

A COMPARATIVE STUDY ON NEUROMOTOR DEVELOPMENT IN TWINS

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Abstract: *Twins are a valuable source of observation, being considered a key instrument in scientific fields such as genetics, biology, or psychology. The literature suggests that the hereditary and environmental influences can be assessed by comparing twin partners. In this paper we have proposed to demonstrate the existence of differences in the neuromotor development of couples of monozygotic and dizygotic twins. In order to follow the infants' evolution, we used the Peabody motor development scale, consisting of 6 subtests targeting archaic reflexes, locomotion, stationing, object manipulation, catching and visual-motor integration. Children were evaluated every month until the age of 1 year. The results obtained show that there are differences between monozygotic and dizygotic twins, which are highlighted by the development stages.*

Key words: *twins, monozygotic, dizygotic, neuromotor development.*

1. Introduction

Twins are a valuable source of observation, being considered a key instrument in scientific fields such as genetics, biology, or psychology. The literature suggests that the hereditary and environmental influences can be assessed by comparing twin partners [12].

On a large scale, studies on infant twins demonstrate the influence of genetics on the childhood motor skills. Apparently, heredity determines intelligence and motor performance.

In 2002, Gesell and Thompson tried to show the effects of stimulating the motor skills by using a pair of identical, female twins. For a wide range of motor skills, from

typical infant behaviours such as catching objects to more advanced behaviours, it has been found that an early stimulation has a modest effect. The conclusion was that motor skills are more strongly influenced by genetics than by the environment [8].

Paul M. (2004) made an experiment in which he noticed the neuromotor development of 2 twins until the age of 22 months. A twin was additionally stimulated to improve the motor skills specific to the developmental stage, while his brother was not given any special attention. The conclusion of the study was unexpected and controversial given that there were no significant differences in the motor performance of the two twins [10].

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Researchers turned their attention to studying twins compared to single children of the same age. The study observed the age at which subjects began rolling, crawling or walking, and found that there was no difference in reaching all of these key skills in the development stages [3].

Regarding children with a retard in the neuromotor development, studies have shown that early intervention through physical therapy can improve motor development and prevent long-term sequelae [2].

As a conclusion, the neuromotor development is a nonlinear process, dependent on the effective integration of all sensory experiences, combined with the environmental demands and situations that are modulated by behaviour and personality reactions [13].

2. Purpose, Objectives and Hypotheses of Research

The aim of the present paper is to analyze and present the results obtained after evaluating the neuromotor development of two couples of twins. Unlike the above-mentioned research, our work follows the neuro-motor development of the twins, but without a proper physical therapy intervention.

In order to achieve the proposed goal, we have suggested the following objectives:

- Carrying out a documentation to ensure the theoretical and methodological basis of the studied subject, with as many ideas and researches as possible, aimed at the neuromotor development of the twin couples;
- Conducting a research study, which will aim at highlighting the differences of

the neuromotor development between couples of monozygotic and dizygotic twins.

Consistent with the purpose and objectives of the research, we proposed to verify the following assumptions:

- *It is assumed that there are differences in the neuromotor development of twins, which have repercussions on the subjects' evolution, namely the delays in the specific motor acquisitions of each month.*
- *It is assumed that there are differences between the neuromotor development of the couples of monozygotic twins and dizygotic twins.*

3. Material and Methods

The research methods used during the research were as follows: the theoretical documentation method, the pedagogical observation method, the survey method, the case study method, the method of data processing and graphic representation, the specific methods of exploration and evaluation.

The subjects selected for the comparative study were 4, out of which 1 male and 3 females. The two couples of twins were a pair of single-sided monozygotic (naturally born), identical and a pair of dizygotic twins (born via caesarean section), fraternal. Both couples of twins were born prematurely at 33 weeks, but none of them had been in intensive care for more than 10 hours. The Apgar Score was 9 for both couples and no respiratory or cardiac complications were reported.

The location of the research was the laboratory of sensory stimulation in the physical therapy recovery base of "Vasile Alecsandri" University of Bacau. The duration of the research was 13 months.

Before we started evaluating the children, we obtained their parents' written consent to include the children in this study.

We used the Peabody Scale of motor development to evaluate the subjects. It offers the possibility to evaluate both gross and fine motor skills, and it can be used from birth up to 72 months.

The Peabody Scale is made up of 6 sub-tests that evaluate the child's reflexes, stationing, locomotion, object manipulation, catching skills and visual-motor integration. The sub-tests for gripping and visual-motor integration form the fine motor skills (FM) scale, and the other subtests are the gross motor skill (GM) scale.

The ranking of the results was done by giving points from 0 to 2 as follows:

- **0** = the child cannot perform the action, and if he/she tries, it does not have the normal course of action;
- **1** = if the activity performed by the child showed a clear resemblance to the basic skills, but did not fully meet the criteria of the movement;
- **2** = if the child performs the item in accordance with the criteria to be fulfilled in the activity.

Following the scoring of the 6 sub-tests, a total motor coefficient (TMC) is formed, indicating the child's total purchases.

Considering that the present paper aims to follow the normal course of the subjects' motor development and mainly of the most important purchases during the first year of life, there was no physical therapy intervention during the monitoring of the twin couples.

4. Results and Discussions

Table 1

The results obtained by subject no.1 of the monozygotic twin pair

Month	Reflexes		Stationing		Locomotion		Catching		Object Handling		Visual-motor integration	
	PO	PMP	PO	PMP	PO	PMP	PO	PMP	PO	PMP	PO	PMP
1	-	-	8	8	6	6	5	6	-	-	6	6
2	2	2	6	6	3	4	3	4	-	-	9	10
3	-	-	4	4	2	2	2	2	-	-	2	2
4	2	2	2	2	6	6	2	2	-	-	4	4
5	-	-	2	2	4	4	6	6	-	-	-	-
6	8	8	4	6	8	8	4	4	-	-	5	6
7	-	-	2	2	4	4	4	4	-	-	6	6
8	-	-	-	-	2	2	6	6	-	-	4	4
9	2	2	2	2	8	10	-	-	-	-	3	4
10	2	2	4	4	9	10	-	-	-	-	7	8
11	-	-	-	-	8	8	4	4	-	-	6	6
12	-	-	-	-	6	6	-	-	2	2	6	6
13	-	-	2	2	2	2	2	2	4	4	8	8

Legend: points obtained (PO), possible maximum points (PMP)

Table 2

The results obtained by subject no.2 of the monozygotic twin pair

Month	Reflexes		Stationing		Locomotion		Catching		Object Handling		Visual-motor integration	
	PO	PMP	PO	PMP	PO	PMP	PO	PMP	PO	PMP	PO	PMP
1	-	-	6	8	4	6	4	6	-	-	5	6
2	1	2	4	6	2	4	2	4	-	-	8	10
3	-	-	3	4	2	2	2	2	-	-	2	2
4	2	2	1	2	5	6	2	2	-	-	4	4
5	-	-	2	2	4	4	6	6	-	-	-	-
6	8	8	4	6	6	8	4	4	-	-	5	6
7	-	-	2	2	3	4	4	4	-	-	6	6
8	-	-	-	-	2	2	6	6	-	-	4	4
9	2	2	2	2	6	10	-	-	-	-	3	4
10	2	2	3	4	9	10	-	-	-	-	7	8
11	-	-	-	-	7	8	4	4	-	-	6	6
12	-	-	-	-	5	6	-	-	2	2	6	6
13	-	-	2	2	2	2	2	2	4	4	8	8

Legend: points obtained (PO), possible maximum points (PMP)

Table 3

The results obtained by subject no.1 of the dizygotic twin pair

Month	Reflexes		Stationing		Locomotion		Catching		Object Handling		Visual-motor integration	
	PO	PMP	PO	PMP	PO	PMP	PO	PMP	PO	PMP	PO	PMP
1	-	-	7	8	6	6	6	6	-	-	6	6
2	2	2	6	6	2	4	4	4	-	-	10	10
3	-	-	4	4	2	2	2	2	-	-	2	2
4	2	2	2	2	4	6	2	2	-	-	4	4
5	-	-	2	2	4	4	5	6	-	-	-	-
6	8	8	6	6	8	8	4	4	-	-	6	6
7	-	-	2	2	4	4	4	4	-	-	6	6
8	-	-	-	-	2	2	6	6	-	-	4	4
9	2	2	2	2	9	10	-	-	-	-	3	4
10	2	2	4	4	10	10	-	-	-	-	6	8
11	-	-	-	-	8	8	4	4	-	-	6	6
12	-	-	-	-	6	6	-	-	2	2	6	6
13	-	-	2	2	2	2	2	2	4	4	8	8

Legend: points obtained (PO), possible maximum points (PMP)

The results obtained by subject no.2 of the dizygotic twin pair Table 4

Month	Reflexes		Stationing		Locomotion		Catching		Object Handling		Visual-motor integration	
	PO	PMP	PO	PMP	PO	PMP	PO	PMP	PO	PMP	PO	PMP
1	-	-	6	8	5	6	6	6	-	-	6	6
2	1	2	6	6	2	4	3	4	-	-	10	10
3	-	-	4	4	2	2	2	2	-	-	2	2
4	2	2	2	2	4	6	2	2	-	-	4	4
5	-	-	1	2	4	4	5	6	-	-	-	-
6	8	8	4	6	6	8	4	4	-	-	6	6
7	-	-	1	2	3	4	4	4	-	-	6	6
8	-	-	-	-	1	2	6	6	-	-	4	4
9	2	2	1	2	6	10	-	-	-	-	3	4
10	2	2	4	4	8	10	-	-	-	-	6	8
11	-	-	-	-	7	8	4	4	-	-	6	6
12	-	-	-	-	6	6	-	-	2	2	6	6
13	-	-	2	2	2	2	2	2	4	4	8	8

Legend: points obtained (PO), possible maximum points (PMP)

The results obtained from the evaluation of total motor acquisitions Table 5

Month	Maximum points	Points obtained		Points obtained	
		MZT1	MZT 2	DZT1	DZT 2
1	26	24	19	25	23
2	26	23	17	24	22
3	10	10	9	10	10
4	14	14	14	14	14
5	12	12	12	11	10
6	32	29	27	32	27
7	16	16	15	16	12
8	12	12	12	12	11
9	18	15	13	16	12
10	24	22	21	22	20
11	18	18	17	18	18
12	14	14	13	14	14
13	18	18	18	18	18

Legend: MZT – monozygotic twin, DZT – dizygotic twin.

Results of the total score obtained in each 13-month sub-test Table 6

	Reflexes	Stationing	Locomotion	Catching	Object Handling	Visual-motor integration
PMP	16	38	72	40	6	70
PO MZ 1	16	35	69	38	6	66
PO MZ 2	15	27	57	36	6	64
PO DZ 1	16	36	67	37	6	67
PO DZ 2	15	32	57	38	6	67

Legend: MZ – monozygotic twin, DZ – dizygotic twin, PO – points obtained, PMP – possible maximum points

In order to highlight the differences between the two couples of twins we proceeded as follows: in the first phase, we compared the members of the monozygotic and the dizygotic twin couple between them, and in the end, we compared the two couples of twins.

The individual results obtained by the pair of monozygotic twins are shown in table no. 1 and 2, and the comparative results obtained by the two twins as a couple are recorded in table no. 5 and table no. 6. The analysis of the results was based on the information in the mentioned tables, from which we highlighted the most important aspects.

Regarding the evolution of reflexes, the only difference was recorded in the 2nd month of life, when the monozygotic twin 2 obtained 1 point, while the monozygotic 1 obtained 2 points. From a total of 16 possible points, monozygotic twin no. 1 achieved the maximum of points, and the monozygotic twin no.2 obtained 15 points.

In terms of the stationing evaluation, the differences were more evident in the first 4 months of life, in favor of the monozygotic twin no.1. Over this period of time, the monozygotic twin no.1 scored a maximum of 8, 6, 4 and 2 points respectively, while his brother got 6, 4, 3 and 1 point. This delay was seen at the end of the evaluation period, when out of the 38 possible points, the twin no. 1 reached 35 points, and the twin no. 2 only scored 27 points.

In the evaluation of the locomotion, as in the other events, the monozygotic twin had a better evolution compared to his brother, being equal only in the 3rd, 5th, 8th and 13th months. Out of the 72 possible points, twin no.1 got 69 points and his brother 57 points.

By evaluating the catching skill, there were no significant differences between the two twins. Small differences can be noticed in the first 2 months of life when the monozygotic twin no.1 achieved 2

points higher than the monozygotic twin no.2. Out of the 40 possible points, the twin no.1 got 38 points and the twin no. 2 scored 36 points.

The object handling was evaluated only in the 12th and 13th months, and it recorded equal and maximum values, i.e. 6 points. The visual-motor integration highlights the tendency of the twin no. 1 to be superior, but only in the first 2 months of life. None of the twins registered the maximum values for this event. Out of the maximum of 70 points, the twin no. 1 scored 66 points, and his brother only 64 points.

According to table no. 5, we notice that there were differences between the two twins each month. The firstborn of the monozygotic twins had a better evolution throughout the evaluation. Out of the maximum score of 240 points reached over the 13 months of evaluation, the twin no. 1 achieved 227 points, and the twin no. 2 realized only 207 points.

The individual results obtained by the dizygotic twin pair are shown in table no. 3 and 4, and 2 of those relating to the couple are recorded in table no. 5 and table no. 6. The analysis of the results was based on the information in the mentioned tables.

Thus, after evaluating the reflexes of the dizygotic twin couple, the first of the brothers had a better start in the 2nd month of life, registering 1 point in addition to the twin no. 2. Except for the first reflex evaluated, the dizygotic twins had an identical evolution throughout the evaluation period. The maximum score was 16 points and was reached only by the twin no. 1, the twin no. 2 recording 15 points in the final evaluation.

In the first 5 months of stationing, the two twins had equal progressions. The differences were recorded in the 6th, 7th and 9th months when the dizygotic twin no. 1 obtained 6, 2 and 2 points, and the monozygotic twin no. 2 obtained 4, 1 and 1

points. Out of the 38 possible points, the first twin got 36 points and the second 32 points.

In terms of locomotor evaluation, according to tables 3 and 4, no developmental differences were observed in the first 5 months. They became more visible between the 6th and 10th months when the dizygotic twin no. 1 obtained 8, 4, 2 and 9 points in the evaluation, and the dizygotic twin 2 obtained 6, 3, 1 and 6 points. Out of a maximum score of 72 points, the first of twins received 67 points and the second, 57 points

Like the monozygotic twins, the dizygotic twins gained 6 points when evaluating the object handling.

Regarding the catching skill evaluation, the dizygotic twin pair showed a difference of 1 point in the second month of the evaluation, in favour of the twin no. 1. Out of a maximum of 40 points, the first of twins got 37 points and the second twin acquired 38 points.

The results obtained from the visual-motor integration evaluation show that there are no differences between the two twins. Out of a maximum of 70 points, both twins reached 67 points.

Following the table with the total motor acquisitions, out of a maximum of 240 points, the first born of the two dizygotic twins obtained 232 points and the second 211 points, the difference being 21 points. This score confirms once again the differences explained in the previous tables and the fact that the first of the dizygotic twins had a better evolution in the neuromotor development.

The differences between the first monozygotic and the dizygotic twin prove to be minor, sometimes even equal in terms of motor acquisitions over the 13 months of evaluation. According to the tables no. 5 and 6, it can be noted that the firstborn of the dizygotic twin pair received a higher score by summing up the motor acquisitions during the

evaluation. Out of a maximum of 240 points for the total motor acquisition, the first twin of the monozygotic couple got 227 points, and the twin of the dizygotic twin pair reached 232 points.

By comparing the second twin pair of monozygotic twins to the second twin in the dizygotic twin pair, we can find that the dizygotic twin achieved a higher score in assessing the on-going motor acquisitions. In tables' no. 5 and 6, periods were observed when the monozygotic twin had better results, periods when they were equal, and periods when the dizygotic twin was above the monozygotic twin. At the gathering of the points obtained over the 13 months of evaluation, the second child in the dizygotic twin couple received 211 points, compared to the monozygotic twin, who obtained 207 points, the difference being only 4 points.

5. Conclusions

In the neuromotor development of the studied twin couples, there were no significant differences in qualitative and quantitative terms. From the point of view of quantity, all the subjects have successfully fulfilled each stage of development. From the point of view of quality, muscle tone was the main factor determining these differences.

During the research, it was observed that in both couples of twins, the second born had a lower tonus compared to the first one. These differences became more apparent after six months, when children had to fight gravity.

According to the obtained results, we can say that the first hypothesis that "There are supposed to be differences in the neuromotor development of twins, which has repercussions on the evolution of the subjects, in the sense of delays in the specific monthly motor acquisitions"

proved to be partly true. The fact that differences have been found between twins as couple during the evaluation is true, but they were not so high as to have a clear influence on the subsequent neuromotor development. Between the monozygotic twin pair, the difference in the score obtained over the 13-month evaluation was 10 points, and between the dizygotic twin pair, 11 points.

The differences found between the twins do not raise problems because the children did not fit into any pathological pattern, even if they had a slight delay in their development. After analyzing each result obtained and consulting us with the pediatrician and neurologist, there were no neurological problems.

As it is also stated in the literature, in the vast majority of the twin pairs, one of them has a slight delay in development, which has proven to be true in the present research as well, especially if they were born prematurely. The hypothesis that “there would be developmental differences between the monozygotic and dizygotic twin pairs” has been found to be false. After analyzing the final score, the difference was only 1 point. Thus, we can conclude that there are no differences between the monozygotic and dizygotic twin pairs.

Given that the study was performed on only 2 couples of twins, the result obtained cannot be generalized, but we consider the analytical evaluation of twin couples important, since prematurity increases the risk of growth deficits and neuromotor development.

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