The statistical significance of hippotherapy for children with psychomotor disabilities

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Abstract: Topic – The recovery and social integration of children with psycho-motility disabilities is an important goal for the integration of Romania into the European Union. Studies conducted in this area reveal that people, who practice therapy using the horse due to a recommendation by professionals, benefit from a much faster recovery and at a much higher level.

Purpose of study – Identification of results for adaptive areas due to participation in a therapy program with the help of the horse for children with psycho-motility disabilities.

Research Methods – A number of 27 children with psycho-motility disabilities I take part in the study.They participate in 20 sessions of treatment with the help of the horse over a period of 2 months.

All participating children are aged 2 to 14. The diagnostics of children are: autism, ADHD, cerebral paralysis.

All participants will be assessed at the beginning and at the end of the program.

For assessment, the ABAS II assessment form shall be used. It is a multifunctional tool used to assess the overall skill level of everyday subjects necessary for the efficient adaptation in life and research.

Results – The results of the assessments are composite scores for skills areas in the General Adaptive, Conceptual, Social and Practical field. These scores are rated as average for each subject. The value of the average will determine how horse therapy using adaptive skills influences the uptake in the scored areas.

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Conclusion: This research aims at demonstrating that therapy with the help of horses – hippotherapy is a method that produces positive effects on the acquisition of skills necessary to children with psycho-motility disabilities.

Keywords: hippotherapy, autism, ADHD, cerebral paralysis, therapy.

JEL Classification: H51, H 52, H 53, H 75

The development of alternative therapies is a viable alternative to allopathic treatment in the case of psychical and motor disabilities. Lately, the large number of children with psychical and motor impairment has determined the appearance of new therapies and recovery methods which help the children in the process of developing new adaptive skills and of their integration, as much as possible, in the social, family and school environment. The new recovery methods are an important way by which these children can acquire skills which may help them in the process of developing functionality in their living environment, as medicines-based treatments are often insufficient.

The alternative therapies include **equine-assisted therapy (EAT). This article presents the methodology used and the results obtained by applying EAT to a group of children with mental disorders. It also analyzes the statistical significance of the results by comparison to a control group.**

Hippotherapy is part of the larger category of equine-assisted therapies[1]. The first information on the beginnings of this therapy dates back to 1930.

The effects of EAT were observed and considered by scientists during World War I, when it has been noticed that mentally or physically impaired people faster recovered and with better results after being on horseback for long periods of time.

Recovery program for children with neuromotor impairment. It was used for the first time in the United States in 1960 and its popularity had been growing as people found out about the efficacy of this therapy.

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[1] *Under the general concept of equine-assisted therapy, support methods and techniques for the disabled are structured, with the most well-known and common listed below:*
- *Hippotherapy – form of therapy of the psyche, ocupational or language therapy using the horse movements as integral part of an intervention program.*
- *Therapeutical horse riding (pedagogical) is the term comprising the entire series of equine activities in which the disabled take part.*
- *Sports horse riding is intended both for healty and motor disabled people, with an emphasis on the competitive aspect of the activities.*

After the 60s, the equine-assisted therapy has been recognized as alternative therapy method and was included in the German, Swiss, Austrian, English and Dutch medical system, and later on in the medical systems of other countries.

It is important to mention that the American Hippotherapy Association was established in 1993, promoting both hippotherapy and the other forms of therapy using horses for the recovery of disabilities.

The Federation of Horses in Education and Therapy International, A.I.S.B.L., which was initially called The International Horse Federation for the Disabled, was set up in 1980.

The importance of equine-assisted therapies in early intervention has already been proven through the recovery of a great number of children afflicted with growth disorders. What is very interesting to the specialists is the way the benefits obtained as a result of these therapies can be mentained as long as possible. In the case of children with development disorders, the therapies must take place for the entire duration of their growth, in order to produce effects in their adulthood, meaning that the children afflicted with the disorder can become partially functional.

In the case of the mentally impaired or the disabled, establishing an emotional balance, an affective, relational functionality as normal as possible is an objective of utmost importance in the treatment. EAT comes to assist physicians, as most often it is not possible to obtain a result without psychotherapy.

The diagnosis of children who can benefit from EAT are: **autism, ADHD, brain paralyses, etc.**

Autism – is a neuro-psychical disorder characterized by learning difficulty, speech problems and difficulty in establishing relationships, communication and social interaction difficulty. Autism is considered a neurodevelopmental disorder, characterized by the lack of emotional reactions, severe mental retardation, communication and social interaction capacity impairment, rigid and repetitive behavior, strange language.

Brain paralyses – disorders characterized by persistent, yet unprogressive movement and posture troubles, due to diverse brain damage which affected in the pre-, peri- or post-natal – the first 3-5 years – an immature brain.

The brain paralysis is a static, non-evolutionary disorder. Children afflicted with spastic paralysis tend to perpetuate their deformations, which can remain in an unphysiological position for a long period of time. Some transitory spasms are

corrected during puberty but the depressive and frustration states may depress functionality.

Brain damage which may lead to tetraparesis include: *hypoxic* cerebrovascular accident (may be determined by a blockage of the main artery, which prevents certain areas of the brain from being oxygenated), hemorrhagic cerebrovascular accident (produced by blockage of a blood vessel) and **traumatic brain injury.**

Traumatic brain injuries are severe skull trauma which usually the result of accidents such as: falls from a higher level, falls from the same level or the result of car crashes.

Another cause of traumatic brain injuries may be the obstetrical maneuvers (use of forceps) or the forced passage through the birth channel.

Brain paralyses are caused by uterine hemorrhages during pregnancy, maternal metabolic disorders and unexpected medicine ingestion by the mother. The newborn's reduced weight increases the risk of perinatal anorexia and brain hemorrhage.

The associated disorders depend on the production mechanism, the extent of the lesions and they may include: mental retardation, learning disorders, behavior disorders, epilepsy, sensorial disorders – visual, hearing, etc.

The attention deficit and hyperactivity disorder (ADHD)

The internationally-used term ADHD refers to a disorder characterized mainly by a profound attention disorder. Also known by specialists as the hyperkinetic syndrome, this neurobiological disorder is present both in children and adults, with a higher incidence in male individuals (9% in boys, compared to 3% in girls).

All these disorders are characterized by development retardation and the children's incapacity to adapt to the family, social and school environment. This is the reason why the early intervention for the recovery of developmental deficits is the most important approach in order to stimulate development or the recovery of developmental retardation.

The research was conducted between September 2014 and December 2014 in the Museum Complex of Natural Sciences Constanta, where equine-assisted therapy activity is deployed under the coordination of Ph.d student Anca Bîlbă, based on a protocol concluded between the "Hipoterapia" Association for Supporting Therapies and the Museum Complex of Natural Sciences Constanta.

27 children with psychomotor disabilities have been selected for the research. The study group comprised 14 children, who participated in 20 therapy sessions for a period of 2 months. The control group was made up of the other 13 children.

The participants were aged 2 to 14 years.

All the participants were assessed at the beginning and at the end of the program.

The ABAS[1] II assessment form was used for assessment. It is a multifunctional tool used for the global assessment of subjects in terms of daily adaptive skills necessary for the efficient functioning in the living and research environment.

The results obtained following the assessment are composite scores for four adaptive domains: General Adaptive, Conceptual, Social and Practical. Based on the scores, the mean values for each assessed subject was calculated. The mean value indicates the way the equine-assisted therapy influences adaptive skills assimilation in the four skill domains listed above.

Given the average age of the children under treatment and the fact that all participants have severe diagnosis which do not allow self-assessment, the parent form[2] for children aged 0 to 5 and the parent form for children aged 5 to 21 were selected.

The researcher used this approach in order to ensure relevant results for the selected skill areas. The record forms were filled out by parents, after the initial fill-out training[3].

The form for groups aged 0 to 5 comprises the following skill areas: communication, community use, functional academics, home living, health and safety, leisure, self-care, self-direction, social and motor. In total, there are 10 development areas.

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[1] *ABAS II – Manual – Adaptive Behavior Assessment) / Patti L. Harrison, Thomas Oakland; translated and adapted by Dragoș Iliescu and Daniela Vercellino. – Second edition – Bucharest, O.S.Romania, 2012*

[2] *Assessment forms – two of the five test forms were selected, i.e. the form for children aged 0 to 5 years, which refers to 9 skill areas and the form for children aged 5 to 21 years which refers to 10 skill areas, of which only 9 were selected, since the 10th area deals with working skills, which is not the case for the studied group, as none of the children has atteined his majority.*

[3] *Each form comprises questions in the developmental areas specific to the selected age group.*

The form for children aged 5 to 21 comprises the following development areas: *communication, community use, functional academics, home living, health and safety, leisure, self-care, self-direction, social and work.*

For each subject taking part in the hippotherapy program, the sessions were structured depending on the diagnosis, the child's age and state at the beginning of the therapy. Following the initial assessment, the adaptive areas with the highest deficit as well as the main development areas depending on the development age were established.

Therefore, for children with language acquisition deficit, therapy programs stimulating speech, including exercises focusing on training the inner muscles, the diaphragm and posture correction were structured.

For children with deficiencies in forming interpersonal relationships and establishing contact, the exercises were generally selected aiming at focusing children's attention through games including several partners, inducing proprioceptive impulses.

For the children with motor deficiencies, the main objective was to correct their position, maintain the balance, coordination, alignment.

Depending on the set objective, the adequate horses for the session, as well as the adequate equipment for the child's age and diagnosis were selected.

EAT was applied to the study group and the indicators for the four skill domains (General Adaptive, Conceptual, Social and Practical) were measured; subsequently, the mean of the four indicators was calculated.

For the control group, the four indicators were measured and their mean was calculated.

Measured results for the study group

After the twenty sessions of therapy with the study group, according to the analysis of the results obtained following the initial and final assessments, the results in Appendix 1 have been obtained.

From a group of 14 disabled children, aged 2 to 14, following twenty equine-assisted therapy sessions, ten of them have recorded an increase in the composite indicator (the mean score of the four areas is positive). Two subjects have recorded a regression for the period when the sessions took place and two of them recorded stagnation.

The mean scores calculated for the four indicators considered, General Adaptive, Conceptual, Social and Practical are the ones in Table 1. The mean values represent the standardized score which measures the patients/subjects' intelligence.

Table 1. Mean standardized scores for the analyzed subjects and the resulting mean difference

Patient/ subject	Mean score before therapy (I)	Mean score after therapy (F)	Difference (F-I)
S1	60.75	62.5	1.75
S2	76	83.25	7.25
S3	72.75	84.25	11.5
S4	49.25	49.25	0
S5	47.75	93	45.25
S6	63.5	74	10.5
S7	49	50.5	1.5
S8	49,5	49,5	0
S9	81	87,25	6,25
S10	47,75	49	1,25
S11	79.5	74.5	-5
S12	65.25	79	13.75
S13	82	79.5	-2.5
S14	76	89.5	13.5

Source: calculation based on the data in Appendix 1.

Results measured for the control group

The control group was made up of 13 children aged 2 to 14, with diagnosis similar to those of the children in the study group, i.e. autism, ADHD, brain paralyses. No therapy/treatment was applied, only the questionnaires at the beginning and at the end of the program were applied to this control group.

The results obtained at the beginning and at the end are shown in the table below. One can easily see that nine subjects recorded regress (the mean difference is a negative value), two of them are stationary and three recorded progress (the mean difference is a positive value).

Tabel 2. Mean standardized scores for the subjects to whom NO therapy was applied and the resulting mean difference

| Patient/ subject	Mean score before therapy (I)	Mean score after therapy (F)	Difference (F-I)
S1	88	84.75	-3.25
S2	48.5	48.5	0
S3	58.25	52.5	-5.75
S4	82.75	72	-10.75
S5	83.75	82	-1.75
S6	50.5	50.5	0
S7	54.75	58.5	3.75
S8	60.75	76.25	15.5
S9	77.5	78.5	1
S10	56.75	53.5	-3.25
S11	44.25	41	-3.25
S12	86.5	66.5	-20
S13	60.25	52.25	-8

Source: calculation based on the data in Appendix 2.

Statistical interpretation of the results

The scaled (standardized) score which measures human intelligence has a normal statistical distribution (Gauss's curve) (Figure 1). Seven development levels corresponding to the scaled scores are indicated on the horizontal axis:

1. very low – under 70 (2,2% of cases);

2. low (71 – 79) (6,7% of cases);

3. below average (80 – 89) (16,1% of cases);

4. average (90 – 109) (50% of cases);

5. above average (110 -119) (16,1% of cases);

6. high (120 – 129) (6,7% of cases);

7. very high – over 130, (2,2% of cases).

Figure 1. Delimitation of intelligence levels based on the values of the composite indicator, within a normal curve
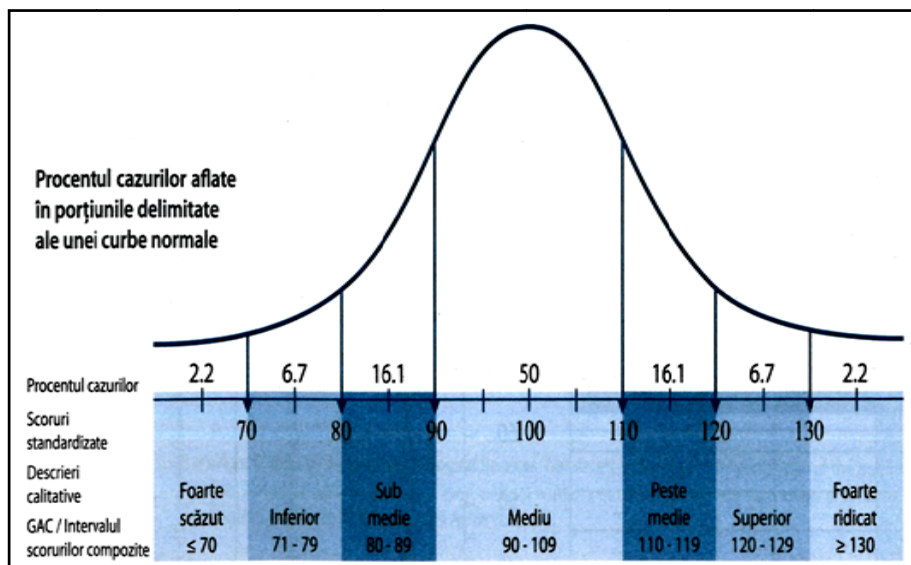
The analysis in Table 1 shows that the score reported for the 14 subjects falls in the 47.75 – 82 range in the pre-therapy stage and in the 49-93 range in the post-therapy period. All the subjects recorded scores under the average values (90-109)

Following the therapy, the group's mean score increased from 64.29 to 71.79 (increase of +7.50 units or 11.67% compared to the initial value) and the variance increased by 1.6% (Table 3).

Table 3. Statistical indicators of the results obtained for the study group

Statistical indicators	Initial	Final	Difference
Maximum value	47.75	49	1.25
Minimum value	82	93	11.00
Group AVERAGE	64.29	71.79	7.50
SD	13.62	16.35	2.74
Variation rate	21.18%	22.78%	1.60%

Source: calculation based on the data in Table 1.

Statistics for the control group

The analysis of Table 2 shows that the score recorded by the 13 subjects falls in the 44.25-88 range in the initial stage and in the 41-84.75 range in the final stage. All the subjects recorded low scores, under 90.

At the end of study, the group mean decreased from 65.58 to 62.83 (decrease of -2.75 units or decrease of 4.2% compared to the initial value) and the variance also decreased (Table 4).

Table 2. Statistical indicators of the results obtained for the control group

Group AVERAGE	65.58	62.83	-2.75
SD	15.76	14.52	-1.25
Variance	24.04%	23.11%	-0.93%
Min	44.25	41	-3.25
Max	88	84.75	-3.25

Source: calculation based on the data in Table 2.

The mean difference for the two groups

After analyzing the data, we may say that the subjects in the control group have suffered a deterioration of the composite indicator and the subjects in the treatment group recorded an improvement of the same indicator. The question is whether there is enough proof, from a statistical point of view, for us to claim that the results obtained by the study group are not the results of chance, but the effect of the hippotherapy sessions.

In order to give an answer to this question, the unpaired t-test shall be used, using the Analys-it application.

The null hypothesis H_0 is the following: the mean difference between the two groups, in the pre- and post-therapy session period, is null.

H_0 : $\mathbf{M_d = 0}$

The alternative hypothesis H_1: the mean difference is positive after the hippotherapy sessions.

H_1 : $\mathbf{M_d \neq 0}$

Note that the difference between the mean score 7.50 -(-2.75) =10.25 and that we would like to find out whether this value is due to chance or not.

The Compare Groups/T-student function is used. The results are listed below, for a 95% confidence level.

Table 3. Results of the (unpaired) t-test applied to the mean difference between the two groups

Mean difference	10.250	
95% CI	1.843	to 18.657
SE	4.0820	
$\mu_\Delta = \mu_{\text{Therapy group}} - \mu_{\text{Cotrol group}}$		
Student t test		
Hypothesized difference	0	
	t statistic	t-critic (2 tails)
	2,51	2.059
DF	25	
p-value	0.0189[1]	

H0: δ = 0; The difference between the means of the populations is equal to 0.
H1: δ ≠ 0; The difference between the means of the populations is not equal to 0.

[1] Reject the null hypothesis in favour of the alternative hypothesis at the 5% significance level.
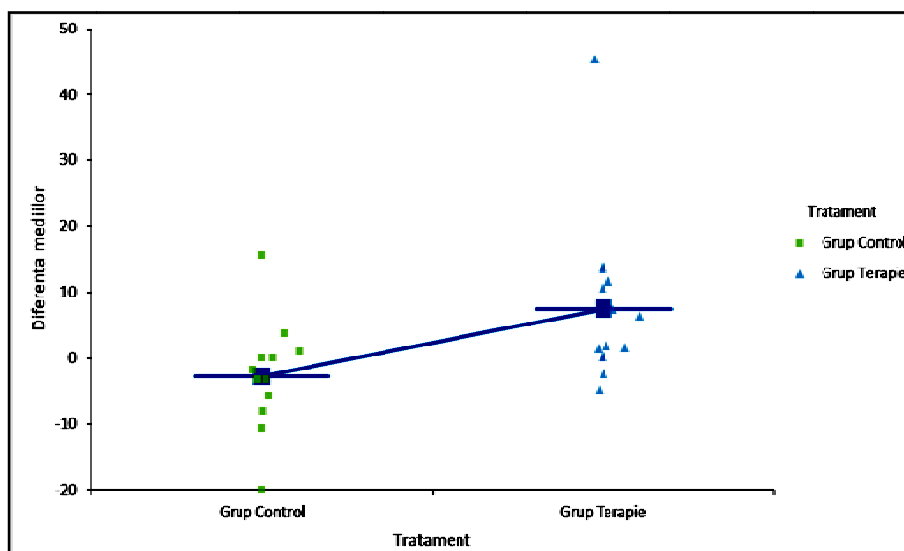
Source: own calculation.

Given this data, the confidence interval (95% probability) for the mean difference value (+10.25) results. **The following confidence interval is obtained for the mean difference: [1.843 – 18.657], which does not comprise zero value.**

Also, *t Stat* equals 2.51, which is higher than *t Critical two-tails* (two-tail t-test) (2.059) and the two-tail t-test probability P(T<=t) is 1.89%, lower than the selected 5% value.

To conclude, the null hypothesis (H_0) can be rejected and the alternative hypothesis H_1 can be accepted. This means that the mean difference is not null and the 10.25 value is not due to chance.

The following figure shows the mean difference of the two groups (Therapy Group and Control Group), which, as shown above, is significant from a statistical point of view.

*Figure 2. The mean differnece for the Control Group
and the Therapy Group*

Source: own calculations.

Conclusions

Conclusions on EAT

After analyzing the results obtained through EAT applied to 27 subjects, we can conclude that equine-assisted therapy is an efficient recovery method for disabled children aged 2 to 4 years, as they have recorded important progress in acquiring adaptive behaviors in day-to-day life.

EAT is a therapy which has a strong motivational impact upon the children. This therapy produces positive effects in acquiring adaptive behaviors in the following skill areas: communication, community use, academic functional, home living, health and safety, leisure, self-care, self-direction, social and motor skills, areas which cover the conceptual, social and practical domains, as well as general adaptive skills domain.

Conclusions on the statistical significance of the results

Following the statistical treatment of the results on EAT on a group of patients (a Control Group and a Group being subject to therapy), a two-tail Student test was applied (*t-Test*) in order to check whether the results obtained after therapy are significant from a statistical point of view. The cognitive-adaptive capacity difference mean of the two groups was measured to 10.25 points.

This value is significantly higher than 0, the Student test recorded t value (25) = 2.51> $t_{critical}$ (2.059) and probability value p=1.89% (two-tail) < 5%. A confidence interval for the mean difference of the two groups has been calculated. This interval is **[1,843 – 18,657]** with 95% probability.

The above values are significant and they indicate that EAT has clear effects in increasing the subjects' cognitive/adaptive capacity.

Acknowledgements

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Appendices

Appendix 1. Patients subject to EAT and their scores

Patient	Date of birth	Diagnosis	GAC I	GAC F	CON I	ON F	SOC I	SOC F	PR I	PR F
S1	21.11.2009	pervasive developmental disorder	60	62	53	58	65	63	65	67
S2	02.04.2009	ADHD, Autistic sindrome	74	84	73	79	81	85	76	85
S3	28.11.2001	Autism	71	83	65	82	84	89	71	83
S4	17.07.2007	retardation, tetraparesis	47	47	50	50	52	52	48	48
S5	21.08.2012	Spastic diparesis	40	93	40	83	53	94	58	102
S6	29.07.2006	ADHD	62	74	48	70	67	73	77	79
S7	11.23.2001	Infantile autism	47	48	50	52	51	52	48	50
S8	08.10.2003	Infantile autism	48	48	49	49	52	52	49	49
S9	06.08.2004	Developmental retardation	82	89	79	93	71	71	92	96
S10	24.07.2003	Infantile autism	48	47	42	50	52	51	49	48
S11	05.05.2005	Autism spectrum disorder	79	73	64	71	89	79	86	75
S12	10.09.2005	Autism spectrum disorder	67	81	56	73	51	65	87	97
S13	20.12.2004	Hemiparesis right side	79	76	76	79	105	100	68	63
S14	16.07.2002	Autism spectrum disorder	76	89	74	87	73	92	81	90

Source: data gathered from the filled-out forms; (Bilba Anca Nicoleta Psychologist's Individual
    Practice), Str. Poporului nr.36, Constanţa, 2015.

Significance:

I – Initial score

F – Final score

GAC – General Adaptativ Score

CON – Conceptual Domain Score

SOC – Social Domain Score

PR – Practical Domain Score

Appendix 2. Patients NOT subject to EAT and their scores

A. Composite scores and the score mean upon initial assessment for the control group

Subject.	GAC Score	Conceptual Domain	Social Domain	Practical Domain	Mean
S1	89	106	68	89	88
S2	46	49	50	49	48.5
S3	57	51	56	69	58.25
S4	82	85	79	85	82.75
S5	83	92	81	79	83.75
S6	48	52	52	50	50.5

Subject.	GAC Score	Conceptual Domain	Social Domain	Practical Domain	Mean
S7	59	53	49	58	54.75
S8	62	76	53	52	60.75
S9	75	85	78	72	77.5
S10	55	51	63	58	56.75
S11	40	46	49	42	44.25
S12	88	83	75	100	86.5
S13	60	55	60	66	60.25

Source: data gathered from the filled-out forms; (Bilba Anca Nicoleta Psychologist's Individual Practice), Str. Poporului nr.36, Constanţa, 2015.

B. Composite scores and the score mean upon final assessment for the control group

Subject	GAC Score	Conceptual Domain	Social Domain	Practical Domain	Mean
S1	85	94	73	87	84.75
S2	46	49	50	49	48.5
S3	49	51	61	49	52.5
S4	70	75	73	70	72
S5	82	87	75	84	82
S6	48	52	52	50	50.5
S7	56	59	53	66	58.5
S8	80	95	56	74	76.25
S9	76	74	87	77	78.5
S10	52	51	60	51	53.5
S11	40	40	44	40	41
S12	67	60	59	80	66.5
S13	51	53	53	52	52.25

Source: data gathered from the filled-out forms (Bilba Anca Nicoleta Psychologist's Individual Practice), Str. Poporului nr.36, Constanţa, 2015.