Review of Randomised Controlled Trials on the Effect of Music Therapy on Autism

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Abstract. Autism is a lifelong neurodevelopmental disorder, is characterized by behavioural deficits in social behaviour, social communication, and interfered repetitive behavior. In recent years, due to the increased morbidity of autism, research focusing on the therapies of autistic people raises public concern and gains the attention of researchers in related fields. Music therapy has the strengths of high convenience and low costs and therefore becomes prevalent in recent years. However, considering the different study design, and diverse backgrounds of participants in existing studies, there is no conclusive results on the effects of music therapy on autism. This article mainly reviewed existing randomized controlled trials which investigated the association between music therapy and autism and found that there is supportive evidence of the protective effects of music therapy on autism. However, due to diverse participants' backgrounds, limited sample size, and various study designs in existing studies, more research is needed. Therefore, future research is recommended conduct to explore different forms of music therapy and its effects on autistic people with various demographic characteristics.

Keywords: Music therapy; autism.

1. Introduction

Autism typically occurs in the preschool years and autistic people have limited social communication skills, and restricted and repetitive behaviours. Approximately one in 100 children are diagnosed with autism worldwide [1]. Moreover, the diagnosis of autism correlated with substantial costs to individuals, families, and the community [2]. The lifetime cost of supporting an autistic individual with and without a learning disability is £1.1 and £1.7 million, respectively, in 2021 in the United Kingdom (UK) [3].

In addition, autistic children have communication difficulties in developing language skills, requesting information from others, and communicating nonverbally [4]. Up to 60% of autistic individuals lack of functional communication skills [5]. Therapy for improving communication skill in autistic children is a public health priority and raises concern. World Health Organisation suggests that evidence-based psychosocial interventions can improve social communication skills and the quality of life among autistic people [1]. Although existing research suggested that music therapy could benefit autistic children [6, 7], due to the various study design, there are no conclusive results. The present study aims to review the influences of music therapy on autistic people in existing randomized controlled trials, and provide the scientific evidence for the further exploring music intervention among autistic people, and the guidance for future research.

2. Autism

2.1 Diagnostic Criteria of Autism

The fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-5) indicated that the deficits in each of three domains of social interaction as well as at least two of the four categories of repetitive and restricted behaviours are required to establish the diagnosis of autism [7]. Deficits in social interaction is classified into three types: social-emotional reciprocity, impairments in nonverbal communicative behaviours, and deficits in building personal relationships [7]. Four categories of restricted and repetitive behaviours include repetitive motor actions, inflexible

adherence to routines, highly restricted interests with abnormal attention, and hyperreactivity to sensory input [7]. International Classification of Diseases-11 (ICD-11) suggested the same characterizations of autism as DSM-5, however, ICD-11 include the lack of previously acquired competencies when refer to the diagnosis of autism. Moreover, ICD-11 provide two categories of autism that include autism with intellectual disability and autism without intellectual disability.

2.2 Prevalence of Autism

World Health Organization estimated that approximately 1 in 100 children has autism worldwide [1]. According to an analysis of data from the Centers for Disease Control and Prevention, approximate 2% of children between the ages of 3 and 17 are currently or have previously diagnosed with autism [8]. The prevalence of autism rises more than 150% from 2000 to 2014, from 6.7 per 1000 in 2000 to 16.8 per 1000 in 2014. Statistics of the United States Centres for Disease Control and Prevention in 2022 showed that one in 44 8-year-old children have been identified with autism, which experienced a dramatic increase compared with one in 69 in 2012 [9]. The occurrence of autism has the gender difference and more boys are diagnosed with autism than girls. It is estimated that the diagnosis of autism among boys is four times of girls. In addition, the prevalence of autism is higher in both Black and Hispanic children compared with children in other ethnicities. Considering the wider diagnosis of autism among minority groups, the differences between different ethnicities becomes smaller in recent years.

2.3 Risk Factors of Autism

Social, environmental and genetic factors contribute to the occurrence of autism. There is an increased chance to seek help comprehensively for a family which has closer access to other families with autistic diagnosis children. Environmental factors associated with autism include prenatal and postnatal maternal factors. Prenatal exposure to air pollution or valproic, advanced prenatal maternal age, increased maternal stressful events, hypertension in pregnant, maternal smoking and maternal gestational diabetes are associated with a high risk of developing autism in their offspring. Postnatal factors correlated with the occurrence of autism include longer time in feeding difficulties, postpartum haemorrhage and postpartum depression.

3. Therapies for Autism

3.1 Current Interventions of Autism

Therapies for autism include musical therapy, drug therapy, art therapy, as well as psychological therapies, which include cognitive behavioural therapy, eye movement desensitization and reprocessing (EMDR), mindfulness-based interventions, positive behaviour support, dialectical behaviour therapy [10]. However, there is no standard clinical therapy for autistic people.

3.2 The Definition of Music Therapy

Music therapy referred to the practises of using music and its components as an intervention with people who want to improve their quality of life in the medical, educational, and everyday environments [11]. Music therapy uses a wide range of musical styles and instruments to help patients across newborn babies, young adults, and old adults to improve cognitive functions, enhance social interaction skills, relieve pressures, attenuate anxiety [12].

3.3 The Types of Music Therapy

3.3.1. Analytical Music Therapy

Analytical music therapy is a psychodynamic approach to help clients to understand their internal emotions and thoughts. Analytical music therapy allows participants to sing or play musical instruments combining improvised with musical dialogue in order to express unconscious thoughts.

3.3.2. Benenzon Music Therapy

Benenzon music is created by a psychiatrist Rolando O. Benenzon. Benenzon music therapy combined with psychoanalysis theory to provide assessment and therapy for participants' mental status by encouraging participants to identify music sounds which are the closest match with their internal state [13].

3.3.3. Cognitive Behavioural Music Therapy

Cognitive behavioural music therapy assists participants who received cognitive behavioural therapy to reinforce some behaviours by listening to music, dancing, singing, or playing musical instruments. Cognitive behavioural therapy combined with music has positive effects on improving moods and cognitions in various kinds of mental diseases that consist autism, depression, anxiety and post-traumatic stress disorder.

3.3.4. Community Music Therapy

Community music therapy is a community-based approach and it needs group members' high levels of engagement. By acknowledging the social and cultural factors associated with community members' mental health, music therapists provide therapy by using improvisation to allow spontaneous co-musicing [13].

3.3.5. Nordoff-Robbins Music Therapy

The core theory of Nordoff-Robbins music therapy based on believing each person has their own sensitivity to music [13]. This core belief motivates Nordoff-Robbins music therapists to assist autistic people improve self-expression. By mainly playing musical instruments (e.g., drum), Nordoff-Robbins music therapy is beneficial for people with developmental difficulties.

3.3.6. Neurologic Music Therapy

Neurologic music therapy is applied in sensory, speech, linguistic, cognitive and motor dysfunctions following by a neurologic diagnosis. Neurologic music therapy includes cognitive treatment which consists of attention, executive functioning and memory, language treatment which includes fluency and vocalization, and motor treatment which includes rehabilitation of motor movements [14]. The framework of neurologic music therapy is based on the neural mechanism of music affecting brain functions. Music could enhance neuroplasticity, and improve cognitive and language functions. Neurologic music therapy has the benefit of improving symptoms of interaction skills in autistic people, as well as Alzheimer's disease, Parkinson's disease and stroke.

3.4 The Strengths of Music Therapy

Musical therapy could provide high flexibility. Music therapy could be personalized in order to suit different groups of people from young adults to old adults, as well as various mental conditions. For example, except for autism, music therapy is effective in relieving depression, sleeping disorders and chronic pain. Music therapy has the strength of decreasing heart rate, which could relieve anxiety and make people more relaxed.

Music therapy is beneficial for appropriately expressing autistic children's emotions. In addition, music therapy is specifically effective for people who have difficulties in verbal communication [12]. Music therapy promotes structural and functional brain changes by influencing the multimodal network of brain areas involved in hearing, emotion, and memory. Functional magnetic resonance imaging evidence showed that music therapy could enhance brain activity which related to memory, attention and emotions, therefore autistic children's emotional empathy and interaction skills could be improved by applying music therapy intervention [2]. Considering the effectiveness of music therapy on social communication skills, it becomes more prevalent when providing therapy for autistic children.

3.5 Limitations of Music Therapy

Although music therapy has strengths in assisting in improving mental status, the disadvantages of music therapy are concerned. Firstly, human' internal states could be affected by music, especially when confronting percussion music. When people are overstimulated by music, it could increase their heart rate and blood pressure, for people who have cardiovascular diseases, music therapy may be detrimental. This indicates the importance of selecting music categories when applying music therapy. Secondly, when patients have traumatic experiences. Specific music may evoke their memory of traumas, which may lead to their severe mental status. Thirdly, current society lacks professional music therapists. The limited training occasions and high techniques required contribute to the difficult route to becoming a music therapist. Besides, music therapy has limitation when providing aids for people who have hearing difficulties. The disadvantages of music therapy indicate that more feasible interventions need to be investigated for autistic people with comorbidities including cardiovascular disease, post-traumatic stress disorder and hearing difficulties.

3.6 Findings on the Music Therapy and Autism in Existed RCTs

3.6.1. Review of the findings

The standard study paradigm of research on autism and music therapy is a randomized controlled trial design. Participants were generally provided musical therapy in various styles, including listening to improvisational music, drumming, and learning music-assisted relaxation techniques.

By conducting a literature search on studies from 1990 to the present on three databases, including Ovid Medline, Embase, and Health and Psychosocial Instruments, after screening and duplication, there are six randomized controlled trials (RCTs) focusing on music therapy and autism. Previous RCTs reported the positive effects of music therapy on autistic people [15,16]. For example, Gattino et al. recruited 24 participants from 7 to 12 years and investigated the difference in the effect of relational music therapy and standard treatment on autistic children, and found the positive effects of relational music on autism [15]. On the other hand, the differences between with and without improvisational music therapy in the treatment of autistic children did not present [17]. For instance, Bieleninik et al. conducted a TIME-A study with a large sample size (N = 364) and did not find significant evidence that music therapy has benefits for autistic participants [17]. The evidence of the long-term effects of improvisational music therapy on autistic children remains inconclusive.

3.6.2. Current Issues in RCTs

Existed RCTs are limited in small sample size, limited follow-up time, and do not rigorously control the music therapy [6, 17]. For instance, Kim et al. recruited 10 participants, and the limited sample size may limit the generalizability of the study results [6]. Additionally, Bieleninik et al. terminated the music therapy for participants in advance, and the reliability of the results may be affected [17]. Moreover, existing studies mostly apply relatively short follow-up times of several months, which may pose a threat to find clear evidence of the effect of music therapy on autistic people. Furthermore, in order to discover solid evidence of the effect of music therapy on autistic people, future research is recommended to recruit a large number of participants, apply a longer follow-up time of years, and rigorously control the music therapy in study design.

4. Summary

Autism has standard diagnostic criteria, and the prevalence of autism is increased recent years. Gender difference is still existed in the prevalence of autism, while the ethnic difference on the occurrence of autism is narrowed. Maternal risk factors associated with autism are widely studied, however, the causation between maternal factors and autism is still unclear. Prevalent music therapy includes analytic music therapy, Benenzon music therapy, cognitive behavioural music therapy, community music therapy, Nordoff-Robbins music therapy, and neurologic music therapy. Music therapy has the strengths of improving cognitive functions, improving emotions, and relieving

pressure, however, music therapy limited in providing aids to hearing difficulty population, and overstimulated by music could also lead to detrimental results. Research on the effect of music therapy and autism has increased these years. However, due to the diverse participants' background, various intervention categories and intensity, as well as different study designs, there is no conclusive results in existing studies. Existed RCTs provided a tendency of supportive evidence on the protective effects of music therapy on autism. The present review provides implicated that the practical application of music therapy intervention among autistic people with comorbidities including post-traumatic stress disorder, hearing difficulty, and cardiovascular disease need to be addressed. Future research needs to conduct to investigate the differences between various music therapy forms for autistic people. It is recommended that studies with rigorous design need to be conducted to investigate the effect of music therapy on autistic people with different characteristics.

References

[1] World Health Orgnization. (2022). Autism.

[2] Sharda, M., Tuerk, C., Chowdhury, R., Jamey, K., Foster, N., Custo-Blanch, M., ... & Hyde, K. (2018). Music improves social communication and auditory–motor connectivity in children with autism. Translational psychiatry, 8(1), 1-13.

[3] LE Welsh Government. (2021). Cost Benefit Analysis of Autism Code of Practice.

[4] Sansosti, F. J., & Powell-Smith, K. A. (2008). Using computer-presented social stories and video models to increase the social communication skills of children with high-functioning autism spectrum disorders. Journal of Positive Behavior Interventions, 10(3), 162-178.

[5] Rose, V., Trembath, D., Keen, D., & Paynter, J. (2016). The proportion of minimally verbal children with autism spectrum disorder in a community‐based early intervention programme. Journal of Intellectual Disability Research, 60(5), 464-477.

[6] Kim, J., Wigram, T., & Gold, C. (2008). The effects of improvisational music therapy on joint attention behaviors in autistic children: a randomized controlled study. Journal of autism and developmental disorders, 38(9), 1758-1766.

[7] American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.).

[8] Christensen, D., & Zubler, J. (2020). From the CDC: Understanding Autism Spectrum Disorder: An evidence-based review of ASD risk factors, evaluation, and diagnosis. The American journal of nursing, 120(10), 30.

[9] Centers for Disease Control and Prevention. (2022). Data & Statistics on Autism Spectrum Disorder. U.S. Department of Health and Human Services.

[10] Sharma, S. R., Gonda, X., & Tarazi, F. I. (2018). Autism spectrum disorder: classification, diagnosis and therapy. Pharmacology & therapeutics, 190, 91-104.

[11] World Federation of Music Therapy (2011). What is music therapy?

[12] Geretsegger, M., Elefant, C., Mössler, K. A., & Gold, C. (2014). Music therapy for people with autism spectrum disorder. Cochrane Database of Systematic Reviews, (6).

[13] Cathy Wong. (2022). What is Music Therapy? Verywell mind.

[14] Jauset-Berrocal, J. A., & Soria-Urios, G. (2018). Cognitive neurorehabilitation: the foundations and applications of neurologic music therapy. Revista de neurologia, 67(8), 303-310.

[15] Gattino, G. S., Riesgo, R. D. S., Longo, D., Leite, J. C. L., & Faccini, L. S. (2011). Effects of relational music therapy on communication of children with autism: a randomized controlled study. Nordic Journal of Music Therapy, 20(2), 142-154

[16] Rabeyron, T., Del Canto, J. P. R., Carasco, E., Bisson, V., Bodeau, N., Vrait, F. X., ... & Bonnot, O. (2020). A randomized controlled trial of 25 sessions comparing music therapy and music listening for children with autism spectrum disorder. Psychiatry Research, 293, 113377.

[17] Bieleninik, Ł., Geretsegger, M., Mössler, K., Assmus, J., Thompson, G., Gattino, G., ... & TIME-A Study Team. (2017). Effects of improvisational music therapy vs enhanced standard care on symptom severity among children with autism spectrum disorder: The TIME-A randomized clinical trial. Jama, 318(6), 525-535.