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Long-Term Follow-Up Study of Somatic Development in Prematurely Born Twins after Life-Threatening Episodes

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Abstract. The study comprised 14 pairs of twins. All the children were prematurely born between the 27 and the 33 weeks of pregnancy with birth weight 600-1900 g. Somatic development was assessed on the basis of the body weight, length/height measurements taken in the 6th and 12th months of the corrected age and in the 24th month of the calendar age. Body mass index was also calculated as weight in kilograms divided by the square of the height in meters. The obtained results were compared with the regional norms for children from Lodz. Moreover, in each child individual measurements and body mass index were normalized as compared to the arithmetic mean and the standard deviation for the established age norm. The percentage of children with body mass deficiency and decreased body length/height was relatively high. Individual assessment of somatic development, taking into account the normalized values enable observation of the direction of changes within the range of somatic features in individual children. Retardation of somatic development of prematurely born twins should be first of all associated with their very low birth weight. Severe complications of prematurity affect physical development of the children examined by us, especially in the first two years of life.

Key-words: Twins, Premature, Somatic development, Follow-Up study

INTRODUCTION

Bigeminal pregnancy is regarded as one of the most frequent causes of premature delivery. On the other hand, prematurely born infants, in spite of great progress in the field of neonatal intensive care, still present a major problem in developmental age medicine. Early complications of premature, such as respiratory distress syndrome, intraventricular haemorrhage, metabolic disturbances (hypoglycemia, hypokalaemia, hyperbilirubinaemia) are a fatal threat to neonates, as well as infections, including generalized ones (sepses) and iatrogenic complications [10].

However, the so-called late complications of premature, which often are remote con-

sequences of illnesses treated during the first hospitalization, are of particular significance. They involve somatic, psychomotor and, later on, mental disorders, which may be long-lasting or may even last the whole life-time [6, 9, 22].

The aim of the present study was to answer questions:

- Do premature twins differ from full-term infants in somatic development in the first two years of their life?
- Are the pattern and the rate of development similar in particular pairs of twins, and if not, why?

MATERIALS AND METHODS

The study comprised 14 pairs of twins, including 7 pairs of girls, 4 pairs of boys and 3 mixed pairs. Now the children are 2 to 6 years old (only three pairs have turned 6 at present). All the children were prematurely born between the 27th and the 33rd weeks of pregnancy with birth weight 600-1900 g (Table 1). Birth weights in particular pairs of twins were different, except one pair of girls (No V, Table 1) and one pair of boys (No VII, Table 1). From the first days of their life the children were hospitalized in the Intensive Care Unit because of their condition involving the risk of life, such as respiratory failure in the course of respiratory distress syndrome, congenital pneumonia or sepsis. After bringing the most severe threats under control and in the absence of the necessity to apply artificial ventilation, the children were transferred to the Clinic of Paediatric Propedeutics and then they were discharged to remain under permanent care of the Outpatient Clinic of Development Control. Table 1 contains diagnoses from the first hospitalization and the ones found (or not found) at present.

Somatic development was assessed on the basis of the body weight, length/height measurements taken in the 6th and 12th months of the corrected age and in the 24th month of the calendar age. The corrected age was calculated by subtracting the number of weeks, wanting of the 40th week of foetal age, from the calendar age [8]. The measurements were performed according to the standard technique: body length with a liberometer (up to the 18th month), body height with an anthropometer exact to 1 mm. Body weight was determined on an infant balance, and in order children on a medical balance exact to 100 g. Body mass index (BMI) was also calculated as the quotient of body weight in kg to length/height in m^2

$$BMI = weight(kg) / height(m)^2.$$

The obtained results were compared with the regional norms for children from Lodz (16), and percentile positions for all three somatic features in the follow-up examinations were established. Moreover, in each child individual measurements and body mass index were normalized as compared to the arithmetic mean and the standard deviation for the established age norm (for the 6th and 12th months of the corrected age and the 24th month of the calendar age).

$$\text{The formula: } z = Xb - Xn/SDn \text{ was applied,}$$

where: z = normalized value, Xb = the value of the studied feature, Xn and SDn = the arithmetic mean and the standard deviation of the control group (norm) [5].

Table 1 - Information concerning the length of gestation time and birth weight and blood group, as well as clinical diagnoses at first hospitalization and at present – individual data

Pair No	Case No	Name	Sex	Blood group	Apgar score	Hbd	Birth weight (g)	Diagnosis at first hospitalization	Present age	Diagnosis at present
I	1.	B.M.	F.	B Rh (+)	5	28	960	1. congenital pneumonia serologic incompatibility AB0, RDS.	7 i 9/12	1. returning infections of airways
	2.	B.M.	F.	B Rh (+)			900	2. pneumonia, RDS, anaemia		2. returning infections of airways, hyperexcitability
II	3.	P.K.	F.	O Rh (+)	3/1/6	29	1300	3. asphyxia, IVH, inguinal hernia	6 i 8/12	3. infection HBV and HCV, mental retardation.
	4.	P.D.	M.	O Rh (+)	7		1500	4. pneumonia, sepsis fungus, hernia		4. infection HBV and HCV, mental retardation
III	5.	R.M.	M	A Rh (-)	0/5	27	800	5. asphyxia, RDS, IVH, pneumonia, anaemia	6 i 4/12	5. infection HBV, mental retardation
	6.	R.M.	M.	A Rh (-)	1/4		600	6. asphyxia, RDS, pneumonia, sepsis		6. infection HBV and HCV, mental retardation
IV	7.	R.P.	M.	B Rh (+)	1	32	1200	7. asphyxia, RDS, pneumonia, fungus infection, hernia	6 i 3/12	7. infection HBV HCV, hernia
	8.	R.P.	M.	B Rh (+)	3/5/5		1100	8. asphyxia, pneumonia, hernia		8. infection HBV and HCV
V	9.	T.M.	F.	A Rh (+)	7/8/8	32	1800	9. RDS, pneumothorax, sepsis, pneumonia, anaemia	6	9. infection HBV
	10.	T.M.	F.	A Rh (+)	7/8		1800	10. pneumonia		10. healthy
VI	11	Ś.P.	F.	O Rh (+)	7/8	32	1850	11. pneumonia, sepsis, hepatocellular damage, anaemia	5 i 7/12	11. infection HBV, vision defect
	12.	Ś.B.	M.	O Rh (-)	6/7		1200	12. pneumonia, hernia, BPD, cytomegaly		12. mental retardation
VII	13.	P.P	M.	O Rh (+)	1/2/5	31	1500	13. RDS, BPD, asphyxia, sepsis, pneumonia, anaemia, hernia	4 i 10/12	13. infection HCV, adenoiditis, hypoacusia
	14.	P.P.	M.	B Rh (+)	6/7/8		1500	14. RDS, sepsis fungus, hernia, cryptorchism		14. Weight deficiency, status post adenoidotomy
VIII	15.	F.Z.	F.	B Rh (+)	7	31	1550	15. RDS, IVH, sepsis	4 i 7/12	15. healthy
	16.	K.S.	M.	AB Rh(+)	8		1700	16. RDS, BPD, pneumonia, sepsis		16. returning infections of airways
IX	17.	S.M.	F.	O Rh (+)	4	30	1100	17. RDS, sepsis, retinopatia II/III, anaemia	4 i 3/12	17. dental caries, height deficiency
	18.	S.M.	F.	O Rh (+)	5		1300	18. RDS, sepsis, retinopatia III, anaemia		18. weight deficiency

(continued)

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Pair No	Case No	Name	Sex	Blood group	Apgar score	Hbd	Birth weight (g)	Diagnosis at first hospitalization	Present age	Diagnosis at present
X	19.	S.P.	F.	O Rh(-)		32	1800	19. RDS, pneumonia,	2 i 7/12	19. returning infections of airways
	20.	S.K.	F.	O Rh(-)			1850	20. RDS, pneumonia, anaemia		20. returning infections of airways
XI	21.	K.M.	F.	AB Rh(+)	5	29	980	21. pneumonia, IVH III, anaemia, pneumonia	2 i 7/12	21. healthy
	22.	K.M.	F.	B Rh(+)	4		1100	22. RDS, asphyxia, convulsions, sepsis, anaemia		22. healthy
XII	23.	S.I.	F.	B Rh(+)	5	32	1900	23. RDS, pneumonia, bacteremia	2 i 6/12	23. rachitis, anaemia
	24.	S.N.	F.		6		1600	24. congenital infection		24. hydrocephalus valvula
XIII	25.	A.A.	F.	A Rh(+)	4/5	29	1200	25. RDS, pneumonia congenital, FoA	2 i 6/12	25. returning infections of airways
	26.	A.K.	F.	B Rh(+)	3/5		1250	26. asphyxia, pneumonia congenital, retinopatia II, hernia		26. healthy
XIV	27.	R.D.	M.	B Rh(+)	7	33	1050	27. congenital infection	1 i 10/12	27. returning of airways
	28.	R.L.	M.	B Rh(+)	8		1050	PDA, FoA, pneumonia protract		28. returning infections of airways
								28. pneumonia protract, pneumocystosis		

This method enables a demonstration of differences in comparison with the accepted norm in the form of standard deviation units. The normalized values obtained in this way are presented in Table 3 and, for chosen pairs of twins, in Figure 1.

RESULTS

As shown in Table 2, the percentage of children with body weight deficiency and decreased body lenght/height was relatively high: particularly 40% body weight deficiency at the age of 6 months and up to 50% body mass deficiency at the age of 24 months. It is worth noticing that in the second year of life we did not observe any accelerated development or equalling the level of development as compared with children born at term; since the percentage of children with body height under the 10^{th} percentile remains at the same level. Individual assessment of somatic development, taking into account the normalized values, is presented in Table 3. It enables observation of the direction of changes within the range of somatic features in individual children, e.g. a

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Table 2 - The frequency of occurrence (numbers, percentage) of individual percentile value ranges of the body weight and length/height, as well as body mass indices in children from twin pregnancies in the following examinations

	6 months * (n=28)			12 months * (n=28)			24 months (n=26)		
Percentil	< 10c	10-90c	>90c	< 10c	10-90c	> 90c	< 10c	10-90c	>90c
Birth weight	11 (39,3%)	17 (60,7%)	0	13 (46,4%)	14 (50%)	1 (3,6%)	13 (50%)	13 (50%)	0
Lenght height	8 (28,6%)	20 (71,4%)	0	7 (25%)	21 (75%)		7 (26,9%)	19 (73,1%)	0
BMI	9 (32,1%)	16 (57, 1%)	3 (10,8%)	6 (21,4%)	18 (64,3%)	4 (14,3%)	8 (30,8%)	15 (57,7%)	3 (15,5%)

*corrected age

gradual decrease of differences in comparison with the control group in the follow-up examinations in child no. 1, an increase of these differences in children marked by nos. 12, 13, 16, as well as differentiation in pairs of twins (pairs no I, II, VI, VII). The biggest deviation from standard, exceeding 1 SD unit, was observed in four pairs of twins (pairs III, VII, IX, XIV) and in one of the twins in pairs I, II. VI. It usually concerned children with body mass of around 1000 g. The children from pairs I, III, VI, VII, XI had a very severe history of their neonatal period (Tab. 1), which also affected their physical development in terms of occurring deviations.

DISCUSSION

Bigeminal pregnancies occur most frequently among multiple gestations. As follows from epidemiological studies, they make 1.5% of all deliveries in Poland [14]. In Lodz and Lodz district the percentage of premature is the highest in Poland and in recent years it has remained at a constant level of about 11% (in 1998 – 10.6%); during this time the frequency of twin deliveries has amounted to 1.4% of the total number, which indicates that they may be a significant potential cause of premature. Therefore children from multiple pregnancies, and particularly those born with a very low body weight, i.e. such as were included in our long-term study, are subject to special paediatric care as a perinatal risk group. As it follows from our observations, physical development of these children is clearly slow, which can be seen both in general comparisons presenting percentile intervals of the examined features (Table 2) and in normalized values (Table 3). Many authors notice that mean values of body weight and height at different periods of developmental age are lower than the mean values for the whole population [2, 3, 4, 7, 14, 22, 23]. At the same time a significant role is ascribed to birth weight, which is one of the essential determinante of children's development [1, 10, 12, 14, 17]. Among the assessed children, Luke distinguished the ones with severe intrauterine hypotrophy; they had definitely more deviations in the range of the basic somatic features, although they also

Table 3 - Normalized values of the analyzed somatic features in the followig examinations

Pair No.	Case No.	Name	Sex	Hbd	Birth weight (g)	6 months (corrected)			12 months (corrected)			24 months (corrected)		
						weight	lenght	BMI	weight	lenght	BMI	weight	height	BMI
I	1.	B.M.*	F	28	960	-0,9	-0,8	-0,3	-0,6	-0,7	-0,1	0,3	-0,6	0,9
	2.	BM*	F		900	-1,7	-1,6	-0,8	-1,7	-1,5	-1,3	-1,8	-1,1	-1,0
II	3.	P.K.	F	29	1300	-0,9	-0,4	-1,2	-0,4	-0,4	-0,1	0,3	-0,5	0,9
	4.	P.D.	M.		1500	-1,5	-1,3	-1,7	-1,8	-1,1	-1,3	-1,7	-0,5	-1,9
III	5.	R.M.*	M.	27	800	-1,4	-1,4	-1,4	-1,1	-3,2	-0,2	-1,8	-1,7	0,9
	6.	R.M.*	M.		600	-1.6	-1,6	-1,5	-2,3	-3,2	-0,8	-2,4	-1,6	-1,9
IV	7.	R.P.	M.	32	1200	0,3	-0,9	1,7	1,1	-0,8	1,8	0,7	-1,2	2,5
	8.	R.P.	M.		1100	0,5	-1,0	2,4	0,8	1,1	1,5	0,5	-1,8	2,9
V	9.	T.M.	F.	32	1800	0,2	-0,7	1,1	-0,2	0,1	-0,4	-0,6	-0,8	0,1
	10.	T.M.	F.		1800	-0,5	-1,1	0,8	-0,1	-0,3	0,1	-0,3	-1,1	0,8
VI	11.	Ś.P.	F.	32	1850	0,1	0,1	0,0	0,4	0,4	0,1	0,3	-0,01	0,3
	12.	Ś.B.	M.		1200	-1,4	-1,5	-1,2	-2,2	-1,9	-1,4	-2,9	-2,4	-1,9
VII	13.	P.P.	M.	31	1500	-1,5	-1,1	-1,9	-1,9	-1,3	-1,5	-2,0	-1,7	-1,2
	14.	P.P.	M.		1500	-1,0	-15	-0,2	-1,8	-1,5	-1,1	-2,4	-2,2	0
VIII	15.	K.Z.	F.	31	1550	-0,5	-0,8	0,5	0,2	-0,3	0,3	-1,0	-0,9	-0,3
	16.	K.S.	M.		1700	-0,8	-1,4	0,1	-1,5	-1,1	0,5	-2,1	-1,7	-1,3
IX	17.	SM.	F.	30	1100	-2,2	-1,1	-2,2	-1,5	-0,9	-1,4	-2,0	-0,6	-1,6
	18.	S.M.	F.		1300	-2,1	-1,0	-2,2	-1,5	-0,9	-1,4	-2,1	-0,6	-1,6
X	19.	S.P.	F.	32	1800	-0,3	-0,1	-0,2	0,6	-0,4	1,3	-0,3	-0,9	0,4
	20.	S.K.	F.		1850	-0,5	-0,4	-0,4	0,9	-0,2	1,6	-0,4	-0,9	0,4
XI	21.	K.M.	F.	29	980	-1,0	-0,6	-0,9	-0,6	-0,04	-0,9	-1,9	0,7	-1,4
	22.	K.M.	F.		1100	-1,3	-0,6	-1,4	-0,8	-0,1	-1,1	-2,1	-0,5	-1,6
XII	23.	S.I.	F.	32	1900	-0,2	-0,5	0,4	-0,7	-0,4	-0,7	-1,2	-0,6	-0,6
	24.	S.N.	F.		1600	-1,4	-0,5	-1,6	-1,5	-0,8	-1,6	-1,6	-0,9	-1,1
XIII	25.	A.A.		29	1200	0,6	-0,7	2,1	1,5	0,5	1,7	0,3	0,4	0,6
	26.	A.K.	F.		1250	-0,5	-0,6	-0,1	0,5	0,1	0,6	1,7	0,2	1,5
XIV	27.	R.D.	M.	33	1050	-124	-1,6	-1,0	-1,9	-2,0	-1,0	no data		
	28.	R.Ł.	M.		1050	-1,6	-1,6	-1,5	-2,3	-2,6	-1,2			

*values (z) of these children are shown in Figure 1.

showed a tendency to correct the disorders [15]. Catching up growth of singletons by twins is the subject matter of many authors' researches [12, 14, 21]. In our study we have not observed a general distinct tendency to recover the growth deficit in the first 2 years of life. However, it should be stressed that in 19 of the 28 children, birth weight was very low or less than 1500 g. The individual analysis of the results of the present study makes it possible to conclude that there exists a connection between retardation of somatic development and very low birth weight, which is confirmed both by our previous studies [6] and other authors' reports [7, 10, 13, 18].

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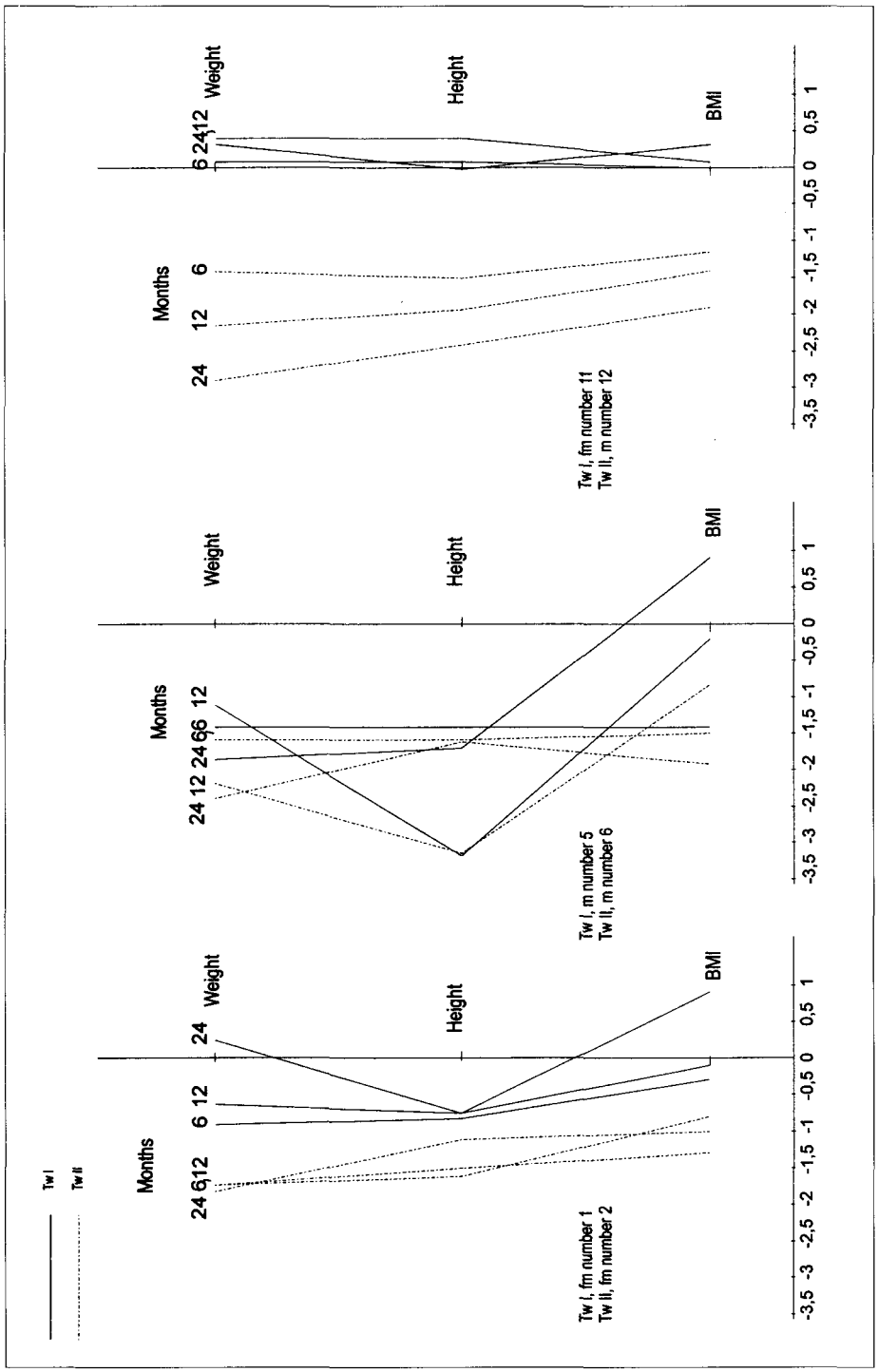

Fig. 1 - Profiles of standard somatic characteristics of children assigned in table 3 by numbers 1, 2, 5, 6, 11, 12 at the age of 6, 12, 24 months.

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Serious illnesses diagnosed in the first days of life, such as asphyxia, RDS, haemorrhages to central nervous system, generalized infections, BPD (Table 1) are regarded as the second very important cause of disturbances in the development of premature infants. Comparing the information from Table 1 and 3, one can easily notice, that the children who had the most severe complications of premature achieve negative values of z, not decreasing even in examination after the 24th month of life. Greater unfavourable deviations from the norm (more negative) in the final examination, as compared with the previous ones, were observed in the children who had also suffered from late complications of premature (no 5, 6, 12, 13, 14). Differentiation of the kind and course of diseases involving the risk of life in premature infants in the first months (days) of life was the cause of the differences in the development of both the twins in the pair. It occurred even in the case of those pairs who had the same birth weight (V and VII). Although in many researches the influence of genetic factors on the development of twins is stressed [11, 19, 20], in our study, however, pathologies of neonatal and early infant periods were of the greatest importance in this respect. All the children remain under further observation concerning their health condition and general development.

CONCLUSIONS

1. Retardation of somatic development of prematurely born twins should be first of all associated with their very low birth weight.
2. Severe complications of premature affect physical development of the children examined by us, especially in the first two years of life.
3. The above mentioned causes disturb the development of prematurely born twins in the same degree as that of prematurely born singletons.

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