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A comparison of motor skills in Turkish children with different visual acuity

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Research Article

Purpose: The aim of this study was to assess motor functions with objective data in children with different visual acuity. **Material and methods:** The study included 30 children with low vision (9 girls and 21 boys) and 30 children who were totally or near blind (13 girls and 17 boys) 30 children with normal sight (15 girls and 15 boys) whose ages were between 7- 14 years. The Bruininks-Oseretsky Motor Proficiency Test (BOMPT) was used for assessment of motor proficiency. **Results:** Intergroup comparisons showed that children with low vision and totally or near blind scores of run, balance, coordination of upper extremities, response speed, abilities of upper extremity and total motor point results had differences in favor of the children with low vision ($p<0.05$). According to the test scores, children with normal sight attained the highest score in all tests. **Conclusion:** It was thought that experiences gained due to visual stimulus were reflected to results. Our study demonstrated an increasing gap in motor skills development between different visual acuity children widens, during elementary school years the children with normal sight refine their motor skills but the children with visual deprivation are left behind.

Key words: Visually impaired persons, Blindness, Motor skills.

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Farklı görme keskinliklerine sahip Türk çocuklarının motor yeteneklerinin karşılaştırılması

Amaç: Bu çalışmanın amacı, farklı görme keskinliklerine sahip Türk çocuklarının motor yeteneklerini karşılaştırmaktı. **Gereç ve yöntem:** Çalışmaya 30 az gören (9 kız ve 21 erkek), 30 tam ve tama yakın kör (13 kız ve 17 erkek) ile 30 gören çocuk (15 kız ve 15 erkek) olmak üzere 7-14 yaşlarında toplam 90 çocuk dahil edildi. Çocukların motor yeteneklerinin değerlendirilmesinde Bruininks-Oseretsky Motor Yeterlilik Testi kullanıldı. **Sonuçlar:** Az gören ve tam ve tama yakın kör çocukların koşma, denge, üst ekstremite koordinasyon, cevap hızı, üst ekstremite beceriklilik ve toplam motor puan sonuçları az görenlerin lehine bulundu ($p<0.05$). Test sonuçlarına göre ise bütün testlerden en yüksek puanı gören çocukların almış olduğu görüldü. **Tartışma:** Bu deneyimlerin görsel uyarana bağlı olarak sonuçlara yansıdığı düşünüldü. Çalışmamız farklı görme keskinliklerine sahip çocuklarının motor gelişimlerindeki farkı, ilkokul yaşlarında gören çocukların motor yeteneklerini belirginleştirirken, görsel yoksunluğu olan çocukların ise ne kadar geride kaldığını göstermektedir.

Anahtar kelimeler: Görme engelliler, Körlük, Motor yetenekler.

Vision is important in planning and performing motor skills. Vision allows a sense of self, extremities and position in space as well as detection of people, objects and motion in the surrounding area.

People make contact with their environment primarily through their visual sense. Early reduction or lack of intersensorial coordination may alter or delay development of basic motor and visual motor skills.[1] Basic motor and visual motor skills begin development during infancy, as the body's mechanical efficiency increases. Control over the upper and lower limbs develops in a sequence that usually starts with symmetrical and bilateral activities (like hand clapping) followed by unilateral movements (such as grasp with the leading hand). Gradually, children's movements become more polished, gaining in speed, agility and stability.[2] Some clinical observers have noted that children with blindness and low vision have slower run and poorer motor skills than children without vision impairment.[3-5]

Low vision and blindness are defined in the 10th revision of the WHO International Statistical Classification of Diseases, Injuries and Causes of Death, 'low vision' is defined as visual acuity of less than 6/18 but equal to or better than 3/60, or a corresponding visual field loss to less than 20°, in the better eye with the best possible correction (ICD-10 visual impairment categories 1 and 2). 'Blindness' is defined as visual acuity of less than 3/60, or a corresponding visual field loss to less than 10°, in the better eye with the best possible correction (ICD-10 visual impairment categories 3, 4 and 5). 'Visual impairment' includes both low vision and blindness.[6,7]

Visual impairment, when defined by visual acuity, increases as the fraction of acuity becomes smaller and objects at a constant distance are increasingly blurred if vision is important in the development of a child's hand eye coordination, then impaired acuity should negatively affect its development and so motor activity associated in the performance of daily tasks. Most children develop the fundamental visual motor skills during the first five years of life through natural spontaneous interaction with the environment.[8] This motor activity is essential in the early stages of development as the child interacts and learns from the environment. Visually impaired children have been noted to need extra help in acquiring optimal levels of functioning in the first years at school.[9] In the literature, studies mentioned visually impaired children's motor activity levels affected but that did not been compared children with different visual acuity levels. Therefore, the aim of this study was how visual impairment could negatively affect motor skills development in school children with different visual acuity levels. Accordingly, this study was designed to compare motor performances of low vision, total or near total blind with a group of sighted, gender and age matched school age children. In addition, we also investigated the incidence and degree of visual impairment in association with consanguinity which is very common in Turkey.

MATERIAL AND METHODS

Subjects:

Ninety children with different visual acuity levels took part in the study. The mean age of the thirty children with low vision was 9.42±2.37 years, the mean age of 30 children with totally or near blind was 9.41±2.18 years, and the mean age of 30 sighted children was 9.36±2.39 years. Near or total blind and children with low vision were attending Mitat Enç Visually Impaired School and Gören Eller Visually Impaired School in Ankara. Sighted children were attending 13 Ekim School in Ankara. Permission for the study was obtained from the Ankara National Education Directory and was presented to the School Directors of each school. Written informed consent was obtained from the parents of all children who participated in the study.

Diagnoses of the children were as follows: congenital nystagmus (n=9), optic atrophy (n=8), congenital cataract (n=6), albinism (n=6), congenital glaucoma (n=6), microphthalmia (n=6), amblyopia (n=4), degenerative retina (n=4), retinitis pigmentosa (n=3), maculoretinopathy (n=3), stargardt (n=2), retinopathy of prematurity

(n=2), coloboma (n=1). Children with low vision and near or total blind children were examined by an ophthalmologist to determine the cause of their visual impairment and presenting visual acuity. Accordingly, visual acuity by Snellen: Six children with low vision's visual acuity were 20/100, 10 children with low vision's visual acuity were 20/200, 12 children with low vision's visual acuity were 20/400 and two children with low vision's visual acuity were 20/600. In the children with totally or near blind, 12 children were vision only light perception (near-total vision loss), 18 children were no light perception (total blindness). These children fit into the low vision and near or total blind categories according to the ICD-9-CM and ICD-10.[6,7,10-12] Children in the control group had visual acuity of 20/20.

The medical status of the children was obtained from their school health report. That health report included children's motor, mental, psychological, eye exam results and general health status. Children with health issues that could interfere with skill to perform the testing were excluded from the study.

An experienced physiotherapist assessed the motor skills of the children. Date of birth and family consanguinity was obtained from the parents. Dominant hand was determined by asking the child which hand was preferred for writing.

Measures:

Visual acuity was measured monocularly with the Snellen Optotype stand vision charts. It is the standard distance acuity chart used in routine ophthalmological exam settings.[13] It contains letters of the alphabet decreasing in size on each consecutive line with the bottom line being the smallest letters. The letter sizes run from the largest, 400, 200, 100, 80, 70, 60, 50…. to the smallest, 20 feet, reflected in the denominator of the acuity fraction. Visual acuity is generally measured with a person seated 20 feet away from the chart. The test distance is reflected in the numerator of the acuity fraction. A person who has read the bottom line of the chart at twenty feet would be recorded as having 20/20 normal visual acuity.[5] Presenting acuity in the better seeing eye according to the low vision definition of the World Health Organization (WHO) was entered for analysis.[6,7,14-16]

The Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) was performed on all children by the physiotherapist.[17] At the time of testing there was no motor skill evaluation material designed for children with visual impairments. BOTMP is standardized, reliable and valid for school-age children.[18] This test is widely used in pediatric rehabilitation to describe motor problems of children aged 4½ to 14½ years.[3-5,18-20] Test consists of three composites including eight subtests: 1-Gross motor skills: a) running speed and agility; running speed during a shuttle run; b) balance (eight items with three assessing static balance while standing on one leg and five assessing performance balance during various walking movements); c) bilateral coordination (eight items, with seven assessing sequential and simultaneous coordination of the upper and lower limbs and one item assessing coordination of upper limbs only), and d) strength: (three items, assessing arm and shoulder strength, abdominal strength, and leg strength); 2-Combined gross and fine motor skills: e) upper limb coordination (nine items) with six assessing coordination of visual tracking with movements of the arms and hands, and three assess precise movements of arms, hands, or fingers, and 3-Fine motor skills including response speed, visual- motor control and upper-limb speed and dexterity: f) Response speed (one item) measures the ability to respond quickly to a moving visual stimulus; g) Visual motor control (eight items), measures the ability to coordinate precise hand and visual movements; h) Upper limb speed and dexterity (eight items), measures hand and finger dexterity, hand speed, and arm speed. The test takes 45-60 minutes to administer.

The tester recorded each subject's raw score. Raw scores were converted to point scores.[5,17,20] For items with more than one trial, the best performance was converted to point score.

Children with sighted and low vision completed all items of the test battery. For the completion of test items that required vision, adaptations were made where possible to allow

children with near or total blindness to perform the test. Adaptations for this group included: running speed and agility tests were done near a wall while holding on a cord. This allowed control of direction and distance covered by the child. Upper- limb coordination test items using a ball were performed with "a ball with bell". The following items were not completed by the near or total blindness group because vision was needed: 8 in the bilateral coordination test and 3, 6, 7 and 8 of upper-limb speed and dexterity test and visual-motor control test. A number of items were required revision. Therefore, those items were analyzed for the children with low vision and sighted peers. We could measure gross motor and both gross and fine motor skills in children with totally or near blind.

Assessments were completed in two different sessions in the same week to decrease attention and concentration loss due to fatigue. Environment was kept calm and quiet.

Statistical analysis:

The values obtained from the study are given as means and standard deviations. Assessment results were analyzed and compared for each group of children using the Mann Whitney U Test. Frequency distributions was performed. Differences were assessed as significant with alpha <0.05.

RESULTS

The mean scores for each group were determined for each subtest of BOTMP and are presented in Table 1. The sighted group obtained higher scores than that of low vision. Mann Whitney U test demonstrated a statistically significant difference among the three groups ($p<0.05$) (Table 2). Analysis of results showed all test score differences, except for running speed and agility, between the sighted and low vision, were in favor of the sighted children ($p<0.05$). Results comparing the children with low vision and children with totally or near blind, except for bilateral coordination and strength showed differences in favor of the children with low vision ($p<0.05$) for those items that members of both groups could complete. As the children with totally or near blind could not complete all tests, we compared the completed ones.

In this study, among the 60 visually impaired children, 41 were progeny of consanguineous marriages; 20 (67.7%) in the low vision group and 21 (70%) in the totally or near blind group.

DISCUSSION

Children with low vision performed significantly below levels of sighted peers in this study. These results support previous studies.[4,8,21-25] Bouchard and Tétreault[3] used the BOTMP in 60 children that were normally sighted and 30 with moderate low vision sighting and demonstrated differences in gross motor skills, especially balance affected. We agree with them. In addition, we found fine motor skills affected in children with low vision compared to health peers. In contrast, Bouchard and Tétreault[3] found fine motor skills were unaffected in their study. The reason for this, Bouchard and Tétreault took moderate level children with low vision in their study.[3] However, our low vision group had both moderate and severe levels. This finding indicated that when visual acuity level decreases, fine motor skills declines. Fine motor skill is needed more visual stimulus to see details. The lower frequency of visual stimuli received and processed and lower activity level of the children with low vision may account for the disparity in test results. Interestingly, differences were not observed in the results of running test. We thought that running speed during a shuttle run was a simple task for children with low vision. Because, they were run a short distance flat area and their better eye was guide them. We believed that early intervention and rehabilitation program addressing areas of weakness, should serve to decrease the disparities.

In the literature, no studies were found comparing the motor skills between low vision and blindness children. Therefore, our results give an idea to the colleagues who work with them. In addition, there was no difference in the results of the strength and bilateral coordination between the children with low vision and children with

Table 1. Mean scores of the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP).

	Sighted	Low vision	Blind
	X±SD	X±SD	X±SD
Gross Motor			
Running speed and agility (0-15)	5.96±2.20	4.43±3.81	1.93±3.17
Balance (0-32)	24.86±4.01	14.23±7.79	6.66±5.50
Bilateral coordination (0-20)	8.43±1.92	5.40±3.39	3.73±3.33
Strength (0-42)	21.00±5.45	16.90±6.62	13.56±7.09
Upper-Limb Coordination (0-21)*	16.10±3.32	8.70±4.60	3.53±3.38
Fine Motor			
Response speed (0-17)	6.96±3.24	3.86±2.63	1.77±2.29
Visual - motor control (0-24)	21.80±3.01	13.90±5.78	
Upper-limb speed and dexterity (0-72)	19.76±4.96	12.43±6.59	
Total (0-243)	124.76±18.57	79.70±33.89	

*Both gross and fine motor.

Table 2. Comparison of the Bruininks - Oseretsky Test of Motor Proficiency (BOTMP) scores.

	Sighted – Low vision	Low vision – Blind	Sighted – Blind
	Z (p)	Z (p)	Z (p)
Running speed and agility	-1.80 (0.071)	-2.89 (0.004)*	-4.87 (<0.001)
Balance	-4.83 (<0.001)	-3.94 (<0.001)	-6.51 (<0.001)
Bilateral coordination	-3.59 (<0.001)	-1.70 (0.089)	-4.86 (<0.001)
Strength	-2.63 (0.008)*	-1.91 (0.055)	-4.13 (<0.001)
Upper limb coordination	-5.32 (<0.001)	-4.19 (<0.001)	-6.51 (<0.001)
Response speed	-3.61 (<0.001)	-3.13 (0.002)*	-5.34 (<0.001)
Visual-motor coordination	-5.43 (<0.001)	-	-
Upper limb speed and dexterity	-4.31 (<0.001)	-	-
Total	-4.99 (<0.001)	-	-

*p<0.05.

totally or near blind in our study. Two factors could account for these findings. First, blind children have poor muscle strength,[23,24,26,27] and have difficulties with spatial positioning and adjusting the gravity line to the gravity centre among children with near and total blindness that affected their bilateral coordination. Second, less or none visual input effects coordination.[8,26,27]

When we looked at sighted and children with totally or near blind, we found differences all tests. We also agree with previous studies demonstrated that children with reduced motor experiences have difficulties orienting in their environment and developing spatial concepts.[23,24,28,29] In the same time, we observed near or total blindness children to be more passive and less secure compared to the sighted children, these children did not use their extremities in rhythm in the same or different

periods during various activities because of insufficient stimulus and unsafe feeling.

In our study, we observed that totally and near blind children limited their independent ambulation in the environment. It was also noticed that they moved uneasily during activities like running, walking etc. We suggest our colleagues who work with low vision, they started early physical therapy in the course of during childhood term rather than waiting for children to reach some arbitrary level of impairment. Wrotniak et al also indicated the importance of early improvement of motor skills in sighted children.[19]

Our second aim was to find out how many children have consanguineous marriage history. Higher percentage marriage history was found in visually impairment children in our study. We agreed with Bittles who pointed out that many single gene disorders have an increased prevalence in consanguineous progeny.[30] As a result of this study, we suggested public education and early intervention. Public education regarding the increased risk of severe visual impairment in progeny of consanguineous marriages is needed to decrease the incidence of low vision and blindness among children. Early intervention is also needed to improve the educational and developmental potential of affected progeny.

This study had some limitation that has to be taken into account. The results are sufficient to propose that the BOTMP be considered a useful tool to compare low vision and fully-sighted children. The modifications we made for children with visually impaired and blind allowed testing of a wider population except for fine motor and visual motor tasks. Development of special scales and tests especially motor proficiency tests for children with totally or near blind will help to better ascertain delays in motor skill development and plan their activity programs. Physiotherapists and occupational therapists work children with low vision or blind, when they choose BOTMP, we suggested they should consider those points.

We concluded that our study demonstrates an increasing gap in motor skills development between children with sighted, low vision and blind widens, during elementary school years the sighted children refine their motor skills but the children with visual deprivation are left behind. Further studies are needed to assess the benefit of rehabilitation programs to improve motor skill development in affected students.

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