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Music as an intervention for children with learning difficulties: systematic literature review

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Abstract: Children are a population that benefits from music as a resource that has multiple effects on the body from psychological to physiological. This article aimed to carry out a systematic review of literature on empirical studies about the effects of music on children with learning difficulties. The research period was 2008-2018 in the databases *Pubmed, Medline,* and *Scopus* using the descriptors music therapy, music education, children, learning difficulties, in languages in English, Portuguese and Spanish. Eleven intervention research articles were selected, and the effects were improvements in social performance and self-expression, on phonological awareness and on executive functions. The studies pointed out that music and/or sound was a strategy used as a way to improve indexes in reading skills, cognitive and emotional aspects for children who have learning difficulties, but without diagnosis.

Key words: systematic review, music therapy, learning difficulties

Música como intervenção para crianças com dificuldades de aprendizagem: revisão sistemática da literatura

Resumo: As crianças são uma população que se beneficia da música como um recurso que tem múltiplos efeitos no organismo, desde psicológicos até fisiológicos. Este artigo teve por objetivo realizar uma revisão sistemática da literatura sobre estudos empíricos que abordassem efeitos da música em crianças com dificuldades de aprendizagem. O período pesquisado foi de 2008-2018 nas bases de dados *Pubmed, Medline, e Scopus,* utilizando-se os descritores *music therapy, music education, children, learning difficulties* nos idiomas inglês, português e espanhol. Foram selecionados 11 artigos de pesquisas de intervenção, e os efeitos foram em melhorias no desempenho social e de auto expressão, efeitos sobre a consciência fonológica e nas funções executivas. Os estudos apontaram que a música e/ou som foi uma estratégia que alcançou melhorias de índices em habilidades de leitura, aspectos cognitivos e emocionais em populações de crianças que apresentam dificuldade de aprendizagem, porém sem diagnóstico.

Palavras-chave: revisão sistemática; musicoterapia; dificuldades de aprendizagem.

Introduction

Music therapy is a healing method that uses music and/or its elements (rhythm, pitch, timbre, melody), involves the activation of areas of the brain, and produces physiological, emotional, and behavioral effects (Gattino, 2015; Rocha & Boggio, 2013; Rodrigues, Loureiro, & Caramelli, 2013). Thus, investigations using music for non-clinical populations, i.e., for populations without a diagnosis, mainly linked to learning, include exposing children and adolescents to music, sometimes with classes, sometimes with music therapy. These

investigations showed improvements in academic learning (Chong & Kim, 2010; Escalda, Lemos & França, 2011; Eugênio, Escalda & Lemos, 2012; McIntyre, 2007; Toschi, Moura, Cavalcante & Souza, 2015), interpersonal relationships (Carminatti & Krug, 2010; Ilari, 2020; Montanchez & Orellana, 2015; Standley, 1996), behavioral skills (Hennessy et al. 2019; Weigsdin & Barbosa, 2014), and language (Besson, Chobert & Marie, 2011; Nie et al., 2022).

Research highlights music practice for non-clinical populations through social and community projects aimed at groups living in conditions of socioeconomic vulnerability (Barbaroux, Dittinger, & Besson, 2019; Bernardes & Filho, 2019; Costa, Amorim & Menezes, 2019; Gentil, 2017; Nobre, 2011). It is worth noting that social and economic vulnerability is associated with impacts on development, resulting in losses in academic learning performance and behavior (Mazer, Dal Bello, & Mazon, 2009; Miguel, Rijo, & Lima, 2012).

In studies with children with deficits in learning and adequate social behavioral performance, an association was identified between these variables (Bolsoni-Silva, Perallis, & Nunes, 2018) and a positive correlation with the low socioeconomic status of the family (Carara, 2017; Elias & Amaral, 2016). Thus, since music affects cognitive and social functioning, the musical resource provides opportunities for child development, especially in vulnerable socioeconomic contexts.

One way to better understand the scenario of using music to minimize negative impacts on the cognitive and social aspects of children living in social vulnerability is through literature reviews. For example, Eugênio et al.'s (2012) systematic review surveyed studies that evaluated the influence of musical education on the cognitive, auditory, and linguistic performance of children and adolescents from 2001 to 2011. Of the thirteen studies in the review, only two were music therapy interventions, and the others involved music classes and musical learning history. The results showed that music influenced phonological acquisition and development and is related to reading skills, increased perception of frequency in speech and music, and improved attention and memory.

In August 2018, Engel, Bueno, and Sleifer (2019) surveyed the contribution of musical training to auditory processing skills in children. The authors found that musical training generally improves aural processing skills, affirming it as an effective method in children's oral and written communication development phases.

Another review was by Fiorese et al. (2020), who verified how music therapy is used in regular schools in learning processes. The period studied was from 2008 to 2018, and the researchers found nine articles that pointed to improvements in cases of dyslexia, ADHD,

emotional aspects, and brain plasticity. The review points to a lack of studies in music therapy, as music education still permeates the theme of effects on learning in many studies.

The reviews mentioned indicate similar benefits in the investigated areas of learning to read, write, engage in learning, and social behavior from the intervention with music. However, the reviews do not systematically relate elements of the intervention itself, the profile of the participants in terms of social or cognitive measures, and the instruments used as a form of evaluation, with the improvement indicators being pointed out mainly based on teachers' observations and school performance reports.

Therefore, this work proposes a review of interventions that use music in children with typical development to measure behavioral, emotional, and learning performance before and after the period of intervention with music (music class and/or music therapy) based on the PICO strategy to choose the investigation components: Population (children); Musical intervention (class, music, sounds, or music therapy); Comparison (evaluation of measures); and Outcomes (outcome of the intervention in the measures of the evaluated variables).

This study aimed to survey and analyze the literature produced between 2008 and 2018 on using music or sounds in interventions with samples of children with learning difficulties without a diagnosis. Using the PRISMA protocol, the review identified music education and music therapy models utilized in those interventions, the evaluated instruments, and the outcomes.

Method

General procedures

This review was substantiated on PsicoInfo, Pubmed, and Scopus databases, and the inclusion criteria were complete empirical articles published between 2008 and 2018 in English, Spanish, and Portuguese, with reports of studies that described musical and/or music therapy intervention in children with neurotypical development. The descriptors used were *Children OR Learning Difficulties OR Music therapy OR Music education*, included in the vocabulary of descriptors in the virtual health library (VHL).

The articles retrieved by the adopted search strategy underwent prior reading of the title and abstract to check whether they met the inclusion criteria; those that did not meet the criteria were discarded. After this stage, the studies were analyzed by two independent reviewers, checking whether the publications met the established criteria based on the Relevance Test (Lima, 2019) and then the calculation for the Reliability Index (RI), as per Polit, Beck, Hungler and Thorell (2004). The articles were analyzed according to the PRISMA protocol (Preferred

Reporting Items for Systematic Reviews and Meta-Analyses) to ensure the quality of the review. This protocol consists of a checklist with 27 items on research elements (title, summary, objective, method, result, and discussion) and a four-step flowchart (identification, selection, eligibility, and inclusion). PRISMA's main focus of analysis is randomized clinical trials, but it can be used as a basis for reporting systematic reviews of other types of research, especially intervention evaluations (Galvão, Pansani, & Harrd, 2015).

The flowchart, as provided for in the PRISMA protocol, presents the steps of the review procedure. No reference manager was used.

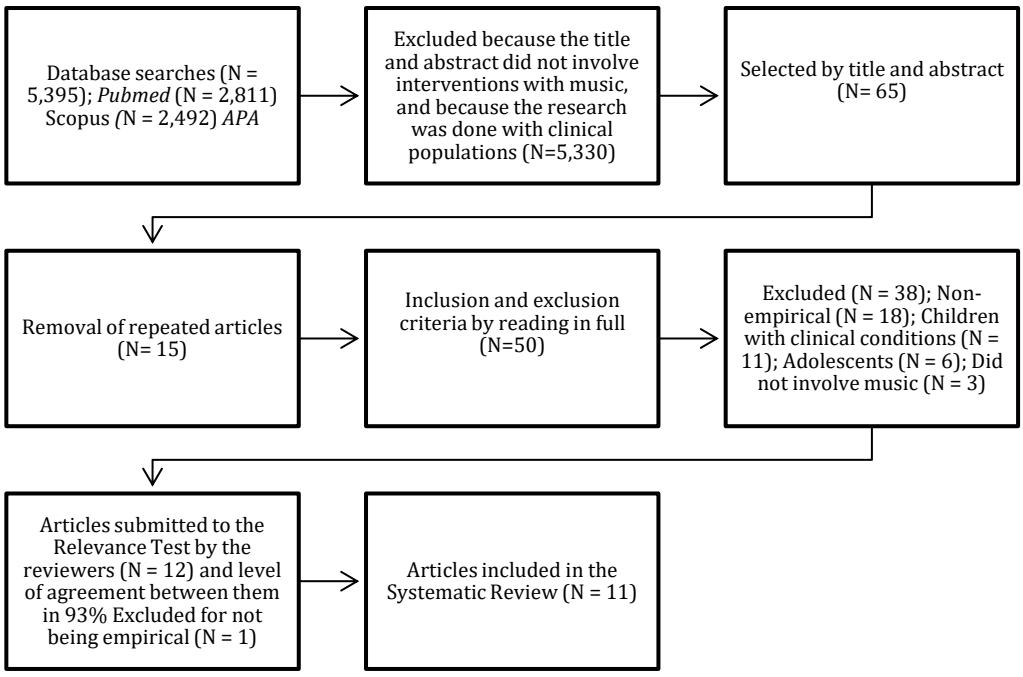

Figure 1. *Study selection flow according to PRISMA*

Outcomes

The characterization of the selected articles is found in Table 1.

The studies show that the years with the highest production were 2016 and 2018, and the most frequent age group was 4 to 6.

Regarding the research location, the country with the most publications was the United States of America, with 36.3% (n = 4). The effects of music or sounds were tested in the areas of interpersonal skills (n = 1), phonological awareness (n = 6), and executive functions (n = 4).

Table 1

Characterization of the selected articles (N = 11)

Year of publication	*N*	Country	*N*	Theme	*N*	Musical Intervention	*N*	Age range	*N*
2011	1	Germany	2			Brazilian			
				Emotional aspects	1	National Curriculum	1	13 months to 3 years	2
2013	2	Brazil	1			German National Curriculum	3		
2015	1	South Korea	1	Phonological awareness	6	Dutch National Curriculum	1	4 to 6 years	4
2016	3	United States	4			Orff method	1		
2017	1	The Netherlands	1	Executive functions	4	El Sistema Youth Orchestra of Los Angeles	1	7 to 10	3
2018	3	England	1						
		Japan	1			Experimental sounds	4	No information	2

Regarding musical interventions, the methods varied, using the national curricula established in the countries studied (Brazilian national curriculum n = 1, Dutch n = 1, and German n = 4).

Concerning the research context, seven took place in schools, two in universities, and two in social project rooms, highlighting the potential for interventions in structurally adequate environments in terms of space and the possibility of meeting children's demands in the school, academic, and community environment. As Gillespie (2018) points out, the school attends individuals who may have learning difficulties, and the effects of music on the brain favor improvements in its functioning.

A study reported evaluating emotional aspects of self-expression, self-efficacy, and social skills (Yum & Kim, 2011) using self-assessment measures through Likert-type questionnaires. This study used the Orff musical education method, which allows for greater flexibility and interaction between students, differentiating itself from the traditional style of studying music with notations and on an individual basis. The intervention time was 60 minutes, once a week for six days. The outcomes indicated improved emotional expression skills, thinking clarification, and quality of friendship relationships.

Table 2 shows the synthesis of studies on the effects on phonological awareness and reading ability. Studies by Cogo-Moreira et al. (2013) and Slater, Tierney, and Kraus (2013) used national music education curricula and that of Patscheke, Degé, and Schwarzer (2016), the teaching system for Youth Orchestra with a musical method. Four studies (Cogo-Moreira

et al., 2013; Slater, Tierney, & Kraus, 2013; Kempert et al., 2016) showed that the sample comprised children with foreign origins from the country of research and with low socioeconomic conditions. These studies used images of brain functioning before and after the intervention through an electroencephalogram, indicating structural changes in brain anatomy of children undergoing intervention with music and/or sound stimuli.

Two studies (Galle et al., 2016; Kempert et al., 2016) comparing musical training and phonological awareness groups revealed that these two interventions effectively improve phonological awareness. The sample profile of the studies in Table 3 included children with low income and immigrants (Sachs et al., 2017), children with a high socioeconomic profile (Jaschke et al., 2018), and children from public schools (Guo et al., 2018). Table 3 displays studies that focus on the assessment of executive functions, IQ, and memory measures. The instruments used covered objectives of measuring learning, auditory perception, memory, planning, inhibitory control, and interpersonal relationships. Regarding intervention time, the study by Bowmer et al. (2018) presents a class time of 40 minutes, while the study by Jaschke, Honing, and Scherder (2018) used a 60-minute class time. Regarding the frequency of classes, only the study by Sachs, Kaplan, Sarkissian, and Habibi (2017) indicated the frequency of twice a week, and the total duration of the musical intervention was found in the studies by Bowmer (2018) and Guo (2018), of eight and six weeks respectively.

Table 2

Studies on effects of music and/or sounds on phonological awareness

Authors/year	General targets	Measuring instruments	Participants	Duration	General results
Cogo-Moreira et al. (2013)	Evaluate musical effectiveness on reading skills and academic performance	Scale of Assessment of Reading Competence by the Teacher (EACOL)	EG n = 114; CG n = 121 Low income	50 minutes, three times a week, 66 classes	Effect on the rate of correct words read per minute and mathematics.
Slater, Tierney, and Kraus (2013)	Comparison of rhythmic maintenance skills	Wechsler Intelligence Scale; Tapping Test	EG n = 29; CG n = 31. Children from gang zones in Los Angeles. Low income.	60 minutes, twice a week, without information on session duration	Improvements in rhythm maintenance in musical and non-musical contexts and in the performance of cognitive functions in the experimental group
Galle, Apfelbaum, and McMurray (2016)	Test acoustic variability and benefits in identifying the term and its counterpart in a visual stimulus (naming)	EEG (Electroencephalogram)	22 babies between 13-15 months of age. Subject as self-control	Phase 1 of habituation of 1-7 minutes (30 habituations) Phase 2 – testing	Variability can benefit performance on word learning tasks

Authors/year	Objectives	Measuring instruments	Participants	Time of intervention	Outcomes
Patscheke, Degé, and Schwarzer (2016)	Determine whether musical training has a positive effect on phonological awareness in children aged 4-6 years	*Test für phonologische Bewusstheitsfähigkeiten (TPB)* German music education curriculum for children (*Musik und tans für kinder*)	39 immigrant children aged 4-6. PEGM n = 13; PG = 11; CG n = 15 sports	20 minutes Three times a week 14 weeks	Effects on phonological awareness units in the musical training and phonological awareness groups compared to the sport group.
Kempert et al. (2016)	Exploring the effects of early musician education in combination with conventional education of perception of weak phonological awareness	Phonological awareness tests German music education curriculum for children (*Musik und tans für kinder*)	424 children, average age 54 months. Children of immigrant parents. CG n = 187; PEGM n = 128; PG = 109	2 years Assessment in the penultimate and final year of preschool	Positive relationships between musical skills and phonological awareness but without significant contribution when musical education was combined with phonological awareness education.

Note. CG- Control Group; EG- Experimental Group; PEG- Phonological Education Condition Group; PEGM- Phonological and Musical Education Condition Group; PG- Phonological Condition Group.

Table 3

Effects of music education on executive functions

Authors	Objectives	Instruments	Participants	Duration	Outcomes
Sachs, Kaplan, Sarkissian, and Habibi (2017)	Investigate the effects of musical education on executive function.	WASI-II, *Hearts and Flowers task*	Latin American immigrant children, 6 years old. CG n = 17; MG n = 14; SG n = 13	Twice a week for two years	Activation in areas involving conflict
Jaschke, Honing, and Scherder (2018)	Research the effects of music education on cognitive skills	*Wechsler Intelligence Scale for Children, Tower of London* (ToL), *dot matrix*	Children with highly educated parents. MG with prior musical knowledge n = 38; MG without prior musical knowledge n = 42; VAG n = 29; CG n = 37	60 minutes	The MG with better performance in tasks that measure verbal IQ, planning, and inhibition than the CG during four segments
Guo et al. (2018)	Investigate the effect of an instrumental practice program on children's cognitive functions using a controlled trial.	WISC – IV, RAN, *Go- No go task*	Public school children in Japan. CG n = 20; SG n = 20	Twice a week for six weeks	Significant improvements in working memory performance in the EG, and no differences in other cognitive tests
Bowmer et al. (2018)	Investigate the effect of weekly musical education on executive function skills	EF *Assessmen*t; *Peg Tapping; Baby Stroop; Dimensional Card Sort; Trucks, Tower of London; Spin the Pots*	41 children between Group A n = 14 (music classes), Group B n = 15 (free class), Group C n = 12 (arts class)	40 minutes per week	Improvements in the performance of planning skills and response inhibition in group A, and without differences between groups in phase 2 (Group B started music classes)

Note. CG = Control group; MG = Music group; SG = Sports group; VAG = Visual arts group; EG = Experimental group.

Discussion

The studies presented disclosed the effects of music intervention on children with learning difficulties. Regarding the curricula used and the musical system method, we understand that they favor a variety of exposure to the contents taught, such as musical notation, rhythmic notation, musical styles and genres, sound parameters, and speech-based music teaching, music (singing, instrumental performance), movement (dance, games, steps, choreography), and creation (improvisation, creation of arrangements, melodies, rhythms) (Fernandes & Justi, 2018). Thus, the diversification in the nuances of the presentation of the musical stimulus favors musical learning and, consequently, cognitive and phonological aspects.

Regarding the benefits of music on social skills, the study by Yun and Kim (2011) agreed with research by Carminatti and Krug (2010) and Costa, Amorim, and Menezes (2019), in which the participants experienced improvements in their skills when participating in choral singing. Social skills favor healthy performance in established relationships and can be considered a protective factor, especially for social and academic development, i.e., acquisition of greeting response classes, tolerance, and knowing how to wait, which are essential skills in several areas in infancy.

The studies by Cogo-Moreira et al. (2013), Slater et al. (2013), and Kempert et al. (2016) bring positive effects on children in vulnerable situations and follow the rationale that musical interventions allow the context of participants' development to be augmented with other elements, relationships, and demands, thus stimulating diverse skills, such as reading, the object of investigation of the studies presented (Toschi et al., 2015). Regarding this data, Rocha and Boggio (2013) and Rodrigues, Loureiro, and Caramelli (2013), among others, report anatomical structural effects, such as the increase in size of the corpus callosum, the region that connects the two hemispheres of the brain, in individuals who have been systematically exposed to music, especially when learning to play an instrument, as this favors involvement in the motor, auditory, and visual perception areas simultaneously.

Galle et al. (2016) and Kempert et al. (2016) compared musical and phonological awareness education groups, indicating the contribution of music as an effective resource for improving reading and writing skills in children starting their school years, as in studies by Escalda et al. (2011), Eugênio et al. (2012), Fiorese et al. (2020), and Toschi et al. (2015). Phonological awareness is a metalinguistic skill that favors understanding

and manipulating the various ways in which oral language can be divided: phrases into words, words into syllables, and syllables into phonemes (Toschi et al., 2015).

The studies also indicated improvements in executive functions, such as conflict resolution, memory, verbal IQ, planning, inhibition, and working memory. Executive function is a set of skills performed by the brain that favors the execution of various activities and that generate effects on the general measure of the intelligence coefficient and, consequently, on learning responses and following commands, which are necessary for school learning (Ribeiro, 2013), besides inhibitory control (Hennessy et al., 2019).

Interestingly, this review did not recover musical intervention studies through music therapy, considering that the area has been active since the middle of the 20th century. However, no studies aimed at children without diagnosed clinical conditions in the period and bases researched. The need for publications in this segment is highlighted, as is also mentioned in the review by Fiorese et al. (2020), which identified music therapy mainly in special education and in populations with disabilities. Another finding, according to the methodological description of the studies in Table 3, was the variation in the intervention time, which is information that can have a greater or lesser impact on the expected changes in terms of the development of cognitive skills.

The studies generally pointed to the benefits of exposure to sounds or musical education in improving skill performance, whether emotional or sound recognition (auditory perception), with an impact on language learning, fluency in reading, writing, or cognitive aspects of executive function. Thus, music favors the learning of formal content and behavior, as pointed out by Weigsdin and Barbosa (2014), Chong and Kim (2010), McIntyre (2007), and Nie et al. (2022), as well as content related to social aspects, as reported by and Besson et al. (2011), Montanchez and Orellana (2015), and Ilari (2020).

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