Benefits of equine therapies on the cognitive of children with Autism Spectrum Disorder: systematic review and meta-analysis

Benefícios da equoterapia no cognitivo de crianças com Transtorno do Espectro Autista: revisão sistemática e meta-análise

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ABSTRACT

Autistic Spectrum Disorder (ASD) is a neurodevelopmental disorder whose main characteristics are changes in cognitive areas and social deficit. The aim of this study was to describe the benefits of equine activities and therapies in the cognitive areas of children with ASD/autism. This is a systematic review with meta-analysis of scientific articles indexed in the following online databases: BVS Salud, Periódicos CAPES, PubMed, Science.Gov and SCIELO, in addition to the website of the National Association of Riding Therapy (ANDE), Brazil, and the REDALYC platform, for inclusion of additional studies. As per Preferred Reporting Items for Systematic Reviews and Meta-analysis and assessed for quality by Consolidated Standards for Reporting of Trials - CONSORT checklist. There were 29 articles eligible for analysis, totaling 591 participants. The methods used in the interventions and evaluations differed between the articles, but it was possible to identify benefits of horse-assisted activities and therapies in the cognitive areas of children with ASD/autism.
areas of children with ASD and autism, especially with regard to social and emotional cognitive, as well as, in reducing irritability, hyperactivity and aggressiveness. Therefore, this systematic review confirms the benefits of horse-assisted activities and therapies in the cognitive areas of children with ASD and autism with intellectual deficit.

Keywords: autism, cognition, therapeutic riding.

RESUMO
O Transtorno do Espectro Autista (TEA) é um transtorno do neurodesenvolvimento cujas principais características são alterações nas áreas cognitivas e déficit social. O objetivo deste estudo foi descrever os benefícios das atividades e terapias equinas nas áreas cognitivas de crianças com TEA/autismo. Trata-se de uma revisão sistemática com metanálise de artigos científicos indexados nas seguintes bases de dados online: BVS Salud, Periódicos CAPES, PubMed, Science.Gov e SCIELO, além do site da Associação Nacional de Equoterapia (ANDE), Brasil, e a plataforma REDALYC, para inclusão de estudos adicionais. De acordo com os Itens Preferenciais de Relatórios para Revisões Sistemáticas e Meta-análise e avaliados quanto à qualidade pelos Padrões Consolidados para Relatórios de Ensaios - lista de verificação CONSORT. Foram 29 artigos elegíveis para análise, totalizando 591 participantes. Os métodos utilizados nas intervenções e avaliações diferiram entre os artigos, mas foi possível identificar benefícios das atividades e terapias assistidas por cavalos nas áreas cognitivas de crianças com TEA e autismo, principalmente no que diz respeito ao cognitivo social e emocional, bem como, na redução da irritabilidade, hiperatividade e agressividade. Sendo assim, esta revisão sistemática confirma os benefícios das atividades e terapias assistidas por cavalos nas áreas cognitivas de crianças com TEA e autismo com déficit intelectual.

Palavras-chave: autismo, cognitivo, equoterapia.

1 INTRODUCTION
Autism Spectrum Disorder (ASD) is a neurodevelopmental and neurobiological disorder whose diagnosis is associated with stereotyped repetitive behaviors and changes in the functioning of two or more areas of adaptive skills, such as communication and social interaction. Furthermore, ASD has a multifactorial etiology and, depending on the severity and developmental delay, it can be classified as mild, moderate or severe (HARRIS, 2017).

The clinical manifestations of ASD precede the first three years of the child's life and are constantly related to difficulties or changes in the development of language, behavior, social interaction and areas cognitive (BARBOSA, 2019; MALCOLM et al., 2018), in addition to learning or communication difficulties, which may be associated with Intellectual Disability (ID) present in approximately 40% of people with ASD and autism, as reported by the United States Center for Disease Control - CDC. It is worth noting that ID is closely linked to intellectual
functioning, that is, the abilities to reason, solve problems, plan, reflect and learn, lower than the average of the general population (POTVIN-BÉLANGER et al., 2021; ZOCCANTE et al., 2021). Understanding these characteristics is essential for the diagnosis and treatment of individuals with ASD, autism and/or ASD with ID, therefore, there is a broad search for new therapies and methods capable of promoting the development of the global skills of individuals with ASD, such as equine-assisted therapies (STEEN et al., 2019).

Equine-assisted activities and therapies receive different terminologies. In Brazil they are designated as Hippotherapy or Equine-Assisted Therapy (EAT) which comprise an interdisciplinary therapeutic method in the areas of health, education and riding, whose objectives are to promote biopsychosocial and sensory development-motor in people with special needs and/or disabilities (LLAMBIAS et al., 2019; FREIRE et al., 2005).

Regardless of the nomenclature, horses are used as the main kinesiotherapeutic tool, as they perform a three-dimensional movement that resembles the movement of the human pelvis during the phases of gait, in addition to allowing human/animal contact and different stimuli throughout the sessions, with the objective of providing improvements in muscle tone, posture, coordination, balance, sensitivity and cognition (BARBOSA, 2019).

These and other benefits of EAT are reported in numerous studies, however, clear evidence on the association between the benefits of EAT in cognitive areas in ASD with or without ID is presented in a relatively smaller number of studies. Most of the time they are addressed indirectly, that is, as a complementary result or in comparative studies between ASD and other pathologies. Therefore, this systematic review with meta-analysis aimed to investigate and analyze the benefits of EAT in the cognitive areas of children with ASD and/or ASD/autism with ID.

2 METHODS

2.1 IDENTIFICATION AND SEARCH STRATEGY FOR STUDIES

This is a systematic review with meta-analysis study, registered in the International Prospective Register of Systematic Reviews PROSPERO, in accordance with the Preferred Reporting Item Guidelines for Systematic Reviews and Meta-Analyses - PRISMA (MOHER et al., 2009).

Thus, the following online databases were used: BVS Salud, CAPES Periodicals,
PubMed, Science.Gov and SCIELO, in addition to the website of the National Association of Riding Therapy (ANDE), Brazil, and the REDALYC platform, for the inclusion of additional studies. There was no delimitation of the period of publication of the articles due to the search differences between databases.

To enable the analyzes and increase the probability of locating the published studies, descriptors selected after consulting the Descriptors in Health Sciences, Bireme (DeCS) were used. The search was conducted using concepts grouped into two blocks: the first with terms related to equine-assisted therapy ("equine assisted therapy", "hippotherapy", "riding therapy") and the second with terms associated with ASD ("autism”, “autism spectrum disorder”, “intellectual disability”). To combine these descriptors, the logical operator “OR” was used within each block and the logical operator “AND” to combine blocks in the databases. The systematic literature searches ended in March 2022, where the data obtained were part of a virtual library at MENDELEY, which allowed the organization, management of references and data for the screening process.

2.2 ELIGIBILITY CRITERIA

Articles that reported the benefits of EAT directly or indirectly in at least one of the areas related to cognitive impairment in children with ASD/autism and ASD with an indication of ID were included. However, articles with similar data and methodologies were excluded, with the exception of the most recent published studies; studies composed of a pathology other than ASD/autism or ASD with ID; non-pediatric population; EAT completion period not defined; incomplete articles and with variables described inconsistently. There were no restrictions regarding language, year of publication of the study, gender, ASD degree, number of study samples and techniques used in the EAT.

2.3 METHODOLOGICAL QUALITY ASSESSMENT

Methodological quality was assessed using Consolidated Standards for Reporting Trials - checklist CONSORT. Thus, all clinical trials included in this research were analyzed according to the following quality criteria: justification for carrying out the study; description of specific objectives and hypotheses; participant eligibility criteria; description of the intervention; description of primary and secondary outcomes; justification of sample size; detailing of masking
and randomization procedures (ALTMAN et al., 2001).

2.4 DATA EXTRACTION

Categories attributed to the outcomes were used to designate the benefits in the cognitive areas, namely: social cognitive (social motivation, social interaction and social skills), communication (language and verbalization), behavior (personality, engagement, self-determination, self-care and interpersonal relationships), attention (orientation and memory), processing (visual, auditory and planning), emotion and empathy (affective social).

For data extraction, a customized database was developed in the Software Microsoft Office Excel 2019 with fields referring to the identification characteristics of the studies, clinical characteristics of the participants, type of study and methodology, therapeutic measures, outcomes observed in the cognitive areas and in the rehabilitation in general.

2.5 STATISTICAL ANALYSIS

The analysis of selected articles was carried out descriptively and in two stages. The first one was related to the year, authorship, study site, type of study, population characteristics, methodological design, intervention characteristics, outcome assessment and study results. The second stage comprised the statistical analysis of the data according to the intervention protocol adopted during the study.

A forest plot graph was used to present the results of the meta-analysis and comparison of studies. For quantitative data, a confidence interval of 95% (95% CI) was considered. Heterogeneity between the findings of the studies was measured by the Cochran Q test (Q test) with assumed significance at \( p < 0.05 \). Another way to assess heterogeneity between studies was through inconsistency \( (I^2) \), which specifies the percentage of variation between studies giving heterogeneity. The values of \( I^2 \) range from 0-100%, where it was assumed that the value corresponding to 0% was indicative of non-heterogeneity and values above 50% of substantial heterogeneity. The analyses were performed on R environment (R CORE TEAM, 2019), RStudio interface (version 1.1.463).
3 RESULTS

3.1 DESCRIPTION OF STUDIES

Initially, 1,496 studies were identified in the searched databases, with the removal of 107 duplicates and the elimination of 1,271 articles after the screening process of the title and abstract reading, resulting in 118 articles eligible for full text reading. Eighty-nine papers were excluded after reading, and 29 articles were considered eligible for systematic review (Figure 1).

![Flowchart with the studies eligible for systematic review and meta-analysis.](source)

Although the 29 articles did not exclusively include randomized controlled trials of ASD with ID, 17 cohort studies were aligned within randomized clinical trials on the benefits of equine-assisted therapy intervention in ASD/autism. There were four case studies, four case-
control surveys, two comparative studies and a single exploratory study. Most researches were carried out between the years 2015 and 2020. Twenty-four articles were published in English, three in Portuguese and two in Spanish.

3.2 ASSESSMENT OF THE METHODOLOGICAL QUALITY OF STUDIES

In the methodological evaluation of the studies, only six criteria from the checklist CONSORT were not widely met. Among them, the description of the professional’s flowchart, the age group of the studied population and the clarity regarding the absent hypothesis in a study (MALCOLM et al., 2018). In general, the randomization and masking process were adequate taking into account the methodological delimitation of the studies, however, in nine articles (POTVIN-BÉLANGER et al., 2021; STEEN et al., 2019; MALCOLM et al., 2018; PETTY et al., 2017; LLAMBIAS et al., 2016; GABRIELS et al., 2015; HOLM et al., 2013; MOHER et al., 2009; ALTMAN et al., 2001) there were no description if the allocation sequence was kept confidential until the intervention.

Data on description of the sample size, reporting of the “recruitment” date and follow-up period were present in all studies. In two articles there was no description of the clinical characteristics of the studied participants (MALCOLM et al.; TAN et al., 2018). In only one study therapy was performed using a simulator of the Simulated Developmental Horse-Riding Program (SDHRP), type as the main therapeutic tool (WUANG et al., 2010). In general, most studies were considered as “strong” and “moderate”.

3.3 CHARACTERISTICS OF SAMPLES AND STUDIES

Regarding the sampling process, there was great variability in the composition of the sample between genders. Sample consisted of 591 children diagnosed or classified with ASD, autism and ASD with characteristics or indicative of ID who participated in the selected studies, of these approximately 77% were male and 22% female. The sample size also diverged between the studies, with the smallest sample consisting of three children and the largest of 116 children, with the exception of case studies carried out with a single child. Despite the variability between the sample number and aspects related to the classification of ASD present in the samples, there was no divergence between the cognitive results and the practice of EAT.

The age group among the research participants was from five to 11 years old, where
practically all were followed before, during and after some periods of intervention with horses, with the exception of one study (STEEN et al., 2019) that carried out the assessment at the beginning and at the end of five sessions and two studies (MALCOLM et al., 2018; AARON et al., 2013) that took place through reports from professionals working in therapy centers.

All children included in the studies participated in equine-assisted interventions. Equine-assisted therapy had different nomenclatures resulting from the location and intended purpose, such as: Occupational Therapy Assisted by Horses, Therapeutic Riding Program, Hippotherapy, Therapeutic Riding, Equestrian Rehabilitation and Intervention through Horse Riding. As for nomenclature, other topics also presented variations, such as the intervention period, evaluations and the number of sessions, however, the selected studies demonstrated as a common objective the rehabilitation in the psychomotor and biopsychosocial areas. The characteristics of the studies are shown in Table 1.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Local</th>
<th>Diagnosis</th>
<th>Sample</th>
<th>Gender Male(%)</th>
<th>Sample AgeMean</th>
<th>Type of Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaron, 2013</td>
<td>USA</td>
<td>ASD</td>
<td>7</td>
<td>55</td>
<td>4</td>
<td>HIP</td>
</tr>
<tr>
<td>Ajzenman H, 2013</td>
<td>USA</td>
<td>ASD</td>
<td>6</td>
<td>70</td>
<td>8.5</td>
<td>HIP</td>
</tr>
<tr>
<td>Anderson, 2016</td>
<td>UK</td>
<td>ASD</td>
<td>15</td>
<td>74</td>
<td>10.5</td>
<td>THR</td>
</tr>
<tr>
<td>Barbosa, 2019</td>
<td>Brazil</td>
<td>ASD</td>
<td>3</td>
<td>100</td>
<td>6.5</td>
<td>E</td>
</tr>
<tr>
<td>Bass, 2009</td>
<td>Florida</td>
<td>Autism</td>
<td>34</td>
<td>85</td>
<td>7</td>
<td>E</td>
</tr>
<tr>
<td>Borgi, 2015</td>
<td>Italy</td>
<td>ASD</td>
<td>28</td>
<td>100</td>
<td>9</td>
<td>EAT</td>
</tr>
<tr>
<td>Cerino, 2016</td>
<td>Pomegranate</td>
<td>ASD</td>
<td>1</td>
<td>100</td>
<td>8</td>
<td>RE</td>
</tr>
<tr>
<td>Fernandez, 2015</td>
<td>Cuba</td>
<td>ASD</td>
<td>10</td>
<td>50</td>
<td>6</td>
<td>E</td>
</tr>
<tr>
<td>Freire, 2015</td>
<td>Brazil</td>
<td>Autism</td>
<td>7</td>
<td>71</td>
<td>6.5</td>
<td>TE</td>
</tr>
<tr>
<td>Gabriels, 2015</td>
<td>Colorado</td>
<td>ASD</td>
<td>116</td>
<td>86.5</td>
<td>11</td>
<td>THR</td>
</tr>
<tr>
<td>Garcia, 2014</td>
<td>Spain</td>
<td>ASD</td>
<td>16</td>
<td>79</td>
<td>10.5</td>
<td>E</td>
</tr>
<tr>
<td>H Steiner, 2015</td>
<td>Budapest</td>
<td>Autism</td>
<td>26</td>
<td>46</td>
<td>11.5</td>
<td>THR</td>
</tr>
<tr>
<td>Harris, 2017</td>
<td>UK</td>
<td>ASD</td>
<td>26</td>
<td>85</td>
<td>7.5</td>
<td>IE</td>
</tr>
<tr>
<td>Holm, 2014</td>
<td>USA</td>
<td>ASD</td>
<td>3</td>
<td>100</td>
<td>7</td>
<td>E</td>
</tr>
<tr>
<td>Kern J, 2011</td>
<td>USA</td>
<td>ASD</td>
<td>24</td>
<td>75</td>
<td>7.5</td>
<td>EAT</td>
</tr>
<tr>
<td>Lanning, 2014</td>
<td>USA</td>
<td>ASD</td>
<td>25</td>
<td>80</td>
<td>9.5</td>
<td>EAT</td>
</tr>
<tr>
<td>Piglet, 2004</td>
<td>Lisbon</td>
<td>Autism</td>
<td>5</td>
<td>80</td>
<td>7.5</td>
<td>EPE</td>
</tr>
<tr>
<td>Llambias, 2016</td>
<td>USA</td>
<td>ASD</td>
<td>7</td>
<td>60</td>
<td>6</td>
<td>E</td>
</tr>
<tr>
<td>Malcolm, 2018</td>
<td>UK</td>
<td>ASD</td>
<td>10</td>
<td>60</td>
<td>7</td>
<td>EAT</td>
</tr>
<tr>
<td>Memishevikj, 2010</td>
<td>Saravajo</td>
<td>ASD</td>
<td>4</td>
<td>50</td>
<td>9</td>
<td>E</td>
</tr>
<tr>
<td>Peters, 2020</td>
<td>USA</td>
<td>Autism</td>
<td>6</td>
<td>85</td>
<td>9.5</td>
<td>EAOT</td>
</tr>
<tr>
<td>Petty, 2017</td>
<td>USA</td>
<td>ASD/Asperger</td>
<td>67</td>
<td>90</td>
<td>11</td>
<td>THR</td>
</tr>
<tr>
<td>Potvin, 2021</td>
<td>Quebec</td>
<td>ASD/Autism</td>
<td>26</td>
<td>54</td>
<td>7</td>
<td>EAT</td>
</tr>
<tr>
<td>Steen, 2019</td>
<td>Netherlands</td>
<td>ASD/Autism</td>
<td>1</td>
<td>-</td>
<td>8</td>
<td>EAT</td>
</tr>
<tr>
<td>Tan, 2017</td>
<td>Australia</td>
<td>ASD</td>
<td>6</td>
<td>20</td>
<td>8.5</td>
<td>EAI</td>
</tr>
<tr>
<td>Ward S, 2013</td>
<td>Virginia</td>
<td>Autism</td>
<td>21</td>
<td>70</td>
<td>7</td>
<td>TE</td>
</tr>
<tr>
<td>Wuang, 2010</td>
<td>Taiwan</td>
<td>Autism</td>
<td>60</td>
<td>78.5</td>
<td>7</td>
<td>SDHRP</td>
</tr>
<tr>
<td>Zhaoxing Pan, 2019</td>
<td>California</td>
<td>ASD</td>
<td>16</td>
<td>80</td>
<td>11</td>
<td>THR</td>
</tr>
</tbody>
</table>
3.4 OVERVIEW OF INTERVENTIONS AND COGNITIVE RESPONSES

As the interventions were carried out in different therapeutic centers, there was a variability between the duration of the sessions and the interventions. Thus, any type of therapy with horses, including the use of an equestrian simulator, was considered a horse-assisted intervention.

The research by Wuang et al. (2010) was the only one carried out using a simulator, the SDHRP, in which the research was carried out over a period of 44 weeks subdivided into 20 weeks of 45 minutes of intervention. The other studies used the horse as a therapeutic tool with durability between 30 and 60 minutes in weekly sessions, except for two studies whose sessions took place between 90 and 180 minutes (STEEEN et al., 2019; ANDERSON, 2016).

The most prevalent interventions among the studies were therapeutic riding performed over a period of approximately ten weeks in almost all studies, and equine-assisted therapy present in seven studies (POTVIN-BÉLANGER et al., 2021; STEEN et al., 2019; MALCOLM et al., 2018; BORGI et al., 2016; LANNING et al., 2014; KERNJ et al., 2011; MEMISHEVIKJ, 2010). Other interventions were associated with riding and equestrian rehabilitation activities, including muscle relaxation techniques, stretching, postural alignment, transfers, balance, sensory and social integration activities in children with ASD and intellectual deficit.

As for the benefits in the cognitive areas, they were measured indirectly, based on the information and reports identified by the authors. In all articles included in this review, the benefits were described as positive, using scales, tests and assessments before and after interventions ranging from motor development to social integration. Although most studies have used assessments and scales to assess equestrian interventions, it is worth mentioning that some studies were carried out through reports from professionals and/or those responsible for the children, who reported advances in cognitive aspects. Twenty-three studies described social interaction as one of the main cognitive benefits of EAT in children and adolescents with ASD and intellectual deficits. Other aspects that make up the cognitive areas identified in the analyzed studies were: improvement in behavior present in 15 studies; development of language and...
communication skills evidenced in 15 surveys; affective social involving empathy and emotions detailed in 11 articles; auditory/visual processing and attention in four and three studies, respectively (complementary material).

3.5 QUANTITATIVE ANALYSIS

The number of studies that included measures of statistical effects was relatively smaller compared to those with descriptive data. Thus, there are differences in the data analysis, however, nine studies were included to carry out the meta-analysis.

The meta-analysis revealed statistical significance (p = 0.01) between the summarized scores and the rating scales used in children with ASD/autism with and without intellectual deficit participating in equine-assisted activities and therapies, as well as the prevalence of males in the intervention and control groups (Figure 2). Considerable heterogeneity was observed in the $I^2$ analysis, being considered substantial in 58%.

Figure 2. Forest plot of intervention and control groups of children with ASD/autism assisted by equine activities and therapies.

<table>
<thead>
<tr>
<th>Study</th>
<th>Experimental</th>
<th>Control</th>
<th>Mean Difference</th>
<th>MD</th>
<th>95%-CI</th>
<th>Weight (fixed)</th>
<th>Weight (random)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bass, 2009</td>
<td>19 7.73 1.6700</td>
<td>15 7.73 1.6500</td>
<td>0.00 [1.12; 1.12]</td>
<td>25.5%</td>
<td>19.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borg, 2015</td>
<td>15 9.20 1.8000</td>
<td>13 8.00 1.5000</td>
<td>1.20 [0.02; 2.42]</td>
<td>21.5%</td>
<td>18.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gabriels R, 2015</td>
<td>58 10.50 3.2000</td>
<td>58 10.00 2.7000</td>
<td>0.50 [0.58; 1.58]</td>
<td>27.7%</td>
<td>19.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garcia, 2014</td>
<td>8 25.16 1.6700</td>
<td>8 22.25 4.5000</td>
<td>2.91 [0.42; 6.24]</td>
<td>2.9%</td>
<td>7.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harris, 2017</td>
<td>12 7.50 10.5700</td>
<td>14 7.00 3.9000</td>
<td>0.50 [5.83; 6.83]</td>
<td>0.8%</td>
<td>2.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lanning, 2014</td>
<td>13 9.80 8.2200</td>
<td>12 8.22 7.3900</td>
<td>1.58 [4.54; 7.70]</td>
<td>0.9%</td>
<td>2.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petty, 2017</td>
<td>31 10.95 3.4200</td>
<td>36 10.01 2.6600</td>
<td>0.94 [0.54; 2.42]</td>
<td>14.6%</td>
<td>10.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wung, 2010</td>
<td>30 9.50 11.2000</td>
<td>30 8.83 7.1000</td>
<td>0.80 [5.05; 14.55]</td>
<td>1.4%</td>
<td>4.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZhaoXing Pan, 2019</td>
<td>8 11.68 2.4500</td>
<td>8 9.80 2.6200</td>
<td>2.08 [0.51; 4.67]</td>
<td>4.6%</td>
<td>9.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Fixed effect model | 194 | 194 | 0.87 [0.31; 1.44] | 100.0% | – |
| Random effects model | 134 [0.29; 2.39] | – | 100.0% |

Source: own authorship, 2022.

4 DISCUSSION

The results of the present study corroborate the researches carried out involving the social and cognitive development of children with ASD/autism with and without intellectual deficit who participate in programs and activities with horses, especially when compared with children who participate in non-equine programs called control groups that may present results, but are to a lesser degree in relation to the groups of activities with horses, as shown in Figure 2 through the data obtained in the evaluations and scores used in the samples of the intervention and control
groups, which showed a predominance of male gender in the samples of the analyzed studies, thus reinforcing the perception of Petty et al. (2017) who associate this fact to the large gender discrepancy in the general population with ASD being male.

There is also a high incidence of children and young adults with ASD treated in health centers and entities dedicated to rehabilitation, so, regardless of whether ASD/autism has or does not have an ID, it is considered a public health problem, given the impacts on health networks and EAT centers. It is worth mentioning that EATs act as facilitators in several areas of health and education, as it has been observed that they are able to reduce anxiety, aggression, irritability, stereotypes and others, in addition to increasing the concentration and attention of individuals with ASD with an indication of ID, especially when related to the cognitive domains, in which they present significant improvements in the emotional, behavioral and social cognitive domains, as described by Petty et al. (2017) when analyzing the relationship between children with ASD and animal’s pets through hippotherapy.

Other authors such as Zoccante et al. (2021) and Harris (2017) also stated that activities involving horses have been beneficial in sensory and behavioral functions, especially in reducing aggression. Similarly, Garcia-Gomez et al. (2014) identified a reduction in aggressive behavior and hyperactivity in children with ASD and autism with ID after therapeutic riding sessions.

These aspects are part of the areas of behavior that represent a challenge for health system and health professionals. The general behavior of children with ASD has shown promising results in approximately 15 studies (ZOCCANTE et al., 2021; PETERS et al., 2020; PAN et al., 2019; TAN, 2018; PETTY et al., 2017; ANDERSON, 2016; BORGI et al., 2016; CERINO et al., 2016; LLAMBIAS et al., 2016; GARCÍA-GÓMEZ et al., 2014; AARON et al., 2013; AJZENMAN et al., 2013; BASS et al., 2009; FREIRE et al., 2005) analyzed by this review. In particular the research developed by Leitão (2004) which analyzed the benefits of psychoeducational riding in children with autism. The analysis consisted of specific points of neuropsychomotor development including behavioral and cognitive analyses, which resulted in cognitive, behavioral and emotional advances (social, affective and empathic), in addition to balance and physical functioning.

Regarding cognitive emotional, other 11 authors (STEEN et al., 2019; TAN, 2018; PETTY et al., 2017; GABRIELS et al., 2015; GARCÍA-GÓMEZ et al.; LANNING et al., 2014; AARON et al., 2013; WARD et al., 2013; MEMISHEVIKJ, 2010; BASS et al., 2009; LEITÃO,
identified progressive improvements in social emotions, associated with the feeling of empathy and engagement. According to Malcolm et al. (2018) and Anderson (2016), equine-assisted therapy provides children with a version of empathy that is restricted to specific types of humans, that is, empathy occurs as a response to sensory experiences and interactions developed through contact with the horse, which is considered a facilitator of the emergence of social behaviors.

Positive effects on social cognitive were found in 23 studies (POTVIN-BÉLANGER et al., 2021; ZOCCANTE et al., 2021; PAN et al., 2019; STEEN et al., 2019; MALCOLM et al., 2018; TAN, 2018; HARRIS, 2017; PETTY et al., 2017; BORGI et al., 2016; CERINO et al., 2016; LLAMBIAS et al., 2016; GABRIELS et al., 2015; STEINER, 2015; GARCÍA-GÓMEZ et al., 2014; LANNING et al., 2014; AJZENMAN et al., 2013; WARD et al., 2013; AARON et al., 2013; KERNJ et al., 2011; MEMISHEVIKJ, 2010; WUANG et al., 2010; BASS et al., 2009; FREIRE et al., 2005), mainly in social interaction and in the development of social skills of children with ASD/autism and intellectual disability, and despite the high variability of interventions children showed similar descriptive results in relation to the social evolution. Furthermore, what is related to social cognitive is associated with the level of interaction with peers and the language presented by children after therapy with horses, as mentioned by Steen et al. (2019).

The improvement in verbal and non-verbal language skills was described by 15 authors (PETERS et al., 2020; PAN et al., 2019; STEEN et al., 2019; MALCOLM et al., 2018; CERINO et al., 2016; FERNÁDEZ, 2015; GABRIELS et al., 2015; GARCÍA-GÓMEZ et al., 2014; LANNING et al., 2014; AARON et al., 2013; WARD et al., 2013; MEMISHEVIKJ, 2010; BASS et al., 2009; FREIRE et al., 2005; LEITÃO, 2004) as important evidence of the benefits of therapy with horses in the areas of communication in ASD, thus suggesting that there are developments in language, communication, sensory awareness, physical and behavioral health, cognition and socialization. Other authors presented similar findings (ANDERSON, 2016; KERNJ et al., 2011; FREIRE et al., 2005), as well as for ASD/autism with ID (POTVIN-BÉLANGER et al., 2021; GABRIELS et al., 2015; GARCÍA-GÓMEZ et al., 2014; KERNJ et al., 2011; WUANG et al., 2010; BASS et al., 2009).

All these benefits pointed out in the cognitive areas suggest an encouragement of new researches associated with horse-assisted activities and therapies in children with ASD/autism.
and ASD with ID. The challenge in carrying out this analysis and meta-analysis is highlighted by the lack of a standardized approach in interventions involving horses and children with ASD or ASD/autism with ID, despite the existence of different scales, assessments and instruments used in studies published in recent years.

5 CONCLUSION REMARKS

This review confirms the benefits of horse-assisted activities and therapies on the cognitive areas of children with ASD and autism with intellectual deficit, mainly with regard to social and emotional cognitive. Another area with significant results was related to the behavior of children who showed reduced irritability, hyperactivity and aggressiveness when participating in hippotherapy, despite the variability of protocols and intervention periods.

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