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Music as a therapeutic approach in children with autism spectrum disorder

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Abstract--Music therapy is an alternative form of therapy that has positive impact in many areas of physical and mental health. The purpose of this study was to review researches systematically on the impact of music therapy in children with autism spectrum disorder. PRISMA model was followed including 17 researches out of 27 researches published in various journals related to music therapy from sources like PubMed and Scopus over 6 years and were analyzed in detail. Findings suggested that music therapy has positive outcomes as a treatment approach in children with autism with one study showing no significant relationship. Most of the studies were done on social skills and communication, stereotype behavior and motor coordination and less on other domains like social affect and responsiveness, understanding others gestures and perspective, resistance to change and echolalia. Future studies need to focus on the domains less studied on.

Keywords--Music therapy, Autism Spectrum Disorder, Positive Outcomes, Stereotype.

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopment disorder the symptoms of which can manifest since 2years of age. Characteristics include lack of social

interaction and communication, and restricted and repetitive behaviors (APA, 2013). Common signs and symptoms include inability to make eye contact, not looking at or listening to people, inability to share enjoyment by pointing at or showing things, inability to have conversation, inability to understand other peoples point of view through their gestures and behavior, not giving anyone the chance to respond, inconsistent affect to what is being said, unusual use of sound or tone of voice, echolalia, intense interest on specific topics, resistance to change, repetitive movement of objects or parts of object or their own body, over or under-sensitivity to various sensory input etc. (NIH, 2018).

People with ASD may also have certain strengths like learning things in detail, long lasting memory, strong learning through visual or auditory sensation and being excellent in a particular subject (NIH, 2018). It has many underlying causes related to brain connectivity, aetiology and clinical manifestation (Masi et al. 2017) although the exact cause is unknown. Some of the common aetiological factors include having a first degree relative with ASD, older parents, having a genetic condition like Down's syndrome, or Fragile X syndrome or Retts syndrome etc., and low birth weight (APA, 2013).

Diagnosis of ASD includes general developmental screening, well-child checkups, checklists and their communication and behavior in school and classroom environment. Most challenges are observed in children attending school as they are not able to engage themselves in social groups, thus restricting their socio communicative development (Coffey, 2013; Dillon & Underwood, 2012). Hence a proper diagnosis of the disorder helps families seek various psychological help and therapies. Therapies are highly expensive and time consuming (Warren et al. 2017; Horlin et al. 2014). Pharmacological treatments help lessen certain symptoms like irritability, aggression, agitation, repetitive behaviors or restricted behaviors. The other issues of communication, interaction, speech, attention etc are dealt by behavior therapy, life skill development, speech therapy and other educational and psychological therapy. Currently the most widely used treatment strategies for autism are contemporary behavioral intervention, developmental approaches and social skill interventions (Roa, Beidel & Murray, 2008; Vismara & Rogers, 2010).

Music is one of the first experiences of every infant in the form of lullaby to calm down or put them to sleep (Trehub, 2003). A child at fetal stage can hear the sounds in the external environment and recognize its mother's voice. Also, listening to music at this stage enhances the neural activity and the neonatal behavior (Partanen et. al, 2013; Arya et. al, 2012; Arabin, 2002) Music is a sound generating specific vibration that moves through the medium of atmosphere and enters the human body through ears and processed by the brain which ultimately impacts the mind and body of the individual (Field et. all, 1998). Music has an aesthetic potential and is known for its healing powers. Music therapy (MT) is used for communication development, stress reduction, crisis intervention, initiation of movement, strong motivator and even to promote memory and imagination (Hegde, 2017; Sarkar & Biswas, 2015). MT could be delivered through either listening to music, or performing songs, or playing instrumental music or even dancing with the rhythm and beats of the music (Sarkar & Biswas, 2015).

Music is a social activity and has ability to draw children's attention and help in promoting attention and language development (Morton, Kershner & Siegel, 1990; Kolko, Anderson & Campbell, 1980; Hargreaves, Marshall & North, 2012). MT is earning name for its applicability in improving social communication and skills in developmental disorders which is the central characteristic in ASD (Perry, 2003). There is promising literature of its use in ASD and is growing every day (Simpson & Keen, 2011). MT is used with both children and adults with ASD centrally for: 1. Cognitive, 2. Behavioral, 3. Communication, 4. Social skills, and 5. Emotional regulation (AMTA, 2008). Music is processed throughout the brain stimulating the cortex of both the hemisphere and its use enhances speech and language skills which are important in ASD (Wan et. al, 2010). MT promotes non threatening relationship that helps in learning, self expression and non verbal communication enhancing socially appropriate and acceptable behaviors as it stimulates multiple sensory modalities. Because of its rhythmic component, it enhances multiple sensory perceptual motor skills, gross motor skills and fine motor skills (AMTA, 2008). Also there are different ways of using MT such as passive listening of music, actively creating music, activity based MT and Improvised Music Therapy (IMT) (Spiro & Himberg, 2016). In this study, quantitative studies were less in number due to difficult clinical condition and rare conditions hence interview based studies with qualitative nature was included to help understand the perspective and experiences and thus this served as the rationale of the study.

Methods

A secondary research for systematic analysis was considered for study with a view on the developments of use of music therapy on the various levels of functioning of children with autism spectrum disorder over a period of 6 years. The various criteria for considering studies for this review are explained as follows:

Types of studies: Both qualitative and quantitative studies over a period of 6 years were included in this systematic review, with data collected through questionnaires and interviews. Studies from 2014 to 2019 was taken because of the popularity and extensive use of activity based MT during this period as prior to this period music therapy in ASD was restricted to passive listening of music (Wigram, 2004; Spiro & Himberg, 2016) and less on activity based MT. Various music therapy approaches including instrumental music, music based short story, sung directives, Randomized Control Trials(RCT) etc. was considered in this systematic analysis. Interview based studies and qualitative studies served as the rationale for the study because of difficult clinical conditions and rare conditions, and qualitative studies helped in understanding the perspectives and experiences.

Type of participants: This study included children with various levels of ASD with an age group ranging from 3-12 years regardless of gender, location and socio economic conditions.

Type of Intervention: The study included only those researches which were done on music intervention with various forms of activities during the therapeutic procedure with a duration ranging from one month session to 5 months session and it included both songs and instrumental music to which the participants

were involved by actively involved in the musical activities designed by the researcher.

Type of outcome: The following 6 outcomes have been identified from all the researches under consideration which has been elaborated in Table 1.

Table 1: Clusters of outcomes of music therapy in children with Autism Spectrum Disorder

Outcome	Included variables	Studies
Attention	behavioral attention	LaGasse et al., 2019
	neural processing	LaGasse et al., 2019
	joint attention	Yoo & Kim, 2018, Srinivasan et al., 2016, Chiengchana & Trakarnrung, 2014
	social attention	Srinivasan et al., 2016
Social Skill	social skill	Bharathi et al., 2019, LaGasse, 2015, Ghasemtabar et al., 2015
	rhythm and tempo adjustment	Yoo & Kim, 2018
	joint attention	Yoo & Kim, 2018
	mathematical ability	Yoo & Kim, 2018
	social affect	Crawford et al., 2017
	social responsiveness	Crawford et al., 2017, LaGasse, 2015
	Performance	Paul et al., 2015
	frequency of social gestures	Paul et al., 2015
	eye contact	Paul et al., 2015
Communication Skill	communication skill	Salomon & Elefant, 2019
	social communication	Sharda et al., 2018
	brain connectivity	Sharda et al., 2018
	Comprehension	Schwartzberg & Silverman, 2016
	social interaction	Thompson et al., 2014
Stereotype	Stereotype	Lakes et al., 2019
	compulsion behavior	Lakes et al., 2019
	matched stimulation	Gibbs et al., 2018
Motor Coordination	motor coordination	Imankhah et al., 2018
Feasibility	study procedures	Gretsegger et al., 2016
	Safety	Gretsegger et al., 2016
	concomitant treatment	Gretsegger et al., 2016
	Consistency	Gretsegger et al., 2016

Search methods for identification of studies

Literature was searched using electronic databases of Scopus and PubMed from 2014 to 2019. Different combination of words including “activity based music

therapy or intervention in children with Autism Spectrum Disorder” was used to search for relevant studies. Then all the articles from 2014 to 2019 examining the use of MT in children with ASD were read thoroughly removing the duplicates. Review studies and studies without systematic data were excluded.

Data collection and Analysis

After all the duplicates were removed, the abstract and the full papers of the included researches were analyzed. They were listed in a table with study characteristics and results. There were many studies that included similar outcomes in different variables. Table 1 depicts the list of outcomes with different variables and the studies. For each of the study the statistical design was studied systematically.

The studies that were included in this systematic review are: 1) all studies where data is primary, 2) pilot studies using quantitative techniques, 3) qualitative studies based on interview and other tests, 4) Improvised techniques of MT i.e. active participation of children with ASD in MT, 5) application of MT for a month or more, and 6) MT given on children with ASD of 3-12 years. There were too few studies on similar controlled design and there were studies conducted by same author which violated the assumption of independent controlled study due to which a systematic approach for analysis was considered over a meta-analysis.

Result

Description of the studies

Preferred Reporting Items for Systematic Review and Meta Analyses (PRISMA) depicted the identification process of the literature (Fig 1). A total of 127 studies in Scopus and 124 studies in PubMed on the use of MT in children were found over a period of 6 years. Removing the duplicates, a total of 131 studies on the use of MT in children were available. Out of these 131 studies only 27 studies were found describing about the use of MT in children with Autism Spectrum Disorder. Identifying the various inclusion criteria mentioned above for these 27 studies, only 17 researches qualified for the analysis of the proposed study. Among these 17 researches, 11 studies were quantitative researches done with primary data collection method and the rest 6 studies were qualitative researches with approaches like survey and interview method.

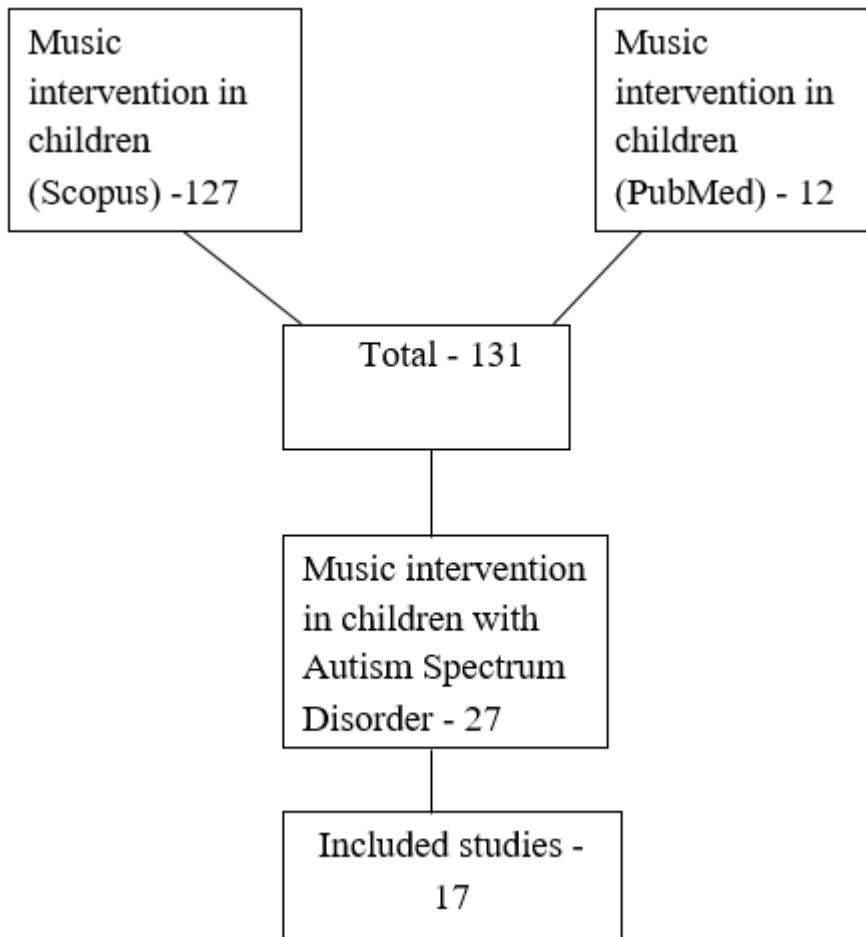


Fig 1: Prisma of Music therapy in children with Autism Spectrum Disorder

Sample and Setting Characteristics

The characteristics of the 11 quantitative studies and 6 qualitative studies are described in the following table (Table 2)

Table 2: Characteristics of the studies

Topic	Author	Variables	Population	Study	Type of Intervention	No. of sessions	Measurements used	Results
Assessing the Impact of Music Therapy on Sensory Gating and Attention in Children With Autism: A Pilot and Feasibility Study	LaGasse, A.B, Manning, R.C.B, Crasta, J.E, Gavin, W.J and Davies P.L, (2019)	neural processing in the brain and behavioral attention	7 children with autism was compared to 7 typical children of age 5 to 12 years	quantitative	individual music therapy	10 times over 5 weeks	Electroencephalopathy and Test of Everyday Attention	music had positive impact on the brain responsivity and behavior for attention and there was difference in brain response and behavior in children with autism and typical children
Music therapy as a therapeutic tool in improving the social skills of autistic children	Bharathi, G, Venugopal, A and Vellingiri, B, (2019)	social skills	54 autistic children ranging from mild to severe	quantitative	Randomized Clinical Trial	3 months	Cochrane Collection Reviews of Randomized trials	music therapy is positively associated to social skills development in autistic children in terms of understanding perspective, response initiation and maintaining interactions with others
Development of vocal communication in children with autism spectrum disorder during improvisational music therapy	Salomon, G.M and Elefant, C, (2019)	communication skills	4 children with autism spectrum disorder	qualitative	improvisational music therapy	20 sessions over 5 months	interview from parents and observation	music therapy was positively associated with vocal communication development among those children in a non linear pattern

Beyond Broadway: Analysis of qualitative characteristics of and individual responses to creatively able, a music and movement intervention for children with autism	Lakes, K.D, Neville, R, Vazou, S, Schuck, S.E.B, Stavropoulos, K, Krishnan, K, Gonzalez, I, Guzman, K, Tavakolnia, A, Stehli, A, Palermo, A, (2019)	stereotype and compulsion behavior	20 children with autism spectrum disorder	qualitative	music and movement therapy	2 months and 1 month with 8 sessions	case study, Repetitive Behavior Scale – Revised, Physical Activity Enjoyment Scale and ASD Clinical Symptom Rating Scale	music and movement therapy reduced the stereotyped and compulsion behavior by 8% and 4%
Dyadic drum playing and social skills: Implications for rhythm mediated intervention for children with autism spectrum disorder	Yoo, G.E and Kim, S.J, (2018)	social skills	42 children with typical development and 10 children with high functioning autism	qualitative	dyadic drum playing and rhythm based music intervention	3 months	case study	positive correlation of rhythmic cuing and tempo adjustment and increasing joint attention among children with autism
Music improves social communication and auditory motor connectivity in children with autism	Sharda, M, Tuerk, C, Chowdhury, R, Jamey, K, Foster, N, Custoblanch, M, Tan, M, Nadig, A, and Hyde, K, (2018)	social communication and brain connectivity	51 autistic children of age 6-12 years	quantitative	improvisational music therapy	8-12 weeks	Social skills rating system scale and EEG	music therapy had positive effects on the social skills development and the resting state brain functional connectivity

The effectiveness of combined music therapy and physical activity on motor coordination in children with autism	Imankhah, F, Khanzadeh, A.A.H and Harischanan, A, (2018)	motor coordination	30 autistic children aged 6-11years	quantitative	music therapy along with play therapy	15 music therapy sessions twice a week	Autism evaluation scale and motor development scale	music therapy along with play therapy had a positive effect on the motor coordination among the autistic children and is of great use
The effects of non-contingent music and response interruption and redirection on vocal stereotypy	Gibbs, A.R, Tullis, C.A, Thomas, R, and Elkins, B, (2018)	stereotype behavior	children with autism	qualitative	with non contingent music, response interruption and redirection therapy	1month	task behavior analysis	combination of the two therapies required fewer implementation and short duration in decreasing vocal stereotypy and increasing on task behavior
International multicentre randomised controlled trial of improvisational music therapy for children with autism spectrum disorder: TIME-A study	Crawford et al. in 2017	social affect and responsiveness	364 children of age 4-7 years with autism	quantitative	improvisational music therapy	5 month	social affect score of autism diagnostic observational schedule and parent rating social responsiveness after 5 months and 12 months	there was no significant influence of improvisational music therapy in the social affect and social responsiveness of children with autism after both 5 months and 12 months

Effects of a music based short story on short and long term reading comprehension of individuals with autism spectrum disorder: A cluster randomized study	Schwartzberg, E.T and Silverman, M.J, (2016)	comprehension	29 autistic children	quantitative	singing and reading short stories	3 day session	5 comprehension check questions	live music based short story telling enhanced the cognitive arousal and attention span and has positive effects in immediate and long term comprehension skills of children with autism
Feasibility of a trial on improvisational music therapy for children with autism spectrum disorder	Gretsegger, M, Holck, U, Bieleninik, and Gold, C, (2016)	study procedures, safety, concomitant treatment and consistency	15 subsamples of autism spectrum disorder	qualitative	improvised music therapy	3 weekly music therapy for 5 months	case study and observation	improvised music therapy has lower consistency outcome but proves feasible treatment approach in high intensity group as compared to low intensity and standard care groups
The effects of embodied rhythm and robotic interventions on the spontaneous and responsive social attention patterns of children with autism spectrum disorder (ASD): A pilot randomized controlled trial	Srinivasan, S.M, Eigsti, I.M, Neely, L, and Bhat, A.N, (2016)	joint attention and training specific social attention	autism spectrum disorder	quantitative	rhythmic and robotic intervention	8 week session	test of everyday attention	Joint attention was improved in rhythmic intervention and robotic intervention and training specific social attention was improved in rhythmic intervention as compared to robotic intervention and comparison group

The effect of sung speech on socio-communicative responsiveness in children with autism spectrum disorders	Paul, A, Sharda, M, Menon, S, Arora, I, Kansal, N, Arora, K, and Singh, N.C, (2015)	performance, frequency of social gestures and eye contact	3 children with Autism Spectrum Disorder of age 3-4 years	Qualitative	sung directives	9 sessions	video recording by 2 independent individuals	sung directives improved the frequency of social gestures and eye contact than the spoken directives among these children
Music therapy: An effective approach in improving social skills of children with autism	Ghasemtabar, S.N, Hosseini, M, Fayyaz, I, Arab, S, Naghasian, H, and Poudineh, Z, (2015)	social skills	27 children with mild to moderate Autism Spectrum Disorder	quantitative	music therapy	12 sessions of music therapy in 45 days	Social skills rating system scale	the use of music therapy increased the social skill scores in the autistic children which was persistent over the follow up sessions than the non music therapy group
Effects of music therapy group intervention on enhancing social skills in children with autism	LaGasse, A.B, (2015)	social skill	17 children with autism spectrum disorder	quantitative	group music therapy	5 month	social responsiveness scale, autism treatment evaluation checklist and video recording	joint attention with peers and eye gaze towards persons was improved among children in the group music intervention as compared to the no music social skill group
Family centered music therapy to promote social engagement in young children with severe autism spectrum disorder: A randomized controlled	Thompson, G.A, McFerran, K.S, and Gold, C, (2014)	social interaction	23 children with severe autism spectrum disorder	quantitative	family centered music therapy	16 weeks	Vineland Social Maturity Scale	family centered music therapy had positive impact on the social interaction improvement of the children with their parents

study								
The effect of Kodaly based music experiences on joint attention in children with autism spectrum disorders	Chiengchana, N, and Trakarnru ng, S, (2014)	joint attention	3 children with autism spectrum disorder	quantitative	Kodaly based music	4 weeks	SAP	Kodaly based music therapy had positive impact on the improvement of joint attention among all the three children with autism spectrum disorder with joint attention problem

Discussion

Music or musical stimuli have confirmed to be preferred by children with autism (Thaut, 1988; Buday, 1995). Analysis of the studies mentioned in Table 2 can be best explained on the basis of outcomes. Hence, an elaborate explanation about the findings of the researches considered in this study is discussed as follows:

Attention: Attention is studied on joint attention (Yoo & Kim, 2018, Srinivasan et al., 2016, Chiengchana & Trakarnrung, 2014), social attention (Srinivasan et al., 2016), behavioral attention and neural processing (LaGasse et al., 2019). In each of these studies a positive impact of MT was observed in increasing each forms of attention along with increased spontaneous and responsive attention (Srinivasan et al., 2016).

Social Skills: A lot of researches was found on the use of MT for various social skills development in autistic children like social responsiveness (Bharathi et al., 2019; Crawford et al., 2017; Srinivasan et al., 2016; LaGasse, 2015), understanding perspective (Bharathi et al., 2019; Schwartzberg & Silverman, 2016), mirroring of activities (Lakes et al., 2019), asynchrony (Yoo & Kim, 2018), social co-operation (Ghasemtabar et al., 2015), eye contact (Paul et al., 2015; Ghasemtabar et al., 2015; Chiengchana & Trakarnrung, 2014), social gestures (Paul et al., 2015; Chiengchana & Trakarnrung, 2014), and social emotions (Thompson et al., 2014). In most of the studies, positive effects was seen on the social skills development with the use of MT, like understanding perspective, mirroring of activities, decrease in asynchrony, increase in giving hi-five (Paul et al., 2015) etc. except social affect (Crawford et al., 2017) and initiation of interaction (Bharathi et al., 2019; LaGasse, 2015). Initiation of interaction in both the studies was ineffective by the use of music therapy. Again, although MT has a positive effect on the affect of an individual (Sole et al., 2014) and social responsiveness of autistic children (LaGasse, 2015), study done by Crawford et al. in 2017 showed no improvements in social affect and social responsiveness in children with autism. Brown's study indicated that music could develop emotional perception of identifying sad emotions in children with autism but music did not help in identifying neutral or happy emotions.

Communication Skills: Studies were conducted on maintaining interaction (Bharathi et al., 2019), vocal communication (Salomon & Elefant, 2019), social communication, family quality of life, brain connectivity (Sharda et al., 2018), comprehension (Schwartzberg & Silverman, 2016) response to name calling, obedience (Paul et al., 2015), response to communication (LaGasse, 2015) and social and reciprocal interaction (Thompson et al., 2014; Chiengchana & Trakarnrung, 2014) of children with Autism Spectrum Disorder after music intervention and it was found that there was significant increase in all these variables with music intervention.

Stereotype: Apart from the social communication aspect, researches were also found in reduced stereotype (Lakes et al., 2019; Gibbs et al., 2018) and increased self regulation (Lakes et al., 2019; Imankhah et al., 2018) with the use of music intervention.

Motor Co-ordination: Studies also explored the use of music intervention on self control in physical movements, performance, involvement in active games (Imankhah et al., 2018), motor planning ability (Imankhah et al., 2018; Paul et al., 2015) and on-task behavior (Gibbs et al., 2018) and each of these studies found favorable outcomes with the use of MT.

Feasibility: Again the feasibility of the use of MT was also explored in studies done by LaGasse et al. in 2019, Gretsegger et al. in 2016, and Schwartzberg & Silverman in 2016. LaGasse et al. in 2019 revealed that MT is feasible in its study protocol along with the study done by Gretsegger et al. in 2016 which also identified that lower intensity MT is more feasible in its treatment fidelity, consistency, measurement completion and increased attendance than the high intensity MT in autistic children. Schwartzberg & Silverman in 2016 concluded that repetition of same MT may lead to extinction of the benefits that was initially gained through music. Hence MT used once a week with innovations in therapy procedure could lead to an increase in desired behavior among children with autism. Apart from the above mentioned outcomes studies also supported the use of MT in increasing confidence (Chiengchana & Trakarnrung, 2014), and social emotions (Thompson et al., 2014) in children with autism. It was also found that MT could be used in any environmental condition, even outside highly controlled experimental setting (Gibbs et al., 2018; Paul et al., 2015; Thompson et al., 2014).

Conclusion

This systematic analysis includes 17 researches which studied about the effects of activity based MT on children suffering from ASD in which the studies included randomized controlled trials, use of both sung directives and instrumental music, both pre-and-post test and follow up sessions, and participants being actively involved in MT. It was found that there is strong evidence of improvement in the areas of attention, communication, social skills, motor co-ordination, maintaining conversation, verbal and non verbal gestures, sharing social emotions, on-task behavior, family quality of life, self regulation, stereotype etc. among children with ASD after undergoing MT which could be observed even after follow up which suggested long term effectiveness of MT on children with Autism. Also the study protocols and feasibility of IMT was also reviewed which suggested promising improvement in MT given in low frequency.

Among these 17 researches, only one research which was conducted by Crawford et al. in 2017 on the effect of IMT on social affect and social responsiveness showed insignificant relationship which is contrary to the research conducted by LaGasse in 2015 which suggested strong evidence of improved social responsiveness with MT.

Limitations

Limitations to the study includes the following. Firstly only two data bases were considered for the extraction of the research papers. Secondly, the study was limited to on active MT in children of not more than 12 years. Thirdly, studies done by the same researchers were not considered for the study. Fourthly, only MT with activity based was considered. Fifthly, a period of only 6 years i.e from

2014 to 2019 was taken for the study purpose. And lastly, MT with single session studies was excluded.

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