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ORIGINAL PAPER

Evaluation and comparison of the sensory processing in infants born by natural delivery and caesarean section

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ABSTRACT

Aim of the study: The aim of this study was to determine whether the examined children have deficits in sensory processing and to assess the occurrence of these disorders, as well as to compare the sensory processes of infants born by natural delivery (ND) and caesarean section (CS).

Material and methods: The research was conducted in May–June 2018 at the Department of Rehabilitation of the Children's Hospital of prof. dr med. Jan Bogdanowicz in Warsaw. Thirty infants born in ND and 30 infants born by CS aged 4–6 months were involved. The inclusion criteria were: term birth (38–42 Hbd), birth weight above 2500 g, ND or CS, and age 4–6 months. Exclusion criteria were: serious psychomotor dysfunctions, e.g. genetic defects, neurological and orthopaedic diseases, sight and hearing defects, infants from complicated and endangered pregnancies, perinatal medical history, hungry and/or tired child during examination, and withdrawal of consent of a parent or legal guardian for their child to participate in the study. Test of Sensory Function in Infants (TSFI) and the Sensomotor Questionnaire – our own study was used to evaluate sensory processing.

Results: The analysis of TSFI and the Sensomotor Questionnaire showed statistically significant differences between the groups. The largest differences were recorded in the reactivity to tactile deep pressure (RTD) subtest. More than half of the infants delivered by CS and only two children born by ND were in the deficit group in the RTD subtest.

Conclusions: Sensory processing disorders are more common in infants delivered by CS than in infants born by ND. Early diagnosis and possible therapy for improvement, especially in children born by CS, is recommended.

KEY WORDS:

infants, sensory processing, natural delivery, caesarean section.

INTRODUCTION

Sensory processing is a process that takes place in the central nervous system and consists of organising sensory impressions coming from one's body and the outside world, which enables purposeful action to be taken in everyday life [1]. Proper development of sensory processing has a significant impact on the quality of life and creates the foundations for education and social behaviour [2].

Disorders in sensory processing can cause many problems in the areas of intellectual, emotional, motor, and social development. They may manifest in the form of learning difficulties, problems with concentration, inappropriate behaviour, problems in establishing and main-

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TABLE 1. Characteristic of the groups

Group	*n*	Sex		Age (months)	Gestational age (weeks)	Birth weight (grams)	Apgar
		F	M				
ND	30	15	15	4.93 ±0.78	39.2 ±0.96	3487.1 ±452.06	9.96 ±0.18
CS	30	16	14	5.10 ±0.88	39.0 ±1.11	3364.1 ±438.00	10 ±0

ND – natural delivery, CS – caesarean section, F – female, M – male

taining social contacts, failure to cope with everyday duties and stress, and problems with coordination, balance, and motor planning [3–5].

Currently, the number of children with sensory processing disorders is increasing. It is estimated that 5–16% of the average population of pre-school and early school children have sensory difficulties [2, 3, 6–8]. This number is much higher in the case of developmental problems, such as: autism, ADHD, fragile X syndrome, or cerebral palsy [5, 7–9]. Among autistic children, this number ranges from 90% to 95% [6, 7, 10–12].

Usually, the diagnosis of sensory processing disorders is made relatively late – in the pre-school and school period. However, disturbances in this area can be observed much earlier, even in infancy [13]. Detecting and identifying disturbances in the development of sensory processing and initiating early therapy are of key importance for further growth of the child [14]. Early diagnosis gives the opportunity to undertake early intervention, which allows better effects to be achieved in therapy and prevents the development of secondary problems [5]. A significant part of the research concerns pre-school children, and there are only a few reports on infants' diagnostics.

Until now, the aetiology of sensory processing disorders is unknown. The authors conducting research enumerate many possible causes, such as: genetic, environmental, and perinatal factors [3, 5, 7, 8, 15]. Its occurrence and the increasing number of children with a deficit in this area are the reason for considerations about its cause.

The aim of this study is to determine whether the examined children have deficits in sensory processing and to assess the occurrence of these disorders, as well as to compare the sensory processes of infants born by natural delivery (ND) and caesarean section (CS).

MATERIAL AND METHODS

The research was conducted in May–June 2018 at the Department of Rehabilitation of the Children's Hospital of prof. dr med. Jan Bogdanowicz in Warsaw. The study involved 60 infants aged 4–6 months: 30 infants born by ND and 30 infants born by CS. The characteristics of the study group are presented in Table 1. The inclusion criteria were: term birth (38–42 Hbd), birth weight above 2500 g, ND or CS, and age 4–6 months. Exclusion criteria were: serious psychomotor dysfunctions, e.g. genetic defects, neurological, and orthopaedic diseases, visual and hearing defects, infants with complicated and pathological pregnancies, perinatal medical history, anxiety because of hunger and/or being tired during the examination, and withdrawal of consent of a parent or legal guardian for their child to participate in the study. The sample composition is found in Figure 1.

Prior to starting the tests, the parents gave signed consent for participation in the research and were informed about its course and purpose as well as about the voluntary possibility of resigning from participation in the study at any time. The study consisted of an interview with the parents regarding the basic information about the child and the course of pregnancy and delivery. Then the parents filled in the Sensomotor Questionnaire – our own questionnaire, which consisted of 25 questions concerning the child's everyday reactions to typical nursing activities, its contact with parents or reactions to stimuli from the outside world. Parents could mark the answer "yes" or "no". Positive answers indicated the existence of difficulties in performing the given activity.

In this research the Test of Sensory Function in Infants (TSFI) was used. This test was published in the United States, and its authors are Georgia A. DeGangi and Stanley I. Greenspan. The test is intended for infants aged 4–18 months and evaluates sensory processing disorders or the risk of their occurrence. During the test the child's reactions to simple task situations are evaluated. The test consists of 24 samples collected in five sub-tests, which enable the assessment of functioning of the senses. The following characteristics are observed: reactivity to tactile deep pressure (RTD), adaptive motor functions (AMF), visual tactile integration (VTI), ocular-motor control (OMC), and reactivity to vestibular (RVS). The test takes about 20 minutes. Depending on the obtained points, the subjects are qualified to one of three groups: norm, risk,

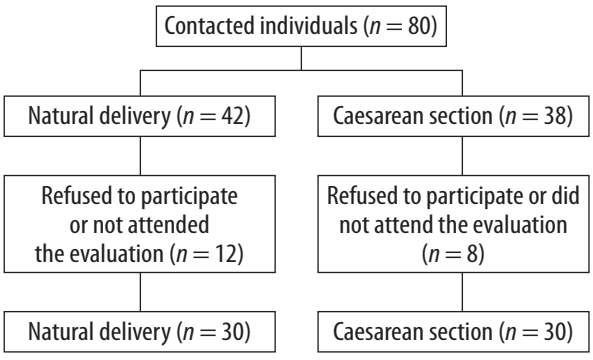

FIGURE 1. Flowchart of the subject samples

TABLE 2. The results of Test of Sensory Function in Infants (TSFI) test in both groups

Subtest	ND			CS			χ^2	*p*
	Normal (%)	At risk (%)	Deficient (%)	Normal (%)	At risk (%)	Deficient (%)		
TSFI RTD	76.7	16.7	6.7	23.3	23.3	53.3	19.75556	0.00005
TSFI AMF	93.3	3.3	3.3	83.3	6.7	10.0	1.503145	0.47162
TSFI VTI	93.3	0.0	6.7	86.7	13.3	0.0	6.074074	0.04798
TSFI OMC	83.3	–	16.7	73.3	–	26.7	0.883797	0.34716
TSFI RVS	50.0	13.3	36.7	30.0	26.7	43.3	3	0.22313
TSFI total	76.7	16.7	6.7	43.3	20.0	36.7	9.099456	0.01057

RTD – reactivity to tactile deep pressure, AMF – adaptive motor functions, VTI – visual tactile integration, OMC – ocular-motor control, RVS – reactivity to vestibular stimulation, ND – natural delivery, CS – caesarean section

TABLE 3. The results of the Sensomotor Questionnaire

	ND	CS	*T*	*p*
Total SQ	3.90 ±2.50	6.27 ±2.32	–3.81	0.00

SQ – Sensomotor Questionnaire, ND – natural delivery, CS – caesarean section

or deficit. The results are interpreted depending on the age range to which the child was qualified. The authors of the test specified age ranges: 4–6 months, 7–9 months, 10–12 months, and 13–18 months [14]. Each infant was examined during one meeting, always by the same researcher.

The statistical analysis of the results was made using the Statistica v.13 program. Student's t-test and chi-square test were used. It was assumed that the probability is statistically significant if $p < 0.05$.

RESULTS

The results in terms of TSFI total score were analysed, as well as individual subtests in the group of infants born by ND and infants delivered by CS. Depending on the achieved points, the subjects were assigned to groups: norm, risk, or deficit, and then a comparison of both groups was made. The results are shown in Table 2.

It was shown that, as a result of the general TSFI, in the deficit group there were 11 infants delivered by CS and only two infants born by natural delivery. Comparison of infants born by ND and by CS showed a statistically significant difference in the overall outcome of TSFI ($p = 0.0157$).

The greatest differences were recorded in the RTD subtest. More than half of infants delivered by CS and only two children born by ND were in the deficit group. Upon comparison of both groups, a statistically significant difference was recorded ($p = 0.00005$).

Both groups were statistically significantly different also in the results of the VTI test ($p = 0.04798$).

In the remaining subtests (AMF, OMC, RVS) more infants born by ND were within normal range than in the group of infants delivered by CS; however, these differences were not statistically significant.

The results of the Sensomotor Questionnaire were summed up for each group (Table 3). The analysis showed statistically significant differences between the groups ($p = 0.00034$).

It was observed that the mean value of points in the group of infants delivered by CS was almost 50% higher than in the group of infants born by ND.

Analysing individual questions, it was observed that almost half (43.3%) of babies born by CS have problems falling asleep. In addition, in the opinion of parents, children born through CS are more often irritated and upset, have problems with effective calming down, and weaker tolerance to treatments such as bathing, creaming, and washing face and/or hair. In the remaining questions there were no statistically significant differences. Questions in which statistically significant differences were observed are presented in Table 4.

TABLE 4. Selected questions of the Sensomotor Questionnaire

Observed phenomenon	ND (%)	CS (%)	*p*
Problems falling asleep	10.0	43.3	0.00351
Irritation, nervousness	6.7	36.7	0.00480
Problems with effective calming down	6.7	33.3	0.00982
Crying/anxiety during bath	0.0	20.0	0.00982
Crying/anxiety during cream the face	3.3	23.3	0.02269
Bright light sensitivity	46.7	20.0	0.02846
Crying/anxiety during hair or face washing	0.0	13.3	0.03843
Fretfulness/anxiety	3.3	20.0	0.04435

ND – natural delivery, CS – caesarean section

DISCUSSION

In recent years, the number of children with sensory processing disorders has increased [3]. Some risk factors are more common in children with difficulties in this respect than in the population of children developing properly [5]. The aetiology of sensory problems is still unknown. Among the many reasons, research authors mention perinatal complications, including delivery by

CS [7, 11, 16]. In Poland and throughout the world, there is a continuous increase in delivery by CS [17–20]. The abovementioned facts, as well as our own clinical observations, have contributed to the exploration of this topic. The aim of the study was to compare the sensory profile of infants born by ND and by CS.

The results of the TSFI test show that delivery by CS has a negative effect on the sensory processing in the examined infants. Children born by CS more often show abnormalities of sensory processes compared to children born by natural birth, especially in the area of sensitivity to tactile deep pressure. Most researchers using the TSFI test focus on children born prematurely [21–25]. Cabral, as well as Chorna, in their research observed differences between premature babies and babies born full term in the RTD subtest [21, 22]. Affanasowicz, however, proved that the RTD was one of the least developed areas in risk-group children, of whom 45% of the respondents were infants delivered by CS [13].

The results of the TSFI test are consistent with the results of the Sensomotor Questionnaire. According to the parents of infants delivered by CS, their children are more often irritable and upset. Parents mainly reported difficulties with falling asleep and effective calming down, as well as weaker tolerance for nourishing treatments, which is confirmed by observations of May-Benson and Wienier [11, 25].

Research conducted by Glasson, Hultman, and Zhang suggest a correlation between CS and the risk of autism in children [26–28]. Although sensory disorders often occur alone, they can co-exist with other diseases, which contributes to the escalation of problems [8, 10, 16]. Such a situation applies to children with autism, most of which are characterised by a deficit in sensory processing. Problems in sensorimotor development often appear prior to the diagnosis of autism, and as May-Benson noted, these disorders may be a key factor in the regulatory difficulties presented by this population [11].

Diagnosis of sensory processing disorders is made relatively late, in pre-school and school age. The current study, as well as reports from other scientists, indicates that symptoms in this area may occur much earlier, even in infancy [8]. Knowledge of potential factors contributing to this condition is important. In infancy, deficits in sensory processing can be very subtle and should not be underestimated. Identifying disorders and ensuring appropriate intervention in early childhood can significantly prevent or minimise later problems [8, 9, 14, 29].

The strength of this study lies in the application of a relatively easy-to-use TSFI test, which is a reliable and credible tool for assessing sensory process disorders in infants [8, 13, 14]. Not only does it detect and determine sensory processing problems, but it is also helpful in conducting targeted neurodevelopment therapy, as demonstrated by Matyja's research [4].

Analysing the above examination, one should also take into account other factors that may influence the results of the study, and have not been considered, such as: muscle tone disorders, different temperaments of infants, or the environment in which they are raised. The results of the study should be interpreted cautiously. Although the test is intended for children from the age of four months, the most reliable and credible results are obtained in infants between seven and 18 months of age [30].

CONCLUSIONS

Based on the conducted research, the following conclusions were established:

- Sensory processing disorders are more common in infants delivered by CS than in infants born by ND.
- The largest difference in sensory processing disorders between the studied groups includes sensitivity to deep touch.
- Early diagnosis and possible therapy for improvement, especially in children born by CS, is recommended.

DISCLOSURE

The authors declare no conflict of interest.

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