



What is the Effectiveness of Treatment for Retained Primitive Reflexes (RPR's) on Children with Autism Spectrum Disorder (ASD) and/or Attention Deficit Hyperactivity Disorder (ADHD)?

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Abstract

Retained Primitive Reflexes (RPR's) are frequently observed in children with attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) and may serve as early indicators of developmental delays or nervous system dysfunction. Therefore, it is crucial that effective treatments are developed in order to limit the effects of these, creating a better quality of life for patients. This is an important outcome for patients, which is not an objective measurement. This literature review examines five articles on different treatments for children with ASD and/or ADHD. The treatments examined are hemispheric integration therapy, chiropractic management and TENS. It then compares the quality and reliability of these articles, using the CASP tool and their results, grouping them into three themes: reduction of RPR's, increase in skills and reduction in background activity. Ensuring trustworthiness in articles is integral in establishing whether articles are credible and reliable [91]. This author then explains how the results found can be applied to practice and where further research is needed. Research has an important role in transforming health care [92].

Keywords: Children; Autism spectrum disorder; ADHD; Retained primitive reflexes; Treatments; Literature review; Neurology; Database search; Hemispheric intergration therapy; TENS

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Key Points

1. Treating RPR's can reduce their presence, help increase the child's skills and reduce background activity in the brain. This can improve the child's quality of life, cognition and academic progress. It can also reduce instances of behaviours that challenge.
2. Research into RPR's is limited and the pool of authors is small. Therefore, more research needs to be done into this area, to diversify the pool of authors and evidence.
3. Both qualitative and quantitative articles can have their reliability tested using different versions of the CASP tool. This has shown that each type of article has different areas and degrees of reliability and credibility and areas where these can be questioned and compared.

Introduction

The focus of this literature review will be the question 'What is the effectiveness of treatment for Retained Primitive Reflexes (RPR's) on children with Autism Spectrum Disorder (ASD) and/or Attention Deficit Hyperactivity Disorder (ADHD)?' Babies are born with reflexes which help them to react to their environment [4]. The integration of these reflexes in infancy allows the brain to develop from the bottom up, if this doesn't occur then the development of more advanced areas may be delayed [5]. Bottom-up development allows for primitive areas of the brain to develop first and more advanced areas develop later [6]. RPR's disproportionately affect people with learning disabilities, ASD and ADHD [7]. ASD means there are problems with the theory of understanding other people's minds and often co-occurs with ADHD [8]. ADHD is a neurodevelopmental problem which often results in impulsivity, forgetfulness and distraction [9].

This literature review examines five research articles on the effectiveness of different treatments for RPR's in children with ASD and/or ADHD. It aims to improve awareness of RPR's and offer

recommendations for further research and policies. It is important for learning disability nurses to have an awareness of RPR's, so they can offer support for patients and families experiencing difficulties arising from behaviours. Some treatments are administered at home, so community nurses can support carers in providing accurate treatment [10]. Therefore, it could be helpful for nurses to be able to identify symptoms. Limited guidance is currently available on this [11].

Methods

Firstly, this author wrote a proposal which outlined how they developed their question. For this, they used the PICO model. This focuses on population, intervention, comparison and outcome [12]. This author used an adapted version of this, due to a lack of availability of literature, which would have made it difficult to compare the treatments. The ability to identify patient-based issues and convert these into specific questions is an essential skill to be developed at the undergraduate level and learning to ask questions using the PICO framework stimulates thinking beyond generic conditions [13]. Additionally, PICO is suggested in clinical settings and was identified to be a more comprehensive form of question formulation [14]. This author felt it fitted the question well as it is therapy-centred [15]. This author then used this tool to find subjects for each of the categories as outlined below in Table 1. Using this tool, this author then developed their research question and keywords [16], as outlined in Table 2.

It is important to use these keywords to help bring up more relevant articles in a database search, as it is often how articles are indexed [17]. When this author completed their preliminary search, they noticed that the terminology used to research RPR's had changed over time. This is why it is important to include synonyms in database searches [18]. Boolean operators were used between each synonym and keyword. And was used to include all keywords and "or" was used between the synonyms. The command "or" finds articles containing the phrase or synonyms and provides specificity, the word and finds articles containing all the keywords [19]. Truncation was utilized to identify variations of keywords [19]. To highlight the relevance and scope of the search the inclusion and exclusion criteria from Table 3 below were used [20].

This allowed for high-quality articles to be found. For example, peer-reviewed articles, which have been critiqued by another expert [21]. Researchers should also use a relevant time frame and have an understanding of recent findings [21]. This is why a time frame of 10 years was given. One limitation of this inclusion and exclusion criteria is that it excludes articles written in other languages and could therefore exclude important data. This author had limited time to complete this literature review, and so did not feel it appropriate to use translated articles. A study should not be ruled out because it is in a different language [21]. This author decided to use online databases for the search. This makes the articles easily accessible when writing a literature review, as searches can be saved [22]. It is advisable to produce a comprehensive search by searching multiple databases [23]. Therefore, this author chose CINAHL Ultimate and Science Direct. CINAHL Ultimate was selected as it is the largest nursing database [24]. Using the CINAHL database brought up three results, therefore, this author searched Science Direct, which brought up eleven articles, by two different searches due to how the database includes keywords in the search. Science Direct offers peer-reviewed

interdisciplinary articles [25].

Critical Review

To analyse the articles, this author used the CASP tool. This increases consistency in decision-making and allows for transparency [26]. One issue with using this tool is it struggles to appraise a study's approach to inquiry and may give hints that bias the author [27]. More information on each of the studies is in the data extraction table in Appendix A.

The first article this author examined is the Hemispheric Integration Therapy (HIT) in the treatment of ADHD [28]. Hemispheric-based training programmes, such as HIT, are programmes which are specifically developed for each of the participants to target weaker areas of the brain [29]. The study had a clearly defined aim to document objective improvement in 4 children with ADHD, utilizing HIT, as an alternative to medication. Objectives must be clear and focused on what the researcher wants to discover [30]. The study fulfilled this objective, by recruiting the necessary participants. There is increasing support for utilising participants with experience of the research topic within medical research as it can lead to more in-depth insights [31]. However, these participants were recruited from the authors private practice and their parents paid for their treatment, which means it is not representative of the general population. Sometimes it is difficult for researchers to get access to all members of the target population [32]. However, this means that the results don't have generalizability, making it difficult to apply the results to others in a similar position [33]. This was congruent throughout many of the articles, as many of them were qualitative, which seeks to inform the thinking about a topic and make the results transferable to other similar situations, not to other situations [33].

The second article found was titled The Chiropractic Management of toe-walking in an Eight-year-old Male Diagnosed with ASD Utilizing a Functional Approach: A Case Study [34]. One drawback is that this is a case study which only looked at one participant. A case study is a popular method of qualitative research and produces an in-depth analysis of a single person or group of people [35]. However, a traditional criticism of case studies is that they cannot be generalized [35]. This leaves some studies unrepresentative of the general population, such as this article, which does not outline the researcher's sampling process [21]. The participant was a child, therefore making them vulnerable. When a study contains vulnerable individuals, it is good practice to show within the sampling method how this has been accounted for [35]. If the research was completed within the UK, the researchers would have needed to implement a process involving the Gillick competency assessment to know that the child can consent to their involvement in research [36]. However as this is an international piece of research, they need to abide by the declaration of Helsinki [87] and ensure they gained free and informed consent for the child to participate and have their information shared. This ensures the research is ethical, however, no detail is given on this in the paper. This is one issue with using international studies to inform practice in the UK [88]. The study had a specific aim to discuss the treatment of idiopathic toe-walking utilising cognitive-motor dual-tasking and primitive reflex integration. Idiopathic toe walking means that the child was walking on their tip-toes with no underlying cause for this behaviour [37]. This is a targeted aim, allowing for reflective results. The authors saw a reduction in toe walking, improvement in gait and impulsive behaviour, after a course of both cognitive-motor dual-tasking and primitive reflex integration.

Cognitive-motor dual tasking is when two tasks involving both a person's cognitive and motor resources are completed at the same time [38]. Primitive reflex integration is a set of exercises which the participants must complete [39]. However, it does not say how the article minimized bias and confounding variables. Confounding variables are where the relationship between two variables may be due to a third variable [40]. In this study, the variables are the treatment of RPR's and the effect it has on behaviour and tip-toe walking, however, the participant had previous interventions, which could have impacted the results. Additionally, the researchers did not complete any follow-up visits. The results are reported subjectively, and comparative data is absent, potentially making them imprecise and difficult to analyse. This means that the results could have been influenced by perspective [41].

The last three studies all have the same authors. This could be beneficial as it shows the author's development in this topic over time, however, it could also mean that the same biases occur across all papers. For example, the lead researcher has a book out and offers consultations on the subject, which means he has a financial interest in this topic area [42]. Biases can arise from the actions of the primary authors and can be affected by conflicts of interest. One example of this is the author's exclusion of results from participants who did not respond favorably [43].

The third study is persistent childhood primitive reflex reduction effects on cognitive sensorimotor and academic performance [44]. This one had the specific aim of determining the efficacy of hemispheric-based training programmes to reduce primitive reflexes and to use tests to examine motor and academic skills. To test this the authors used objective measurements gained from all participants who had the same level of exposure. Objectivity means the researcher distances themselves from their topic of research and produces quantitative research, which reduces bias [45]. Quantitative research is concerned with examining how two variables interact with each other [45]. In this paper, the variables were children with ADHD a hemispheric-based training programme and a reduction in RPR's. Measuring this found relevant and comparable results, which were precise with a p value of $p < 0.0001\%$. This shows that the authors completed statistical tests which highlighted the result's significance. A small p-value, as seen in this study, reflects a smaller probability that the results were due to chance [46]. However, it does not state how they controlled confounding variables such as the effects of medication [47]. The study utilized at-home exercises and it does not state how these were completed or if the tests were adapted for individuals, which could also be confounding variables. It also does not explain the recruitment of participants.

The fourth paper is the identification and reduction of RPR's by sensory stimulation in ASD: effects on qEEG networks and cognitive functions [48]. This study aims to describe the reduction of RPR's and changes in cognitive function after Transcutaneous Electrical Nerve Stimulation (TENS). Quantitative Electroencephalography (qEEG) is an assessment which records digital EEG signals which are then processed and analysed using complex mathematical algorithms [49]. The study utilized objective tests and produced results which reflected its aim and were precise. It states that the participants were examined at the Institute for Neurology and Neurosurgery in Havana. Two child neurologists both confirmed a diagnosis of ASD from DSM-V criteria and the autism diagnostic interview-revised. This indicates that there was some rigor to the way participants were recruited, meaning it has

some trustworthiness. The study states that it sought ethical approval from the Institute of Neurology and Neurosurgery Ethics Committee and the institutional review board for the University of Hafia and gave participants sufficient follow-up appointments. This suggests that they worked hard to ensure the protection of participants [50]. However, they did not specify how they controlled confounding variables.

The fifth article is titled The Relationship between RPR's and hemispheric connectivity in ASD [51]. This had the aim of comparing children and adults with ASD and RPR's with a control group who did not receive the treatment for RPR's and examined the effects of qEEG and brain connectivity. Participants were recruited from a database, so all the data was anonymised, but it does not state the selection criteria used. Anonymisation means that the research has been stripped of any information which could identify participants and therefore it does not need to be managed as sensitively [52]. The measurements used were objective. The study gave detailed inclusion and exclusion criteria, which showed how the authors tried to control confounding variables. This shows how they developed the quality of the research, as inclusion and exclusion criteria help to determine the characteristics of participants or elements in the research [53]. However, there is no indication of the participants receiving follow-up appointments. This suggests a morally grey area as the declaration of Helsinki [89] states that participants should be offered sufficient opportunity for communication after research. On top of this, the paper does not say how precise the results are, but they are congruent with other studies. It also has a large participant population. This is beneficial as it means there is less chance of the researchers getting a false positive [54].

Findings from the literature

The findings from the five articles found were mostly congruent with each other. This makes them more reliable, as reliability is the extent to which a measure provides a consistent picture of a characteristic [55]. The results from all the studies have been synthesized into themes [56].

The first theme is the reduction of RPR's which all the articles highlighted. The first paper presents its findings in a quantifiable form, with tables showing the results of the Test of Variable Attention (TOVA) assessments and the Woodcock-Johnson test before and after HIT. TOVA is a computerized, language-free test which precisely measures attention and focus in both audio and visual processing [57]. The Woodcock-Johnson test is a series of subtests used for, amongst other things, diagnosing specific learning disabilities [58]. Whilst statistically this only shows an improvement in skills (which will be examined later), it says that significant positive differences in primitive reflex functioning are due to intervention.

The results of the second study are based on observation, therefore, the reduction of RPR's is inferred empirically. This means that it utilized observation, measurement, and experience to collect new data [59]. Therefore, the results may not be reliable as they can be interpreted as subjective, as the results may have been victims of the author's perspective [60].

The third article recorded the presence of RPR's before and after intervention and then converted this into a percentage, showing that the percentage decreased due to intervention. The reflex which saw the biggest percentage reduction was the right palmer reflex (Which causes infants to grasp objects when they are placed in their hands

Table 1: Application of the Adapted PICO Framework to the Research Question.

Population	Children with ADHD and ASD and retained reflexes
Intervention	Interventions to reduce retained reflexes
Outcomes	Effectiveness at reducing it

Table 2: Keyword Strategy and Search Terminology Used in Database Searches.

Population	Children with ASD and ADHD and Retained reflexes or Minors with ASD and ADHD and retained reflexes or Autistic children with retained reflexes or Children with ASD and retained reflexes, or Autistic minors with retained reflexes or minors with ASD and retained reflexes, or children with ADHD and retained reflexes, or Minors with ADHD and retained reflexes Or Children with ASD and ADHD and retained primitive reflexes or Minors with ASD and ADHD and retained primitive reflexes or children with ASD and retained primitive reflexes or minors with ASD and retained primitive reflexes or children with ADHD and retained primitive reflexes or minors with ADHD and retained primitive reflexes.
Interventions	Interventions or treatments or therapy or strategies
Outcome	Effect* or significance or benefit or outcome

[61]), however, all reflexes saw a decrease of 26% to 39%. This suggests that hemispheric-based training programmes have differing levels of efficacy depending on what areas need to be targeted. For example, it may be more effective at targeting the motor regions. These results were also significant as they had a p-value of less than 0.0001%, suggesting they are highly accurate. To support this, the authors used two statistical tests to interpret the data. The plethora of statistical tests available make it difficult to select an appropriate one, however, statistical data is necessary to provide validity [62].

The fourth study again utilized a quantitative table; however, it listed all the reflexes which were tested and the severity of their presence in each participant before and after treatment. It shows that before treatment their severity ranged between 1 (25%) and 3 (75%) indicating some retention. There were some which were observed to be 0% retained before treatment, which demonstrates how RPR's could affect everyone differently. This is supported by Gieysztor [63], which found that in healthy preschool children, 65% of the children had RPR's, but only 9% had altered development, whilst 29% had delayed development. However, it shows after treatment they were all 0% retained. This demonstrates how a 12-week course of TENS can help people with RPR's. The second and fifth studies' examinations of different themes (i.e. Study 2 examines the increase in skills, whereas study 5 examines the decrease in background activity) implies that RPR's have been reduced.

The second theme which is examined mostly in the second article is an increase in skills. The presence of RPR's can inhibit brain development and can be correlated with cognitive impairment, behaviours that challenge and motor skills [64-66]. The second study documents how the child's gait improved, with a decrease in toe walking and a reduction in falls due to the interventions used. The patient was more comfortable going downstairs and had a reduction in impulsive behavior. It is implied that this is due to intervention and the reduction in RPR's.

The first article showed an increase in all TOVA categories post-intervention and an increase in reading and math's skills from the Woodcock-Johnson test, in all but one case, where the result stayed the same. This could suggest that personal factors may influence the effectiveness of HIT. It also shows an increase in the accuracy of physical skills, such as visual stabilization and touching alternating

finger to nose. This suggests that treatment could have an impact on fine motor skills.

The third study reports a 91% increase in participants' scores on the dichotic listening test, which assessed how the participants processed auditory stimuli and divided their attention. A 100% increase was recorded in synchronized metronome training and in mathematical problem-solving results also increased by 5%. This demonstrates how treatment can have a positive impact on many areas of life. Study four suggests that a reduction in RPR's could increase fine motor skills. The authors also think that integrating reflexes can improve sensory input and the unevenness of some developmental delays. This is further supported by Melillo [67].

The final theme is the reduction in background activity in the brain after treatment. However, it is only mentioned in a few of the studies, suggesting it needs further research. It is proposed that studies be repeated an average of three times before their results are trusted [68]. The waves present in the brain are delta, theta, gamma and alpha. Delta brain waves are the slowest recorded brain waves. These are associated with deep levels of sleep and are prominently seen in brain injuries and patients who struggle with thinking. If waves are suppressed, it leads to an inability to revitalise the brain and body [69]. Theta waves are also present in sleep and daydreaming and ADHD-type symptoms can present when they are pronounced. If they are suppressed, then stress-like symptoms can occur [69]. Gamma waves are the fastest brain activity and are responsible for learning and information processing, therefore, suppressing them can lead to ADHD symptoms. Study four states that after treatment there is a dominant alpha pattern clearly outlined in the qEEG report. Alpha waves are important in creativity and increasing them has been found to reduce the symptoms of depression [70,71]. The fifth study found significant amounts of the delta, theta, alpha and gamma bands, with reduced activity of the alpha frequencies. After treatment, those with ASD, experienced a reduction in the delta absolute power, especially in the frontotemporal region of the right hemisphere. Theta absolute power was also reduced. Before treatment, it stated there was a posterior decrease of the alpha absolute power, which increased after treatment. Similarly with Gamma absolute power, a global decrement in the absolute power was found, but after treatment, this had increased, in anterior regions. The study also found that post-intervention, more interhemispheric connections had appeared. These allow the two hemispheres to better communicate and especially process sensory information [72].

Application to practice

From the results of these studies, this author suggests that it would be beneficial to complete more research in this subject area, to raise awareness of this condition and implement a scheme for testing and treatment for all school-age children. This author also recommends that the validity of these studies is tested, by repeating similar studies in the UK and with larger participant bases, to ensure they are fully representative and that there is confidence in the results [73]. One of the biggest indicators of validity is the ability to reproduce a study [74-76]. This would help ensure bias and extraneous variables are limited, as well as allow the studies to use materials from the UK, to ensure the results are applicable. Many studies on this topic have been influenced by one author, therefore, there is a need to diversify the pool of researchers examining it to understand different perspectives. Broadening the pool of research helps to work towards personalized treatments [77]. Establishing diverse evidence base rooted in the

Table 3: Inclusion and Exclusion Criteria for Article Selection.

PICO	Inclusion	Exclusion
Population	Children with ASD and/or ADHD with retained reflexes	Adults, children without ASD and or ADHD, but without RR, Children with RR but without ASD or ADHD.
Interventions	Interventions for RR	Interventions for ASD or ADHD.
Outcomes	Improvement in motor, cognitive or sensory skills. Quantitative results	Qualitative results.
Type	Within the last 10 years, Primary research, the English language, Peer-reviewed.	Outside the last 10 years, non-primary research, Non-English, Non-peer-reviewed.

accounts of ethnic communities can enhance culturally sensitive and compassionate care [78]. It may also be useful to complete research on how treatment for RPR's affects people with a combined diagnosis of ASD and ADHD as this has minimal research. Another area to research could be its effect on people with learning disabilities as this is a grey area but may have a broader application [79]. State that there is an altered baseline of brain activity in children with ADHD, suggesting this research could have a wider application due to the treatment's effects on brain waves.

As proven in the results of these five articles, the treatment of RPR's can positively impact children's quality of life (for example, improving mobility, as indicated in study 2). Therefore, this author further recommends that as more research is completed and published, there is a national testing and treatment pathway implemented. This would be started with children expected to start in specialist schools, as there is a heightened presence of RPR's in that population, however, these recommendations could be introduced to all children starting school in time (This would be important as 26% of children with learning disabilities attend mainstream schools [80]). There would be benefits in this as it improves the quality of their life by, for example, reducing the risk of behaviours that challenge [81], but could also reduce an individual's long-term health costs to the NHS and local authorities.

Alongside the national testing and treatment pathway, this author would also recommend an awareness campaign be rolled out. This would be started by offering all children's community learning disability teams, neurodevelopmental teams and specialist educational needs schools awareness sessions. Training would be offered to help with recognizing symptoms, completing assessments and referrals for assessment/ treatment if they have already started school. Attendees would be encouraged to share this knowledge with their patients and families. Childhood health surveillance is helped by circulating knowledge [82]. In time, awareness sessions may also be rolled out to all other paediatric teams. Teachers may also receive training on how it may present in the classroom and how to support children with this.

This literature review has been instrumental in providing this author with a basic understanding of the topic, and previously published articles; and has highlighted the grounds for further research, thus highlighting the benefits of completing literature reviews [83]. However, this literature review was limited as it was completed by a novice researcher, meaning they do not have sophisticated skills in this area [84]. It also only found five articles relevant to its research topic. This suggests that it had a limited scope and could be missing contradictory evidence. This could be due to issues with the review methodology. Research suggests that all methods should be peer-reviewed [85]. This method was reviewed by academic tutors, but not by other researchers. This is why this author recommends completing further research. Another limitation is that

this author struggled to find articles which included participants with both ASD and ADHD. This suggests that the contraindications of both need to be further examined. Additionally, the research found was international. This may indicate that the objectives of the research do not apply to the UK as different countries may have different objectives [86]. Internationally, there are also different political and cultural sensitivities which should be accounted for [90].

Conclusion

The five articles examined in this literature review provide a consensus that treatment is effective at reducing the symptoms of RPR's in children with ASD and ADHD. The results show treatment can help children improve in other areas, such as math's and fine motor skills. This improves their quality of life. Treatment also reduces background activity in the brain. This provides a strong basis for further research and the implementation of a testing and treatment scheme for children in the UK. A more rigorous approach to research needs to be applied in this area to ensure studies are representative and have validity.

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