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Environmental factors and psychomotor development in children up to the age of 3

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ABSTRACT

Introduction: Chemical compounds and other pollutants found in the environment have a well-documented, adverse effect on the life and health of individuals. Those who are most vulnerable to toxic effects include prospective parents, pregnant women, foetuses, and young children. In Poland, both the prevention and early detection of developmental abnormalities is insufficient. The objective of the study was to analyse how the pre- and post-natal development of a child is affected by toxicants the mother has been exposed to.

Materials and methods: The study was conducted in the form of a diagnostic survey. The degree of toxic exposure was assessed based on Wawrzynów's questionnaire, the Mothers' Toxic Exposure Assessment Questionnaire' (Kwestionariusz Oceny Narażenia Matek Dzieci na Toksyny – KONT-15). The evaluation of child development was based on the following psychometric tools: the Munich Functional Developmental Diagnostics (MFDD), the Speech (MM-speech) and Reflex (MM-reflexes) Development Questionnaire, IRMIK (Inwentarz Rozwoju Mowy i Komunikacji) – the Polish adaptation of the MacArthur-Bates Communication Development Inventories (CDI), and the Child Development (RD-18) questionnaire, also designed by Wawrzynów.

Results: The study included 102 mothers of children up to 3 years of age. Most of the surveyed mothers indicated large urban agglomerations with more than 100,000 inhabitants as their current place of residence. The study demonstrated that a substantial majority of the mothers had come into contact with toxicants. A statistically significant relationship was demonstrated between developmental delays in children and high exposure to toxins in mothers. There was no statistically significant relationship between maternal exposure to toxins and delays in the development of speech and reflexes.

Conclusions: Environmental pollutants found primarily in air, food, medication, and everyday items, exert a negative influence on childhood development. A high maternal exposure to toxins contributes to developmental delays in speech and reflexes in children. Delays in speech and communication development were observed more frequently in children who were older. Developmental delays in children were more common among younger children.

Keywords: environmental pollutants; toxins; children; psychomotor development.

INTRODUCTION

Environmental toxicology is a well-known term but is used relatively rarely in the context of childhood development. Toxicology is the study of toxins and the negative impact they have on the life and health of living organisms.

The environment in which we live and function is becoming increasingly polluted.

Chemical compounds and other pollutants found in food, medication, soil, air and water have a well-documented, adverse effect on human life and health. Numerous experiments have confirmed the influence of toxins on impairments in brain development [1], i.e. abnormal cell division and differentiation, abnormal synapse formation, aberrant regulation of apoptosis as well as inadequate neurotransmitter development and function [2].

Those most vulnerable to toxic effects include prospective parents, pregnant women, foetuses, and young children. Foetal and infant metabolic pathways are not yet fully developed, hence the differences in the absorption, metabolism, elimination and excretion of toxins and xenobiotics from the body [3]. Children are particularly sensitive to the toxic effects of medication and poisonous substances in the environment because their mechanisms of biotransformation and renal excretion are not yet fully developed [4]. Thus, in this population group, contaminants may be converted into active forms [5], posing a greater threat than for adults.

The negative effects of environmental factors are often associated with dysfunctions in children, specifically in the areas of cognitive, social, emotional, somatic and sensory development. Moore identified 5 key pollutants impacting on children's health: lead, mercury, pesticides, dioxins and noise [6]. Noise disorganises functioning at the early stages of child development [7] and may lead to auditory dysfunctions.

The influence of toxins on speech development in children up to the age of 36 months has also been demonstrated. At this stage, children who are apparently healthy and well-developed are generally not subjected to specialist diagnostic and screening tests. Prevention, early multidisciplinary detection of anomalies, and early childhood development support can often be insufficient in Poland. This can usually be attributed to a lack of funds and/or willingness to invest in children which significantly delays the remedial, educational, and therapeutic intervention process. This, in turn, frustrates parents who are seeking help for their child or leads them to underestimate the problem, mainly due to systemic weaknesses, all at the expense of the child with deepening dysfunctions. Another key point is that early care and education providers (creche, preschool, and elementary school staff) are not qualified to detect minor developmental anomalies. The implementation of early interventions should be regarded as a priority in the first months of the child's life.

The objective of the study was to analyse the effects of maternal toxic exposure on the pre- and post-natal development of the child.

MATERIALS AND METHODS

Materials

The survey was conducted on 102 mothers of children aged up to 3 years, living in the west of Poland. Among the studied children, 37 were girls and 65 were boys. The mean age for the girls was 18.7 (SD = 10.2) months, and for the boys – 19.3 (SD = 10.0) months. The median age was 18 months for the girls, and 22 months for the boys. The analysis did not reveal any statistically significant differences between the girl and boy groups (Tab. 1).

Among of mothers 54.1% had a female child reported that their current place of residence was a large urban area with more than 100,000 inhabitants, 27% lived in a rural area, 16.2% in an urban area with between 10,000–100,000 inhabitants and only 2.7% lived in a small town with less than 10,000 inhabitants. Among mothers with a male child, 43.1% lived in large urban areas with more than 100,000 inhabitants, 35.4% lived in a rural area, 10.8% in an urban area with between 10,000–100,000 inhabitants and 10.8% lived in a small town.

TABLE 1. Characteristics of children included in the study

Age (in months)	Sex										
	girls					boys					
	n	M ±SD	min.–max.	Q1–Q3	Me	n	M ±SD	min.–max.	Q1–Q3	Me	p G vs. B
	37	17.6 ±9.9	1–36	9–28	18	65	19.3 ±10.0	1–36	10–25	22	0.458

n – number; M – mean; SD – standard deviation; min. – minimum; max. – maximum; Q1 – lower quartile; Q3 – upper quartile; Me – median; p – test significance level; G – girls; B – boys

TABLE 2. General characteristics of the mothers of studied children

		Child's sex				
		girls		boys		
		n	%	n	%	p G vs. B
Current place of residence	rural	10	27	23	35.4	0.306
	urban with less than 10,000 inhabitants	1	2.7	7	10.8	
	urban with 10,000–100,000 inhabitants	6	16.2	7	10.8	
	urban with more than 100,000 inhabitants	20	54.1	28	43.1	
Place where the mother grew up	rural	10	27.0	16	24.6	0.401
	urban with less than 10,000 inhabitants	3	8.1	13	20.0	
	urban with 10,000–100,000 inhabitants	20	54.1	32	49.2	
	urban with more than 100,000 inhabitants	4	10.8	4	6.2	
Mother's education	secondary	6	16.2	7	10.8	0.303
	vocational	1	2.7	0	0.0	
	3rd-level (1st cycle)	1	2.7	4	6.2	
	3rd-level (2nd cycle)	14	37.8	34	52.3	
	3rd-level (2nd cycle + postgraduate)	14	37.8	20	30.8	
	doctorate	1	2.7	0	0.0	

n – number; % – percentage; p – significance level; G – girls; B – boys

The mothers, irrespective of the child's sex, had mainly grown up in urban areas with populations between 10,000–100,000 inhabitants. An undergraduate level of study was reported by 37.8% of mothers with girls, and 52.3% of mothers of boys. Secondary education, on the other hand, was declared by 26.2% of mothers with girls and 10.8% of mothers with boys. The analysis did not reveal any statistically significant relationships among the analysed variables (Tab. 2).

Methods

The study was conducted in the form of a diagnostic survey. The degree of toxic exposure was assessed based on Wawrzynów's questionnaire: the Mothers' Toxic Exposure Assessment Questionnaire (Kwestionariusz Oceny Narażenia Matek Dzieci na Toksyny – KONT-15). It consists of 15 questions about the mother's exposure to specific listed noxious/toxic factors. The assessment of the degree of toxic exposure was conducted in 3 separate periods: (A) leading up to the pregnancy, (B) during pregnancy, and (C) the breastfeeding period. The total possible points on the KONT-15 scale in the analysed maternity-related periods range from 0 – no toxic exposure, to 15 – high toxic exposure. Child development was assessed in 3 age groups: group 1 – 1–12 months old (n = 22); group 2 – 13–24 months old (n = 38); group 3 – 25–36 months old (n = 42).

Four psychometric instruments were used to evaluate child development:

1. The Munich Functional Developmental Diagnostics (MFDD) – separately for each of the 3 age groups (MFDD 1–12, MFDD 13–24, MFDD 25–36) and 1 for all age groups (MFDD 1–36). This tool was used to assess child development in all children included in the study (n = 102) and was regarded as the gold standard [8].
2. The Speech Development Questionnaire (MM-speech) and orofacial Reflex Development Questionnaire (MM-reflexes) devised by Machoś for children up to 12 months old. This instrument was used for assessing development in 33 children [9].
3. IRMIK (Inwentarz Rozwoju Mowy i Komunikacji) – the Polish adaptation of the MacArthur-Bates Communication Development Inventories (CDI), in which the children were divided into 2 age groups: IRMIK 8–18 for the 8–18 months old (n = 25); and IRMIK 19–36 for the 19–36 months old (n = 56). Consequently, 21 children aged under 8 months were excluded from this assessment [10, 11].
4. The Child Development (RD-18) questionnaire developed by Wawrzynów (n = 102), comprising 18 items with the following parameters to differentiate the effect of the mother's toxic exposure: diagnosis of developmental disorders, duration of labour, administration of oxytocin, muscle tone, parental attitude towards the child and the need for further specialist diagnostics. On the RD-18 scale, the child can score between 0–18 points. The higher the score, the more severe the child's developmental delay. The following classification was adopted in the final analysis, based on the receiver operating characteristic (ROC) curve:

- RD-18 ≤10 – normal development,
- RD-18 >10 – delayed development.

The mothers were divided into 2 groups based on the ROC curve:

- KONT-15 – 0–39 points – low toxic exposure,
- KONT-15 – 40–45 points – high toxic exposure.

Statistical analysis

The distribution of survey data was tested for normality using the Shapiro–Wilk test. Normal distribution was not confirmed ($p < 0.05$). To verify the hypothesis that there is no difference between the medians (M) in the 2 groups, the non-parametric Mann–Whitney U-test of significance was used. The differences between the prevalence of characteristics were verified using Pearson's χ^2 test, χ^2 test with the Yates correction or Fisher's exact test. The analytical process also included plotting ROC curves in order to determine relationships between the sensitivity and specificity of the analysed test. The area under the ROC curve was regarded as a measure of the goodness and accuracy of the given classifier. Across all statistical tests, results were regarded as significant if the calculated probability p did not exceed the adopted significance level of 0.05 ($p < 0.05$). Calculations and charts were made using the Statistica 12 PL statistical software package.

RESULTS

The assessment of the children's toxic exposure based on the KONT-15 showed that a substantial majority of mothers, during the 3 periods subject to analysis, had come into contact with or ingested toxicants with a potentially negative influence on their child's development (Tab. 3).

The analysis based on the MFDD test revealed a statistically significant relationship ($p = 0.038$) between a child's developmental delays and a high toxic exposure in the mother (Tab. 4).

The analysis showed that delays in speech and orofacial reflex development were more common in children whose mothers had a high exposure to toxicants. However, no statistically significant correlations were identified between the mother's toxic exposure and the child's developmental delays in the studied areas ($p > 0.05$) – Table 5.

Observations made using IRMIK – the Polish adaptation of the MacArthur-Bates CDI, led to the conclusion that developmental delays were more prevalent among older children whose mothers had a higher exposure to toxicants. The analysis pointed to a statistically significant correlation ($p < 0.05$) between the presence of this category of developmental disorders and a high degree of toxic exposure in the mother (Tab. 6).

Analysis of the parameters included in the RD-18 questionnaire demonstrated that delays were observed more frequently in children whose mothers had a higher exposure to toxicants. A statistically significant relationship was found between a mother having a higher toxic exposure and the occurrence of developmental delays among younger children (Tab. 7).

Not all tools used in this study to measure child development correlate with each other at $p < 0.05$. This is because only 2 of them (MFDD and RD-18) could be applied to all children, while

TABLE 3. Assessment of the toxic exposure of mothers of the studied children according to the Mothers' Toxic Exposure Assessment Questionnaire

		Studied period					
		A		B		C	
Item	Type of toxin	n	%	n	%	n	%
1.	foods containing preservatives and colourings	100	98.0	98	96.1	98	96.1
2.	soy products	89	87.3	86	84.3	89	87.3
3.	expired food	86	84.3	82	80.4	84	82.4
4.	farm-raised fish	100	98.0	98	96.1	96	94.1
5.	burnt or grilled food	102	100.0	100	98.0	98	96.1
6.	canned and jarred foods	93	91.2	92	90.2	90	88.2
7.	fast foods	93	91.2	87	85.3	84	82.4
8.	products containing aflatoxins	90	88.2	89	87.3	91	89.2
9.	products containing patulin	80	78.4	79	77.5	73	71.6
10.	medications	89	87.3	87	85.3	87	85.3
11.	hormones	83	81.4	69	67.6	70	68.6
12.	cigarettes or tobacco smoke	93	91.2	85	83.3	85	83.3
13.	other psychostimulants	62	60.8	1	1.0	1	1.0
14.	drugs or alcohol	86	84.3	3	2.9	8	7.8
15.	smog	79	77.5	79	77.5	77	75.5
Statistics of affirmative answers							
M ±SD		13.0 ±3.0		11.1 ±3.2		11.1 ±3.1	
Min.–Max.		4–15		2–14		1–14	
Q1–Q3		12–15		11–13		11–13	
Me		15		13		13	

n – number; % – percentage; M – mean; SD – standard deviation; Min. – minimum; Max. – maximum; Q1 – lower quartile; Q3 – upper quartile; Me – median; A – before pregnancy; B – during pregnancy; C – after delivery

TABLE 4. The effects of the mother's toxic exposure on the child's overall development score according to The Munich Functional Developmental Diagnostics (MFDD)

Child's overall development score according to MFDD	Mother's toxic exposure level				p
	low		high		
	n	%	n	%	
Development at 1–12 months					
normal	3	21.4	0	0.0	0.067
delayed	11	78.6	19	100.0	
Development at 13–24 months					
normal	1	6.3	0	0.0	1.000
delayed	15	93.8	16	100.0	
Development at 25–36 months					
normal	0	0.0	0	0.0	1.000
delayed	16	100.0	21	100.0	
Development at 1–36 months					
normal	4	8.7	0	0.0	**0.038**
delayed	42	91.3	56	100.0	

n – number; % – percentage; p – significance level

TABLE 5. The effects of the mother's exposure on speech and reflex development according to a questionnaire developed by Machoś

Child's development score according to MM	Mother's toxic exposure level				p
	low		high		
	n	%	n	%	
Speech development (MMm 1–12)					
normal	4	28.6	2	10.5	0.363
delayed	10	71.4	17	89.5	
Reflex development (MMo 1–12)					
normal	6	42.9	3	15.8	0.122
delayed	8	57.1	16	84.2	
Overall child development (MM 1–12)					
normal	2	14.3	0	0.0	0.172
delayed	12	85.7	19	100.0	

n – number; % – percentage; p – significance level (Fisher test)

TABLE 6. The effects of the mother's toxic exposure on the child's development score according to IRMIK

Child's development according to IRMIK	Mother's toxic exposure level				p
	low		high		
	n	%	n	%	
Development at 8–18 months					
normal	6	46.2	3	25.0	0.041
delayed	7	53.8	9	75.0	
Development at 19–36 months					
normal	6	23.1	1	3.3	**0.041**
delayed	20	76.9	29	96.7	
Development at 8–36 months					
normal	12	30.8	4	9.5	**0.024**
delayed	27	69.2	38	90.5	

n – number; % – percentage; p – significance level (Fisher test)

MM–speech, MM–reflexes, IRMIK 8–18 and IRMIK 19–36 were applied only to a segment of the studied population (Tab. 8).

The analysis revealed statistically significant correlations ($p < 0.05$) between the degree of the mother's toxic exposure and the child development score obtained with the use of the MFRDK, IRMIK 19–36 and RD–18 questionnaires. The absence of a statistically significant relationship ($p > 0.05$) between the mother's toxic exposure and the child's development score observed in the MM-speech, MM-reflexes and IRMIK 8–18 questionnaires may be due to the small sample size (Tab. 9).

DISCUSSION

Contaminants found in the environment in which people live and function have a well-documented, adverse effect on human life and health. The negative effects of these environmental factors are also associated with multifaceted dysfunctions in children.

Children's environmental health was the main agenda point in the national environmental health action plan for 2019 in Malaysia. Children living in Malaysia are exposed to many environmental hazards, including air and water pollution, and pesticides in food. Due to the exceptional vulnerability of children, associated with their immature immune systems and internal organs, there is an ever-growing need to recognise health hazards in this scope [12].

A study by Myszkowska-Ryciak et al. demonstrated that pregnant women have a fragmentary knowledge when it comes to healthy nutrition before and during pregnancy [13]. Findings by other authors [14, 15] are similar, revealing that 54% of studied pregnant women do not appreciate the effects of pre-pregnancy nutrition on foetal development and the course of the pregnancy. This is confirmed by the findings in this study, which showed that a substantial majority of mothers, in the

TABLE 7. The effects of the mother's toxic exposure on the child's development score according to the Child Development (RD-18) questionnaire

Child's development score according to RD-18	Mother's toxic exposure level				p
	low		high		
	n	%	n	%	
Development at 1–12 months					
normal	6	75.0	2	14.3	**0.008**
delayed	2	25.0	12	85.7	
Development at 13–24 months					
normal	5	26.3	2	10.5	0.405
delayed	14	73.7	17	89.5	
Development at 25–36 months					
normal	4	21.1	1	4.3	0.158
delayed	15	78.9	22	95.7	
Development at 1–36 months					
normal	15	32.6	5	8.9	**0.006**
delayed	31	67.4	51	91.9	

n – number; % – percentage; p – significance level (Fisher test)

TABLE 8. Spearman correlation coefficients for child development scores obtained using the respective tools

Test	MFDD 1–36	MM-speech	MM-reflexes	IRMIK 8–18	IRMIK 19–36	RD-18
MFDD 1–36	X	*rho* = 0.398	***rho* = 0.515**	***rho* = 0.642**	***rho* = 0.413**	***rho* = 0.265**
MM-speech	**p = 0.024**	X	*rho* = 0.064	*rho* = 0.213	-	***rho* = 0.544**
MM-reflexes	**p = 0.003**	p = 0.117	X	*rho* = 0.354	-	*rho* = 0.188
IRMIK 8–18	p = 1.000	p = 0.479	p = 0.241	X	-	*rho* = -0.042
IRMIK 19–36	**p < 0.001**	-	-	-	X	*rho* = -0.109
RD-18	**p = 0.005**	**p = 0.002**	p = 0.286	p = 0.533	p = 0.672	X

p – significance level; *rho* – Spearman rank correlation

period leading up to conception, consumed foods containing preservatives and colourings, tinned and jarred foods, fast foods, and products past their expiry date. In studies conducted by other research teams, more than half of the participants recognised the link between a woman's poor dietary practices during pregnancy and the child having a low birth weight [16, 17]. A research Watson et al. examined the connection between aflatoxin exposure and impaired growth in children living in the Gambia. The study of 374 infants demonstrated a small but significant effect of aflatoxin exposure on the growth of the children [18]. Our own study suggests that exposure to various types of toxins, including aflatoxins, has an adverse effect on children's psychomotor development.

The majority of mothers in this study live or grew up in large urban agglomerations. This entails being surrounded by a polluted environment at the time around conception, during pregnancy and after childbirth. There are numerous reports confirming the influence of environmental pollution on pre- and post-natal development, as well as how healthy one is in adult life. Sobczak described the effects of contaminants on foetal and early life development, claiming that the most common causes of pollution include the production of chemicals for agricultural and economic use, degradation processes in the physical and chemical ageing of materials, and during combustion and utilisation processes. Chemically contaminated soil, water and air also play a significant role. Some of these chemicals survive in the environment for several decades and may get into the human body through the respiratory tract, digestive system and/or the skin. According to Sobczak, exposure to even relatively low doses of certain chemical substances causes adverse and irreversible effects in foetal development and early childhood development [19].

For many years, the disruption of epigenetic regulation by environmental toxins has been a focus of scientific interest, aimed at understanding its impact on human health. There is a particularly concerning body of evidence pointing to the correlation between the degree of human exposure to toxic factors and behavioural deficits related to developmental disorders. The developing nervous system is particularly sensitive to the influence of signals originating from the environment [20]. There was also a significant study conducted by the US Center for Disease Control and Prevention (2005),

TABLE 9. Analysis of the relationships between the mother's exposure and the child's development scores according to the test used

Child development according to the respective test	Mother's toxic exposure level				p
	low		high		
	n	%	n	%	
MFDD					
normal	4	8.7	0	0.0	**0.038**
delayed	42	91.3	56	100.0	
MM-speech					
normal	4	28.6	2	10.5	0.363
delayed	10	71.4	17	89.5	
MM-reflexes					
normal	6	42.9	3	15.8	0.122
delayed	8	57.1	16	84.2	
IRMIK 8–18					
normal	6	46.2	3	25.0	0.411
delayed	7	53.8	9	75.0	
IRMIK 19–36					
normal	6	23.1	1	3.3	**0.041**
delayed	20	76.9	29	96.7	
RD–18					
normal	15	32.6	5	8.9	**0.005**
delayed	31	67.4	51	91.1	

n – number; % – percentage; p – significance level

suggesting that toxic substances are deposited in tissues and body fluids contributing to delayed foetal and child development [21]. In 2004, the Environmental Working Group (EWG) tested umbilical cord blood from 10 new-born babies for dangerous chemical substances. The tests revealed 413 substances, of which 287 were xenobiotics easily transferred to the foetus. Of these 287 xenobiotics, 180 substances are known to cause cancer in humans and animals, 217 are toxic to the brain and the nervous system, and 208 caused birth defects or abnormal development when tested on animals [22].

Bank-Nilsen et al. examined the relationship between the levels of heavy metals in pregnant women and the repercussions of these on new-born children. Heavy metals in maternal blood can adversely affect foetal growth and development in a dose-dependent manner. Both diet and lifestyle factors are important sources of heavy metals. The study found a concerningly high percentage of mothers smoking tobacco products in early pregnancy [23]. Our observations also confirmed the use of tobacco and/or exposure to smoke in the period leading up to the pregnancy, during pregnancy, and afterwards.

The link between toxins and delayed pre- and post-natal development is unquestionable. The Natural Resources Defense Council identified approx. 11 toxic compounds and categories of chemicals which are used in products found in the immediate environment of children, i.e. at home, at school or in the playground [24]. They include: asbestos, bisphenol A (BPA), which is found in baby bottles and teats, kitchen utensils for new-borns, infants and young children [25], formaldehyde, hexane, hexavalent chromium compounds, methylene chloride, flame retardant chemicals, phthalates, trichloroethylene, vinyl chloride.

The present findings suggest that the highest exposure to toxicants occurred in the period leading up to conception. The analysis pointed to a statistically significant relationship between the high toxic exposure of the mother and delayed speech development in the child.

While delayed speech development is merely a symptom rather than a separate diagnosis, it is indicative of a divergence from the standards adopted in the given population in terms of timing and milestones. Normal speech development depends on a range of different factors [26]. The factors conducive to the development of speech pathologies include hearing and vision impairments, nervous system dysfunctions, abnormal mental development, demotivating factors for speech development and structural abnormalities of the speech apparatus [27].

In the general population, environmental pollutants and their impact on prospective parents, the foetus and then the young child are an under-appreciated phenomenon and problem. This is not due to a lack of information, but rather that these issues are not regarded as a serious problem in Poland. Everyone is aware of the consequences of pollution, but specific prevention measures are still few and far between. Teams of specialists working with prospective parents, pregnant women and young children should be open to a multi-disciplinary approach to rehabilitation, treatment and therapeutic interventions.

In speech therapy and related approaches, very little is said about the effects of pollution on child development. Therapy proceeds according to the standards adopted from the method being implemented. As a result, it is not always possible to achieve rapid progress in therapy, irrespective of the child's dysfunction. The problem lies in the absence of a holistic approach to the patient and treating the patient as an object of therapeutic intervention rather than as a person whose problem is comprised of many undiscovered elements. The process calls for teamwork to comprehensively support the patient in overcoming their dysfunctions.

The negative impact of environmental toxins on the developing foetus, young child, and on the parents in the period leading up to conception, is unquestionable. There is no denying the harmful effects of genetically modified food, processed food products, chemicals sprayed on food during vegetation or added to extend shelf life, and improper food handling. Harmful consequences can also ensue from unhealthy environments containing moulds, mildew, paints, oils, dust and gas emissions, as well as in contaminated tools, implements and utensils used in the kitchen, as toys or in childcare. Other crucial aspects of research are related to the perinatal exposure to dioxins and its effects on eating behaviours in children, particularly in girls. However, a longer observation time is needed to clarify whether the observed changes in emotional development, affecting eating styles and behaviours, are related to dioxin exposure [28].

CONCLUSIONS

1. Environmental pollutants found primarily in food, medication, everyday items, and air exert a negative influence on childhood development.
2. A high exposure of mothers to toxins contributes to developmental delays in speech and reflexes in children.
3. More frequent delays in speech and communication development were observed in the group of older children.
4. Child development delays were more common among younger children.

REFERENCES

1. Schetter T. Developmental disabilities – impairment of children's brain development and function: The role of environmental factors. Environ Health Perspect 2001;109(6):813-6.
2. Landrigan JP. What causes autism? Exploring the environmental contribution. Curr Opin Pediatr 2010;22(2):219-25.
3. Piotrowski JK, editor. Podstawy toksykologii: kompendium dla studentów szkół wyższych. Warszawa: Wydawnictwa Naukowo-Techniczne; 2006.
4. Winneke G. Appraisal of neurobehavioral methods in environmental health research: The developing brain as a target for neurotoxic chemicals. Int J Hyg Environ Health 2007;210(5):601-9.
5. Berkowitz GS, Wolff MS, Matte T, Susser E, Landrigan PJ. The rationale for a national prospective cohort study of environmental exposure and childhood development. Environ Res 2001;85(2):59-68.
6. Moore CF. Children and pollution: why scientists disagree. Oxford: Oxford University Press; 2009.
7. Gerc K, Piasecka B, Sikorska I. Zanieczyszczenie ekologiczne terenu zamieszkania oraz jego wpływ na zaistnienie zaburzeń rozwoju psychomotorycznego dziecka. Probl Hig Epidemiol 2012;93(1):55-61.
8. Hellbrügge T. Monachijska Funkcjonalna Diagnostyka Rozwojowa. Wrocław: Fundacja "Promyk Słońca"; 2013.
9. Machoś M. Diagnoza neurologopedyczna niemowlęcia od 0 do 12 miesiąca. Bytom: Ergo-Sum; 2011.
10. Smoczyńska M, Krajewski G. Krótki Inwentarz Rozwoju Mowy i Komunikacji A i B. Warszawa: Instytut Badań Edukacyjnych; 2015.
11. Smoczyńska M, Krajewski G, Łuniewska M, Haman E, Bulkowski K, Kochańska M. Inwentarze Rozwoju Mowy i Komunikacji (IRMiK). Słowa i Gesty. Słowa i Zdania. Warszawa: Instytut Badań Edukacyjnych; 2015.
12. Abdullah R. Malaysia: country report on children's environmental health. Rev Environ Health 2020;35(1):49-52. doi: 10.1515/reveh-2019-0077.
13. Myszkowska-Ryciak J, Gurtatowska A, Harton A, Gajewska D. Poziom wiedzy żywieniowej a wybrane aspekty sposobu żywienia kobiet w okresie ciąży. Probl Hig Epidemiol 2013;94(3):600-4.
14. Golec J, Hanke W, Dąbrowski S. Ryzyko zaburzeń płodności u osób zawodowo eksponowanych na pestycydy. Med Pr 2003;54(5):465-72.
15. Miranowicz-Dzierżawska K. Substancje działające szkodliwie na rozrodczość – zagrożenie, narażenie, uregulowania prawne. Bezp Pr Nauk Prakt 2012;12:11-5.
16. Godala M, Pietrzak K, Łaszek M, Gawron-Skarbek A, Szatko F. Zachowania zdrowotne łódzkich kobiet w ciąży. Cz. I. Sposób żywienia i suplementacja witaminowo-mineralna. Probl Hig Epidemiol 2012;93(1):38-42.
17. Kozłowska-Wojciechowska M, Makarewicz-Wujec M. Wiedza i zachowania żywieniowe kobiet ciężarnych. Rocz Państw Zakl Hig 2002;53(2):167-75.
18. Watson S, Moore SE, Darboe MK, Chen G, Tu YK, Huang YT, et al. Impaired growth in rural Gambian infants exposed to aflatoxin: a prospective cohort study. BMC Public Health 2018;18(1):1247. doi: 10.1186/s12889-018-6164-4.
19. Sobczak A. Czynniki chemiczne w środowisku zagrażające zdrowiu ludzi. Med Środow 2012;15(1):7-17.
20. Poston RG, Saha RN. Epigenetic Effects of Polobrominated Diphenyl Ethers on Human Health. Int J Environ Res Public Health 2019;16(15):e2703. doi: 10.3390/ijerph16152703.
21. Rashing R. Reproductive roulette. Declining Reproductive Health, Dangerous Chemicals, and a New Way Forward. Washington: Center for American Progress; 2009. https://cdn.americanprogress.org/wp-content/uploads/issues/2009/07/pdf/reproductive_roulette.pdf (15.12.2017).
22. Houlihan J, Kropp T, Wiles R. Body Burden: The Pollution in Newborns. A benchmark investigation of industrial chemicals, pollutants and pesticides in umbilical cord blood. Washington: Environmental Working Group; 2005. https://www.ewg.org/research/body-burden-pollution-newborns#.Wo1irqjOXIU (5.02.2018).
23. Bank-Nielsen PI, Long M, Bonefeld-Jørgensen EC. Pregnant Inuit Women's Exposure to Metals and Association with Fetal Growth Outcomes: ACCEPT 2010–2015. Int J Environ Res Public Health 2019;16(7):e1171. doi: 10.3390/ijerph16071171.
24. Knowledge base Natural Resources Defense Council. New York: Natural Resources Defense Council, Inc. 2018. http://www.nrdc.org/health/toxics.asp (8.12.2017).
25. Becker M, Edwards S, Massey R. Toxic chemicals in toys and children's products: limitations of current responses and recommendations for government and industry. Environ Sci Technol 2010;44(21):7986-91.
26. Obrębowski A. Niedosłuch a zaburzenia mowy u dzieci. Otorynolaryngologia 2004;3(2):51-4.
27. Méhes K. Delayed speech development, facial asymmetry, strabismus, and transverse ear lobe creases: a new syndrome? J Med Genet 1993;30(1):76-7.
28. Nguyen ATN, Nishijo M, Pham TT, Tran NN, Tran AH, Hoang LV, et al. Sex-specific effects of perinatal dioxin exposure on eating behavior in 3-year-old Vietnamese children. BMC Pediatr 2018;18:213. doi: 10.1186/s12887-018-1171-2.