Persistence of primitive reflexes and associated motor problems in healthy preschool children

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Abstract

Introduction

Retained primitive reflexes can disturb natural development and involve difficulties in social and educational children's life. They can also impact on psychomotor development. Mature responses in a child's psychomotor progress can only occur if the central nervous system itself has reached maturity. The process consist the transition made from brain stem reflex response to cortically controlled response. This study define the occurrence of primitive reflexes in healthy 4–6 years old children and analyze the impact of survived primitive reflexes on psychomotor development.

Material and methods

The study involved 35 participants aged 4–6 years healthy preschool children. The study tools were: primitive reflexes tests by Sally Goddard for children and Motor Proficiency – Test (MOT 4–6 test) in 18 tasks.

Results

Over a half (65%) preschool children had survived the primitive reflexes on the residual level. Eleven percent of them had no retained primitive reflexes. According to the psychomotor ability, 9% of the children were in the category of "altered development", 29% in "delayed development", 59% in "normal" and 3% in "very good development". The greater the severity of the reflex, the motor efficiency was lower ($p < 0.05$).

Conclusions

It seems reasonable to introduce reflexes integration therapy in children's with low psychomotor skills. Primitive reflexes routinely tested, can contribute to improved early psychomotor development in children with needs, thus preventing many difficulties which children can encounter within their social and school life.

Keywords: primitive reflexes, preschool children, psychomotor development, MOT 4–6
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Introduction

Primitive reflexes are automatic movement patterns that commence during pregnancy and are fully present at birth in term infants. They are natural reactions that start a developmental process which releases a neural circuit for a specific function. Primitive reflexes should integrate and impede reflex reactions to allow development of natural motoric action [1, 2]. Brain injury can cause reoccurring reflex reactions. They can be observed in cerebral palsy patients or people who have suffered a stroke. There are many studies associated with the role of primitive reflexes in development of cerebral palsy [3]. There are few studies about asymmetrical tonic neck reflex (ATNR), symmetrical tonic neck reflex (STNR) or tonic labyrinthine reflex (TLR) in the healthy population, and they are mainly focused on adults [4, 5].

Primitive reflexes play a developmental role, preparing the neonate to move against gravity, gradually leading to voluntary movement by the process of integration during the first months of life. Mature responses in a child's psychomotor progress can only occur if the central nervous system itself has reached maturity. The process consists of the transition from a brain stem reflex response to a cortically controlled response [6]. If the process has not progressed properly, the child may demonstrate poor motor ability, which can manifest itself in difficulties in running, cycling and balance, and the child may be clumsy. There may also be problems with throwing and catching, and the child might avoid games involving physical movement. Psychomotor disturbances, also known as minimal brain disorders, can modify and hinder a child's spontaneous development process. The first signs can be seen in early childhood, but many of them are seen later, i.e. learning and behaviour difficulties during the pre-school years. Reflex retention and academic or behaviour difficulties experienced by children when they reach school age may be linked [7–10].

The asymmetrical tonic neck reflex (ATNR), symmetrical tonic neck reflex (STNR) and tonic labyrinthine reflex (TLR), along with the plantar reflex, palmar reflex, rooting reflex and spinal Galant reflex, if retained, play a great role in decreasing the brain's ability and efficiency in processing sensory information. The ATNR emerges 18 weeks in utero and diminishes completely 3–9 months after birth. The effect of the retained ATNR can be poor eye tracking and difficulty crossing the visual midline. The occurrence of the reflex can cause difficulties in learning to read, telling the time and left-right confusion as well. In the posture we can observe spinal deformities caused by the ATNR, which is not only a health problem of the person but also represents a high cost to society [3, 11].

The STNR emerges 6–9 months after birth and integrates into the central nervous system 9–11 months after birth. The retained STNR can be characterized by poor posture, poor eye-hand co-ordination and focusing difficulties. Children with a retained STNR may have problems with sitting still at a desk or learning to swim, and usually they do not feel comfortable with ball games.

The TLR is a reflex that emerges at birth and disappears completely in 2–4 months after birth. It results in poor balance, disorientation and problems with re-establishing the emotional and physical balance. The TLR can entail binocular vision leading to a poor sense of timing and frequent careless mistakes [8, 12].

Psychomotor development encompasses changing abilities from the beginning of life, from fetal and neonatal periods through infancy and childhood to adolescence. Estimating the degree of psychomotor development can lead to finding a way of potential help for better growing up. It can also indicate that a child has great potential and requires a specific, individual program to reach his/her full potential.

The aim of the study was to define the occurrence of primitive reflexes in healthy 4–6-year-old children and analyse the impact of retained primitive reflexes on psychomotor development.

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Material and methods

Participants

The study was approved by the Medical University Ethical Committee. All the parents of the subjects were kept informed of the purpose and process of examination and subsequently gave their written consent prior to the study.

The data were collected from 35 healthy children aged 4 to 6 from a Lower Silesia preschool (Poland). The condition for exclusion was a statement of special educational needs. The age, height, weight, sex and body mass index (BMI) from the examined children are shown in Table I. Perinatal parameters such as Apgar score, birth weight, week of birth and kind of birth of each participant are reported in Table II.

Table I

Subjects' characteristics

Parameter	**Value**		
Age [years]	4	5	6
Number of subjects	15	15	5
Boys	5	9	2
Girls	10	6	3
Height, mean ± SD [m]	1.05 ±0.7	1.08 ±0.6	1.09 ±0.5
Weight, mean ± SD [kg]	16.3 ±1.63	17.3 ±2.87	20.3 ±2.21
BMI, mean ± SD [kg/m^2]	14.9 ±2.2	14.8 ±2.5	16.9 ±1.4

Table II

Subjects' characteristics

Parameter	**Value**		
Age [years]	4	5	6
Apgar, mean ± SD [points]	10 ±1	10 ±0	10 ±0
Birth weight, mean ± SD [g]	3522 ±465	3285 ±372	3310 ±371
Week of birth, mean ± SD	40 ±1.6	39 ±1.7	39 ±0.7
Natural childbirth/Caesarean section	80%/20%	73%/27%	80%/20%

Each child was assessed individually by Primitive Reflex Tests (ATNR, STNR, TLR) and by a Motor Proficiency Test for children between 4 and 6 years (MOT 4–6).

Measurement of primitive reflexes

The asymmetrical tonic neck reflex test was carried out in a quadruped position of the child with shoulders and hips flexed to 90°, elbows extended, hands flat, fingers extended and head in a neutral position. The examiner gently rotated the head passively to the right laterally and held for 5 s. The head was slowly rotated back to the midline, and then the procedure was repeated for the other side. This sequence was repeated four times.

The ATNR was measured for the left (ATNR L) and right (ATNR R) side.

The classification was made using a five-point rating scale suggested by Goddard [12–14]:

- 0. No movement of the opposite arm, shoulder or hip (no reflex occurs);
- 1. Slight deflection of the opposite arm or movement of shoulder or hip (reflex present in 25%);
- 2. Clear deflection of the opposite arm with or without involving the shoulder or hip (reflex present in 50%);
- 3. Significant deflection of the opposite arm with or without involving the shoulder or hip (reflex present in 50%);
- 4. Descent of the opposite arm as a result of rotation of the head. Uncontrolled hip movement can also occur (reflex survived in 100% on the facial side).

The symmetrical tonic neck reflex test was carried out in a quadruped position with the head passively bent and extended. The STNR was measured for flexion (STNR FLX) and extension (STNR EXT).

The five-point rating scale for STNR was as follows:

- 0. No reaction;
- 1. Shaking of one or two arms or minimal movement of the trunk;
- 2. Elbow movement and/or hips or bending of the spine;
- 3. Deflection of the arms when lowering the head and spontaneous straightening of the hands when lifting the head;
- 4. Bending arms or going back to sitting on the heels.

The tonic labyrinthine reflex was tested in standing position, feet pushed together, hands along the trunk. The child was asked to tilt the head back “as if looking at the ceiling” and close the eyes. The child was supported by the examiner. After 10 s the child was asked to bend the head slowly “as if looking at the toes” and stand in the position for 10 s. The movement was repeated four times. The TLR was measured for flexion (TLR FLX) and extension (TLR EXT).

Points were assigned as follows:

- 0. No reaction;
- 1. Minimal balance disturbances whilst changing head position;
- 2. Balance disturbances during the test and/or muscle tone change;
- 3. The child almost loses balance and/or shows disorientation after the task;
- 4. Loss of balance and/or significant muscle tone change whilst attempting balance stabilisation. Dizziness and nausea may occur.

The higher the children scored on the primitive reflex test, the lower the integration they represented.

Measurement of psychomotor abilities

Children were also examined by the Motor Proficiency Test for children between 4 and 6 years (MOT 4–6) [14]. The test includes 18 tasks. They are divided into four areas: 1. Stability, 2. Locomotion, 3. Object control 4. Fine movement skills. Tasks to perform by children are shown in Table III.

Table III

MOT 4–6 test – description of items

1. Forward jump in a hoop*	7. Carrying balls from box to box	13. Catching a tennis ring
2. Forward balance	8. Reverse balance	14. Jumping Jacks
3. Placing dots on a sheet	9. Throwing at a target disk	15. Jumping over a cord
4. Grasping a tissue with toes	10. Collecting matches	16. Rolling around the long axis of the body
5. Sideward jump	11. Passing through a hoop	17. Standing up holding a ball on the head
6. Catching a stick	12. Jumping in a hoop on 1 foot, standing on 1 leg	18. Jump and turn in a hoop

*The first item not rated because it was use to accustom the child to the test situation.

The tasks were classified on a three-point rating scale, where 0 means skill not mastered and 2 means skill mastered. All task scores were added up to generate a score out of a possible total of 34. The higher the movement skill level, the higher the children scored in the MOT 4–6 assessment protocol.

Statistical analysis

The statistical analysis was carried out using Statistica version 10.0. Descriptive statistics were computed for all variables. The results were expressed as means ± standard deviations. Differences between girls and boys and their body parameters were tested by Student's *t*-test. The statistical evaluation was performed using Pearson's correlation. All parameters were considered statistically significantly different if $p < 0.05$.

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Results

On the basis of the studies 11% of preschool children have no retained primitive reflexes. At least one of the retained reflexes from the studied was detected in 89% of examined children, but 65% of the pre-schoolers have barely a residual degree of the reflex.

The most frequently occurring reflex (66% of children) is the ATNR L, and the least frequently occurring is the STNR FLX (34% of children), where STNR FLX does not show presence of the maximum intensity in any of the children. The results in percentages are shown in Figures 1 and and22.

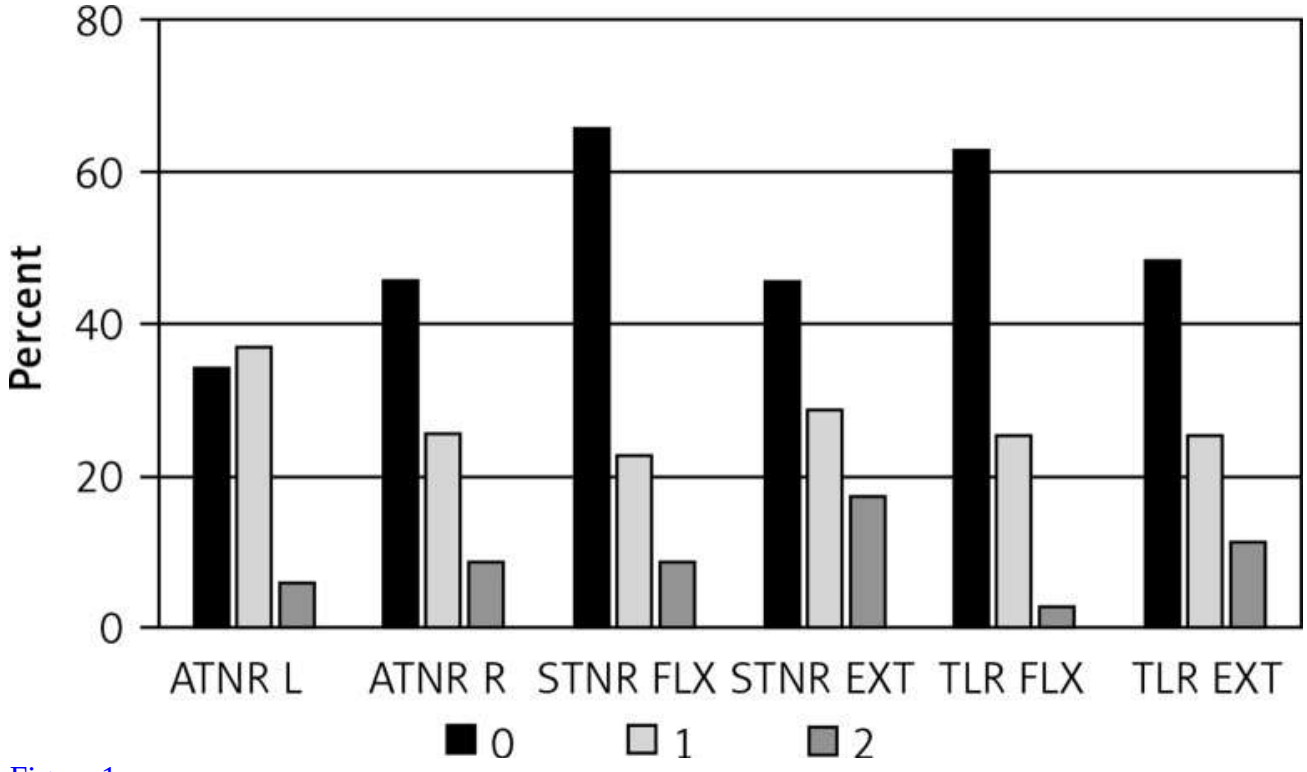

Figure 1

0–2 points for primitive reflexes in group

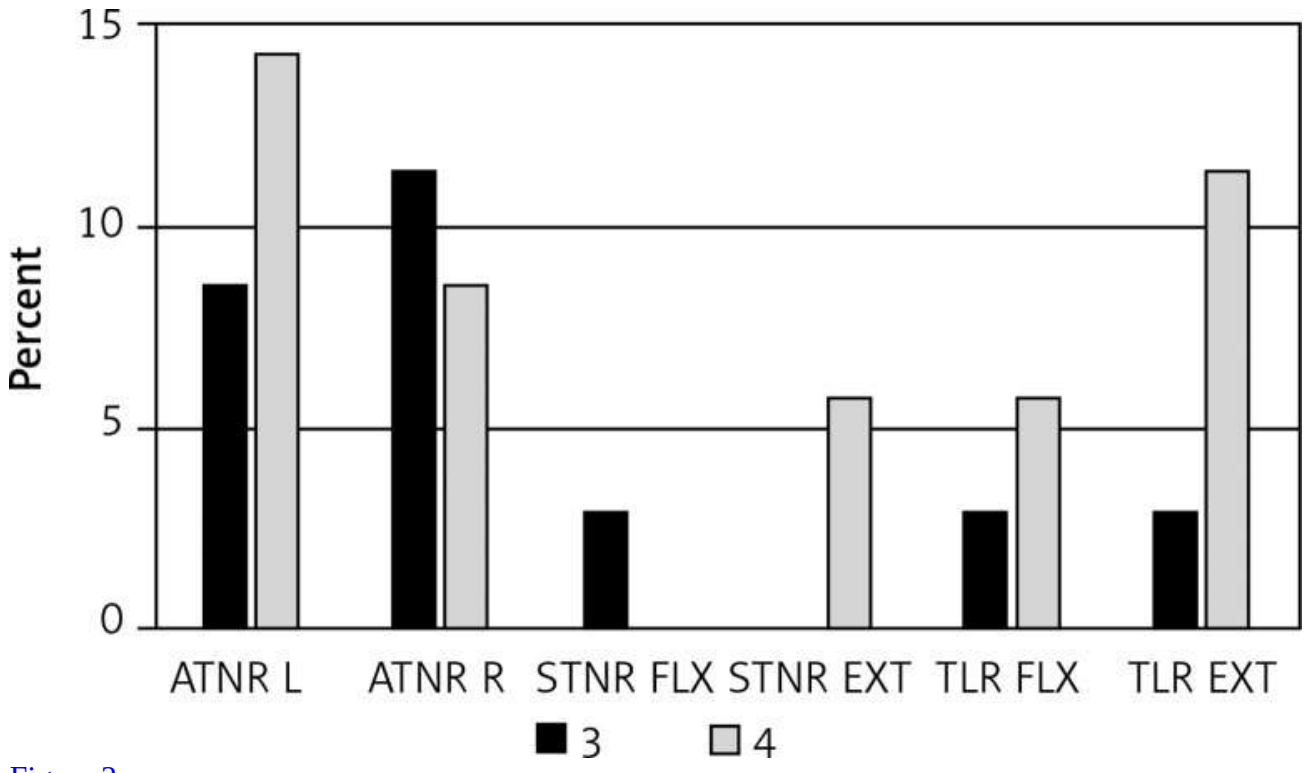

Figure 2

3–4 points for primitive reflexes in group

The figures indicate that ATNR L performs at the top of the point scale, appearing in 14% of children. Successively, the highest numbers of participants exhibited TLR EXT (12%) and ATNR R (9%). Reflexes STNR EXT and TLR FLX are the strongest in 6% of those studied.

The pre-schoolers' best results in the MOT 4–6 test are shown in Figure 3.

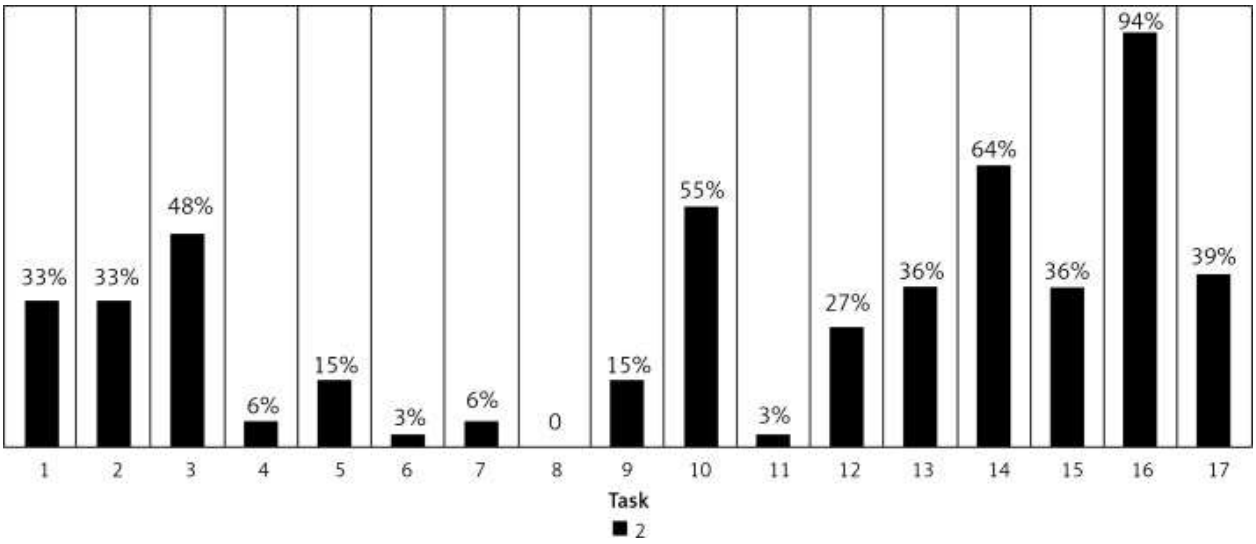

Figure 3

Maximum points in MOT 4–6 test

The easiest task for children was 16, which was completed by 94% of the surveyed children. Task 6 was completed by 6% of children; it proved to be the most difficult. Task 8 was also difficult, and 21% of children received 1 point for that task; moreover, none of the children received a maximum point value for that task.

The data were compared between girls and boys. 63% of girls showed very good or normal development. In the group of boys there was no one with very good development, and 60% of boys were in the normal development group. Similarly, in the level of retained primitive reflexes, girls showed a higher degree of integration. Sixty-nine percent of girls achieved good or complete integration (level none and low), whereas 63% of boys achieved a similar level of integration. Although examined girls achieved a better level of psychomotor development and reflex integration than boys, there was no significant difference between them (Figures 4 and and55).

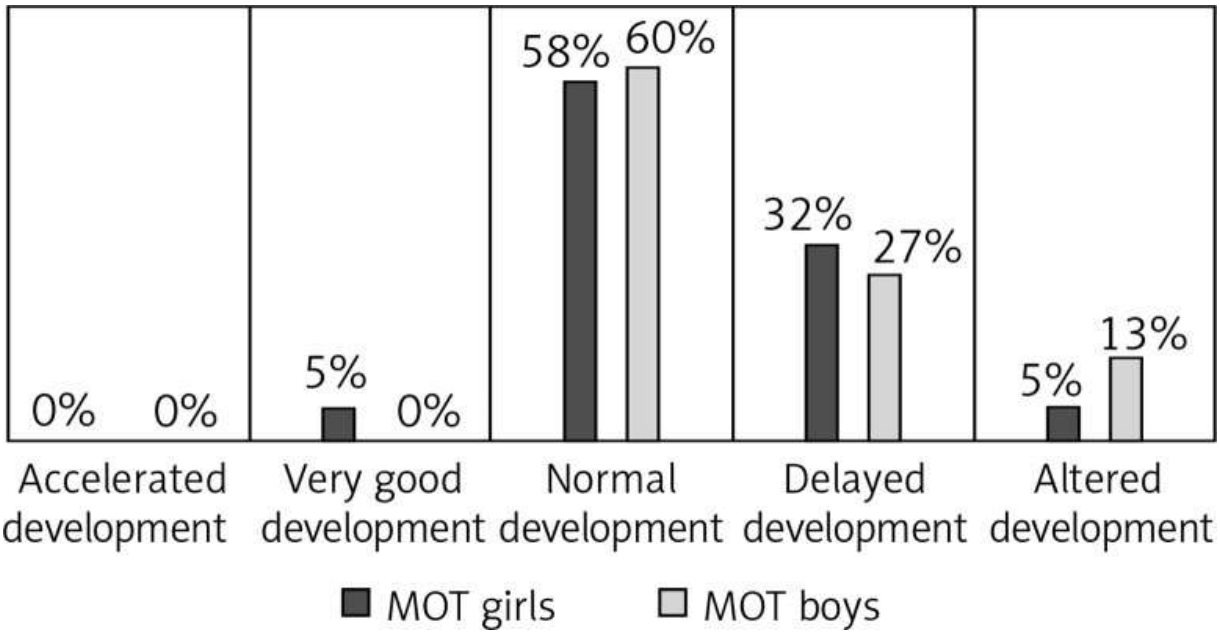

Figure 4

Psychomotor development level of girls and boys

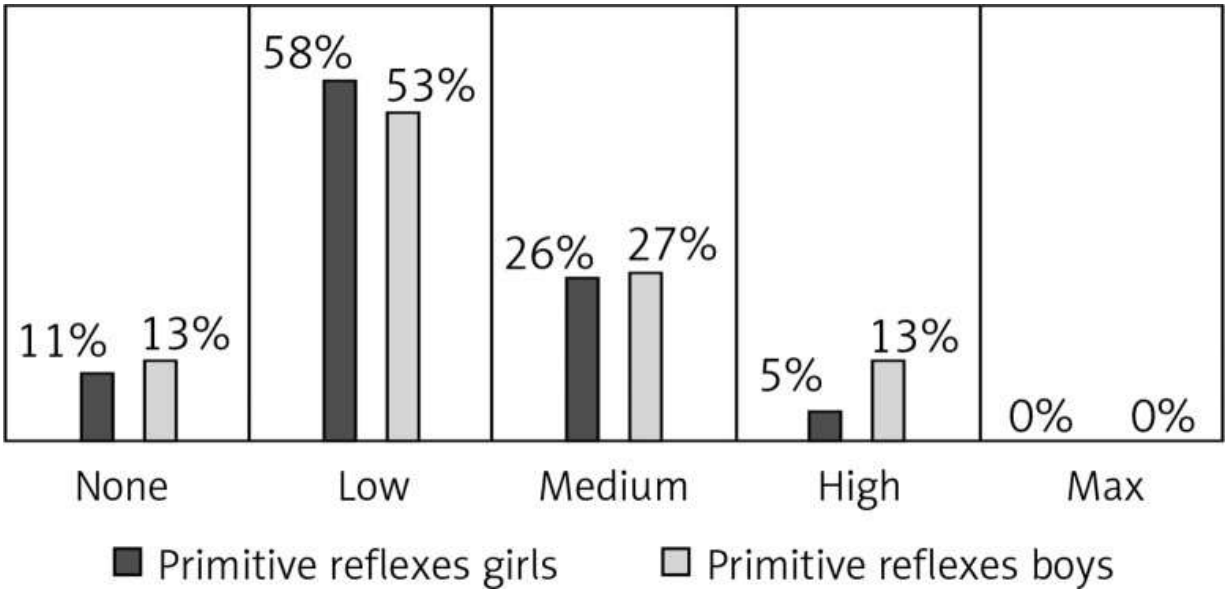

Figure 5

Retained primitive reflexes level of girls and boys

Higher motor efficiency is due to lower severity of the reflex.

Statistical analysis shows an inverse correlation between the number of points in the test of reflexes and psychomotor efficiency at $p < 0.05$. Children sufficiently motorized demonstrate a fuller integration of reflexes. MOT 4–6 tasks in general are significantly correlated with the primitive reflexes total score ($p < 0.05$; $R = –0.34$).

Correlations between week of birth, prevalence of reflexes and motoric skills were also studied. Children born before term show a higher level of non-integrated reflexes compared to children born at term. They also have a lower level of motoric skills.

Children were measured for weight and height, and the body mass index (BMI) was calculated. The results are: 40% of preschool children are in the normal range, 34% are underweight, 11% are overweight and 14% obese. There is no correlation between birth weight, APGAR points, current BMI and integration level of primitive reflexes or psychomotor abilities.

Children rehabilitated in infancy by the Vojta method stand out against the group with decreased motor performance and a higher rate of occurrence of reflexes. Since there were only 2 people in the group, further groups should be examined to determine the significance of the observed phenomenon.

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Discussion

Studies on primitive reflexes have been widely conducted on children with cerebral palsy [2]. The level of non-integrated reflexes in the group is high and inadequate in comparison with healthy children. There are few studies about the primitive reflexes in healthy children; therefore we have started to conduct them. The examined group in the present study is different from those in the available literature. The test group consisted of healthy children, with no reported special needs. However, the majority of children showed persistent reflexes, and even marginally persistent reflexes, as the study found, affect the psychomotor development of children.

In our research over 60% of children demonstrated at least one primitive reflex at level 1–2 and 25% of them at levels 3 and 4. It means that most of the examined pre-school children have non-integrated reflexes. This leads us to the conclusion that large scale testing should be considered, helping to conduct early therapy before the disorders are revealed by the child's inadequate behaviour at school age. Grzywniak [15] conducted research comparing the level of primitive reflexes in two groups of healthy school age children, one from an orphanage and the second one comprising children during therapy having learning difficulties. Grzywniak noted that 55% of healthy children had retained the primitive reflexes at levels 1 and 2. The research did not show any children with reflexes at level 3 or 4. The results can be explained by higher age of examined children and cannot be directly compared. The difference noted above can encourage further research on the dynamics of primitive reflexes in healthy children.

Screening studies can help preschool children with those difficulties by repeating mimic movement patterns from the first year of life. The therapy could involve movements based on early brain development sequences. As a result, children's brains can have a "second chance" to pass through the stages which have been missing [16–19].

Bruijn *et al.* [5] studied whether the ATNR or STNR can still appear in healthy adults. Ten subjects were measured, and primitive reflexes were found to exist in adults.

Studies on motor abilities in children measured by MOT 4–6 were conducted by Cools *et al.* [20]. The children's MOT 4–6 mean performance in the research was 19 (SD = 4.8) In our

study mean performance was 15 (SD = 4.7). Distribution of children's performance was as follows: over 4% were classified in the category "altered development", nearly 19% in "delayed development", 75% in "normal development", about 1% in "very good development" and none in "accelerated development". Our study showed almost the same tendency. Nine percent of children were in the category "altered development", 29% in "delayed development", 59% in "normal" and 3% in "very good development". It shows that there were more children under the normal range in our study and slightly more above the normal range than in Cools' research. Nowak *et al.* has nearly the same results. They show the need for stimulating 21% of 4-year-old children [21, 22].

Our study shows that without training of primitive reflexes integration, it may be impossible to correct motoric functions and help clumsy children to reach the degree of psychomotor level as their compeers. In order to prevent psychomotor delays of elder children, it is necessary to conduct an examination of the degree of reflexes integration in pre-schoolers and, as a result, if necessary, apply reflex therapy. The tests are a handy tool for qualified physiotherapists or physicians, and thus might be applied during standard periodical medical evaluation of each child. If the staff know the impact of the primitive reflexes on development of healthy children, not only would they have a faster reaction to their persistence, but they could also prevent subsequent disorders.

For the examination, tests carried out in the study can be used alternatively, with a high probability that the MOT 4–6 test results will indicate not only the level of psychomotor efficiency but also the reflexes integration degree. The use of reflex tests will allow determination of the degree of psychomotor skills of a healthy child. Additionally, if performed at an early age, they will allow one to adjust the treatment according to the true source of disorders, not just the results.

We observed a significant correlation between the psychomotor test MOT 4–6 and primitive reflexes test. The study shows the necessity to evaluate children thoroughly in order to identify the causes of children's motoric problems in the brain immaturity rather than focusing on symptoms. The failure to perform integration of the reflexes may cause difficulties for the children to achieve proper motor skills for their age. Treatment should at first concern the root of the problem, not only the symptoms; thus training should concentrate on reflexes, and after that abilities such as balance, hand function and postural problems, etc., can be taken into consideration

In conclusion, even the primitive reflexes present in traces are significant for psychomotor skills. It seems reasonable to introduce reflexes integration therapy in children with low psychomotor skills. Primitive reflexes routinely tested can contribute to improved early psychomotor development in children with needs, thus preventing many difficulties which children might encounter within their social and school life.

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Conflict of interest

The authors declare no conflict of interest.

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References

1. De Jager M. Sequence of primitive reflexes in development. Johannesburg: Mind Moves Institute; 2009. [Google Scholar]
2. Zafeiriou DI. Primitive reflexes and postural reactions in the neurodevelopmental examination. Pediatr Neurol. 2004;131:1–8. [PubMed] [Google Scholar]
3. Kawakami M, Liu M, Otsuka T, et al. Asymmetrical skull deformity in children with Cerebral Palsy: frequency and correlation with postural abnormalities and deformities. J Rehabil Med. 2013;45:149–53. [PubMed] [Google Scholar]
4. Zemke R. Application of an ATNR Rating Scale to normal preschool children. Am J Occup Ther. 1985;39:178–80. [PubMed] [Google Scholar]
5. Bruijn SM, Massaad F, MacLellan MJ, et al. Are effects of the symmetric and asymmetric tonic reflexes still visible in healthy adults? Neurosci Lett. 2013;556:89–92. [PubMed] [Google Scholar]
6. Goddard S. The role of primitive survival reflexes in the development of the visual system. J Behav Opt. 1995;6:31–3. [Google Scholar]
7. Taylor M, Houghton S, Chapman E. Primitive reflexes and attention-deficit/hyperactivity disorder: developmental origins of classroom dysfunction. Int J Spec Educ. 2004;19:23–36. [Google Scholar]
8. Kiebzak W, Kowalski IM, Domagalska M, et al. Assessment of visual perception in adolescents with a history of central coordination disorder in early life – 15-year follow up study. Arch Med Sci. 2012;8:879–85. [PMC free article] [PubMed] [Google Scholar]
9. Nemeth D, Hallgató E, Janacsek K, Sándor T, Londe Z. Perceptual and motor factors of implicit skill learning. Neuroreport. 2009;20:1654–8. [PubMed] [Google Scholar]
10. Sadowska L. Vaclav Vojta's neurokinesiological concept for the diagnosis and therapy of children with disturbances of motor development. Ortop Traumatol Rehabil. 2001;3:519–26. [PubMed] [Google Scholar]
11. Kowalski IM, Dwornik M, Lewandowski R, et al. Early detection of idiopathic scoliosis – analysis of three screening models. Arch Med Sci. 2015;11:1058–64. [PMC free article] [PubMed] [Google Scholar]
12. Goddard-Blythe S. The well balanced child. Warsaw: Świat Książki,; 2006. [Google Scholar]
13. Goddard-Blythe S, Hyland D. Screening for neurological dysfunction in the specific learning difficulty child. Br J Occu Ther. 1996;61:459–464. [Google Scholar]
14. Goddard-Blythe S. Course Book. 2011. [Google Scholar]
15. Zimmer R, Volkamer M. Motor skills test for 4-6 years old children. Weinheim: Beltz; 1987. [Google Scholar]
16. Grzywniak C. The effect of the form of persistent trace reflexes to rise the difficulties of school. Szkoła Specjalna. 2010;2:98–112. [Google Scholar]
17. Bilbilaj S. Directions for LD treatment with reflex therapy. Acad J Inter Stud. 2013;2:77–80. [Google Scholar]
18. McPhilips M, Sheehy N. Prevalence of persistent primary reflexes and motor problems in children with reading difficulties. Dyslexia. 2004;10:316–38. [PubMed] [Google Scholar]
19. McPhilips M, Jordan-Black JN. Primary reflex persistence in children with reading difficulties (dyslexia): a cross-sectional study. Neuropsych. 2007;45:748–54. [PubMed] [Google Scholar]

20. Cools W, De Martelaer K, Vandaele B. Assessment of movement skill performance in preschool children: convergent validity between MOT 4-6 and M-ABC. J Sports Sci Med. 2010;9:597–604. [PMC free article] [PubMed] [Google Scholar]
21. Nowak A, Romanowska-Tołłoczko A, Bartusiak I. Abnormalities in motor development of children as early signs of psychomotor disturbances. Probl Phisic Train Sp. 2009;9:192–5. [Google Scholar]
22. Nowak A, Bartusiak I, Romanowska-Tolloczko A. Psychomotor diagnosis of four-year-old children as a realization of an early intervention program in the nursery schools. Sport Ped. 2009;9:188–91.