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EFFECT OF BRAIN GYM EXERCISES ON POSTURAL CONTROL IN STUDENTS WITH HEARING IMPAIREMET

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Abstract:

Introduction

Hearing impaired children, showed deficits in both the movement and the balance on the postural control. this research was conducted for the objective of revealing the impact of exercising the brain gym on the postural control, among the students with hearing impairment, Methods. A single before and after without control group experimental design, was performed. it involved 26 students with bilateral hearing impairment (deaf and dumb) their age ranged from 7 to 10 years. male & female. they fulfilled the inclusion criteria. One experimental group, participated in the intervention in which static and dynamic balance were measured by using BOTs. The students were subject to train the exercises for 1 hour per day – 3 times a week on the activities of the brain gym . that was run for 12 weeks, and pre & post intervention values were, measured. Results . there was a significant increase in the point score, scale score after intervention rather than the before treatment of the study's group, with the probability of ,<0,001). There was no great differences regarding the point score, among girls & boys with the probability of p>0,05)- while there was no great increase in the scale score among males for the before intervention rather than among the females as the probability was >0,05)- while there was a great increase in the scale score among the 7,1-8,8 months of age group before treatment. compared with that of 8,9-10,8 months age group. with the probability =0,0008- and no significant differences post treatment with the probability of p>0,05).

Conclusions . the study showed: practicing the exercises of the brain gym was useful for the postural control among the students injured by the hearing impairments.

The key words of the study. Brain gym exercises. postural control, hearing impairment .

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Introduction :

The deafness injury (hearing loss) is very serious deficit causing the children suffering from this injury to be unable to hear . the children who are injured with deafness (hearing loss) represent a major problem as it is connected with the problems of growing up like: the social abilities, the skills of communicating with others, The development of movement. The estimates of the world health organization reported that in (2005) about 278 million of the people all over the world. suffer from being unable to hear (hearing impairment). Ranging from moderate to profound of hearing impairment among the 2 ears as .41 DB of hearing loss [1].

The children who are injured with this deficit show difficult movement and suffer from miss balancing in the postural control – the stability of the postural requires more information about the central nervous system to provide movement interaction that can help in keeping the balance of the body. also, the maturity of the vestibular system helps in keeping the stabilization of the vision of the neck, and the movement of the body in the surrounding place, it also helps the postural control, which is very important to achieve the development of the movement's features (aspects) due to the close relation between the inner ear and the vestibular system, either of them may be influenced or harmed by the factors of development. giving reasons to the accompanying disorder of the inner ear among the children who are injured of hearing loss either it is inherent, or natural or obtained . the published reports from the world health organization , indicated to that the rate of the disorder of the inner ear ranged from 30-70% among the children injured with hearing loss(deafness) but there was not enough evidence about these estimates[2].

It is very important to appeal to the anatomical integrity of the inner ear to keep the balance of the human body. the system of the cochlea of the inner ear does two functions they are the cochlea is associated with and responsible for the function of auditory, while the system of the inner ear is in connection with and responsible for balancing the body. the main function of the auditory system is to keep the balance of the body as for the ability of hearing it comes next to that of the auditory system, as it is considered of secondary feature[3]

the balance of the body becomes affected when the system of the inner ear shows disorder, especially among the people who are injured with a disease of the inner ear, or in the auditory nerve and hearing impairment. the people who suffer from injuries in the internal ear, may face some problems in relation with disorder of the inner ear, accompanying or coherent with a disease of the inner ear or the auditory nerve (hearing loss). The previous literatures showed that, the disorder of the inner ear is a repeated result among the evaluation process of otoneurologic among the people suffering from the inner disorder of the ear (those who lost their ability to hear) [4-5].

Regarding the people who are injured with internal ear disorder leading to hearing impairment, they expose changes for the sensory information given by the sense of balance (due to disorder of the inner ear) the reason can be an injury in the internal ear. which may cause changes in the balance of the body, The literatures concluded that, there is no enough data available about the balance among the children suffering from hearing impairment contrary to that of the children

who enjoy normal and good hearing skills., especially when the matter is associated with the dynamic balance activity – that is the major aim of this research [6].
Gilman reported that the people who suffer from hearing difficulties , expose lower level of satisfaction with life rather than their normal hearing counterparts[7] .
The brain gym program is an educational program for increasing the moving skill among the hard of hearing children . it works for promotion and implementation in 87 states all over the world. , its materials were translated into about 40 languages. due to its great benefits, many training courses were presented and became available on the international websites in many countries [8].
The educators and the experts of reading **paul and gail denisson** , designed the brain gym as a treatment in 1970 for the purpose of developing the skills of the memory, the concentration and the academic skills. This type of treatment, wanted the injured children to share in the movements, so that they can help the body to remember the movements since the first stages of life, when they were prepared to learn how to coordinate their hands, their ears, their eyes and above all, their body. the programme of brain gym has 26 simple movements. they can improve both the behavioral, the academical performance, depending on activating the hemispheres of the brain, by the neurological remodeling for the aim of improving the whole – brain learning skills [9].
The brain gym program was applied among the children who suffer from specific deficits. they include disorder for attention deficit, hyperactivity of attention deficit disorder, dyspraxia, dyslexia.and they are many fields which are subject to great development, including the concentration, the physical coordination, test making, memory, academic reading ,writing, organizational skills [10].
The researchers suggested that by, integrating the left and the right sides of the brain, then the difficulties of learning , the psychological and the emotional stress will becom excluded.enabling the children to increase their learning skills. there are several qualitive studies, accepting and encouraging using this type of treatment, but there are few empirical researches, that are available, revealing the positive impacts of the brain gym program [11-12].

Subjects & methods:

Design:

the presented single pre – post study, was conducted in ALAMAL – School for deaf and dumb in kafr al sheikh. One experimental group participated in a pre and post – training designed intervention, in which the Bruininks -oseretsky test of motor proficiency. second edition (BOT-2) was used to measure static and dynamic .

Sampling

A total of 26 students with bilateral hearing impairment (deaf & dumb) with the age ranging from 7- 10 years of both males & females, were chosen for the study. the participants were selected from al -Amal school for deaf & dumb, in kafr al sheikh. all the subjects (the children)

signed a form of accepting before being subject to the study, The inclusion criteria, was a clinical diagnosis of bilateral sensorineural hearing loss, they were selected from the second grade through the fifth grade with IQ level in an average range (85-115) and measurement of the range and sensitivity of person's sense of hearing was used to measure the commanding of the language of sign to be sure of understanding the orders in association with the methodology by all the participants , but refused the participants who suffered from Neurological and orthopedic disorder , visual impairment , mental deficiency , those who receive medical drugs , that can cause confusion or mark child less alert , surgical interference in any part of the body that may hamper the child performance during practicing the activities , the students wearing hearing aids or making cochlear implantation, all of them were refused to participate in this study.

procedures:

All the students were firstly screened for balance deficit (static and dynamic balance) by using one method of evaluating the balance, the assessment and the treatment program, were conducted for each child individually, before and after the treatment period. the protocol of the work was explained to the children and to their parents, before conducting the study. All the participants were screened (examined) according to inclusion and exclusion criteria. then met the parents of the participants, told them about the study, and received a written approval from them.

one experimental group, participated in the before and after training program, then measured the static and the dynamic balance by using BOT S. The students were trained for 1 hour per day. for 3 times a week on the activities of the gym brain, for the period of 12 weeks, - then they measured the values of the pre- and post-intervention.

Intervention:

-The tools which were, used for selecting the students with balance deficit were the following:

The static balance evaluation.

Romberg test :

It is the test under which the participants kept standing up . with their feet bare, they put their foot together in a parallel state. they put their arms along their body. they closed their eyes. - they remained for only1 minute.

The test of the single leg stance :

It is the test in which the participants kept standing up . their feet were bare, with unipodal support. they stood on their dominant leg .they closed their eyes, for half a minute, - the test showed that the participants who were unable to keep unipodal support. during the determined time, were marked as being subject to static balance alteration.

Evaluation of the dynamic balance .

Unterberger step test

It is the test in which the participants walked in a place closing their eyes. they lifted their knees up to about 45 degrees, they lifted their hips to about 90 marks. they made 50 steps, they extended their arms in front of them at 90 marks, The participants who practiced left and right rotation, equal to, or more than 45 marks, were marked as having adynamic balance alteration.

The test of time up and go(TUG)

IT is the test which has asset of movements , they are the sitting , the standing up , marching , and the postural control . the children sat on a chair , after hearing the order (run) they could lift raise up from their position of sitting , they marched for about 3 meter in the straight line fastly , then they moved back to the first sitting place on the same chair , (TUG) cared for the time for the children to complete the activity .

1- Evaluation of the postural control

The test of bruinink – Oseretsky for perfecting the movement

The 2nd edition (BOT -2)

IT is an individually administrated examination that measures a wide array of gross and fine skills for controlling the movement among the child with the age of 4 years, till 21 years. it is designed to provide the practitioners, such as occupational therapist, development adaptive physical, educational teachers and researchers, among others, with high dependability and validity . It has interrater ranging from moderate to strong , it has also dependability for test – retest, about the whole shape for the all-movement elements. and for a short shape [13].

It classified into 4 elements of movement domains; each element involves 2 subtests for the movement. they were 1- the fine manual control: the fine movement adjusting, the integration of the fine movement:2. The manual coordination: the manual dexterity, coordination for the upper limb.3: The coordination of the body.: it involves the bilateral coordination , the balance. 4: strength & agility it is concerned with running speed & agility, strength. The sub exam of the balance, for BOT-2 contains 9 items. 4 of these items are practiced while closing the eyes and another 4 items are practiced while opening the eyes [14].

1-standing with the feet placed apart on a line (with open eye)
2- Walking straight forward on a line.
3- Standing on one leg on a line (eye opened)
4- Standing with feet placed apart on a line (with closed eye)
5- Walking forward with heel directed to toe on a line
6- Standing on one leg on aline (closed eye)
7- Standing on one leg on balance beam (with eye open)
8- Standing heel dirwcted to toe on balance beam.
9- Standing on one leg on balance beam (with closed eye)

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Instrumentation for treatment

(Exercises of brain gym):

It is an important program that is designed from physical activities which help both the body and the mind to improve the learning and the performance among the participants of the study including all ages and abilities [8].

Brain gym exercises, are designed to specifically develop and stimulate the vestibular system, to promote balance, to improve core strength, and to increase cross – lateral neural connections between the brain hemispheres [15].

The program consists of twenty six fast , interstingly, energize exercises directed to improve brain and body integration . it helps reach to full learning and living potential in all areas. the exercises are mere short exercises, which can be performed by the participants for the purpose of releasing the stress , to expend the extra energy , and to improve learning skills [15].

Therefore each activity will be performed in a small place in the classroom or at the participants seat . they express fun movements, which are prepared to include the brain . most of these activities are of great benefit and useful for the young participants , of all ages .

But the brain gym exercises do not introduce any recommendations for the exercises , thus we will select the movements on the basis of choosing one movement exercise from each classification . they include (midline movements , 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 will take place on the basis of 2-3 days per week for the period of 12 weeks according to the availability of the participants [16].

The exercises were as the following:

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 [17] (figure 1).

Figure .1 drinking water

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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. the large places of the brain hemispheres are activated as shown in (figure 2) [17] .

Figure 2cross crawl

3- Elephant:

This exercise is very integrative activity for the brain gym program. The exercise is 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 will draw alazy 8 models in the mid area then the participant can start up the middle & out and will round with his eyes, and will follow the movement of the finger tips . this exercise must not be done fastly for 3 to 5 times on the left and in equal number of times, by using the right ear against the right shoulder for the aim of increasing the effectiveness and the validity[17] (Figure 3).

Figure 3. Elephant

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 will lead to attention to the gravitational center of the participants body[17] (figure 4).

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Figure.4 Brain Button

5-Hook Up :

This exercise is performed by asking the participants 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. [17] (figure 5).

Figure. 5 Hooks up

5- 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 (which is widespread in the infant skeleton- and can be replaced by bone during the growth process) of the ears from top to button many times [17] (figure 6).

Figure 6; The exercise of Thinking Cap

7. The exercise of lazy eights:

This type of exercises requires the participants 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 classroom. the participants were asked to, follow slowly the form of a big figure of 8, they asked the participants' to concentrate their eyes on the thumb finger [18].

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 will help to improve the position and to stabilize the pelvis , leading to increasing the ability of the participants to concentrate [19].

9-Calf pumb: .

In this exercise, the participants 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 participants should put the weight on the left leg then they were asked to have a breath to expel and account of 8. as well as the participants 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 of the floor., then making the bent knees up , then they were asked to cross the ankles . this type of activity helped in relaxing the calves and to enhance the breathing and the circulation process [19] .

10: The gravity glider exercise :

It is the exercise in which the participants were asked to sit in a chair it would remain extended forward in it , the participants were asked to put their legs out , and to cross over left at the ankle .then they were asked to take deep breath and expel for account 8. While leaning forward, extending their arms towards their feet. the participants 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 participants. [19].

The participants were led by the supervisor when practicing this exercise. the supervisor described to them this activity, and set the model of the movement. While practicing the movements, the participants were asked to stop after 30seconds because it was the least time, which was advised for practicing the brain gym exercises [11].

Outcomes measures :

Measurement of the postural control.

Power analysis:

The statistical analysis, showed that the minimal proper sizes of the chosen sample (12 participants) were able to reject the null hypothesis with 80% at -,05 level by using the paired t test .

Statistical analysis :

-The descriptive statistics tools were used for treating the data of the participants for the population of the study .

-The paired t test was made to compare between the mean values of the point scale, The scale score between pre - post treatment in the population of the study and among the sub- population included both the age and the gender .

-The unpaired t test was conducted for making comparison between the mean values of the point scale, the scale score between the girls and the boys, and between7, 1- 8,8 months and 8,9-10 months of the population's age .

-The statistical tests, level of significance was at $p<0,05$. The measures of statistics were made by using the package of the statistics for the social researches [SPSS], version 25 windows.

Ethical approval

This study was conducted according to the international policies and regulations ,It depended on the principals of declaration of helsinki convention and was approved by the ethical committee for the collage of physical therapy, Cairo university, Egypt (P.T.REC/012/002168).

Informed consent :

Informed consent has been obtained from the legal guardians of all individuals included in this study.

Results:

Subject characteristics:

Twenty-six (12 (46.2%) girls and 14 (53.8%) boys) students with hearing impairment participated in this study. Their mean ± SD age were 9.07 ± 1.27 months with maximum and minimum values of 10.8 and 7.1 months. Subjects were grouped into two age groups; 7.1-8.8 months 13 (50%) subjects and 8.9-10.8 months 13 (50%) subjects (Table 1).

Table 1. Descriptive statistics for age of the study group.

	$\overline{X}$ **±SD**	**Minimum**	**Maximum**	**Range**
Age (months)	9.07 ± 1.27	7.1	10.8	3.7
Age classes				
		No (%)		
7.1-8.8 months		13 (50%)		
8.9-10.8 months		13 (50%)		

$\overline{X}$ **: Mean** **SD: Standard Deviation**

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Sex distribution:

The sex distribution of study group revealed that there were 12 girls with reported percentage of 46.2% and 14 boys with reported percentage of 53.8% as shown in (table 2) .

Table 2. The frequency distribution of sex in study group:

	Study group	
	Girls	**Boys**
No.	12 (46.2%)	14 (53.8%)
Total	26 (100%)	

Effect of brain gym exercises on postural control :

I. Mean values of point score pre and post treatment:

The mean ± SD point score pre treatment was 24 ± 3.8 while post treatment was 33.5 ± 2.42. The mean difference between pre and post treatment was -9.5 and the percent of improvement was 39.58%. There was a significant increase in the point score post treatment compared with that pre treatment (p = 0.0001) (Table 3).

Table 3. ***Comparison of mean values of point score between pre and post treatment:***

	Point score	**MD**	**% of Improvement**	**t- value**	**p-value**	**Sig**
	$\overline{X}$ **± SD**					
Pre treatment	24 ± 3.8	-9.5	39.58	-18.77	0.0001	**S**
Post treatment	33.5 ± 2.42					

x̄: Mean **SD: Standard deviation** **MD: Mean difference**

t value: Paired t value **p value: Probability value** **S: Significat**

II.Mean value of scale score pre and post treatment

The mean ± SD scale score pre treatment was 7.23 ± 2.32 while post treatment was 16.23 ± 3.78. The mean difference between pre and post treatment was -9 and the percent of

improvement was 124.48%. There was a significant increase in the scale score post treatment compared with that pre treatment (p = 0.0001) (Table 4)

Table 4. ***Comparison of mean values of scale score between pre and post treatment:***

	Scale score	MD	% of Improvement	t- value	p-value	Sig
	$\overline{X}$ ± SD					
Pre treatment	7.23 ± 2.32	-9	124.48	-15.54	0.0001	**S**
Post treatment	16.23 ± 3.78					

x̄: Mean SD: Standard deviation MD: Mean difference

t value: Paired t value p value: Probability value S: Significant

Effect of gender on postural control :

I- Effect of gender on point score:

Girls:

The mean ± SD point score pre treatment of girls was 23.41 ± 3.62 while post treatment was 33.25 ± 2.6. The mean difference was -9.84 and the percent of improvement was 42.03%. There was a significant increase in point score of girls post treatment compared with that pre treatment (p = 0.0001) (Table 5).

Boys:

The mean ± SD point score pre treatment of boys was 24.5 ± 4.01 while post treatment was 33.71 ± 2.33. The mean difference was -9.21 and the percent of improvement was 37.59%. There was a significant increase in point score of boys post treatment compared with that pre treatment (p = 0.0001) (Table 5).

Comparison between girls and boys

Pre treatment

The mean difference in point score between girls and boys pre treatment was -1.09. There was no significant difference in the point score between girls and boys pre treatment (p = 0.48) (table 5).

Post treatment

The mean difference in point score between girls and boys post treatment was -0.46. There was no significant difference in the point score between girls and boys post treatment (p = 0.63) (table 5).

Table 5. Mean point score pre and post treatment of the girls and boys.

Point score	Pre treatment	Post treatment	MD	% of improvement	t- value	P-value	Sig
	$\overline{X}$ ±SD	$\overline{X}$ ±SD					
Girls	23.41 ± 3.62	33.25 ± 2.6	-9.84	42.03	-15.42	0.0001	**S**
Boys	24.5 ± 4.01	33.71 ± 2.33	-9.21	37.59	-11.83	0.0001	**S**
MD	-1.09	-0.46					
t- value	-0.71	-0.48					
P-value	0.48	0.63					
Sig	**NS**	**NS**					

$\overline{X}$: Mean SD: Standard deviation MD: Mean difference
p value: Probability value S: Significant NS: Non significant

II- Effect of gender on scale score:

Girls:

The mean ± SD scale score pre treatment of girls was 6.16 ± 1.74 while post treatment was 14.91 ± 4.46. The mean difference was -8.75 and the percent of improvement was 142.05%. There was a significant increase in scale score of girls post treatment compared with that pre treatment (p = 0.0001). (Table 6).

Boys:

The mean ± SD scale score pre treatment of boys was 8.14 ± 2.41 while post treatment was 17.35 ± 2.8. The mean difference was -9.21 and the percent of improvement was 113.14%. There was a significant increase in scale score of boys post treatment compared with that pre treatment (p = 0.0001). (Table 6).

Comparison between girls and boys

Pre treatment

The mean difference in scale score between girls and boys pre treatment was -1.98. There was a significant increase in the scale score of boys compared with that of girls pre treatment (p = 0.02). (table 6).

Post treatment

The mean difference in scale score between girls and boys post treatment was -2.44. There was no significant difference in the scale score between girls and boys post treatment (p = 0.1). (table 6).

Table 6. Mean scale score pre and post treatment of the girls and boys.

Scale score	Pre treatment	Post treatment	MD	% of improvement	t-value	P-value	Sig
	$\overline{X}$ ±SD	$\overline{X}$ ±SD					
Girls	6.16 ± 1.74	14.91 ± 4.46	-8.75	142.05	-8,.74	0.0001	**S**
Boys	8.14 ± 2.41	17.35 ± 2.8	-9.21	113.14	-13.53	0.0001	**S**
MD	-1.98	-2.44					
t- value	-2.35	-1.69					
P-value	0.02	0.1					
Sig	**S**	**NS**					

$\overline{X}$ **: Mean** **SD: Standard deviation** **MD: Mean difference**
p value: Probability value **S: Significant** **NS: Non significant**

Effect of age on postural control :

I- Effect of age on point score:

7.1-8.8 months:

The mean ± SD point score pre treatment of 7.1-8.8 months age group was 24.3 ± 3.94 while post treatment was 33.23 ± 2.45. The mean difference was -8.93 and the percent of improvement was 36.75%. There was a significant increase in point score of 7.1-8.8 months age group post treatment compared with that pre treatment (p = 0.0001). (Table 7).

8.9-10.8 months:

The mean ± SD point score pre treatment of 8.9-10.8 months age group was 23.7 ± 3.8 while post treatment was 33.76 ± 2.45. The mean difference was -10.06 and the percent of improvement was 42.45%. There was a significant increase in point score of 8.9-10.8 months age group post treatment compared with that pre treatment (p = 0.0001). (Table 7).

Comparison between girls and boys

Pre treatment

The mean difference in point score between 7.1-8.8 months and 8.9-10.8 months age groups pre treatment was 0.6. There was no significant difference in the point score between 7.1-8.8 months and 8.9-10.8 months age groups pre treatment (p = 0.68). (table 7).

Post treatment

The mean difference in point score between 7.1-8.8 months and 8.9-10.8 months age groups post treatment was -0.53. There was no significant difference in the point score between 7.1-8.8 months and 8.9-10.8 months age groups post treatment (p = 0.58). (table 7).

Table 7. Mean point score pre and post treatment of the 7.1-8.8 months and 8.9-10.8 months age groups.

Point score	Pre treatment	Post treatment	MD	% of improvement	t- value	P-value	Sig
	$\overline{X}$ ±SD	$\overline{X}$ ±SD					
7.1-8.8 months	24.3 ± 3.94	33.23 ± 2.45	-8.93	36.75	-10,.67	0.0001	**S**
8.9-10.8 months	23.7 ± 3.8	33.76 ± 2.45	-10.06	42.45	-17..99	0.0001	**S**
MD	0.6	-0.53					
t- value	0.4	-0.55					
P-value	0.68	0.58					
Sig	**NS**	**NS**					

$\overline{X}$ **: Mean** **SD: Standard deviation** **MD: Mean difference**
p va**lue: Probability value** **S: Significant** **NS: Non significant**

II- Effect of age on scale score:

7.1-8.8 months:

The mean ± SD scale score pre treatment of 7.1-8.8 months age group was 8.38 ± 2.46 while post treatment was 16.76 ± 3.37. The mean difference was -8.38 and the percent of improvement was 100%. There was a significant increase in scale score of 7.1-8.8 months age group post treatment compared with that pre treatment (p = 0.0001). (Table 8).

8.9-10.8 months:

The mean ± SD scale score pre treatment of 8.9-10.8 months age group was 6.07 ± 1.5 while post treatment was 15.7 ± 4.23. The mean difference was -9.63 and the percent of improvement was 158.65%. There was a significant increase in scale score of 8.9-10.8 months age group post treatment compared with that pre treatment (p = 0.0001). (Table 8).

Comparison between girls and boys

Pre treatment

The mean difference in scale score between 7.1-8.8 months and 8.9-10.8 months age groups pre treatment was 2.31. There was a significant increase in the scale score of 7.1-8.8 months age group compared with that of 8.9-10.8 months age groups pre treatment (p = 0.008). (table 8).

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Post treatment

The mean difference in scale score between 7.1-8.8 months and 8.9-10.8 months age groups post treatment was 1.06. There was no significant difference in the scale score between 7.1-8.8 months and 8.9-10.8 months age groups post treatment (p = 0.48). (table 8).

Table 8. Mean scale score pre and post treatment of the 7.1-8.8 months and 8.9-10.8 months age groups.

Scale score	Pre treatment	Post treatment	MD	% of improvement	t- value	P-value	Sig
	$\overline{X}$ ±SD	$\overline{X}$ ±SD					
7.1-8.8 months	8.38 ± 2.46	16.76 ± 3.37	-8.38	100	-10..97	0.0001	**S**
8.9-10.8 months	6.07 ± 1.5	15.7 ± 4.23	-9.63	158.65	-11,.09	0.0001	**S**
MD	2.31	1.06					
t- value	2,.88	0,.71					
P-value	0.008	0.48					
Sig	**S**	**NS**					

$\overline{X}$: Mean **SD: Standard deviation** **MD: Mean difference**
p value: Probability value **S: Significant** **NS: Non significant**

Discussion

The participants who suffered from hearing impairment, showed more instability regarding the the position control compared with the other listeners of the same age and gender. the population who suffered from hearing impairment of degrees ranging from mild to moderate, proved more stability for the position control compared with the other participants who suffered from the degrees ranging from severe and profound. the participants who suffered from hearing impairment of the grade severe and profound, showed bigger instability regarding the position control, in comparison to the other participants who suffer from the hearing loss with degrees ranging from mild to moderate[20].

Ayanniyi et al.,[21] concluded that the students who suffered from hearing loss, their performance was poor regarding the tests of the static balance rather than with their peers students having normal hearing. but the dynamic balance, was comparable between the both groups of the participants,

Melo, R .S et al [22] suggested that the children, suffering from sensorineural hearing impairment, faced changes in a larger scale regarding the static and the dynamic balance compare to the other students who enjoy normal hearing of those in the same group of age and gender.

The brain gym exercise, consists of enjoyable and simple movements and activities, which are used to deal with the children in the educational motion, for the purpose of increasing their skills and experience for all the brain learning process [23]. These exercises help in making all the learning process easier . they are effective for increasing the academic skill. the word education came from the Latin origin “educare “ it means “ to draw out : the term kinesiology came from the Greek root “ kinesis) it meant: motion “ it deals with studying the motion of the human body [24] .

The educational movement, is a system used to help the children of any age to draw out the possibilities which are closed in the body. the specialists of education, could know and determine the problem about the failure in the schools by designing programs to encourage and stamp the education process. these programs achieved some success. but the question was, that why do some student achieve success while some other students fail to achieve such success? In the educating movement program, it is noticed that some students: "try too hard" and “switch off” the mechanism of the brain integration. Which is very necessary the fulfill the learning programme . the student received the information , through the back of the brain as an: impress” but it cannot be accessed to the front brain as an “express”. The deficit to express what is known leading to closing the children in failure syndrome. the experts of the educational movement discovered the solution. in that the all brain learning process, through the movement modelling and the brain gym exercises could help the children to reach to these parts of the brain which were not available to them. the changes in the learning process were immediate, because the children knew and learnt how to receive the information, and how to express themselves at the same time [25].

The brain is avery important organ. As it is the main center of each thing. the brain gym can assist the hearing loss students to move with a group of simple physical activities[26]. thus, this study was run, to determine the impact of the brain gym exercises , inbalance among the students who were suffered from hearing impairment .

Hafez.R[27] Showed in her research on gymnasts , that the program of brain gym was presented to the participants for a period of 8 weeks. This program reached to the finding, that an increase in the test for the standing stork , the dynamic balance and the level of performance for enhancing the skill of the students was noticeable. these findings were important for the trainers to help in achieving better understanding for the concepts of the brain gym activities about the impacts of the training program. thus, it is concluded that the exercises of brain gym. were useful for the normal children when achieving different and several objectives.

This study aimed to detect the impact of brain gym exercises on the postural control among the students suffering from hearing impairment . the finding of this study. showed that brain gym exercises had valuable effect on postural control, which is in consistence with the observation of **Rajendran et al** .[28] who stated that the program of the exercise which increased the visual movement and somatosensory abilities had great impact in developing the deficits associated with the vestibular system among the injured children with hearing loss.

Brain gym is a group of the exercises for the cognitive learning process , which are very important for all ages it helps into increasing self-respect . it also improves the eye sight, and increases the creativity, & develop communication skills. brain gym brings improvement in fields of concentration, memory, and academic fields – including, reading, writing, math , physical coordination and others [26] .

Valdosta made a study in high school of U.S to know the impacts of using brain gym exercises on the performance of the students and their participation . the 2 chosen classes included 50 students . they participated in the study for 8 weeks , they were instructed with the same plans of both the lesson and the materials , before beginning to each class . the brain gym group did 3 minutes of specific exercises , but the students in the control group did not . the results showed no significant differences for the achievement& participation of the students. the study showed, that the hearing impaired students who practiced the brain gym exercises increased their participation in the lessons and helped in concentrate [30].

these findings was in consistence with another study made by **Jennifer** .[31] The teacher noticed that brain gym had apositive impact on all the variables of the behaviors . the findings of this research was used to introduce information for the managers. the instructors and for the guardians of the students, who looked for more effective classrooms management strategies, the findings also increased the concentration skills among the participating children.

The results revealed also an increase of statistical significance in the point score and scale score of the BOTs after treatment in comparison with the before intervention (P = 0,0001)

These results were supported by Dennison [32]. Who revealed that BGI claims that brain gym has “a sound basis in neuroscience “. And it consists of “integrated cross- lateral, balance requiring movements that mechanically activate both hemispheres of the brain via the motor and sensory cortexes, stimulate the vestibular (balance) system for equilibrium. And decreases the fight or fight mechanism".

Our findings also corroborated studies by **Nagarkar et al** [9] who reported that brain gym activity improves the ability of coordination for one side of the brain with the other , it occurs in the auditory , visual and motion mid field , the place where the two sides overlap. Brain gym helps to motivate the brain to balance the stress around the specific memories, the situations, improve the skills of the people. The brain gym exercises help in stimulating the reflex to work without to think under stress. its protocol helps to increase the academic & the behavioral achievement by motivating the hemispheres of the brain through neurological re-modelling for the purpose of improving the all brain learning activity.

Limitations:

include a sample of the small size .

Conclusions :

the findings of this study , showed that brain gym exercises improve postural control in students with hearing impairment .

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There is no financial interest or receiving any financial advantages from this study to the writers.

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The authours state that there is no any conflict of interest.

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