A Comparison of Static and Dynamic Balance Among Blind, Deaf and Non-handicapped Primary School Age Children in the State of Bahrain

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ABSTRACT

The purpose of this study was to compare the performance level of static and dynamic balance among blind, deaf and non-handicapped boys and girls, aged 6-12, in the State of Bahrain. Balance was measured using the Hughes Basic Gross Motor Assessment to investigate the differences between the three groups in dynamic and static balance. A two by three analysis of variance fixed model was used as the appropriate statistical tool to test the null hypothesis, with an alpha level of 0.05. The results indicated that there was a significant difference among the normal, blind, and deaf children for static and total balance. No significant difference was found between the normal children and the deaf children in dynamic balance. However, there was a significant difference between the male and the female total balance mean scores for the three groups of the study.

Maintaining balance needs an interaction of a number of neuro-physiological structures, senses, and pathways. Equilibrium is obtained through the combined efforts of stretch reflexes, proprioceptive information, vestibular apparatus, visual information and voluntary movements. However, hearing and vision are the most important sensory organs relating to an affecting body balance. This finding has been supported by many investigators who explained that the inner ear governs both functions of hearing and balance[1,2,3]. Therefore, a hearing loss often affects the balance level.

The various components and differences between dynamic and static balance equilibrium were investigated by Travis[4]. He reported that there are differences between both variables. This unrelatedness is indicated in the approximately zero correlation between performance on the stabilometer[5] and the amount of body sway of the head in the standing. These results are in agreement with those findings from other researchers, who found no significant correlation in subjects' ability to stand on a narrow beam and the ability to walk along a beam[6].

As early as 1932 researchers revealed that deaf children were equal to normal children in manual or fine motor skills and inferior to hearing children in balance skills[7,8]. Further investigation were conducted by Myklebust[9] to analyze the cause of hearing loss and its relationship to balance in deaf students. He classified 703 deaf students from the New Jersey School of the Deaf in five groups according to etiology. The results indicated that deaf meningitis children were significantly inferior in balance skills to all other etiological classifications and that was due to the non-functioning semi-circular canals rather than the loss of hearing. Also, the deaf children as a group displayed inferior static balance skills as compared to hearing children and the deaf in general had poorer dynamic balance[7,8,10]. These findings are in agreement with other studies.

Identifying specific remedial activities to improve the balance deficits of the deaf was recommended by Lindsey and O'Neal[11]. Their main emphasis was to compare the performance of 31 eight year old boys and girls, black and white. The findings demonstrated deficient abilities in static and dynamic balance skills as compared to hearing eight year

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olds. Thus, a recommendation has been made that more studies are needed to identify specific remedial activities to improve the deficits of deaf children.

The second important sense contributing to maintaining balance is vision which assists in providing information about the body's position with regard to its environment. Even with destruction of the vestibular apparatus, vision can compensate and allow the person to maintain a degree of equilibrium. Voluntary movement, directed from a cortical centre, allows one to have a conscious awareness of the body's position and whether the body is balanced.

In an effort to investigate the effect of vision on balance, Travis[4] used the ataximeter (which records body sway while standing) to measure static balance and the stabilometer to measure dynamic balance, with eyes open and eyes closed. The results indicated that a fine visual point of reference for the dominant eye is of great importance in controlling static balance. Also, in the trials with eyes closed, static balance was difficult to maintain. These findings confirm the conclusion of other studies[12,13]. Dickinson[14] stated that peripheral vision is very important in maintenance of balance. Additional interesting findings of his study indicated that weight, not height is an important factor in dynamic performance. Subjects with greater weight balanced better. Also, there was a significant sex difference in balancing in favour of women. He also explained that vision does play an important part in balance ability, that blind children have great difficulty in standing on a balance beam and that they demonstrate balance ability scores inferior to sighted children. These blind children were found to balance no better than sighted adults who were blind folded. This indicates not only that vision is highly important in normal balancing but also that little compensation for absence of visual cues is possible for the blind under normal conditions[15]. These results showed that both kinds of balance are aided greatly when visual cues are present; the finer the visual points of reference, the better the balance performance.

The major focus of the present study was to investigate the differences in the performance level of static and dynamic balance between deaf, blind, and normal boys and girls, aged 6-12, in the State of Bahrain in order to make the correct baseline for future instructional programmes.

METHODS

Selection of Subjects

A total of 54 male and female students were randomly selected to serve as subjects in this study. There were three groups: 18 blind students from Al-Noor Institute for the Blind; 18 deaf students from the Rehabilitation Centre, Isa-Town, who had a hearing loss of not less than 70 decibels and met the special education criteria for placement as deaf children; and 18 normal students from Isa-Town primary school. Sex was represented equally in all three groups (Table I).

Data Collection Procedures

Subjects were tested (using the Hughes Basic Gross Motor Assessment, BGMA, balance 1,3)[16] in the second semester of the 1985-86 school year to investigate the difference between the three groups in dynamic and static balance. The total communication system was utilized with the deaf students, whereas the technique of being put through movements by an assistant was used with the blind students. The test was modified to be suitable for the subjects. A test-retest was used within two weeks to test the reliability coefficient of the test on the Bahraini subjects (Table II).

Data Analysis

A two by three analysis of variance fixed model was used as the appropriate statistical tool to test the null hypothesis, with an alpha level of 0.05, power level of 0.80 and effect size of 0.25. Mean scores, standard deviations, and standard error of the mean for male, female, and both sexes were computed for each of static, dynamic, and total balance (Table III and Figure 1). The Least Significant Difference (LSD). Test was utilized as a follow up procedure for further analysis of mean differences ($LSD = t_{0.05} \sqrt{2S^2/n}$).

Results

1. There was a significant difference among normal, deaf, and blind children for static balance. The mean scores for normal were greater than the mean scores for both deaf and blind subjects, whereas the mean scores for the deaf were greater than the mean scores for the blind (Table IV, V, and Figure 2).

2. No significant difference was found between the normal children's mean scores and the deaf children's mean scores in the dynamic balance (Table VI, VII, and Figure 3).

3. There was a significant difference among the normal, deaf, and blind children for total balance. The mean scores for the normal were greater than the mean scores for the deaf, and the mean scores for the deaf were greater than the mean scores for the blind (Table VIII, IX, and Figure 4).

4. There was a significant difference between the male and female total balance mean scores (dynamic and static). Female mean scores were greater than the male mean scores for the three groups of the study (Table VIII, IX, and Figure 4).

5. There was no significant interaction between sex of subjects and the group categories used in this study (Table V, VII, IX).

TABLE I

Means, Standard Deviations, and Standard Error of the Means for Males, Females and Both Sexes (Age, Height, Weight)

Variables	*Categories* [·]	*Sex*								
		Males			*Females*			*Both Sexes*		
		mean	*SD*	*SE*	*Mean*	*SD*	*SE*	*Mean*	*SD*	*SE*
Age (Years)	Normal	11.0	1.12	0.40	11.40	0.88	0.311	12.22	1.0	0.25
	Deaf	10.66	1.0	0.35	11.77	0.67	0.24	11.22	1.0	0.24
	Blind	11.44	0.73	0.26	11.3	0.71	0.25	11.39	0.69	0.25
	Total	10.66	2.17	0.42	11.52	0.75	0.15	11.28	0.89	0.14
Height (cm)	Normal	138.0	7.32	2.59	143.11	4.17	1.47	140.64	6.31	1.53
	Deaf	136.0	6.64	2.35	140.0	15.54	5.49	139.55	11.08	2.61
	Blind	136.17	9.43	3.14	138.22	10.09	3.37	137.19	9.54	2.25
	Total	136.78	7.64	1.47	140.44	10.73	2.07	138.59	9.40	1.28
Weight (Kg)	Normal	29.83	5.11	1.7	37.44	3.71	1.24	33.61	5.84	1.38
	Deaf	27.50	4.27	1.42	36.39	12.36	4.12	31.94	10.06	2.37
	Blind	36.33	11.47	3.82	33.39	4.79	1.59	34.86	8.66	2.04
	Total	31.24	8.27	1.59	35.74	7.84	1.51	33.49	8.30	1.13

[·] Normal (n=18), Deaf (n=18), Blind (n=18), Total (n=54)

TABLE II

Reliability Coefficient for Static, Dynamic, and Total Balance

Items	*Blind*		*Deaf*		*Normal*	
	r	*reliability coeff.*	*r*	*reliability coeff.*	*r*	*reliability coeff.*
Static Balance	0.85	0.91	0.80	0.88	0.98	0.99
Dynamic Balance	0.86	0.92	0.73	0.84	0.89	0.94
Total Balance	0.89	0.94	0.72	0.83	0.94	0.96

TABLE III

Means, Standard Deviation, and Standard Error of the Mean for Males, Females and Both Sexes in STATIC, DYNAMIC AND TOTAL BALANCE

Categories	*SEX*								
	Male			*Female*			*Both Sexes*		
	$\bar{X}$	*SD*	*SE* $\bar{X}$	$\bar{X}$	*SD*	*SE* $\bar{X}$	$\bar{X}$	*SD*	*SE* $\bar{X}$
Static Balance	7.814	3.772	0.739	13.184	3.438	0.661	14.406	3.605	0.543
Dynamic Balance	11.77	2.423	0.052	13.078	1.59	0.306	12.424	2.0	0.301
Total Balance	19.592	4.290	0.841	26.22	4.335	0.834	22.90	4.312	0.650

FIGURE (1)

Mean Scores for Males, Females and Both Sexes in Static, Dynamic and Total Balance

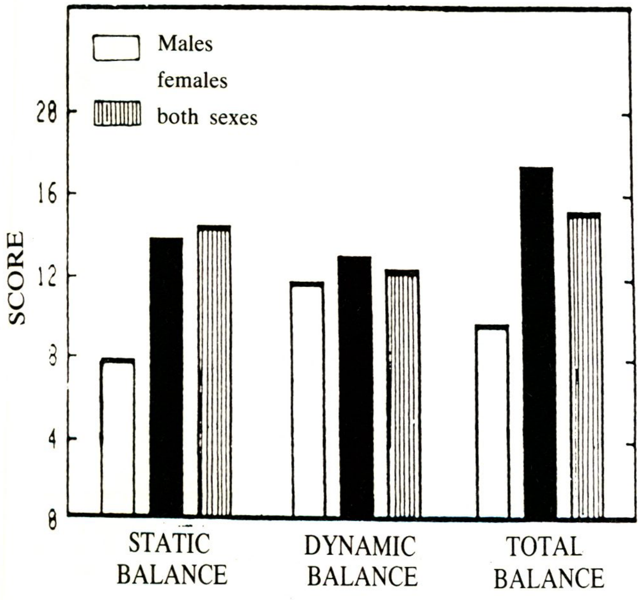


FIGURE (2)

Mean STATIC BALANCE Scores of Normal, Deaf and Blind Groups

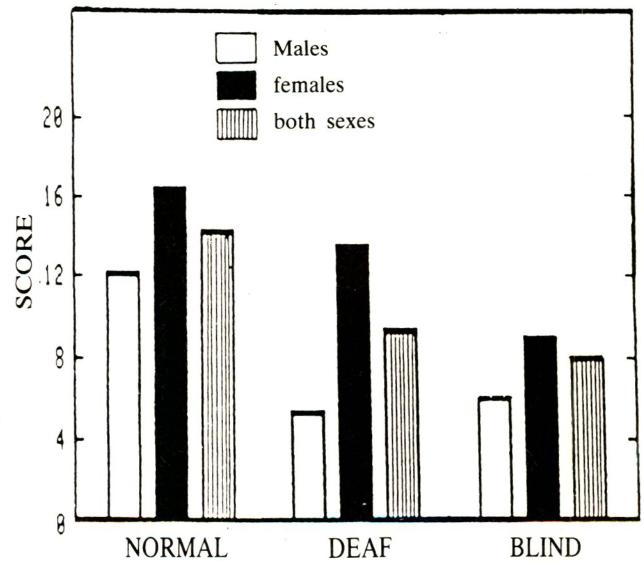


TABLE IV

Means, Standard Deviations, and Standard Error of the Mean for Males, Females and Both Sexes in STATIC BALANCE

		SEX		
Categories		*Male*	*Female*	*Both sexes*
	Mean	12.11	16.55	14.33
Normal	SD	1.536	1.0138	2.612
(n=18)	SE $\bar{X}$	0.543	0.358	0.548
	Mean	5.33	13.44	9.38
Deaf	SD	2.449	2.651	4.852
(n=18)	SE X	0.865	0.937	1.176
	Mean	6.0	9.44	7.72
Blind	SD	2.549	1.33	2.652
(n=18)	SE $\bar{X}$	0.880	0.470	0.242
	Mean	7.814	13.148	10.48
Total	SD	3.772	3.438	3.605
(n=54)	SE $\bar{X}$	0.739	0.674	0.495

TABLE V

Two by Three Analysis of Variance for STATIC BALANCE

Source of Variation	*SS*	*df*	*MS*	*F Com.*	*f t*
Sex	3542.2585	1	3542.2585	68.95 *	4.07
Groups	5508.5926	2	2754.296	53.616 *	3.23
Interaction	283.026	2	141.513	2.737	3.23
Error	2465.777	48	51.37		
Total	14346.888	53			

* $\alpha = 0.05$

df = 1, 48 & 2, 48

TABLE VI

Means, Standard Deviation and Standard Error of the Mean for Males, Females, and Both Sexes in DYNAMIC BALANCE

		SEX		
Categories		*Male*	*Female*	*Both Sexes*
	Mean	12.22	13.66	12.94
Normal	SD	1.481	5.0	1.304
(n=18)	SE $\bar{X}$	0.523	1.768	0.316
	Mean	12.66	13.55	13.11
Deaf	SD	1.0	0.527	0.90
(n=18)	SE $\bar{X}$	0.353	0.186	0.218
	Mean	10.44	12.0	11.22
Blind	SD	3.574	2.397	3.05
(n=18)	SE $\bar{X}$	1.263	0.847	0.739
	Mean	11.777	13.074	12.42
Total	SD	2.423	1.591	2.00
(n=54)	SE $\bar{X}$	0.475	0.312	0.274

TABLE VII

Two by Three Analysis of Variance for DYNAMIC BALANCE

Source of Variation	*SS*	*df*	*MS*	*F Com.*	*f t*
Sex	4202.9251	1	4202.951	50.929 *	4.07
Groups	2753.0185	2	1376.509	16.677 *	3.23
Interaction	222.4174	2	11120.537	134.74	3.23
Error	3961.722	48	82.535		
Total	33159.406	53			

* $\alpha = 0.05$

df = 1, 48 & 2, 48

TABLE VIII

Means, Standard Deviations, and Standard Error of the Means for Males, Females and Both Sexes in TOTAL BALANCE

Categories		*SEX*		
		Male	*Female*	*Both Sexes*
Normal (n=18)	Mean	24.33	30.22	27.27
	SD	2.236	1.394	4.281
	SE $\bar{X}$	0.790	0.492	1.038
Deaf (n=18)	Mean	18.0	27.0	22.5
	SD	2.394	2.645	5.238
	SE $\bar{X}$	0.846	0.935	1.270
Blind (n=18)	Mean	16.44	21.44	18.94
	SD	3.126	2.788	3.857
	SE $\bar{X}$	1.105	0.985	0.935
Total (n=54)	Mean	19.592	26.22	22.906
	SD	4.290	4.335	4.312
	SE $\bar{X}$	0.841	0.850	0.592

TABLE IX

Two by Three Analysis of Variance for TOTAL BALANCE

Source of Variation	*SS*	*df*	*MS*	*F Com.*	*f t*
Sex	7745.1836	1	7745.1836	57.84 *	4.07
Handicapped	5783.8945	2	2891.9473	21.5968 *	3.23
Interaction	505.4434	2	252.7217	1.887	3.23
Error	6427.499	48	133.906		
Total	47506.294	53			

* $\propto = 0.05$

df = 1, 48 & 2, 48

FIGURE (3)

Mean DYNAMIC BALANCE Scores of Normal, Deaf and Blind Groups

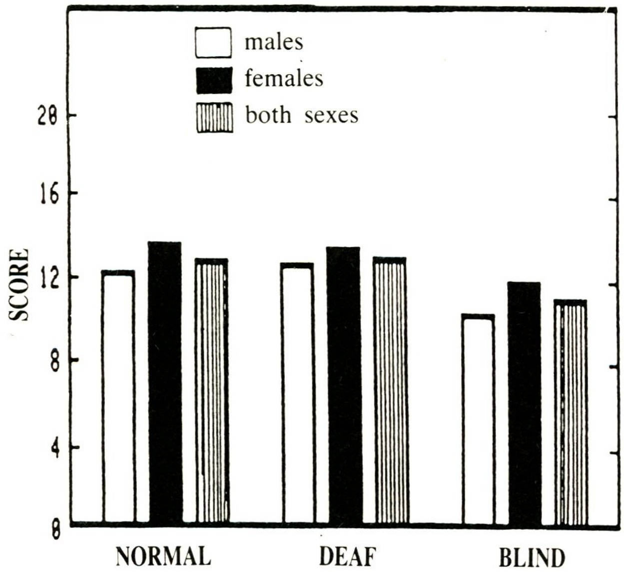
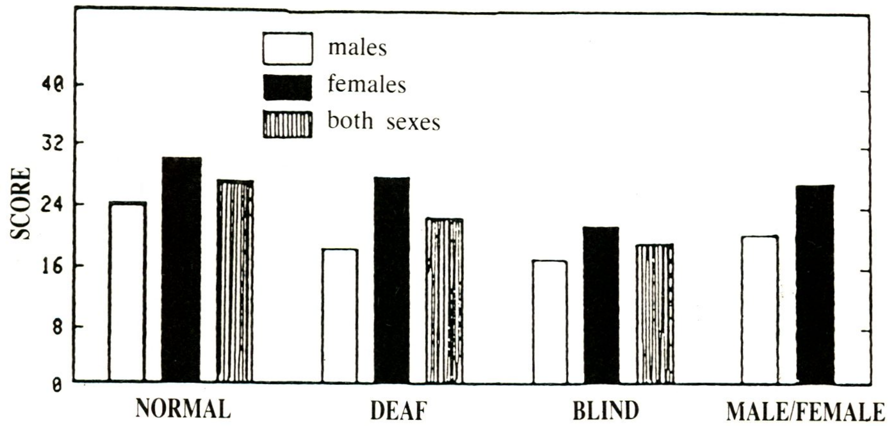


FIGURE (4)

Mean Total Balance Scores of Normal, Deaf, Blind and Both Sexes



DISCUSSION

Results of this study confirm the conclusions of related studies,[4,11,12,13] which agreed that deaf and blind children are in general inferior to normal children in total balance performance. At the same time, the blind children were the most inferior group to either the normal or deaf children. That shows the importance of visual cues in assisting balance ability.

However, in dynamic balance, the results indicate that the deaf children were not less than the normal children. This observation is consistent with other findings[7,9,10] which agreed that the deaf population is inferior to the normal population in balance performance unless there is disfunction of the semicircular canals due to meningitis.

Sex has a direct effect on total balance performance. Female children were better than male children in the three groups (normal, blind, deaf). This finding is supported by Travis' findings[4] that a sex difference existed in balancing in favour of women. The researcher refers this result to the anatomical structure of the female; the pelvis is wider than that of the male, which tends to lower the centre of gravity and gives better balance control.

CONCLUSIONS

1) Deaf and blind children are inferior to normal children in total balance performance. 2) Normal children are superior to deaf and blind children, and the deaf are better than the blind children in the total balance performance. 3) Deaf children are not inferior to normal children in dynamic balance. Therefore, different programmes are needed with the necessary adaptation to suit each group, which may be effective in eliminating or improving known balance deficits.

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