Advancement in gross motor and fine motor functions with quality of daily activities through brain gym exercise in down syndrome children: an interventional study

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Abstract:

Background & need of research: Fine and gross motor skills need attention for children's development in growing age. children with Down syndrome can have difficulties with fine motor skills due to their low tone and/or hypermobility in their hands, wrist, or elbows. Brain gym exercise is an experience to facilitate new learning activities. Brain gym is a great source of personal development to rapid transformation and improves the quality of life. so, there was a need to find out whether brain gym exercisesaffect gross and fine motor functions in children with Down syndrome. **Methods:** it was an interventional study in which 60 down syndrome children with age 5 to 12 yrs. were randomly divided into 2 groups, group A received brain gym exercise, and group B was a control group. Pre- and post-treatment datawere takenfrom the second edition Test of gross motor development and the functional dexterity Test for gross motor and fine motor respectively. quality of daily activities would bemeasured usinga functional independent measure scale and results correlate with the motor functions of children with Down syndrome. **Results:** Data were analysed by using SPSS 26. Pre-treatment and post-treatment comparison of TGMD-2 and functional dexterity Test scores between the group and within the group were done by unpaired t-test and paired t-test respectively with a CI level of 95%. The correlation between motor functions and the quality of daily activities wasanalyzed by a persons correlation test. The result shows a significant difference in p-value (P = 0.05). **Conclusion:** The results of the study concluded that there was a more significant effect of brain gym exercise on gross motor and fine motor functions with improvement in the quality of daily activities of children with down syndrome.

Keywords: 1. Brain gym exercise, 2.Down syndrome, 3.Gross motor function, 4.Fine motor function, 5.functional dexterity Test, 6.test for gross motor development second edition (TGMD-2), 7.quality of daily activities.

Introduction

Down syndrome is the most commonly occurring chromosomal variance noted worldwide, with 1 in 1000 births resulting in a child with DS.[1]Brain structure and function may control the development of mental and motor abilities. Structural and functional disorders of the central nervous system may be controlled by genetic conditions. For instance, children with Down syndrome (DS) who have an extra chromosome 21 present with many brain disorders that cause retarded psychomotor and motor development and problems with learning.[2]

children with Down syndrome have an intellectual disability and physical retardation, flat facial profile, an upward slant of eyes, and epicanthic folds.[3] activities of daily living are a major issue in challenged children. ADLs are basic self-care tasks that we expect all individuals to master: like getting dressed and undressed, feeding yourself, brushing your teeth, taking a shower, and going to the bathroom. Adaptive behaviors encompass conceptual skills (language, reading, writing, self-directions), social skills (self-

esteem, gullibility, naiveté, avoiding victimization), and practical adaptive skills (dressing, toileting, preparing meals, using transportation, occupational skills) that allow individuals to be functional in their everyday life.[4]In down syndrome children lack all that functional activities.

Children with Down Syndrome are usually delayed in all areas of their development, e.g., gross and fine motor skills, communication, and cognitive behaviors. If learning and understanding are very delayed, this affects how a child learns to move from one position to another and causes a delay in physical skills as well. Gross motor skills describe the way your child moves around, e.g., by rolling, sitting, crawling, standing, and walking, and their abilities within these positions. Fine motor skills describe how your child uses their hands, both separately and together, and how this affects their self-care skills and independence, e.g., playing, feeding, dressing, and writing.[5]

Brain Gym is a curriculum basically focused on theories of neuroscience and educational kinesiology. The intervention of brain gym consists of integrated, cross-lateral, balancerequiring movements that mechanically activate both hemispheres of the brain through themotor and sensory cortexes. Exercise can stimulate the brain in such a way that neurons are often in a condition to handle the different data from outside and are capable of responding to a" corporate member" of their duty in compliance with parts of brain activity by means of the principle of" brain-body link". Waqar M. Naqvi (2020) suggested Brain Gym is a great source of personal development, enabling individuals to obtain rapid transformations and also improve their quality of life in different age groups.[6]Ihsana El Khuluqo (2019) suggested the hat Brain Gym method is proven as an effort that can improve children's fine motor skills, that the development of children's fine motor skills can be seen by being able to train the muscles of the hand/fingers, being able to coordinate muscles and eyes. Brain gym exercises helpwith concentration, anger, poor motor coordination, and poor communication skills.

Here need arise for motor functions is a key component of daily activities in children as well as adults or elderly people. Children with down syndrome have difficulty in skill activities and gross motor activities. So, the aim of this study was to examine gross motor and fine motor abilities with brain gym exercise intervention. As they are significantly affected in Down Syndrome children. another purpose of the study was to assets motor function as a feature of the quality of daily activities.

Methodology

The study was approved by the institutional ethical committee. After that selection of patients was done by convenient sampling and collection of the patients by random sampling method (simple randomized technique) from K. K. Sheth physiotherapy center Rajkot, Gujrat. A total of 60 (30 boys and 30 girls) down syndrome children were selected. (Sample size was calculated through the G Power formula). children were included according to GMFCS levels 1,2, and ,3 and genetic report showed trisomy 21. children aged 5 to 12 years (M=8.59years SD=2.18years). children with cardiopulmonary or respiratory impairments, other neurological impairments, and musculoskeletal impairments of the lower extremity which would affect walking were excluded from the study. Consent was taken from the children's parents. Pre-treatment TGMD 2, functional dexterity Test and paediatric FIM were taken for gross motor function, fine motor function, and daily activities measure respectively. After that children were randomly distributed into two groups. Group A total of 25 children (13 boys and 12 girls) received brain gym exercises; Group B total al 24 (12 boys and 12 girls) was the control group They did not receive any treatment.There were no statistically significant differences in the mean age of children in both groups.

Interventions

Brain gym exercises treatment protocol

The program consists of twenty-sixfasts,interestingly, energize exercises directed to improve brain and body integration.It is an important program that is designed for physical activities which help both the body and the mind to improve the learning and the performance among the participants of the study in-

cluding all ages and abilities. Therefore, each activity was performed in a small place in the room. they express fun movements, which are prepared to include the brain. the brain gym exercises do not introduce any recommendations for the exercises, thus here selected the movements on the basis of choosing one movement exercise from each classification. they include (midlinemovements, the activities of the energy, deepening the attitudes – all of these exercises are presented). the research found that some movements from the brain gym including the earth – the space and the balance buttons, are excluded. but the other brain gym movements are included. the performance of the brain gym movements wastaking place on the basis of 6 days per week for the period of 8 weeks.

The intervention of brain gym exercise starts with Marching as a warm up exercise, in which subjects stand straight and lift both the legs continuously slight above for time duration of 1 minute. Then first exercise started, 1, Drinking water: drinking water activates the brain. it depends on all the actions including the electrical and the chemical actions for the brain and for the central nervous, based on conducting electricity between the brain and the senses. the research concluded that drinking water helps the body to stay awake and lively, and can think properly with improve fine motor.

2, Cross Crawl It is simple form. it is across- lateral marching in the place. it depends on reaching the right elbow to the left knee. then the left elbow to the right knee. it was done for time duration of 2 minute (5 sets of 8 repetition). the large places of the brain hemispheres are activated as shown infig.1.

Fig. 1 cross crawl

Fig. 2 Elephant

3, Elephant: This exercise is very integrative activity for the brain gym program. The exercise was practiced by putting the left ear on the left shoulder side then tighten to put a piece of paper in the place between them. then extending the left arm on the form of a trunk of an elephant, Relax the knees, bend the flow, then the arm was draw lazy 8 models in the mid area then the participant can start up the middle & out and will round with his eyes, and was follow the movement of the finger tips. Shown in fig.2.

4, Brain Buttons: the exercise of the brain buttons depends on putting one hand over the navel and putting the other hand to simulate the points located between the ribs, putting the hand over the navel waslead to attention to the gravitational canter of the participants body. time duration of 2 minutes (10 repetitions) shown in fig. 3.

Fig. 3Brain Buttons

Fig.4 Hook Up

Fig. 5 Thinking Caps

5, HookUp: This exercise was performed by asking the children to cross one ankle over the other. then crossing the hands. clasping and inverting them. the participants were asked to stretch their arms out in front of them. then putting the back of the hands together and the thumbs indicating down. they were asked to lift one hand over the other, and putting the palms in the place facing and interlocking the fingers of the participants. they were asked in this step to roll the closed hands towards the body. they rested on the chest with the elbows put down.it wasdone for duration of 5 minutes (30 repetitions) shown in fig. 4.

6, The exerciseof thinking caps This activity helps in awaking up the mechanisms of hearing, and the memory. it is performed by the participants through unrolling the outer cartilage of the ears from top to button many times. duration was 2 minutes (10 repetition) shown in fig.5.

7, The exercise of lazy eights: This type of exercises requires the children to stretch their arms straight out in front of them and, must be equal to their shoulders' level – putting their thumb finger going towards the ceiling of the room. The children were asked to, follow slowly the form of a big figure of 8, they asked the children to concentrate their eyes on the thumb finger. Duration: 1 minute (5 repetition)

8, the exercise of the rocker: It depends on directing the participants to sit comfortably on a strong ground, then they were asked to lean back on the arms making the bent knees up then they were asked to cross the ankles and asked them also to make sacrum put on the floor, then rocking the sacrum to help in making circular movements, shaping the figure 8. by doing this movement it was help to improve the position and to stabilize the pelvis, leading to increasing the ability of the children to stable.

9, Calfpump: In this exercise, the children were directed to stand facing the wall. they were asked to lean towards the wall, they were asked to place their hands flat into the wall. they were directed to return the right leg back to have the ball and the toes of the feet in touch with the floor. the children should put the weight on the left leg then they were asked to have a breath to expel and acount of 8. as well as the children were asked to put the right heel down to the ground. then extend in the calf, then more extending till being fully comfortable they were asked to relax and to put the heel back on the floor., then make the bent knees up, then they were asked to cross the ankles.

10, The gravity glider exercise: It is the exercise in which the children were asked to sit in a chair would remain extended forward in it, the children were asked to put their legs out, and to cross over left at the ankle .then they were asked to take a deep breath and expel for acount 8. While leaning forward, extending their arms towards their feet. the children were asked to repeat the movements and to relax. The exercise of gravity gilder, is an important extension activity for the strings of the joint between the thigh and the lower leg of the participants, it helps in improving the position. It also helps in increasing the flow of both the oxygen& the blood. There is no doubt that, this exercise helps in improving both the stability,

and increases the ability of expression, and above all it increases the degree of confidence among the children. The children were led by the supervisor when practicing this exercise.[7]

Outcomes

The outcomes were measured at baseline and after treatment. The outcomes variables are TGMD 2, functional dexterity Test, and paediatric FIM to measure gross motor functions, fine motor functions and daily activities of living respectively. Test for gross motor development second edition combines fun activities with a reliable and valid procedure that will give you meaningful results in identifying children with gross motor problems. TGMD-2 in identifying children who are significantly behind their peers in gross motor development are also provided. Score of test was 46 to 160 more score indicate good gross motor functions. The scale has a reliability of 0.84 to 0.96 for measuring gross motor functions.[8] the Functional Dexterity Test (FDT) was developed as a measure of dexterity that takes a minimum amount of time to administer, yet provides information regarding the children ability to use the hand for daily tasks requiring a 3-jaw chuck prehension between the fingers and the thumb. turning the page and take a block. Here considers time taken less than 55 seconds was normal functional use. The test has a highly reliable (0.99).[9]The FIM instrument Includes measures of independence for self-care, including sphincter control, transfers, locomotion, communication, and social cognitionIs an 18-item, seven-level, ordinal scale. Here used 13 items cognition part were excluded from scale. Total score between 13 to 91 more score more independent child. The scale has a reliability of 0.88.[10]

Statistical Analysis

The statistical analysis was conducted using SPSS version 26.0 and descriptive statistics were used. The data follow the normality So Pre-treatment and post-treatment comparison of TGMD 2 and functional dexterity test scores between the group and within the group was done by unpaired t test and paired t test respectively. The correlation between motor functions and the quality of daily activities was analysed by persons correlation test with CI level 95%. The result shows a significant difference in p-value ($P < 0.05$).

Results

Total of 46 children data completed, valid baseline data with boys and girl's ratio of 1:1 and mean age of 8.59 ± 2.18(mean ± SD). Table 1, shows the intra-group comparison of the pre- and post-value of TGMD 2 and functional dexterity score. Here, group A showed a significant difference between pre- and post-value ($p < 0.05$). But group B did not show significant improvement in gross motor and fine motor functions. Table 2, showed an Intergroup comparison of TGMD 2 and functional dexterity score for Group A, and B and here the results of group A were more significant ($P<0.05$) than group B. Table 3, showed highly correlation between activities of daily living and gross motor function ($r= 0.794$). but activities of daily living and fine motor functions have mild correlation [dominant hand ($r=0.399$) and non-dominant hand ($r=0.395$)].

Table 1: intra-group comparison of the pre- and post-value of TGMD 2 and functional dexterity score

Group	Variables	Mean	SD	t value	P value
A	PRE TGMD 2	81.39	17.31	-18.916	0.00
	POST TGMD 2	114.39	17.79		
	PRE FDT (DOMINENT HAND)	58.04	13.49	9.788	0.00
	POST FDT (DOMINENT HAND)	50.78	12.66		
	PRE FDT (NON DOMINENT HAND)	64.09	13.88	6.494	0.00
	POST FDT (NON DOMINENT HAND)	58.09	13.04		
B	PRE TGMD 2	69.09	21.56	-0.839	0.411
	POST TGMD 2	70.17	21.73		
	PRE FDT (DOMINENT HAND)	69.13	16.39	2.878	0.09
	POST FDT (DOMINENT HAND)	67.57	17.072		
	PRE FDT (NON DOMINENT HAND)	75.70	13.92	1.533	0.140
	POST FDT (NON DOMINENT HAND)	74.91	13.41		

Table 2: inter-group comparison of mean and SD of TGMD 2 and functional dexterity score

GROUP	Variables	Mean	SD	t value	P value
A	TGMD 2	-33.00	8.367	7.548	0.00
B	TGMD 2	-1.08	6.215		
A	FDT (DOMINENT HAND)	7.26	3.558	-3.787	0.00
B	FDT (DOMINENT HAND)	1.565	2.608		
A	FDT (NON DOMINENT)	6.00	4.431	-4.312	0.00
B	FDT (NON DOMINENT)	0.783	2.449		

Table 3: correlation between daily activities with motor function

Depended variable	In depended Variables	r value	P value
PRE FIM-SCORE	TGMD 2	.794	0.00
	FDT DOMINENET HAND	-.399	0.059
	FDT (NON DOMINENET HAND)	-.395	0.061
POST FIM SCORE	TGMD 2	.687	0.00
	FDT (DOMINENET HAND)	-.332	.122
	FDT (NON DOMINENET HAND)	-.331	.123

Discussion

The results of the present study indicated a significant difference between the interventional group, and control group. The improvement of the gross motor functions and fine motor functions in the component of TGMD 2 and functional dexterity test in an interventional group A (brain gym exercise) was significant. Also shown improvement in daily activities due to improvement in gross motor functions.

A total of 60 children were included in the study, 11 children were excluded as they did not follow the inclusion criteria. The remaining 49 children were randomly divided into 25 in group A and 24 in group B. 3 children were Dropouts as 2 children did not continue the treatment, and 1 child did not turn in for a follow-up, due to illness. Baseline with 46 patients provided valid data. Here result showed group A hadsignificant difference between pre and post data ($p < 0.005$) and group B had not significant difference between pre and post data. In between both groups showed significant difference ($p<0.005$) group A was showed more significant improvement then group B. functional independent measure showed more significant improvement with gross motor functions ($r=0.794$).

Similar findings of the other study, author Elvina Sari Sinaga(2022) studied on The Effect of Brain Gym on Improving Fine Motor and Gross Motor Skills in Pre-School Children with concluded that brain gym therapy had ability development gross motor and fine motor skills of children.[11]author Sara Jalilinasab (2021) suggested Fundamental motor and social skills of children: the role of Brain Gym exercise and concluded brain gym exercise group more improvement in motor and social skills.[12]

organization of the Motor System of brain for Voluntary Movements to The ability to produce and modulate force output is an essential aspect of motor control, as tasks performed require the ability to control our force output to accurately suit the tasks at hand. As force production and modulation play such an important role, it is not surprising that there is extensive literature focused on how force is encoded in the healthy brain. When producing a movement, the force output of a skeletal muscle can be changed over a large range.Recent research was conducted with neurotypical five-year-old children to determine how to improve fine motor skills using physical exercise.The researchers concluded that the physical exercise sessions improved fine motor skills in neurotypical five-year-old children. The exercise program had simple physical activities that could be easily implemented in a kindergarten program.[13] this study data suggested brain gym exercise use for improvement in gross motor functions, fine motor functions as well as activities of daily living in down syndrome children.

Conclusion

Based on the findings of the study, it can be concluded that the effect of brain gym exercise protocol is more effective in improving gross motor and fine motor functions with improving activities of daily living in down syndrome children. Activities of daily living had mild correlation with fine motor functions but strong correlation with gross motor functions.

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Abbreviations –ADL- activities of daily living
CI - confidence interval
DS- down syndrome
FDT- functional dexterity test

FIM- functional independent measure

GMFCS-gross motor function classification system

TGMD 2- test of gross motor development second edition

References

1. *Pitetti K, Baynard T, Agiovlasitis S. Children and adolescents with Down syndrome, physical fitness and physical activity. J Sport Health Sci [Internet]. 2013 Mar 1 [cited 2023 Feb 18];2(1):47–57.*
2. *Vaishnavi V Siroya, Waqar M Naqvi, Chaitanya A Kulkarni. Importance of Brain gym as exercise in physiotherapy and rehabilitation. Int J Res Pharm Sci [Internet]. 2020 Dec 21 [cited 2023 Feb 18];11(SPL4):1386–9.*
3. *Aaron DH, Jansen CWS. Development of the Functional Dexterity Test (FDT): construction, validity, reliability, and normative data. J Hand Ther Off J Am Soc Hand Ther. 2003;16(1):12–21.*
4. *Jalilinasab S, Saemi E, Abedanzadeh R. Fundamental motor and social skills of children: the role of Brain Gym exercise. Early Child Dev Care [Internet]. 2022 Oct 26 [cited 2023 Feb 21];192(14):2256–67.*