

TREATMENTS FOR ASD

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Treatments for Autism Spectrum Disorder: Literature Review

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Abstract

This paper is a literature review of some of the popular treatments for autism spectrum disorder (ASD). It begins with an overview of ASD, the common symptoms, and comorbidities. It includes a review of pharmacological treatments, behavioral treatments, and dietary treatments. Some treatment options in each of those categories are explained and reviewed. The paper also presents the comparison of various treatments to determine which is the most effective. The paper then concludes with what the most effective treatments are and how combined treatments are used.

Treatments for Autism Spectrum Disorder: Literature Review

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) defines ASD as “persistent deficits in social communication and social interaction across multiple contexts” (American Psychiatric Association [APA], 2013). Symptoms are typically visible around age two but could be seen earlier. The symptoms are broken into three main categories: communication, emotional and social difficulties. To be diagnosed the symptoms need to cause major disruption to daily functioning. They should also be persistent through weeks as well as locations (APA, 2013); this means that the symptoms observed will last for multiple weeks and be present in multiple locations.

Each person diagnosed with autism is also given a severity level. The levels help indicate what kind of assistance the individual may need. For example, a level one diagnosis means the patient needs the least amount of support. Their communication is described in the DSM-5 as “difficulty initiating social interactions” as well as “unsuccessful responses to social overtures of others” (APA, 2013, Table 1). People with ASD may also express less interest in social interactions (APA, 2013). They also present with difficulty switching activities and staying organized. A patient with a level two diagnosis needs substantial support. They have “deficits in verbal and nonverbal social communication skills” as well as deficits in social skills even with support (APA, 2013, Table 1). Level two ASD patients present a difficulty with change and have restricted or repetitive behaviors that may interfere with functioning. Lastly, a patient with a level three diagnosis presents with “severe deficits in verbal and nonverbal social communication

skills” which cause “severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others,” (APA, 2013, Table 1). Level three ASD patients have extreme difficulty with change and present restricted or repetitive behaviors that impair functioning. They require the greatest level of support (APA, 2013).

The three levels of severity are used to make decisions about treatment and accommodations. The levels determine which interventions may be appropriate and how often the patient will need those interventions. Moreover, the levels help inform decisions on what kind of accommodations or daily help can be approved and provided for the patient.

While there is not a cure for ASD there are many treatments that can help with symptoms. For example, individuals with ASD need various interventions depending on their symptoms and level of disorder severity. These interventions are based on treatment categories consisting of pharmacological, behavioral, and dietary plans. One important distinction when deciding treatment options is whether the treatment is evidence based. The patient’s treatment team will determine what ASD symptoms the patient has and determine which intervention or interventions will be most appropriate for that patient. This literature review covers some of the more common treatment options and are grouped into three main categories: communication, emotional and social symptoms. It is important to note that there is some overlap when symptoms are grouped this way.

Communication

A person’s communication skills are greatly affected when they have ASD. One of the main symptoms is difficulty giving and receiving information. This can include repetitive or rigid language, uneven language development, and poor conversation skills (National Institutes

of Health [NIH], 2020). Rigid language looks like conversations that are not related to the conversation that everyone else is having. In patients with uneven language development, this can be displayed as a large vocabulary for an area of interest, but not for general conversation. Some patients are non-verbal and their conversation skills include eye contact, gestures and reading someone's emotions (NIH, 2020). Another area of communication that can be affected in ASD patients is reciprocal communication skills which is depicted by difficulty in back-and-forth conversation. The final way communication development can be affected in the ASD patient is the presence of echolalia. Echolalia is repeating words or phrases that the patient heard instead of spontaneously communicating (Davis, 2017).

Emotional

As described above, the problems noted with communication skills are some of the more visible symptoms of ASD, while the emotional symptoms can be more challenging to identify. The emotional symptoms are often compounded by the communication symptoms and are therefore complex to diagnose. The first two emotional symptoms are anxiety and the inability to recognize emotions, both in themselves and others (APA, 2013). The final symptom is irritability which has many potential contributing factors in patients with ASD. Some causes are frustration caused by an inability to communicate needs, pain, medical conditions, stress, and other psychiatric disorders (McGuire et al., 2016). Another cause is sensory processing disorder, a common comorbidity to ASD (Weeks et al., 2012). Sensory processing disorder affects the way the brain interprets sensory input. Some patients exhibit sensory experiences as greater than they are and others require greater sensory input to self-regulate (Tavassoli et al., 2017).

Social

Like the emotional symptoms noted above, in those individuals with ASD the social symptoms can be a result of the communication challenges. Specifically, some of the social difficulties frequently seen are the lack of engaging with others and a strict adhering to rules or schedules. Moreover, the problems with communication and emotion identification and regulation are what cause the delay in social skill development. It is not as easy for ASD patients to participate in spontaneous conversations with others and build relationships. This can be caused in part by missing social cues. Missing social cues can look like not being able to identify the emotions of others or not understanding nonverbal communication. For these reasons, starting and building relationships is harder for people with ASD (APA, 2013).

Pharmacological Interventions

The first category of treatment options is pharmacological interventions. These are often used to treat comorbidities and include “inattention, hyperactivity, anxiety, sleep disturbances, irritability, repetitive behavior, aggression and self-injury,” (Eissa et al. 2018, p.6). They are also used to treat attention deficit hyperactivity disorder (ADHD) like symptoms. Some of the common medications are selective serotonin reuptake inhibitors (SSRI), psychostimulants, antipsychotics, melatonin, folic acid and atomoxetine (LeClerc & Easley, 2015).

Selective Serotonin Reuptake Inhibitors

Selective Serotonin Reuptake Inhibitors (SSRI) are used to help with repetitive behaviors as well as to treat anxiety and irritability. They work by increasing serotonin levels in the brain. Specifically, SSRIs block the reabsorption of serotonin by nerve cells so that the serotonin stays in the brain (National Health Service, 2018). One type of SSRI is fluoxetine (Prozac) which is an

antidepressant (National Health Service, 2018). There is ample research to support the use of SSRIs in adults, but less in children.

For example, one study found that adults taking fluoxetine showed significantly greater score reductions for repetitive behaviors as compared to the placebo group (Hollander et al., 2012). In another study, low doses of fluoxetine were given to children with the goal of treating “anxiety, irritability, tantrums, and/or aggression regarding change and transitions, and other rigid/repetitive symptoms” (Crowell et al., 2017, p.166). The study found that most of the children had a significant decrease in these symptoms at a very low dose. Half of the children also showed improvement in social and conversational abilities. The authors concluded that children respond well to low doses of fluoxetine (Crowell et al., 2017). Additionally, fluoxetine can be used to treat obsessive-compulsive behaviors. One study found that children and adolescents treated with fluoxetine had significantly lower obsessive compulsive behavior scores compared to the placebo group (Reddihough et al., 2019). Fluoxetine is a good treatment choice for a patient with anxiety, irritation, or repetitive behaviors.

Psychostimulants

Another category of medications is psychostimulants which are used to treat hyperactivity. One of the common psychostimulants recommended is methylphenidate, also called Ritalin or Concerta. Methylphenidate works by increasing dopamine levels, a neurotransmitter that affects pleasure, movement, and attention (NIH, 2014). These types of drugs which are stimulants, work to treat hyperactivity because the brain of a hyperactive person is seeking sensory input and stimulation and cannot get enough from everyday circumstances. The increase of dopamine from methylphenidate will fulfill the stimulation the brain is craving.

Additionally, methylphenidate is used to treat hyperactive symptoms and ADHD in children with ASD. One study in children concluded that low doses of methylphenidate were effective in treating hyperactive symptoms in children with ASD, the children were evaluated by parents, teachers, and clinicians and all reported a decrease in symptoms (Pearson et al., 2013). The study also noted that some patients may need higher drug doses, but the recommendation is to start at a low dose and increase as needed (Pearson et al., 2013). Another study evaluating the long-term efficacy of methylphenidate in children and adolescents with ADHD and ASD found that it reduced severity of the illnesses in the first two years of treatment with methylphenidate (Ventura et al., 2020). Methylphenidate is a good treatment option for children with ASD who are presenting with hyperactivity or a comorbid diagnosis of ADHD.

Antipsychotic

Antipsychotics can be used to treat tantrums, aggression, and self-injurious behaviors. Antipsychotics work by blocking dopamine pathways to reduce dopamine transmission in the brain (Guzman, 2019). One of the atypical antipsychotics used to treat ASD is risperidone which has been shown to be effective in reducing repetitive behaviors as well as decreasing social withdrawal and hyperactivity. One study that measured the efficacy of risperidone in children found that the group of children taking risperidone showed a greater decrease in irritability compared to the children in the placebo group (McCracken et al., 2002). These results indicate that after 8 weeks of treatment, risperidone was effective in reducing irritability in ASD children. Another study showed that patients taking risperidone improved from baseline irritability scores that were almost double the score improvements of the placebo group. Shea et al. (2004) concluded that risperidone was effective in treating irritability and was tolerated well in children

with ASD. Hellings et al. (2006) evaluated the efficacy of risperidone for treating irritability in children, adolescents, and adults. They showed that risperidone effectively reduced irritability as over half of the participants taking risperidone showed at least a 25% reduction in irritability scores on the Irritability Subscale Score (Hellings et al., 2006).

Another antipsychotic, aripiprazole, is also used to treat irritability. Trials in children and adolescents with ASD show it to be significant in reducing repetitive behaviors (Owen et al., 2009). Moreover, the decrease in irritability subscale scores, as shown in the aberrant behavior checklist, was significantly greater for patients in the aripiprazole group compared with the placebo group (Owen et al., 2009). Another study reported similar results when conducting a double-blind study on children and teens with ASD to determine the efficacy, safety, and tolerability of aripiprazole to treat tantrums, aggression, and self-injurious behavior (Marcus et al., 2009). Specifically, they found that the aripiprazole group had greater improvements on the aberrant behavior checklist irritability subscales scores as compared to the placebo group. The study also concluded that aripiprazole was effective and well tolerated for treating irritability in children and teens with ASD (Marcus et al., 2009). As with risperidone, aripiprazole is an efficacious option for treating irritability in children.

Other Common Medications

There are other common treatments that are used to manage ASD symptoms, but the treatments do not meet the same medical criteria of the drug categories discussed above. These treatments include melatonin, folinic acid, and atomoxetine. For example, melatonin is a hormone supplement, folinic acid is an active form of the vitamin group folate, and atomoxetine

is a cognitive-enhancing medication. Importantly, all these treatments can be prescribed by a doctor.

Melatonin, a natural hormone produced by the brain as a response to the dark, is commonly supplemented in a synthetic form to improve sleep and reduce insomnia (NIH, 2021). The physiologic action of melatonin is to help regulate the body's circadian rhythm which facilitates better sleep. While many people supplement with synthetic melatonin, few studies have assessed its use in ASD patients. Because 50-80% of children with ASD have sleep problems, melatonin may help manage and improve sleep quality in these children (Hohn et al., 2019).

One study that measured the efficacy of prolonged-release melatonin as a long-term treatment for insomnia in children with autism found it to significantly increase total sleep time while reducing sleep latency and increasing the duration of uninterrupted sleep. (Maras et al., 2018). Another study that assessed melatonin dosage and sleep latency in children found that when children with ASD are given 1mg or 3mg of melatonin 30 minutes before bedtime they fell asleep faster (Malow et al., 2011). The authors noted that these sleep improvements were visible within one week of the children taking an effective dose. While these studies support the efficacy of melatonin use for insomnia in children with ASD, additional studies are necessary.

Another treatment, still being tested in studies to assess its use in children with ASD, is folic acid supplementation. Specifically, folic acid, which is used to treat folic acid deficiency, may help improve spoken language in children with ASD. One study, which supplemented folic acid in 5, 10, and 25mg doses twice a day to children with ASD, found there was a statistically significant improvement in verbal communication in patients with

abnormal folate metabolism but not in participants with normal folate metabolism (Frye et al., 2016). Interestingly, a secondary outcome was an increase in daily living skills as measured on the Vineland Adaptive Behavior Scale in the folic acid group as compared with the placebo group (Frye et al., 2016). The study noted that they did not see any serious adverse effects with folic acid supplementation in the participants (Frye et al., 2016). Another study also tested the efficacy of folic acid in reducing symptoms in ASD children, but unlike the study by Frye et al. this study did not group patients based on their folic acid metabolism (Renard et al., 2020). Overall, there was significant improvement in global Autism Diagnostic Observation Schedule (ADOS) score, reciprocal social interaction score, and communication score in the folic acid group compared to the placebo group (Renard et al., 2020). From these initial study results, there is evidence for folic acid supplementation being an effective treatment in ASD patients with folic acid deficiency, but not in those with normal folate metabolism.

Atomoxetine, a norepinephrine reuptake inhibitor, is given to ASD patients to manage hyperactive tendencies in children. Like methylphenidate (described earlier), atomoxetine increases dopamine in the brain, but through a different physiologic mechanism. One study showed that atomoxetine moderately improves ADHD symptoms in patients with ASD (Harfterkamp et al, 2012). Specifically, after eight weeks of treatment with atomoxetine, the scores on the ADHD-Rating Scale had significantly improved in the group taking the drug compared to the placebo group (Harfterkamp et al, 2012). Another study found that while the children with ASD in the group receiving atomoxetine had less ADHD symptoms than the placebo group, the ASD children also had lower effective rates than their developing peers

(Arnold et al., 2006). Atomoxetine could be a good alternate option for a child presenting ADHD symptoms for whom methylphenidate does not work.

Behavioral Interventions

Behavioral interventions are used to address comorbidities or to teach life skills. Some of the comorbidities that are treated include anxiety, repetitive behaviors, and a lack of communication skills. Importantly, the main goal of treatment should be to increase independence, not to make the person “acceptable” to society. Moreover, the goal of any behavioral therapy is to teach coping mechanisms or life skills. The common behavioral interventions used in children with ASD include cognitive behavioral therapy, applied behavioral analysis, treatment and education of autistic and communication handicapped model, sensory based approaches, and the Developmental, Individual Difference, Relationship-based Model/Floortime. Each of these interventions is effective and currently used in ASD treatment plans.

Cognitive Behavioral Therapy (CBT)

One behavioral intervention option is cognitive behavioral therapy (CBT). The purpose of CBT is to help those individuals affected by ASD achieve their goals and adapt their ways of living. In this type of intervention, the therapist focuses on changing beliefs in the patient, not on changing personality. Thus, this therapy works to help the patient learn independence and how to control their own lives. Importantly, CBT is often used to treat the comorbidity of anxiety disorders (Association for Behavioral and Cognitive Therapies, n.d.).

CBT is generally performed the same for all patients with similar goals. One study concluded that relief from anxiety can be attainable through CBT especially in children with

high-functioning autism (Wood et al., 2009). In their study, it was noted that although relief from anxiety was shown, CBT is not always effective in teaching ASD patients to generalize their coping skills. For example, patients learn to use their coping skills in the environment where their therapy is performed, but do not know how to use them in other environments or situations to ease their anxiety. Therefore, these authors further assessed whether modifications to typical CBT help with coping skill generalization. They found that when the parents and teachers were trained in providing cues about what coping strategies to use with the ASD children, these children learned how to use the new cues to better cope in the classroom and at home (Wood et al., 2009).

One method of CBT is visualization. Although visualization is not always included in the CBT treatment plan, it is effective for people with ASD. For example, Ekman & Hiltunen (2015) found significant improvement in anxiety and avoidance behaviors from pre to post therapy suggesting that visualization helps the patients to conceptualize the social and emotional cues they find difficult to understand.

Applied Behavioral Analysis (ABA)

Another behavioral intervention used in ASD is applied behavioral analysis (ABA). This intervention is used to help with behavior issues in people with autism although the ethics of this treatment are debated. For example, the true purpose of ABA is to decrease undesired behaviors and increase social behaviors. Unfortunately, ABA was first created with the purpose of curing ASD thus there are groups who believe that ABA is a form of abuse because it is used with aversive reinforcement (Child Mind Institute, n.d.). In contrast, others support ABA as a form of intervention as it is used to teach independence and life skills. Importantly, the opposition or

support of ABA intervention is dependent on a person's experience and the therapist's treatment goals. When done correctly and in an ethical manner, ABA can be used to treat food selectivity and teach life skills needed for independence. ABA is a reinforcement-based therapy in which the therapist prompts and reinforces behavior (Kirkham, 2017) with techniques that include modeling, using pictures, small groups, and reinforcements (Association for Science in Autism Treatment, n.d.).

More important than the anecdotal evidence for or against ABA is the evidence from research. In one example, the modified sequential oral sensory (M-SOS) approach was compared to ABA therapy to treat food selectivity in children with ASD. ABA therapy had an 80% or greater acceptance for first time food exposure, whereas M-SOS had no increase in acceptance (Peterson et al., 2016).

To determine if ABA is an effective treatment for the symptoms of ASD the different treatment approaches need to be assessed. The main treatment approaches include discrete trial training, early intensive behavioral intervention, pivotal response training and the verbal behavior intervention. When comparing the methods, it is important to note that while these are all considered separate methods used by ABA therapists there is often overlap in their use. A therapist will use more than one of the methods in those with ASD depending on the individual therapy goals.

Discrete Trial Training (DTT)

The first type of ABA therapy is discrete trial training (DTT). DTT consists of five steps. The first step involves the use of a cue where the teacher gives instructions. The next step is a prompt which is when the teacher helps the child to give the correct response. At this step, the

teacher gradually gives less help. The third step occurs when the child gives a response to the cue, and that is followed by the fourth step, the consequence. In this step the teacher will reinforce or reward the correct response and indicate if the response was wrong and give no reinforcement. The final step of DTT is the intertrial interval and at this point the teacher will pause before giving the next cue. Each DTT trial lasts 5-20 seconds and is conducted one on one with a teacher and child in a calm, not distracting environment. It is used to teach new skills or behaviors, communication skills, imitation and more (Smith, 2001).

One review of studies of language therapy for children found that while DTT is a common intervention, normalized language training was more effective in helping with language skills than DTT (Delprato, 2001). In contrast, another study of speech and language interventions for children with ASD concluded that DTT is a good way to build the foundation for learning skills through other methods (Goldstein, 2002). The studies are inconclusive as to the efficacy of DTT in building language skills in children with ASD, thus, more research is necessary.

Early Intensive Behavioral Intervention (EIBI)

In addition to DTT, ABA therapists use early intensive behavioral intervention (EIBI) in those children with ASD between the ages of one and four. Of note is that this intervention is performed in the home or school setting. Interestingly while EIBI is a common technique used in ABA intervention, there is not enough evidence to determine its effectiveness in improving behavior problems in children with ASD. One study of children with ASD found that EIBI improves adaptive behavior but does not have a significant impact on decreasing the severity of autism symptoms (Reichow et al., 2018). Other results reported in this study, however, noted that

EIBI can improve IQ, expressive language skills and receptive language skills. There was no evidence that this intervention helps improve behavior problems (Reichow et al., 2018).

Pivotal Response Training (PRT)

The third technique used by ABA therapists is pivotal response training (PRT), which is a play-based intervention with the goal of improving broad areas of development instead of specific behaviors. This training is based on the idea that changes in vital development areas, such as language and motor skills, will spread to improvement in other development areas. PRT, (similar to Floortime which is discussed later in this paper) is organized around the child's interests and what they want to play with. Like other ABA techniques, PRT uses positive reinforcement to teach social interactions (Applied Behavior Analysis Programs Guide, n.d.). For example, one study of children with ASD compared the traditional ABA approach, with DTT and PRT for improving verbal expressive communication and revealed that PRT is more effective at improving social communication skills in children with ASD than the structured approach (Mohammadzaheri et al., 2014). Another study compared the use of PRT and basic ABA therapy for improving ASD symptoms in children. The researchers found that the PRT group had a positive effect on ASD symptoms but did not have definitive improvements on any other areas such as the child's communication skills or parent stress (Duifhuis et al., 2017).

Verbal Behavior Intervention (VBI)

The final ABA therapy technique used in intervention in those with ASD is the verbal behavior intervention (VBI). VBI is based on learning language skills to help the child with ASD get their needs met as opposed to just increasing general vocabulary. This method helps children gain functional language skills, meaning they can use words to get their needs met. Additionally,

positive reinforcement is used to obtain correct answers in the same way it is used in other ABA methods. As an example, a child is asked “what an object is” and if the child communicates in any way what the object is, they are rewarded. In the beginning stages of VBI many prompts are used, and non-verbal communication is acceptable, but the goal of the intervention is to use no prompts and have a verbal response (Applied Behavior Analysis Programs Guide Staff, 2020).

While this method is used often in intervention, there is little research-based evidence to support its effectiveness (Applied Behavior Analysis Programs Guide Staff, 2020). In one review, Carr & Firth (2005) concluded that “the VB approach is based on sound conceptual logic and is empirically supported by a number of studies,” (p. 21) and calls for more research-based evidence.

Treatment and Education of Autistic and Communication Handicapped (TEACCH)

The third behavioral intervention used in those with ASD is the treatment and education of autistic and communication handicapped (TEACCH) education method. TEACCH is a program created to provide structured learning to children with ASD. The program focuses on the individual child’s interests and needs and creates a program specific to them (Butler, 2007). There are four main aspects to the TEACCH method including structure, visual information, special interests, and meaningful or self-initiated communication (Mesibov & Shae, 2010). Structure refers to both an environment that is physically consistent as well as one that contains a consistent schedule. In the second aspect of the TEACCH method, visual information is important because many ASD patients are visual learners. One study showed that children with ASD can follow written instructions better than verbal or demonstrated instructions. Additionally, TEEACH uses special interests to engage the child with ASD. The learning

activities utilize the patient's interests to keep them engaged and willing to keep learning and participating. The final aspect of the TEEACH method is meaningful or self-initiated communication. Here, the purpose is for the child to learn functional language skills. It is noteworthy that TEACCH is used in self-contained special education classrooms and is more effective in this setting; this method cannot be used in the normal classroom (Mesibov & Shea, 2010).

As examples of the TEACCH methods, in a small study of three students with severe disabilities, TEEACH increased the student's engagement (Park & Kim, 2018). Moreover, another study comparing methods of teaching children with ASD found statistically significant differences when a nonspecific program was compared with the TEEACH method in the areas of daily living skills, socialization, and maladaptive behaviors (Panerai et al., 2009). The nonspecific program group was defined as education in a mainstream school, but not specifically designed for children with ASD. The TEACCH method was performed at home and in the mainstream schools. The study showed that the TEACCH program was more effective than a nonspecific program for educating ASD children (Panerai et al., 2009). Another study on the success of TEACCH for children with ASD was measured by parent satisfaction. The parents whose children were participating in the TEEACH method reported high satisfaction rates with the education their children were receiving (Mesibov & Shea, 2010).

Sensory Based Approaches

An additional category of behavioral interventions is sensory based interventions. Sensory based approaches are for people with ASD who are hyper-reactive or hypo-reactive to sensory information. It is important to address hyper- or hypo-reactivity because it can impair

everyday functioning. Sensory approaches desensitize the individual's sensory system or teach the individual appropriate ways to give their sensory systems the input it needs. Those with hypo-reactivity need extra sensory input (Weitlauf et al., 2017).

One study found that parents and teachers of ASD patients treated with sensory integration therapy reported greater significant improvements in meeting goals than those of ASD patients treated with fine motor interventions (Pfeiffer et al., 2011). Padmanabha et al. (2018) showed a significant difference in Parent Rated 10-item Likert Scale scores of children receiving a sensory integration intervention as compared with children in standard therapy. In addition, there was a marked decline in motor stereotypes and hyperactivity in the sensory integration group. There were also greater improvements in the sensory integration group's eye contact, auditory sensitivity, and tactile sensitivity (Padmanabha et al. 2018).

Developmental, Individual Difference, Relationship-based Model/ Floortime

The final type of behavioral intervention is the Developmental, Individual Difference, Relationship-based Model (DIR) developed by Dr. Stanley Greenspan (Interdisciplinary Council on Development and Learning [ICDL], n.d.). His technique called Floortime is a type of social communication intervention that is not commonly used with adults but is used in ASD children who have developmental delays to meet missed milestones. Importantly, the National Institute for Health and Care Excellence (NICE) (2013) recommends social-communication interventions for children with ASD. The overall goal of this intervention as stated by the ICDL (n.d.) is to “build healthy foundations for social, emotional, and intellectual capacities rather than focusing exclusively on skills and isolated behaviors,” (para. 4). The technique is conducted by psychologists, special education teachers, and therapists, especially speech and occupational

therapists. The best results occur when parents and caregivers are also taught the therapy techniques they can be done at home. The person conducting the therapy interacts with the child by doing activities the child enjoys which works on the social or emotional goals set. Because the emphasis of the therapy is on the child's emotions which are crucial for development, the intervention needs to be enjoyable for the children. (ICDL, n.d.)

Using the DIRFloortime technique, one study consisting of 11 children with ASD who interacted with their parents during the intervention activities showed significant score increases for emotional functioning, communication, and daily living skills (Liao et al., 2014). Another study of 24 children with ASD that compared the emotional functioning of children receiving DIRFloortime to a control group that did not found a significant increase in the Functional Emotional Assessment Scale scores in the children participating in the DIRFloortime therapy (Solomon et al., 2007). Moreover, there was also a significant difference in the Childhood Autism Rating Scale, showing a decrease in autistic severity, between the intervention group and the control (Solomon et al., 2007). Another study of children with ASD showed that DIRFloortime increased social interaction skills (Casenhiser et al., 2011).

Dietary Treatment

Another option for people with ASD is dietary treatments. Unlike the other treatment options outlined in this paper, it is difficult to determine definitively if dietary treatments work for those with ASD. Importantly, there is minimal scientific evidence to support the adoption of these treatments across all ASD patients, but dietary treatments may be an effective option for treating specific problems. Three common dietary treatments available are tetrahydrobiopterin,

gluten free diets, and probiotics. The use of these approaches requires trial and error among individuals to determine the effectiveness.

Tetrahydrobiopterin (BH4)

The first dietary intervention is tetrahydrobiopterin (BH4) which is a cofactor vital for metabolic pathways. These pathways include the production of monoamine neurotransmitters and nitric oxide as well as the destruction of phenylalanine. Irregularity in the functioning of these pathways has been shown in those with ASD. Moreover, reports of reduced amounts of BH4 in the central nervous system of patients with ASD have been found (Klaiman et al., 2013). For example, one study reported that there is evidence of an association between ASD and metabolic pathway abnormalities (Delhey et al., 2018). Additionally, BH4 had a positive effect on oxidative damage and methylation metabolism. There was no evidence however to support that BH4 is effective in treating any autism symptoms if the patient does not have abnormalities in their metabolic systems (Delhey et al., 2018).

One study of children with ASD treated with BH4 found that those children receiving BH4 showed improvements in some of the main symptoms of ASD such as social awareness, autism mannerisms, hyperactivity, and inappropriate speech (Klaiman et al., 2013). The results also showed that those in the BH4 group decreased their stereotypic behaviors such as hyperactivity and inappropriate speech (Klaiman et al., 2013).

Probiotics

Another dietary intervention used for treatment in those with ASD is probiotic supplementation which targets GI symptoms. The prevalence of GI symptoms among ASD patients ranges from 9% to 70% (Santocchi et al., 2020). As reported by Abdellatif et al. (2020)

microbiota in the GI system are vital for brain development in early childhood, and there is evidence for an association between GI symptoms and more severe levels of ASD. Furthermore, probiotic use is important for patients with ASD due to their struggle to communicate GI discomfort. This is especially true of patients diagnosed with a level two or three ASD severity as they may have little functional communication.

Additionally, probiotics can be used to treat sensory symptoms in people with ASD. One study compared ASD patients who have GI symptoms to those who did not. The study found significant improvements in GI symptoms as well as a normalization of their sensory processing scores in the GI group who received the probiotic. The probiotic GI group also showed improved sensory scores (Santocchi et al., 2020). In conclusion there is evidence to support the use of probiotics for all ASD patients or all ASD patients with GI symptoms.

Gluten Free Diet

The final dietary intervention utilized in those with ASD is a gluten free diet which is popular but has little evidence that supports efficacy. Moreover, although much anecdotal evidence supports this type of diet in those with ASD, researchers believe that the evidence is due to the placebo effect or reasons other than ASD (Hurwitz, 2013). For example, the amount of evidence-based information that supports using gluten free diets in those with autism is no different than in those without autism. This lack of information is especially apparent unless a person is gluten intolerant.

One study compared the effects of a gluten free diet on people with ASD and found significant improvements in the gluten free diet group compared to the gluten diet group for scores on the Autism Diagnostic Observation Schedule-2, Restricted and Repetitive Behaviors,

Social Communication Questionnaire, and the Autism Spectrum Rating Scale which all test autism severity (Piwowarczyk et al., 2019). However, no significant differences in GI symptoms between the gluten free diet group and the gluten diet group were noted (Piwowarczyk et al., 2019). The studies that have been conducted do not show definitive evidence that a gluten free diet will alleviate ASD symptoms in a patient who does not also have GI symptoms.

Conclusion

It is difficult to determine the most effective treatment for ASD because each therapy targets different symptoms and comorbidities. Therefore, many patients participate in at least one therapy in each intervention category. While it is common for patients to participate in multiple interventions there is little evidence to support this practice as treatment efficacy varies widely. Moreover, it is difficult to conduct research on each therapy intervention because patients are typically in more than one therapy. The research on combined interventions is limited (Vivanti, 2017). After examining the evidence-based practices for ASD one study concluded that ASD patients should have a multidisciplinary approach to treatment that continues into adulthood (Politte et al., 2015).

Fortunately, a few studies have investigated the efficacy of multiple types of therapies at once. One study compared the impact on challenging behaviors when the ASD patient was treated with sensory interventions and behavioral interventions. The patients were treated with both treatments in varied orders and the results showed the behavioral interventions reduced challenging behaviors in ASD patients better than the sensory interventions (Lydon et al., 2017). Similarly, another study comparing sensory interventions and behavioral interventions for self-

injurious behavior found that the behavioral interventions were more effective in reducing self-injurious behavior than a sensory intervention (Devlin et al., 2009).

Regarding the various pharmacological interventions, it is difficult to determine if the use of one drug is more effective than the use of other drugs because few studies have compared multiple medications. The results of one study that compared the effectiveness of different psychiatric medications for ASD found there was not enough empirical evidence to support that one medication was more effective than the other (Coleman et al., 2019). The authors concluded that medication use is based on the specific effectiveness in individuals and their opinion on how well the medication worked. Additionally, the methods of the study did not measure the medication doses in the participants and lacked continuity across participants as to what symptoms were targeted (Coleman et al., 2019).

Unfortunately, the dietary options also cannot be compared because the dietary interventions used in those with ASD are based on the individual's biology and what their digestive and metabolic systems require. It is unlikely that one dietary option will work for all ASD patients. For example, if a patient can digest gluten well, then a gluten free diet will probably not help them. Only trial and error for individual patients can determine which dietary intervention is the most effective for them.

Importantly, Politte et al. (2015) state that behavioral interventions have the most evidence of efficacy in treating "core social communication impairments" (p.52). The behavioral interventions described earlier have consistently been used as therapy in those with ASD and therefore much literature describes the efficacy of behavioral intervention use in various ages and severities of patients with ASD. While there cannot be a definitive answer to what the most

effective behavioral interventions are for ASD, some interventions are more effective. As Mesibov & Shea (2010) stated, more important than naming the best intervention is answering the question of “What do we know that may best help this client?” (p. 577).

There needs to be more research into ASD treatments that are anecdotally effective so that evidentially effective treatments can be implemented. Moreover, clear definitions of the current ASD theories and interventions are necessary. Specifically, there is some confusion between terms in the ASD community and the ASD research community. One example is the difference between behavioral and developmental interventions (Vivanti, 2017).

While it would be helpful for parents and practitioners to be able to determine which interventions are most effective for each ASD severity level, it is not possible with the current research. As previously stated, there is not enough scientific evidence to clearly determine which interventions are best for treating each ASD symptom. Also, patients in each level are likely to have similar symptoms at various severity levels. It is likely that similar interventions will be effective across the severity levels, but this cannot be stated definitively with the current evidence. Some patients at higher severity levels may need the interventions for longer or more often to have similar effective levels to their peers diagnosed with lower severity levels.

In conclusion, at this time considering the current evidence, the most effective method of treatment for patients with ASD cannot be determined. Each practitioner and patient need to collaborate and try different interventions to determine what works best. Using this individualistic approach, ASD treatment options can be narrowed by selecting interventions that have sufficient scientific evidence to support their efficacy.

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