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Effects of a Program of Adapted Therapeutic Horse-riding in a Group of Autism Spectrum Disorder Children

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Abstract

Introduction. The use of horses in therapy has a fairly long history. There are many references to the therapeutic benefits of this activity. Such therapies have been undergoing a boom internationally in recent years. However scientific research into the effective use of this activity in children with autism is still in the early stages of development.

Method. The impact of a therapeutic horse-riding program on a set of psychosocial variables in a group of 8 autism spectrum disorder subjects of 7 to 16 years in age is evaluated. The study design was quasi-experimental, test-retest, with two groups – experimental and control. The measurement instruments were the "Behavior Assessment System for Children" (BASC), and a quality-of-life questionnaire based on a standard model used in mental health contexts. The treatment program comprised twenty-four 45-minute sessions.

Results. The results show significant differences in some of the quality-of-life indicators and there were lower levels of aggressiveness (BASC).

Discusion and conclusions. The horse riding is particularly well matched to the specific characteristics of persons with autism, since it is based on an individual activity but at the same time brings into play multiple interactions in a context which is more structured and less chaotic than other team sports.

Keywords: Autism, behavior assessment, quality-of-life, therapeutic horse-riding, adapted horse-riding.

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Efectos de un Programa de Equitación Adaptada y Terapéutica en un Grupo de Niños con Trastornos del Espectro Autista

Resumen

Introducción. El uso de caballos en la terapia tiene una historia bastante larga. Hay muchas referencias acerca de los beneficios terapéuticos de esta actividad. Estas terapias han experimentado un auge a nivel internacional en los últimos años. Sin embargo, la investigación científica sobre el uso efectivo de esta actividad en los niños con autismo se encuentra todavía en las primeras etapas de desarrollo.

Método. Se evalúa el impacto de un programa de equitación terapéutica en un conjunto de variables psicosociales en un grupo de 16 sujetos con trastorno del espectro autista de 7 a 14 años de edad. El diseño del estudio fue cuasi-experimental, test-retest, con grupo experimental y grupo de control. Los instrumentos de medición fueron el "Sistema de Evaluación de la Conducta Infantil" (BASC) y un cuestionario de calidad de vida basado en un modelo estándar que se utiliza en los contextos de salud mental. El programa de tratamiento comprende veinticuatro sesiones de 45 minutos.

Resultados. Los resultados mostraron diferencias significativas en algunos de los indicadores de calidad de vida y niveles más bajos de agresividad en la batería (BASC).

Discusión y conclusiones. La equitación es una actividad que se adapta particularmente bien a las características específicas de las personas con autismo, ya que se basa en una actividad individual, pero al mismo tiempo pone en juego múltiples interacciones en un contexto que es más estructurado y menos caótico que otros deportes de equipo.

Palabras Clave: Autismo, calidad de vida, equitación terapéutica, equitación adaptada, evaluación de la conducta.

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Introduction

The classical concept of autism has changed greatly since the original descriptions by Kanner (1943). Given the variability in cognitive impairment and social communication, today one speaks of a continuum rather than a specific diagnostic category, and it is ever commoner to use the term Autism Spectrum Disorders (ASD's) coined by Wing & Gould (1979). In the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (American Psychiatric Association, 2002), Autistic Disorder is classified as a subgroup of Pervasive Developmental Disorders, together with Rett's Disorder, Childhood Disintegrative Disorder, Asperger's Disorder, and Pervasive Developmental Disorder Not Otherwise Specified. The new classification proposal of DSM-5 (American Psychiatric Association, 2013) categorizes these disorders (except for Rett's Disorder because of its clear genetic identification and unique pattern of symptoms) as Neurodevelopmental Disorders, under which there is a single category termed Autism Spectrum Disorders. This new category condenses the three key symptoms (qualitative social interaction impairment, qualitative communication impairment, and restricted patterns of behaviour, interests, and activities) into two (persistent deficits in communication and social interaction, and restricted patterns of behaviour, interests, and activities), and allows for three levels of involvement to be established according to the intensity of support required.

Despite all the advances in neuroscience and genetic methods, it has still not been possible to establish a model explaining the ætiology and pathophysiology of ASD, although it is presumed that the basis is genetic and that epigenetic and environmental factors are involved (Mulas et al., 2010). Current studies show that ASD's are far commoner than previously thought. Indeed, the recognized prevalence has gone from one case of autism per 2500 children twenty-five years ago to one in 88 children today (data from the Centers for Disease Control and Prevention, 2012). The reason is that current figures cover the entire spectrum, including the mildest, highly functional, cases.

With no defined biological markers for ASD, diagnosis is made by observing the behaviour of the person, analysing their developmental history, and applying a battery of medical and psychological tests for the presence of signs and symptoms of autism. These include structured systems of information acquisition such as the CARS (Childhood Autism Rating Scale: Schopler et al., 1988), ADI-R (Autism Diagnostic Interview – Revised: Lord, Rutter &

Le Couteur, 1994), and ADOS-G (Autism Diagnostic Observation Schedule: Lord et al., 1989) which have given diagnostic classification greater reliability.

A recent report by an independent research centre and funded by the U.S. government's Agency for Healthcare Research and Quality (AHRQ) reviews 159 studies, and notes that treatments for ASD children can be classified into four categories (see the full report in Warren et al., 2011). Each category comprises treatments aimed at alleviating a specific set of symptoms and behaviours. They are: (I) programs of behaviour and development; (II) programs of education and learning; (III) medication; and (IV) other treatments and therapies. Because any given ASD child may present different types of symptoms, the family may have to choose between the available treatments, therapies, and programs in accordance with the child's needs. Indeed, the plan for a given child may include some aspect of each of the four categories of treatment. Warren et al. (2011) place equestrian therapies in their fourth category of "other treatments and therapies". It is interesting that the work of Bass, Duchowny & Llabre (2009) was the first work on such therapies to be included in a rigorous scientific review such as that of Warren et al. (2011).

The use of horses in therapy has a fairly long history (Saywell, 1988). As we shall detail below, there are many references to the therapeutic benefits of this activity. While scientific research into the effective use of this activity in children with autism is still in the early stages of development, such therapies have been undergoing a boom internationally in recent years. There are a rapidly growing number of horse-riding centres which devote part of their activity to therapies with different groups, including persons with autism. Although, as noted above, the scientific evidence is still far from definitive, the literature seems to indicate that therapeutic horse-riding and horse handling have a positive impact on the development of communication and social interaction of persons with autism and other neurodevelopmental disorders (Francis, 2003; Leitão, 2004; Lercari & Rivero, 2006; Bass, Duchowny & Llabre, 2009; Ward et al., 2013), increase adaptive behaviour and motivation (Taylor et al., 2009), favourably affect motor skills (Freire, 2000; Wuang et al., 2010), help improve quality-of-life (Kern et al., 2011; Walter & Hesse, 2006), reduce maladaptive behaviours while providing significant improvements in adaptive skills (Cincinnati Therapeutic Horse-Riding and H., 2006; Gabriels et al., 2009, 2012), lower the levels of cortisol and increase those of oxytocin (Tabares et al., 2012), and even improve some of the symptoms of the disorder itself (Van den Hout, 2010; Kern et al., 2011; Ward et al., 2013). Those studies, however, investigated just

partial aspects of the personal development of persons with ASD (see Table 1). They did not use evaluation tools that would allow one to make an overall assessment, as would have been the case if they had applied a multidimensional instrument such as the BASC battery of Reynolds & Kamphaus (1992).

Table 1. **Summary of works consulted**

	Sample (N)	Control Group	Peer reviewed	Skills evaluated
Freire (2000)	7	No	No	Motor and postural tone
Francis (2003)	4	No	No	Communication
Leitão (2004)	5	No	Yes	Interaction; communication; behaviour
Lercari & Rivero (2006)	12	No	No	Interaction; communication
Cincinnati Therapeutic Riding & H. (2006)	4	No	No	Adapted behaviour
Taylor et al. (2009)	3	No	Yes	Motivation; intentional behaviour
Bass, Duchowny & Llabre (2009)	19	Yes	Yes	Attention; interaction; intentional behaviour; sensory integration
Bass & Llabre (2010)	25	Yes	In press	Attention interaction; intentional behaviour sensory integration
Wuang et al. (2010)	60	Yes	Yes	Motor skills; sensory integration
Van den Hout (2010)	68	No	No	Autism symptoms (CARS); communication; sociability; sensory/cognitive awareness; physical behaviour (ATEC)
Kern et al. (2011)	20	Single case.	Yes	Autism symptoms (CARS); interaction; quality of life
Gabriels et al (2012)	41	Yes	Yes	Adaptive skills; communication skills; motor coordination and planning; reduction of aberrant behaviour
Tabares et al. (2012)	8	Single case.	Yes	Salivary cortisol and progesterone; estimated oxytocin
Ward et al. (2013)	21	Single case.	Yes	Autism symptoms (GARS-2); sensory responses (SPSC. Dunn, 2006).

Regardless of the possible therapeutic effects of the interaction with horses for persons with ASD, horse-riding is emerging as a suitable activity for children and adults with autism. Participation in sports and leisure activities is an essential element of any program targeted at improving people's quality-of-life (Schalock & Verdugo, 2002). As Rubio & García-Gómez (2011) show, horse-riding as a sport and leisure activity is an alternative that particularly fits

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the characteristics of persons with autism and attention deficit hyperactivity disorder (ADHD). In essence, there are three reasons. One is that, while done individually, multiple interactions come into play in a form that is more clearly structured than in other sports done in groups. Another is that it is primarily based on epidermal and tactile communication with the animal, as well as, although to a lesser extent, on verbal communication (which is usually altered in persons with autism). And the third is that it is done in a natural outdoor environment, something that is highly motivational.

Physical exercise is good for everyone's health. But it is especially important for children with autism because their social, communicative, and motivational difficulties cause them to have lower levels of physical activity than the general population. They therefore run the risk of additional disorders associated with this relative inactivity (Pan & Frey, 2006; Pan, 2008; Kleinhans, 2010). Although these studies have failed to provide completely definitive evidence (Sowa & Meulenbroek, 2012), it does seem that sport provides persons with ASD the opportunity of improving voluntary motor balance and movement, and their social and cognitive competences, of gaining confidence in their sporting activities, of reducing the emergence of stereotyped behaviours, and to some extent of relieving co-morbidities (Reid, 2005; Szot, 1997; Rosenthal-Malek & Mitchell, 1997; Elliott et al., 1994; Keyes, 2009; Yanardağ, Yılmaz, & Aras, 2010).

Aims

Therefore, the intention with the present work was to try to ascertain the social and behavioural effects of a program of initiation to horse-riding and of therapeutic horse-riding in a group of ASD pupils. The variables to consider related to the subjects' adaptive capacity measured with the BASC battery of tests (Reynolds & Kamphaus, 1992) and to their quality-of-life.

Method

Participants

The sample consisted of 32 pupils diagnosed with ASD, attending mainstream schools in the Provinces of Cáceres and Badajoz, Spain. However, there is only enough information about 16. Two groups were formed: 8 pupils in the experimental group, and 8 in the control group. Their characteristics were: Ages 7 to 14 years. 13 pupils lived in the City of Cáceres

and 3 lived in other towns in the Province, all in urban settings of Cáceres, Plasencia, and Trujillo (Spain). IQ > 50: two subjects in the range 50/70, and the rest with > 90. CARS scores: mean 31 (mild autism). No subject had had contact with horses during the two years prior to participating in the program, and only one had previously participated in horse-riding activities. Conventional treatment, both medical and re-education, were maintained unchanged throughout the program.

Gender: 3 girls, 13 boys, for a ratio of 1:4 . The equivalent prevalence ratio for the general population is approximately 1:4 (Rodríguez-Barrionuevo & Rodríguez-Vives, 2002).

The sampling method was of convenience, since random sampling was unfeasible due to the dispersion of potential subjects.

Instruments

The dependent variables were the *social, affective, and emotional variables*: adaptive skills, social skills, leadership, withdrawal, anxiety, depression, behavioural problems, atypicality, aggressiveness, hyperactivity, attention problems, and somatization. They were measured through the multidimensional *BASC-T (for Teachers) test battery* (Reynolds & Kamphaus, 1992). This has five components that evaluate the subject from different perspectives and which can be used individually or in any combination. They are: a self-report on personality; a structured developmental history; a pupil observation system; and two assessment questionnaires, one for parents (P) and one for teachers (T), designed to collect information on the behaviour of the child or adolescent in different contexts. We used the teacher rating form (T) in the present study. Reliability of the global dimension of the BASC ranged from .77 to .91.

Dependent variables related to *quality-of-life:* measured through an ad hoc parent questionnaire based on the *Quality-of-Life Model* of Schalock & Verdugo (2002). To elaborate and validate the instrument, we used a procedure of consensus via inter-rater validation with a group of experts in the treatment of pupils with special educational needs. The result was a 7-item questionnaire yielding indicators of the following dimensions: emotional well-being, interpersonal relationships, personal development, physical well-being, self-determination, social inclusion, and familial well-being. The reliability indicator (Cronbach's alpha) was acceptable (.641).

Intervention program

The three-month intervention program consisted of twice-weekly sessions (a total of 24 sessions) of three-quarters of an hour each, with groups of 4 pupils. The practical sessions in which the pupils of the experimental group participated were held in the Monfragüe Equestrian Centre of Cáceres, which has over fifteen years experience of training young riders in its Riding School. Each session consisted of three phases forming a continuum of the central riding activity. This pattern was based on that used by Bass, Duchowny & Llabre (2009) which was designed and implemented by instructors with PATH International (Professional Association of Therapeutic Horsemanship International, formerly NARHA) training. The first phase corresponded to activities prior to mounting – preparing the equipment and the horse. The second phase corresponded to mounting and riding. In the first sessions, each pupil was helped by a monitor leading the horse with a halter. The third phase corresponded to learning to round off the work with the horse, to dismount, bring in the horse, gather and put away the equipment, and say goodbye to the horses and to the monitors.

Because of the cognitive and behavioural characteristics of ASD children, some adaptations were made to fit the riding activity to their particular educational needs. These were based on the work of Horvat, Németh & Gal (2003), Brown (1996), Rivière (1998), Hodgdon (1995), and Schopler, Mesibov & Hearsey (1995). Essentially, they were: inciting the subjects to do the program's activities by assuming a lightly intrusive attitude; using highly structured teaching based on errorless learning; and using environmental visual structuring cues.

The educational objectives of the intervention were based primarily on the document "The regulations of the official rating program for riders of the Spanish Equestrian Federation", in particular, in the content related to levels 1 and 2 of the gallop. This text is available in "Curso de Equitación. Galopes. Niveles 1 al 4", published in 2008 by Ediciones Tutor S.A. The detailed information about the programme appears Rubio & García-Gómez (2011) and García-Gómez et al. (2012).

Procedure

Firstly, contacts with the parents from two Autism associations were established. They were invited to take part and written permissions were requested for that participation in the programme. In addition, parents were asked to bring the necessary details for this study.

Thereafter, the insurance and the medical reports for the practice of horse riding were also requested.

Before the start of these sessions of contact with a horse, two informative meetings were held with the monitors in which an autism specialist informed them of the subjects' basic characteristics, what their needs are, and what aspects are to be taken into account when interacting with them. Similarly, another two informative meetings were held in which the monitors informed the parents and other collaborators in the sessions about the basic characteristics of handling horses and what preventive practices should be followed at all times. After these initial informative meetings, the program sessions themselves were initiated.

Moreover, the collaborators of this study asked the teachers of these children to fill in the BASC questionnaire before and after the treatment programme.

Design and data analysis

As noted above, the objective of this work was to examine the effects of a therapeutic horse-riding program (independent variable) on a group of personal, social, and emotional variables of pupils with ASD (dependent variables). The design was to use a pre-test and post-test with an experimental and a control group. The impossibility of forming the groups at random imposes a certain limit on the validity of its results. In the classification terminology of Montero & León (2007), the design is a sub-class of quasi-experimental studies denoted "quasi-control".

Nonparametric statistics were used for hypothesis testing since the samples were very small. The significance level for intergroup differences was taken to be .05. Descriptive statistics were calculated for the appropriate variables.

Results

The presentation of the results will correspond to the impact of the therapeutic horse-riding program on: a set of psychosocial variables as evaluated with the BASC questionnaire and the quality-of-life as evaluated by an instrument based on the model of Schalock & Verdugo (2002).

Effects of therapeutic horse-riding program on the psychosocial variables evaluated by the BASC questionnaire

The data from the questionnaires completed by the teachers (BASC-T), as shown in Table 2, showed significant differences in the variable aggressiveness $p = .039$; $d = 0.220$. In the initial assessment (test) to the experimental group, the mean score for the aggressiveness variable was 4.6 and after treatment (retest) it was 3.33. It also highlights the score for hyper-activity $p = .077$; $d = 0.549$.

Suffice it to say that the values for the variable "atypicality" in the experimental group ($p = .066$; $d = 0.392$) are close to significance but in the control group also observed that maturation effect ($p = .063$; $d = 0.64$).

Table 2. **Wilcoxon test for paired samples in the BASC-T test and retest for the experimental group**

N=8	Mean test	S.D. test	Mean retest	S.D. retest	Sig. (2 tail)	Effect size *d*
Aggressiveness	4.67	5.750	3.333	4.926	.039	0.220
Hyperactivity	13.50	9.649	9.333	5.645	.077	0.549
Behaviour problems	2.17	1.329	1.833	1.722	.480	1
Attention problems	13.33	7.062	13.500	7.231	.915	0
Learning problems	10.67	8.091	10.500	6.978	1.00	0
Atypicality	11.67	2.733	10.333	3.141	.066	0.392
Depression	3.67	3.204	4.500	4.230	.336	-0.282
Anxiety	4.33	5.391	4.166	4.578	.854	0
Withdrawal	13.83	3.545	12.000	3.405	.343	0.333
Somatization	1.33	1.751	1.166	1.329	.655	0
Externalize problems	156.17	21.949	146.833	16.363	.116	0.535
Internalize problems	148.67	26.815	150.166	19.104	.344	-0.087
School problems	117.00	25.132	116.833	24.103	.917	0.049
Social skills	6.17	5.492	7.500	9.396	.500	-0.137
Leadership	5.83	2.483	6.166	3.188	.516	-0.392
Study skills	11.50	9.160	13.500	9.853	.140	-0.222
Adaptive skills	99.50	14.789	101.833	19.772	.588	-0.119

Also the Table 3 presents the statistics corresponding to control group.

***Table 3*. Wilcoxon test for paired samples in the BASC-T test and retest for the control group**

N=8	Mean test	S.D. test	Mean retest	S.D. retest	Sig. (2 tail)	Effect size *d*
Aggressiveness	1.75	1.258	1.25	1.500	.665	0.36
Hyperactivity	6.00	5.416	4.50	2.645	.461	0.35
Behaviour problems	0.50	0.577	0.50	1.000	1.000	0
Attention problems	12.50	4.123	11.50	3.696	.461	0.25
Learning problems	9.25	4.856	8.25	2.500	.414	0.31
Atypicality	5.50	2.380	4.00	2.309	.063	0.64
Depression	1.00	1.414	0.75	0.957	.655	0.20
Anxiety	2.00	0.000	1.50	1.732	.458	0.40
Withdrawal	9.00	5.888	7.75	2.753	.276	0.27
Somatization	0.00	0.000	0.00	0.000	.100	0
Externalize problems	12.00	3.266	8.75	3.095	.582	1
Internalize problems	5.25	3.403	4.50	2.516	.465	0.25
School problems	14.75	7.544	11.50	5.916	.461	0.48
Social skills	133.00	8.981	130.25	7.804	.066	0.35
Leadership	126.75	5.188	124.50	5.567	.655	0.47
Study skills	112.75	14.796	109.25	10.461	.144	0.27
Adaptive skills	120.50	14.434	110.75	9.394	.068	0.80

Consulting in Cohen's tables (1988) we obtain a power < 0.25 for a sample of $n = 8$. Ist a very low statistical power, therefore this sample could only detect effect sizes $d \geq 0.70$. Therefore there is a high probability of making Type II errors. So we included Cohen's d values for consulting the effect size, the effect size is a solid statistic.

Effects of the therapeutic horse-riding program on quality-of-life

The questionnaire to assess the quality-of-life was completed by the parents of both groups (experimental and control) after completion of the intervention program. The Mann-Whitney test (Table 4) revealed significant differences in favour of the experimental group in the dimensions "Interpersonal relations" and "Social inclusion", although these specific improvements were insufficient for there to be a significant difference in the total quality-of-life score ($p = .086$).

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Table 4. Mann-Whitney test and descriptive statistics for independent samples: experimental group versus control group to quality-of-life

Dimensions	Z	Asymptotic sig. (two-tailed)	Mean±SD Experimental group	Mean±SD Control group	Effect size *d*
Emotional well-being	-0.732	.464	4.33 ±1.03	3.50±1.91	0.54
Interpersonal relations	-2.882	.004	5.00± 0.00	2.00±2.06	2.05
Personal development	-0.231	.818	3.66± 0.51	3.50±1.29	0.16
Physical well-being	-0.366	.714	4.50± 0.40	4.50±1	0
Self-determination	-1.107	.268	3.00±1.41	2.00±1.41	0.70
Social inclusion	-2.282	.022	4.00± 0.83	2.00±0.81	2.43
Familial well-being	-0.220	.826	3.66±1.21	3.50±1.0	0.14
Total quality-of-life	-1.716	.086	25.16±1.67	22.25±4.5	0.85

Discussion and conclusions

The socio-emotional variables evaluated by the BASC are to some extent more dependent on the context than are the constituent variables of autism, and are therefore more influenced by intervention programs. But we noted above that, of all the variables analysed in this survey, significant differences were only found in aggressiveness (p = .039).

Some of the works consulted in our literature review refer to significant changes in some of the variables studied in the BASC. They did not use the same evaluation instrument however. Leitão (2004) refers to improvements in behaviour and social interaction; the work of Cincinnati Therapeutic Horse-Riding & Horsemanship (2006) reports improvements in adapted behaviour; Bass, Duchowny & Llabre (2009), Kern et al. (2011) and Ward et al. (2013) refer to significant improvements in interactive competences; and Gabriels et al. (2012) report significant reductions in challenging behaviour. In contrast, as noted above, our data show significant differences only in aggressiveness.

The possible influence of the therapeutic horse-riding program on the subjects' aggressive behaviour can be explained as being due to the relaxing effect even of passive physical activity (Von-Knorring et al., 2008). The inability to control behaviour is a possible explanation of the nature of the restricted and repetitive behaviours of persons with ASD, and the origin of this executive dysfunction may be a deficit in frontal lobe functioning. In this sense, Anderson-Hanley, Tureck & Schneiderman (2011) indicate that improving executive control

functions in persons with ASD together with the direct benefits of exercise may help them achieve greater behavioural control.

There is a growing scientific literature demonstrating the psycho-physiological improvements resulting from moderate intensity exercise in persons with ASD, such as with the experimental subjects of the present study. Sowa & Meulenbroek (2012) list the benefits that have been reported in the various studies in the literature on the effect of sporting activities on persons with ASD: constituting an opportunity for social integration; reduction in stereotyped behaviours; improving motor performance and physical capacities in general; fostering self-determination and thereby improving their quality-of-life; improving cognitive skills and academic performance; reducing stress; and improving social skills. The work of Tabares et al. (2012) also lends a certain support to our data in that it finds reduced cortisol levels, increased progesterone levels, and therefore increased oxytocin levels in a group of ASD individuals following sessions of hippotherapy. This change in hormonal status favours, among other things, the modulation of aggressive behaviour.

The last group of variables analysed were related to the quality-of-life. Previous work has found therapeutic horse-riding programs to improve the quality-of-life of persons with ASD (Kern et al., 2011). Walter & Hesse (2006) also report improvements in the quality-of-life of patients with psychiatric disorders (both neuroses and psychoses). Our data showed the experimental group pupils to obtain better indicators of quality-of-life than the control group pupils in two of the dimensions analysed – interpersonal relations and social inclusion.

For an explanation, one must take into account the behavioural characteristics of persons with ASD. Yanardağ, Yılmaz & Aras (2010) note that ASD children usually do not play with their peers or participate in physical and sports activities because of their difficulties in integrating and communicating with their classmates, their repetitive behaviours, restricted interests, and, in many cases, inferior motor performance. Hence, giving them the opportunity to participate in a leisure or sport physical activity such as horse-riding contributes directly to improving their quality-of-life.

By way of synthesis, we can say that the present study provides a vision that is complementary to foregoing work (Table 1 summarizes the literature consulted), and is the first to

contribute information on the impact of therapeutic horse-riding on a comprehensive set of psychosocial skills evaluated with an instrument as complete as the BASC questionnaire.

The therapeutic horse-riding program described in this work has involved a group of subjects with ASD in a range of sports and leisure activities in which they have learned to handle horses and other aspects of horsemanship. This activity is particularly well matched to the specific characteristics of persons with autism, since it is based on an individual activity but at the same time brings into play multiple interactions in a context which is more structured and less chaotic than other team sports. Its essence is communication that is tactile and epidermal with the animal rather than verbal (which is usually altered in persons with ASD), and it is performed in a highly motivating natural environment. Thus, horse-riding, with the necessary adjustments to adapt it to this group of persons, is a sports and leisure activity that can well form part of the repertoire of activities suggested for persons with ASD.

Limitations

Clear limitations of the present study need to be taken into account in interpreting the results in the sense that the improvements observed may have been due to other uncontrolled variables. The quasi-experimental nature of the study design, with the control group not being selected totally at random, may have influenced the results. The study sample was very small and in no way representative, so that it is not possible to generalize the findings to a larger population. Also, the heterogeneity of the sample, with the diversity of profiles, to a certain extent conditioned how the intervention sessions were carried out, and thus may have diluted the effects of the treatment. And finally, the benefits can not be guaranteed to be permanent since the study did not include a longitudinal type of design.

These limitations are to some extent common to most of the works consulted on this topic, and could serve as a referent for the improved experimental design of new contributions.

Future research

Finally we would note that, further effort is needed to allow greater control of the variables involved, with more strictly controlled designs, larger samples, longitudinal studies to evaluate the duration of any benefits, studies on samples with differing degrees of severity of the syndrome, and studies allowing variation in the intensity, duration, and frequency of

the sessions. Also, one needs to determine the physical and psychological mechanisms and processes that are put into play in horse-riding that would explain its therapeutic benefits for persons with autism.

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