordination was not observed in the group of children aged 5 through 7 years and 11 months. Only in the group of older children (aged 8-9) retardation of eye-hand intergation development could be noted. These results require, however, to be repeated in a more numerous study group.

A connection between IUGR and short-term verbal memory disorders is also observed in this age group (Geva, Eshel, Leitner, Valevski, Harel, 2008). A specific neuro-cognitive development profile can be observed, which may cause learning difficulties and worse school achievements (Leitne, Fattal-Valevski, Geva, Eshel, Toledano-Alhadef, Rotstein, Bassan, Radianu, Bitchonsky, Jaffa, Harel, 2007). In the presently conducted studies researchers note that speech development disorders and retardation, requiring logopedic care, were relatively frequent. Logopedic disorders may be the cause of problems at school.

Some authors pay attention to the possibility of a connection between IUGR and an increased frequency of autistic disorders and intellectual disability (Leonard, Nassar N, Bourke, Blair, Mulroy, de Klerk, Bower, 2008). The results of the current research indicated that one child suffered from disorders of autistic nature.

Studies concerning the course of mental development of children with IUGR are inconclusive. Some authors emphasise the connection between IUGR and lower intellectual efficiency, in this case children with more complex disorders occurring in prenatal period were examined (Tideman, Marsal, Ley, 2007). In the current study group reduced intellectual development was not observed. Raven's Progressive Matrices Test results, evaluating abilities of proper thinking relatively independent of individual experience, fell within the range of medium and high performance. It is worth noticing, however, that the majority of children come from educated families (secondary and higher education), what may also be connected with the achieved test results. Parents with secondary and higher education constituted 71% of the study group.

Some authors present research according to which the connection between IUGR and low intellectual efficiency in later developmental periods is insignificant, whereas family factors are of much greater importance (Sommerfelt, Andersson, Sonnander, Ahlsten, Ellertsen, Markestad, Jacobsen, Hoffman, Bakketeig, 2000). Longitudinal studies lasting for over 30 years indicated that prematurely born children raised in poverty have much more learning difficulties and worse educational achievements in adulthood. No such connection was detected in the group of children born with small birth weight (Nomura, Halperin, Newcorn, Davey, Fifer, Savitz, Brooks-Gunn, 2009). In the current research the study group was rather homogenous in terms of socio-economic standing, the majority of parents declared their income at the level of the national average.

Obtained results confirm previous observations, namely that children born with intrauterine growth retardation and with low birth weight are at greater risk of developmental disorders, however, the occurance of such disfunctions depends on numerous mutually affecting factors. Developmental disorders, which may occur in this group of children, constitute a broad and diversified spectrum and require taking into account not only the cognitive area and evaluation of intellectual and perceptive abilities. The analysis of social and emotional

development of the child as well as socio-economic conditions of the family are also of great importance.

The presented pilot study constitute only a part of the planned research and are based on a small study group. Further research as well as a more detailed statistic analysis of the results will be continued in order to detect possible connections between various factors affecting child's development.

The obtained results will allow for compiling a set of preventive actions and activities supporting the development of this group of children.

References

Przetacznik-Gierowska M., (2000). *Zasady i prawidłowości psychicznego rozwoju człowieka* [In:] Przetacznik-Gierowska M., Tyszkowa M.*, Psychologia rozwoju człowieka. Zagadnienia ogólne*, , Tom I p. 57-80. Warszawa: PWN.

Kornas-Biela D. (2000). *Okres prenatalny* [In:] Harwas-Napierała B., Trempała J., *Psychologia rozwoju człowieka. Charakterystyka okresów życia człowieka.* Volumine II, p. 17-42; Warszawa: PWN.

Bada-Ellzey K.(translation: Gadzinowski J.), (2001). *Podejmowanie decyzji w neonatologii.* 2-3, D.W. Publishing Co.

Geva R., Eshel R., Leitner Y., Valevski AF., Harel S. (2006). Neuropsychological outcome of children with intrauretine growth restriction: a 9 year prospective study, *Pediatrics, 118, p. 91-100.*

Theodore RF., Thompson JM., Waldie KE., Becroft DM, Robinson E., Wild CJ, Clark PM., Mitchell EA. (2009). Determinants of cognitive ability at 7 years a longitudinal case-control study of children born small-for-gestational age of term, *European Journal of Pediatrics*, 168, p. 1217-1224.

De Bie H.M.A., Oostrom K.J., Delemarre-van de Waal H.A. (2010). Brain development, intelligence and cognitive outcome in children born small for gestational age. *Hormone Research in Paediatrics,* p. 73, 6-14.

Nomura Y., Halperin JM., Newcorn JH., Davey Ch., Fifer WP., Savitz DA., Brooks-Gunn J. (2009). The risk for impaired learning-related abilities in childhood and educational attainment among adults born near-term, *Journal of Pediatric Psychology*, *34, p. 406-418.*

Frydrychowicz A.,Koźniewska E., Sobolewska M., Zwierzyńska E., (1998). *Testy psychologiczne i pedagogiczne w poradnictwie*, Warszawa:L Centrum Metodyczne Pomocy Psychologiczno-Pedagogicznej.

Puga B., Puga P.G., de Arriba A., Armendariz Y., Labarta JI., Longas AF. (2009). Psychomotor and intelektual development of children born small for gestational age. Transversal and longitudinal study. *Pediatric Endocrinological Review*, *6, p. 358-70.*

Geva R., Eshel R., Leitner Y., Fattal-Valevski A., Harel S. (2008). Verbal short-term memory span in children: long-term modality dependent effects of intrauterine growth restriction. *Journal of Child Psychology and Psychiatry, 49, p. 1321-30.*

Leitner Y., Fattal-Valevski A., Geva R., Eshel R., Toledano-Alhadef H., Rotstein M., Bassan H., Radianu B., Bitchonsky O., Jaffa A.J., Harel S. (2007). Neurodevelopmental outcome of children with intrauterine growth retardation: a longitunal, 10-year prospective study. *Journal of Child Neurology, 22, p. 580-587.*

Leonard H., Nassar N., Bourke J., Blair E., Mulroy S., de Klerk N., Bower C. (2008). Relation between intrauterine growth and subsequent intellectual dissability in a ten-year population cohort of children in Western Australia, *American Journal of Epidemiology*, *1, p. 103-111.*

Tideman E., Marsal K., Ley D. (2007). Cognitive function in young adults following intrauterine growth restriction with abnormal fetal aortic blood flow, *Ultrasound in Obsterics and Gynecology, 29, p. 614-618.*

Sommerfelt K., Andersson HW., Sonnander K., Ahlsten G., Ellertsen B., Markestad T., Jacobsen G., Hoffman HJ., Bakketeig L. (2000). Cognitive development of term small for gestational age children at five years of age*, Archives of Disease in Childhood, 83, p. 25-30.*