THE EFFECTS OF A MUSIC AND MOVEMENT PROGRAM ON GAIT, BALANCE AND PSYCHOLOGICAL PARAMETRES OF ADULTS WITH CEREBRAL PALSY

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The purpose of this investigation was to examine the effect of a music and movement intervention program on gait, balance and psychological parameters of 10 male athletes in throwing events (ball and disc) with Cerebral Palsy (CP) (spastic hemiplegia), all coming from a sport club in Thessaloniki. Participants were divided randomly by methodical selection into two groups, the Intervention Group (IG) (n=5) and the Control Group (CG) (n=5). The IG participated in a music and movement program of 16 sessions (8 weeks, with a frequency of 2 times/week for 50 minutes per session), which designed on the base of the theory of Rhythmic Auditory Stimulation (RAS) method. Audit results showed differences on gait, balance and psychological parameters were statistically significant ($p \leq .05$) prior and after the intervention program for the IG, but not for the CG ($p > .05$). In conclusion, the application of a music and movement program designed on the base of the theory of RAS method had a positive and significant influence in motor and psychological skills.

Cerebral palsy (CP) is a non-progressive disorder occurring in early brain development that results in abnormal movement and posture (Rosenbaum, et al., 2007). The main features of participants with CP are impaired movement and posture that involves gait and upper body coordination as well as problems with balance and psychological problems such as negative emotional image and low self-esteem (Fairhurst, 2012; Graham & Selber, 2003; Krigger, 2006; Murphy & Such-Neibar, 2003; Reddihough & Collins, 2003; Rapp & Torres, 2000; Sandström, 2007; Steenbergen & Utley, 2005).

Spastic Hemiplegia (SH) is a type of CP that affects partially or totally only one half molecule of the body and common problems for those with SH include motor difficulties, such as small stride length, asymmetric walking, slowness, and reduced ability to coordinate movements, which affects the posture and walking as well as symmetrical proper use of the trunk and upper-extremity (Boyd, et al., 2010; Kułak & Sobaniec, 2005; Motta, Antonello, & Stignani, 2011; Staudt et al., 2004; van der Slot et al., 2007; Willis, Morello, Davie, Rice, & Bennett, 2002).

Studies showed that people with CP due to difficulties in physical and mental function, social support and other features have difficulty with rhythmic perception, rhythmic performance of movement and responsiveness rhythmic auditory stimuli (Kwak & Kim, 2013; McRorie & Cooper, 2004). The difficulty of understanding rhythmic sounds restricts the efficiency of movement and creates psychological distress, with consistent tendency for isolation and negative emotions towards familiar environment and self (Manuel, Naughton, Balkrishnan, Paterson-Smith, & Koman, 2003; Shields, Murdoch, Loy, Dodd, & Taylor, 2006).

In intervention studies involving persons with mobility limitation it was observed that the use of music and rhythm programs activated the motor and auditory system and consistently, improved balance, walking and mental health conditions (Jeong & Kim, 2007; Kim et al., 2011). Moreover, it seemed to be of significant benefit as regards to coordination of movements and at the same time, improvement of gross and fine motor skills, enhancement of tactile sensation and improvement of emotional and social development, especially in the case individuals with CP participated in music and motor activities basically designed on the theory of rhythmic auditory stimulation (Rhythmic Auditory Stimulation-RAS) (Chung, 2002; Farrell, Bagley, Davids, Foti, & Moore, 1999; Jiang, 2013; Kim et al., 2011; Kim, Kwak, Park, & Cho, 2012; Kwak, 2007; Kwak & Kim, 2013; Thaut, Hurt, Dragon, & Mcintosh, 1998; Varsamis, Staikopoulos, & Kartasidou, 2012).

Rhythmic Auditory Stimulation (RAS) is a neurological technique using the physiological effects of auditory rhythm on the motor system to improve the control of movement in rehabilitation and therapy (Thaut, 2005, p. 139). Rhythm is an essential element of motor movement including motor control and output (Molinari, Leggio, De Martin, Cerasa, & Thaut, 2003), since rhythmic auditory cuing facilitates movement by providing a mechanism for planning movements (Thaut, et al., 2007).

It has been reported that intervention programs based on RAS method may improve upper and lower extremity function and gait in terms of velocity, stride length and rhythm (Abbud, Li, & De Mont, 2009; Amatachaya, Keawsutthi, Amatachaya, & Manimmanakorn, 2009; Kim, et al., 2007; Richards, Senesac, Davis, Woodbury, & Nadeau, 2008; Thaut, et al., 2007), as well as psychological stress parameters such as depression, anger, wellness and quality of life to people with various kinds of neurological diseases (Hayashi, Nagaoka, & Mizuno, 2006; Jeong & Kim, 2007; Pacchetti ,et al., 2000).

Previous researchers have incorporated music components into rehabilitation exercise programs as a means of motivating stroke patients and adding a "fun" component to the repetitive and sometimes painful rehabilitation exercise routines (Kim & Koh, 2005; Purdie, Hamilton, & Baldwin, 1997). Another study concluded that the soothing quality of music invites people to initiate and maintain motivation to exercise for a longer period (Olderog-Millard & Smith, 1989). Additionally, it has been reported in a recent study that an 8 week RAS music and movement intervention program can improve physiological and psychological factors in patients who have experienced a stroke (Jeong & Kim, 2007).

In this regard, it was hypothesized by the authors that a music and movement intervention program based on RAS method, would maximize the therapeutic benefit of combining music and physical exercise. Although it was considered very difficult to persuade the participants to follow other than their typical training program, the combination of music and exercise was assumed to keep athlete's interest throughout the whole duration of the intervention program. Therefore, the purpose of the present study was to evaluate the effectiveness of an 8 week training intervention program, which based on RAS method, on gait, balance and psychological parameters of 10 male athletes in throwing events with CP.

Method

Participants

The sample consisted of 10 male athletes in throwing events (ball and disc) with Cerebral Palsy (CP), all coming from a sport club in Thessaloniki. All individuals had ambulatory cerebral palsy (spastic right and left hemiplegia) and volunteered to participate in the study.

For the classification at the Gross Motor Function level (GMFCS), the participants were classified according to the GMFCS with Borderline Intelligence Quotient (IQ= 68-83) into two Levels I and II. The IQ level was derived from the official developmental files assigned by the Greek State, using the Wechsler Adult Intelligence Scale (WAIS) in previous years.

Next, participants were divided randomly by methodical selection into two groups of 5 individuals. The first intervention group (IG) (mean age 35.20±13.01 years) followed an 8 week music and movement intervention program designed according to the theory of Rhythmic Auditory Stimulation (RAS) at a frequency of twice per week for 50 minutes each session. The program included gait and balance with music exercises. The Control group (CG) individuals (mean age 38.80±12.28 years) followed only their regular training program in ball and disc. All participants provided a written informed consent form prior participation was approved by the Institutional Review Board, to ensure the rights of all participants.

Test procedures and instruments

First, all the anthropometric data were collected for all participants. Next, all participants answered the Profile Of Mood States (POMS) and Self-Esteem (RSE) questionnaires. Finally, procedures of measurement for gait and balance took place, using two relative tests and a balance platform. All participants of both groups, were tested prior and after the application of the RAS intervention program.

Gait tests

Two tests were used for the purposes of this study. The Timed Up and Go test (TUG) used to assess the mobility, which measures the gait time (sec) (Podsiadlo & Richarson, 1991) derived from the scores of five efforts and the 10 Meter Walk Test (10 MWT), which evaluates the normal and fast gait speed (m/s) (Bohannon, 1997) measuring the scores of the first three efforts.

Balance tests

The Berg Balance Scale (or BBS) is a widely used clinical test of a person's static and dynamic balance abilities (Blum & Korner-Bitensky, 2008), named after Katherine Berg, one of the developers (Berg, Wood-Dauphinėe, Williams, & Gayton, 1989). For functional balance tests, the BBS is generally considered to be the gold standard (Langley & Mackintosh, 2007). The test takes 15–20 minutes and comprises a set of 14 simple balance related tasks, ranging from standing up from a sitting position, to standing on one foot. The degree of success in achieving each task is given a score of zero (unable) to four (independent), and the final measure is the sum of all of the scores (Berg, Wood-Dauphinėe, Williams, & Maki, 1992).

For static and dynamic balance control an EPS pressure platform (Loran Engineering S.r.I., Bologna – Italy) was used. The system uses 2304 force sensing resistors in an active area of 70x50 cm to record plantar pressure at 25Hz. All participants performed a double-leg stance (DLS) and they were instructed to stand erect, as motionless as possible, on a normal comfortable posture, with opened eyes looking straight ahead at a cross marked at approximately eye level on a black board three meters away and barefoot with feet shoulder width apart on the platform with the arms by their sides. Each participant was requested to keep a quiet stance posture for 30 seconds. The assessment included four measurements, and a five-minute rest was provided between successive trials. The best trial was further analyzed (Ageberg, Roberts, Holmström, & Fridén, 2003). Ample time was provided for familiarization. A computer program (Footchecker 3.2, Engineering S.r.I., Bologna-Italy) was used to compute peak-to-peak amplitude (CoPmax) and standard deviation of the COP from the mean value of COP in antero-posterior (SDy) and medio-lateral (SDx) axis in mm, often defined as sway amplitude.

The assessment of dynamic balance, was measured by recording the push-time to right leg (ms), to left leg (ms) and the mean value push-time both right and left leg. The participant following the examiners signal covered a distance of two meters in passing of the foot pressures analysis, with hands free beside the thighs and legs in dimension equal to the opening of the basin. The effort was performed four times and the examiner obtained the score of efforts, both on the right and left leg, and also the value of both legs.

Psychological parameters

Assessment of psychological parameters included the use of the Self Esteem Scale (RSE) questionnaire (Rosenberg, 1965), that consists of ten-items on a four-point scale with the final high or low scoring of the test determinining the relevant self-esteem percentage. Furthermore, the Profile of Mood States (POMS) consisting of 65 items on a four-point scale from 0 («any») up to 4 («very»), was used to evaluate the factors of tension, depression, anger, fatigue, activity, confusion and total profile score (McNair, Lorr, & Droppleman, 1971; Shacham, 1983; Zervas, Ekkekakis, Psychoundaki, & Kakkos, 1993).

An electronic metronome (KORG INC, 2002) with tempo (70-90 beat per minute) was used for the recording of music time (tempo). Listening of music tracks (songs) included the use of a CD with several tracks in 4/4 music meter and a sound CD machine.

Intervention program

The music and movement intervention program had a duration of 8 weeks with frequency twice per week for 50 minutes per session.

At the beginning, the participants were encouraged to sing to improve mood at the beginning of each session.

The warm-up period included stretching exercises from the upper and particularly lower body accompanied with music tracks of 4/4 music meter and music time (tempo) of 70 beat per minute.

During the main par, participants were walking to the rhythm , when we changed the original music track (song) with other, but with the same musical measure 4/4 and other music time (tempo) (90 beat per minute) while the same time done various movements with their body parts. The aim was to facilitate the integration of rhythm in movement. Then the participant's continued to move with pace in the space, with layout in a straight line, a distance of 10 m with forward steps, back, right and left, also called in intermediate, to remain standing on one leg with change for some seconds. This choice of exercises aimed the integration of rhythm in movement as well as improve balance, so in non-affected as to affected side, even if it is difficult.

Cool down included relaxation exercises, breathing and attention when we changing the original music track (song) with other, but with the same musical measure 4/4 and other music time (tempo) (70 beat per minute) so that to calm the body and return all bodily functions to early levels. In particular, the breathing exercises are helping to improve rhythm breathing, in order to facilitate the integration of rhythm in movement.

At the end, the participants were encouraged to sing to improve mood and motivation for active participation in program at the next time at the ending of each session.

Results

Gait tests

Timed Up and Go Test (TUG-Test)

ANOVA repeated measurement test revealed a statistically significant main effect of time or group in gait time (sec) ($F_{1,8}$=13.60, p=.006, η^2=.630). Statistically significant group x time interaction difference was also noticed in gait time (sec) ($F_{1,8}$=6.14, p=.038, η^2=.434).

The post hoc paired t-test revealed statistically significant differences in the IG between the two measurements regarding gait time (sec) (t=3.95, df=4, p=.017). Means and SD values of gait tests pre and post training for Intervention and Control group are represented in Table 1.

10 Meter Walk Test (10 MWT)

ANOVA repeated measurement test revealed a statistically significant main effect of time or group in normal gait speed (m/s) ($F_{1,8}$=8.53, p=.019, η^2=.516), but not in fast gait speed (m/s) ($F_{1,8}$=4.84, p=.059, η^2=.377).

Additionally, statistically significant group x time interaction difference was also noticed in normal gait speed (m/s) ($F_{1,8}$=17.71, p=.003, η^2=.689) and fast gait speed (m/s) ($F_{1,8}$=31.17, p=.001, η^2=.796).

The post hoc paired t-test revealed statistically significant differences in IG between the two measurements regarding normal gait speed (m/s) (t= -5.95, df=4, p=.004) and fast gait speed (m/s) (t= -5.53, df=4, p=.005).

The means and SD values of gait tests pre and post training for IG and CG are represented in Table 1.

Balance tasks

Berg Balance Scale (BBS)

ANOVA repeated measurement test revealed a statistically significant main effect of time or group in Berg Balance score ($F_{1,8}$=18.01, p=.003, η^2=.692).Additionally, statistically significant group x time interaction difference was also noticed in Berg Balance score ($F_{1,8}$=15.013, p=.005, η^2=.652). The post hoc paired t-test revealed statistically significant differences in intervention group between the two measurements regarding Berg Balance score (t= -8.63, df=4, p=.001).

Digital Footchecker

The ANOVA repeated measurement test revealed a statistically significant main effect of time or group in CoPmax ($F_{1,8}$=23.37, p=.001, η^2=.745) and CoPsd ($F_{1,8}$=11.81, p=.009, η^2=.596), in balance task (double leg stance) in M/L direction, and CoPmax ($F_{1,8}$=17.80, p=.003, η^2=.690), and CoPsd ($F_{1,8}$=51.164, p=.000, η^2=.865) in A/P direction, respectively.

Additionally, statistically significant group x time interaction difference was also noticed CoPmax [($F_{1,8}$=7.425, p=.026, η^2=.481), ($F_{1,8}$=15.626, p=.004, η^2=.661)], and CoPsd [($F_{1,8}$=13.963, p=.006, η^2=.636), ($F_{1,8}$=27.251, p=.001, η^2=.773)] in M/L and A/P direction respectively. However, there was not significant main effect or interaction in time right foot (ms) [($F_{1,8}$=1.847, p=.211, η^2=.188), ($F_{1,8}$=4.048, p=.079, η^2=.336)], in time left foot (ms) [($F_{1,8}$=4.244, p=.073, η^2=.347), ($F_{1,8}$=.905, p=.369, η^2=.102)] and time right and left foot (ms) [($F_{1,8}$=3.538, p=.097, η^2=.307), ($F_{1,8}$=2.267, p=.171, η^2=.221)], respectively.

The post hoc paired t-test revealed statistically significant differences in intervention group between the two measurements regarding static and dynamic balance score (t= -8.63, df=4, p=.001), CoPmax (t=4.53, df=4, p=.011), CoPsd (t=6.98, df=4, p=.002), in M/L direction and CoPmax (t=4.83, df=4, p=.008) and CoPsd (t=6.82, df=4, p=.002), in A/P direction.

The means and SD values of balance (static and dynamic) tasks PRE and POST training for Intervention and Control group are represented in Table 1.

Psychological tests

Self-Esteem Scale (RSE)

The ANOVA repeated measurement test revealed a statistically significant main effect of time or group in self esteem (score) ($F_{1,8}$=8.00, p=.022, η^2=.500).

Additionally, statistically significant group x time interaction difference was also noticed in self esteem (score) ($F_{1,8}$=8.00, p=.022, η^2=.500).

The post hoc paired t-test revealed statistically significant differences in intervention group between the two measurements regarding self esteem (score) (t= -9.49, df=4, p=.001).

Profile Of Mood States (POMS)

The ANOVA repeated measurement test revealed a statistically significant main effect of time or group in sprightfulness (score) ($F_{1,8}$=41.26, p=.000, η^2=.838), total score ($F_{1,8}$=5.82, p=.042, η^2=.421), but not in intention (score) ($F_{1,8}$=1.733, p=.224, η^2=.178), depression (score) ($F_{1,8}$=2.84, p=.131, η^2=.262), aggressiveness (score) ($F_{1,8}$=3.65, p=.092, η^2=.314), fatigue (score) ($F_{1,8}$=2.86, p=.129, η^2=.263) and confusion (score) ($F_{1,8}$=4.744, p=.061, η^2=.372).

Additionally, statistically significant group x time interaction difference was also noticed in intention (score) ($F_{1,8}$=9.86, p=.014, η^2=.552), depression (score) ($F_{1,8}$=7.879, p=.023, η^2=.496), aggressiveness (score) ($F_{1,8}$=11.502, p=.009, η^2=.590), confusion (score) ($F_{1,8}$=5.502, p=.047, η^2=.407), sprightfulness (score) ($F_{1,8}$=41.263, p=.000, η^2=.838), total score ($F_{1,8}$=9.845, p=.014, η^2=.552), but not in fatigue (score) ($F_{1,8}$=.526, p=.489, η^2=.062).

The post hoc paired t-test revealed statistically significant differences in intervention group between the two measurements regarding intention (score) (t=2.93, df=4, p=.043), aggressiveness (score) (t=2.78, df=4, p=.050), sprightfulness (score) (t= -7.48, df=4, p=.002), total score (t=2.86, df=4, p=.046), but not in depression (score) (t=2.41, df=4, p=.074), fatigue (score) (t=1.33, df=4, p=.255) and confusion (score) (t=2.45, df=4, p=.070).

The means and SD values of psychological tests PRE and POST training for Intervention and Control group are represented in Table 1.

The control of normality distribution with test Kolmogorov-Smirnov Z to all data of Intervention and Control group PRE and POST training showed that the data values followed a normal distribution.

Table 1. The measurements of gait, balance and psychological parameters; PRE and POST training for intervention and control group

	Intervention Group (n=5)		Control Group (n=5)	
	Pre	Post	Pre	Post
Gait				
Timed Up and Go Test (TUG-Test)				
Gait time (sec)	10.21±1.93	7.52±1.46*	10.32±2.37	9.80±1.40
10 Meter Walk Test (10 MWT)				
Normal gait speed (m/s)	.59±.13	.73±.10*	.60±.11	.57±.12
Fast gait speed (m/s)	.86±.17	1.05±.16*	.85±.24	.77±.18
Balance				
Berg Balance Scale (BBS)				
Berg Balance (score)	41.00±4.12	49.80±5.67*	41.60±4.45	42.00±4.30
Digital Footchecker				
CoPmax-M/L (mm)	11.67±4.62	6.87±3.40*	14.27±4.26	12.93±4.31
CoPsd-M/L (mm)	3.63±1.31	2.15±0.95*	4.36±1.67	4.42±1.88
CoPmax-A/P (mm)	19.81±5.28	14.20±5.14*	21.65±4.32	21.47±4.15
CoPsd-A/P (mm)	6.29±1.42	3.87±1.76*	7.30±1.97	6.93±1.88
Time Right Foot (ms)	1545.2±468.2	1243.6±331.5*	1673.4±535.9	1731.8±317.1
Time Left Foot (ms)	1504.4±601.7	1145.4±382.0*	1806.0±651.9	1673.8±261.3
Time Right and Left Foot (ms)	1524.8±517.9	1194.4±342.4*	1739.4±586.3	1702.8±280.2
Psychological parameters				
Self-Esteem Scale (RSE)				
Self Esteem (score)	30.40±4.22	36.40±4.10*	30.40±4.62	30.40±3.85
Profile Of Mood States (POMS)				
Intension (score)	5.80±3.42	1.40±1.67*	7.40±4.88	9.20±5.76
Depression (score)	7.60±6.80	.40±.55	5.40±6.19	7.20±5.72
Aggressiveness (score)	9.60±8.17	1.00±1.73*	6.80±4.97	9.20±6.53
Fatigue (score)	5.00±7.00	1.00±1.00	6.00±8.94	4.40±6.19
Confusion (score)	7.00±5.61	1.60±1.67	6.40±4.51	6.60±3.71
Sprightfulness (score)	16.00±3.39	21.60±2.88*	20.20±2.77	20.20±3.70
Total score	119.00±32.57	83.80±7.82*	111.80±25.06	116.40±25.80

Discussion

This study has demonstrated that an 8 week RAS music and movement intervention program can produce increased the gait, balance and psychological parameters of athletes with CP. Although the measurements of outcome have varied from one previous study to another, the findings of this study are consistent with previous music and movement intervention studies indicating that interventions incorporating the rhythmic elements of music can improve the function of the lower limb on the affected side, decrease the walking variances of the people with CP (Chung, 2002; Farrell, et al., 1999; Jiang, 2013; Kim, et al., 2011; Kim et al., 2012; Kwak, 2007; Kwak & Kim, 2013; Thaut ,et al., 1998; Varsamis, et al., 2012). On the other hand, the score of depression, fatigue and confusion of participants has not been statistically significantly increased by previous interventions. In this study, however, whereas the control group showed a reduction in gait, balance and psychological parameters, the experimental group showed a clear pattern of improvement. Although these changes were not statistically significant, the magnitude of the changes may be significant, as discussed below.

The music and movement intervention program, that used in this study was designed to increase the gait, balance and psychological parameters of the joints in the intervention group. To measure the gait, the researchers used the Timed Up and Go test (TUG) (Podsiadlo & Richardson, 1991) and the 10 Meter Walk Test (10 MWT) (Bohannon, 1997). For the balance ability we used the Berg Balance Scale (BBS) (Berg et al., 1992) and the EPS pressure platform (Loran Engineering S.r.I., Bologna – Italy).

The psychosocial benefits of music in a movement intervention program have been well documented (Aldredge, 1994; Kim, 1998). Many studies have reported the benefits of music in terms of enhancing motivation and endurance in movement regimens. This study also demonstrated that the RAS music and movement intervention program has several positive effects on psychological outcomes, as demonstrated by improved mood state and self esteem, that measured with the Self Esteem Scale (RSE) (Rosenberg, 1965) and the Profile of Mood States (POMS) questionnaires (McNair et al., 1971; Shacham, 1983; Zervas et al., 1993).

The RAS music and movement intervention program was effective in improving the physical and psychological state of athletes with CP. A unique and potentially significant contribution of this study to research in this field is related to the use of the RAS theory to explore the theory on which music and movement intervention programs are based. Unlike many of the preceding studies that have concentrated on physical recovery from CP and have used music only as a background to the intervention, this study placed a much greater emphasis on music (dynamic rhythm) in the intervention, with the music being the major intervening variable.

While this study was not designed to discover the precise physiological mechanisms of the intervention, the study may assist future researchers in building a physiologically plausible theory to support the RAS intervention. Dynamic rhythms are known to exert a strong stimulus effect on brain plasticity and the nervous system through the auditory system. The powerful neurological stimulus induced by dynamic rhythm and by physical movement that reinforces the stimulus can have a strong beneficial effect on increasing the plasticity of the nervous system. More rigorous future research efforts are necessary to understand the precise physiological mechanism behind RAS music and movement intervention programs and to cross-validate the positive findings, which obtained in this investigation program.

This study is also limited in terms of explicating the differential effects of the intervention component such as movement, psychological support and stimulating music. Also, future research should be conducted on separating the effect of each component of this intervention to clearly understand the mechanism of the intervention.

The results of this intervention program support the view that a well-designed program of music and movement intervention based on the theory of the RAS method, helps to improve gait, balance and psychological parameters of athletes with CP. Thus, the auditory rhythm increases the excitability of motor neurons in the spinal cord, which is directly influenced by the descending pathways from the brain stem and reticular formation, thus bypassing cortical areas (Paltsev & Elner, 1967; Rossignol & Jones, 1976). Moreover the auditory rhythm activates the brain motor areas including the supplementary motor area (SMA), pre-SMA, premotor cortex (PMC), the basal ganglia and the cerebellum (Bengtsson, Lau, & Passingham, 2009; Chen, Penhune, & Zatorre, 2009; Grahn & Brett, 2007; Grahn & Rowe, 2009). Activation of the brain motor areas through rhythm improves muscular activation and results in better movement control (Thaut, McIntosh, Rice, & Prassas, 1992; Thaut, McIntosh, & Rice, 1997).

The findings of this study have several implications. First, a structured music and movement intervention program of CP athletes should be offered for these people. Although the study participants were never part of a structured rehabilitation program prior to this study, and many of them were suffering from various several physical limitations, this intervention was able to produce significant improvement in major functional attributes. Second, clinicians should actively incorporate rhythmic music into movement intervention programs for people with CP because rhythmic music can be a powerful enhancer of the program. In particular, clinicians should pay attention to the choice of music and put more emphasis into making rhythm as the center of the intervention rather than the background. Finally, this study also underscores the importance of an environment based program for people with CP. Given that the incidence of CP is on the increase in many parts of the world, it is essential to address the need for adequate programs along with increased prevention efforts. In particular, because a music and movement intervention program can reach and improve the health outcomes of many poor and under-served individuals who have CP, such programs should be considered a viable means of reducing health disparities among this population in many countries.

In other words, an intervention program with music and movement of short duration may be a suitable alternative form of intervention to improve the aforementioned factors. In action with music and movement, people are active participants in a number of movement activities, which can be enjoyable while improving skills at the same time.

In conclusion even, the people with disabilities and especially CP, which increased systematically, specialized movement programs, which include the element of music, harmony with the movement, have too much to offer to participants, at multiple levels. The findings are very encouraging in this study, but the programs accompanying music and movement, should be extended to other groups of athletes and other neurological problems, and a greater number of participants to be able to generalize the results.

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