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Investigation of Visual Perception and Motor Skills In Low Vision And Healthy Children

Araştırma Makalesi / Research Article

Fatma TAŞKIN, Aydın Devlet Hastanesi
Bilge BAŞAKÇI ÇALIK, Pamukkale Üniversitesi
İbrahim TOPRAK, Pamukkale Üniversitesi

Abstract

Low vision and other visual problems have negative effects on motor development and the learning of complex motor skills. The primary aim of this study was to compare visual perception and motor skills in children with low vision and healthy children and the second was to investigate the relationship of visual perception on motor skills in children with low vision. The study included 30 children with low vision (mean age 11.43±2.82 years) and 38 healthy children(mean age 10.71±2.26 years). The visual perception of the children was assessed using the Motor Free Visual Perception Test-3(MVPT-3) and motor performance was assessed using the Bruininks-Oseretsky Motor Profiency Assessment Inventory-2 Short Form(BOT-2 SF). The healthy group were determined to have significantly higher total scores of visual perception and motor skills compared to the children with low vision ($p < 0.001$). In the group of children with low vision, the MVPT-3 total score, BOT-2 SF subtests and total scores were positively correlated with fine motor control ($r=0.508$, $p=0.04$), manual coordination($r=0.429$, $p=0.18$), body coordination($r=0.624$, $p=0.000$), strength and agility($r=0.389$, $p=0.33$), and in total($r=0.619$, $p=0.000$), respectively. Visual perception and motor performance of children with low vision are lower than their healthy peers. The remaining visual perception in children with low vision is associated with gross and fine motor skills.

Keywords

Visual perception, motor skill, low vision chidren, healthy children, Bruininks-Oseretsky motor profiency assessment inventory, motor free visual perception test

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Az Gören ve Sağlıklı Çocuklarda Görsel Algı ve Motor Becerilerin İncelenmesi

Öz

Az görme ve diğer görme sorunları, motor gelişim ve karmaşık motor becerileri öğrenme üzerine olumsuz etki göstermektedir.Bu çalışmanın birinci amacı; az gören ve sağlıklı çocukların görsel algı ve motor becerilerini karşılaştırmak,ikinci amacı ise; az gören çocuklarda görsel algı ve motor beceri arasındaki ilişkiyi incelemektir. Çalışmaya 30 az gören (yaş ortalaması 11,43±2,82) ve 38 sağlıklı çocuk (yaş ortalaması 10.71±2.26) katıldı. Az gören ve sağlıklı çocukların görsel algılarını değerlendirmek için Motor Beceriden Bağımsız Görsel Algı Testi üçüncü versiyonu (MVPT-3), motor becerilerini değerlendirmek için Bruininks-Oseretsky Motor Yeterlilik Testi Kısa formu ikinci versiyonu (BOT-2 KF) kullanıldı. Sağlıklı çocuklar, az gören çocuklarla karşılaştırıldığında anlamlı derecede daha yüksek görsel algı ve motor beceri toplam puanına sahip idi ($p<0.001$). Az gören çocukların MVPT-3 puanları ile BOT-2 alt test ve toplam puanları incelendiğinde, görsel algının; ince motor kontrol ($r=0,508;p=0,004$), manuel koordinasyon($r=0,429;p=0,018$), vücut koordinasyonu($r=0,624;p=0,000$), kuvvet ve çeviklik ($r=0,389;p=0,033$), testleri ile toplam puan ($r=0,619;p=0,000$), açısından ilişkisi anlamlı idi ($p<0,05$). Az gören çocuklarda görsel algı ve motor beceri, sağlıklı yaşıtlarına göre daha azdır. Az gören çocuklarda geriye kalan görsel algı, kaba ve ince motor beceri ile ilişkilidir.

Anahtar Kelimeler

Görsel algı, motor beceri, az gören çocuk, sağlıklı çocuk, Bruininks-Oseretsky motor yeterlilik testi, motor beceriden bağımsız görsel algı testi.

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Sorumlu Yazar:Fatma Taşkın, fatos_taskin09@hotmail.com

Giriş

Low vision is defined as a level of vision when the person cannot perform visual activities with standard glasses or contact lenses. According to the World Health Organization's VISION 2020 (WHO's Global Initiative for Preventable Blindness) report, prevention and rehabilitation are among the priority targets (Pizzarello et al, 2004). The aims of aid and rehabilitation of children with low vision are to improve visual perception, to enable the child to use the current level of vision in the most efficient way, improve quality of life, gain self-sufficiency, thereby raising independent and productive individuals who will have equal opportunities with their peers both in education and socially (Britto, Poongothai, Mamta, Van Dijk, and Jesudasan, 2005).

Visual perception is defined as the comprehension, processing and interpretation of information by seeing the stimuli coming from the environment, people, objects and symbols. If visual perception disorders are not detected in children at an early age, they can prevent learning and if treatment is not started immediately, serious learning difficulties and related disorders are likely to occur in the future (Butun Ayhan, Mutlu, Aki, and Aral, 2015).

Vision has an effect on motor proficiency, balance, fine motor skills, mobility-orientation and cognitive functions (Haddad, Lobato, Sampaio, and Kara-José 2006). Visual problems in children cover a wide area including social life, school and home life. Children with healthy levels of vision perceive the stimuli they receive from the environment and transform them into motor responses. However, for visually impaired children, difficulties are experienced in going to school and home, reading-writing skills, overcoming obstacles such as pavement-steps, climbing stairs, determining spatial distance of household items, eating, bathing, dressing and social skills (Vicari, Belluci, and Carlesimo, 2005).

Children with low vision do not know how to use the remaining level of vision and do not feel safe because their independent movements are restricted. Compared to healthy sighted peers, they spend more energy performing daily activities, so their physical fitness needs to be good (Reimer, Cox, Nijhuis-Van Der Sanden, and Boonstra, 2011). Although there is a limited number of studies in literature evaluating the motor skills of visually impaired children (Atasavun Uysal and Düger, 2011; Basakci Calik 2009; Bouchard, and Tetreault 2000; Reimer, Cox, Nijhuis-Van der Sanden, and Boonstra 2011; Houwen, Visscher, Lemmink, and Hartman 2008) to the best of our knowledge, there is no study comparing visual perception and motor skills in children with low vision and healthy children. The primary aim of this study was to compare the visual perception and motor skills between of children with low vision and healthy children. The second aim was to examine the relationship between visual perception and motor skills in children with low vision.

Methods

This study was conducted in primary/ secondary schools in Aydın and Denizli between March 2017- May 2018. The study was explained to the parents and school administrators. Written informed consent was obtained from the parents or legal guardian of each child.

Approval for the study was granted by the Ethics Committee for Non-Interventional Clinical Research of Pamukkale University (decision no:60116787-020 / 47560, dated: 03.08.2016). All procedures were conducted according to the principles of the Declaration of Helsinki.

Participants

The study included 30 low vision children (16 females, 14 males) with no neurological or orthopedic problems except low vision with an age range of 6-15 years and 38 age-matched, healthy children (20 females, 18 males). The children with low vision were examined by a specialist ophthalmologist and according to the visual acuity, the diagnosis of low vision was made. Descriptive

data of the children, including age, gender, height, weight, body mass index (BMI), were recorded on a sociodemographic data form. All the evaluations of visual perception and motor skills were made by the same physiotherapist (FT).

Evaluation of Visual Perception

To evaluate the visual perception of the children with low vision and healthy children, the third version of the Motor Skill Free Visual Perception Test (MVPT-3) was used. MVPT-3 is a test which was developed by Ronald Colarusso and Donald Hammill (2003) as an alternative to visual perception tests that require writing to be copied, which does not require motor skills, and aims to measure visual perception rather than visual or motor skills. This test is a valid and reliable test for individuals aged 4 to 95 years. It takes approximately 20-40 minutes. MVPT-3 contains all visual perception subtitles. The test consists of a total of 9 sub-tests and 65 shapes including visual distinction (1-8), shape formation (9-13), visual memory-I (14-21), visual affinity-I (22-34), visual discrimination (35-45), space position (46- 50), shape-ground (51-55), visual affinity II (56-60) and visual memory-II (61-65). It differs from other tests by offering multiple response options and using shapes. The validity and reliability of MVPT-3 for a Turkish population was performed by Metin S and Aral N (Metin, and Aral, 2014).

Evaluation of Motor Skills

The Bruininks-Oseretsky Motor Profiency Assessment Inventory-2 Short Form (BOT-2 SF) was used to evaluate the motor skills of the low vision and healthy children.

The second version of the Bruininks-Oseretsky Motor Profienct Assessment Inventory Test (BOT-2) is widely used and is an adjunctive measurement in the assessment of motor problems in children with normal development and in children with developmental disorders who can perform detailed measurement tasks (Bruininks, and Bruininks, 2005).

The BOT-2 consists of 8 sub-tests and 46 items and is completed in 45-60 minutes. The short form consists of 8 sub-tests and 14 items and is completed in 15-20 minutes. It is applicable to children aged 4-21 years (Deitz, Kartin, and Koop, 2007). BOT-2 provides information about general motor skills and gives information about fine and gross motor skills separately. Compared to other motor skills tests, it has the advantages of being applicable to a wider age range, can be easily understood by children, is visually attractive to children, is easy to implement, and especially provides information about coordination, unlike other tests (Bruininks, 1978).

Statistical analysis

The data were analyzed with SPSS 17.0 software. Continuous variables were given as mean ± standard deviation values and categorical variables as number and percentage. The Mann Whitney U test was used to determine differences between the groups. For all comparisons, a value of $p < 0.05$ was accepted as statistically significant. Correlations were classified as low (r: 0.10-0.49), moderate (r: 0.50-0.69) or high (r: 0.70-1.00).

Results

There were no statistically significant differences between the groups in terms of age, height, body weight and body mass index (BMI) of the 30 low vision and 38 healthy children ($p > 0.05$) (Table 1).

Table 1. Demographic characteristics of participants

Physical properties	Low Vision Children (n=30)		Healthy Children (n=38)		Z*
	X±SD	95% CI	X±SD	95% CI	
Age(years)	11.43±2.82	10.37-12.48	10.71±2.26	10.71-11.45	1.172
Height (cm)	147.27±18.37	140.41 -154.13	146.92±15.19	141.93-151.91	0.85
Weight (kg)	40.92±15.31	35.20-46.63	41.81±15.80	36.61-47.00	-.234

Body Mass Index (BMI) (kg/ m²)	18.21±3.56	16.88-19.54	18.65±4.18	17.28-20.02	-.461
Gender (F/M)	16/14		20/18		-.057

*Independent Samples t-test, n=Number of cases, X=mean, SD=Standard Deviation, BMI=Body Mass Index, cm=Centimeter, kg=Kilogram, F=Female, M=Male

In the comparisons of the total score of visual perception and motor skills total and subtests scores, the control group of healthy children were determined to have statistically significantly better scores than the low vision children (p <0.001) (Table 2).

Table 2. Comparison of MVPT-3 total score and BOT-2 total core and BOT-2 subtest scores of the participants

Variables	Low Vision Children (n=30)		Healthy Children (n=38)		Z	p*
	X±SD	95% CI	X±SD	95% CI		
MVPT-3 Total Score(0-65)	38.97±11.28	26.81-32.32	50.05±11.18	46.38-53.73	-6.064	0.000
Fine Motor Control (0-24)	15.93±6.48	13.51-18.35	22.68±2.05	21.97-23.33	-4.984	0.000
Manual Coordination(0-21)	9.20±4.75	7.42-10.97	18.21±2.66	17.58-19.15	-6.515	0.000
Body Coordination(0-15)	12.50±2.75	11.49-13.56	15±0.00	15.00-15.00	-6.225	0.000
Strength and Agility(0-28)	13.63±3.01	12.50-14.75	19.57±1.94	18.96-20.24	-6.369	0.000
BOT-2 Total Score(0-88)	51.30±14.31	45.98-56.69	75.23±5.21	73.52-76.95	-6.557	0.000

Min: Minimum value, max: Maximum value, n: Number of cases, X: Mean, SD: Standard Deviation, *Mann-Whitney U test

When the MVPT-3 scores, BOT-2 SF subtests and total scores of the children with low vision were examined, visual perception was statistically significantly correlated with fine motor control (r = 0.508; p = 0.004), manual coordination (r = 0.429; p = 0.018), body coordination (r = 0.624; p = 0.000), strength and agility (r = 0.389; p = 0.033) and BOT-2 total score (r = 0.619; p = 0.000)(Table 3).

Table 3. The relationship between visual perception score and motor skill scores of low vision children

BOT-2 Subtests	**MVPT-3 Total Score**	
	R	P
Fine Motor Control	0.508	.004**
Manual Coordination	0.429	.018*
Body Coordination	0.624	.000*
Strength and Agility	0.389	.033**
Total Score	0.619	.000**

*Spearman correlation, **Pearson correlation, R: Correlation coefficient, p: Significance level.

Discussion

The aim of this study was to evaluate the relationship between visual perception and motor skills of 30 children with low vision and to compare them with healthy children. The results demonstrated that visual perception was correlated with all subtests of motor skills and the total motor skill score in children with low vision. And children with low vision had lower scores in all the motor skills and visual perception tests compared to their healthy peers.

Previous studies in literature on the effect of low vision and other visual problems on motor development and the learning of complex motor skills have shown that individuals with visual problems may have problems with motor skills (Houwen, Visscher, Lemmink, and Hartman, 2009). A study

conducted on children with different levels of visual acuity reported that the motor skills of sighted children were established at primary school age, whereas children with visual impairment were reported to have delayed development (Atasavun Uysal, and Duger, 2011). Visual perception subtest and total test scores in pre-school age children differ significantly according to major muscle motor skills. Tepeli (2014) reported that visual perception skill has an important effect on gross motor development. This finding indicates that the visual perception skills of children improve as their gross motor skills increase, and conversely, gross motor skills degrade as visual perception skills decrease.

In the current study, when compared with healthy children, children with low vision were observed to have lower motor control, fine motor control, manual coordination, body coordination and running speed-agility subscales, and low BOT-2 SF scores in total. Balance and coordination occur in a coordinated manner with visual-vestibular and proprioceptive mechanisms. The lack of visual perception negatively affects the balance and coordination mechanism. In this study, this result was confirmed by the relationship between visual perception and motor skills subtests. Motor skills are affected by both gross and fine motor skills. In terms of gross motor skills, it can be suggested that due to the inadequate experience of the children with low vision, they restricted their ability to use their limbs in different ways during rhythmic movements, either simultaneously or at different times, and because of insufficient stimuli and insecurity, this could lead to a lack of strength resulting from passive interaction with the environment.

Due to insufficient visual stimulation of children with low vision, or near or total blindness, their daily life activities are restricted and their quality of life is adversely affected (Atasavun Uysal, and Duger, 2011). Matsuba et al. (2003) stated that there were delays in the development of self-care activities of children with severe visual impairment, and that these children had to eat with a spoon. Elbasan et al. (2011) investigated the effect of visual perception and motor skills on GYA in 35 mildly mentally handicapped children aged 5-17 years, and reported that visual perception is an important factor in the independence of children with mental and motor insufficiency. Daily life activities include both fine and gross motor skills and in the current study, both fine and gross motor skills were found to be correlated with visual perception as shown in the literature.

Studies have shown that the factors affecting visual function such as visual acuity, visual field and contrast sensitivity cause insufficiency in activities such as walking and stair climbing (West et al, 2002). Activities such as walking, running, jumping, hopping, climbing, throwing, catching, turning, and balance are related to gross motor skills that require control of the arms and legs. In accordance with the literature, the current study results showed a correlation between visual perception and gross motor skills. The significant relationship was determined between visual perception and body coordination, and running speed-agility subtests, supports this conclusion.

Murphy and O'Driscoll (1989) emphasized that in the preschool period, visually impaired children have motor development close to that of healthy sighted children, but delays in basic motor skills such as postural control, balance, lower and upper extremity coordination, and motor movements planning are seen at 6-7 years of age. It was stated that strength, coordination, flexibility and ultimately the development of fine motor skills would be adversely affected by the non development of basic motor skills in the early period.

Uyanik et al. (2001) examined the factors affecting the writing performance of 70 primary school students and stated that one of these was visual perception. Aki and Kayihan (2003) emphasized that the writing speed of those with low vision increased with visual perception education. Smith (2002) concluded that visual perception and writing are related to each other. Developments in writing are related to fine motor skills. In the current study, it was also seen that fine motor control and manual coordination subtests were related to fine motor skills correlated to visual perception. That children with low vision have inadequate speed and endurance of hand functions for activities such as writing and

eating supports these results. It can be considered that low vision children cannot develop fine hand skills and sufficient hand-eye coordination due to the lack of visual function.

In a study examining the relationship between writing and visual motor control skills of 26 normal-sighted children with an average age of 9.9 years and 42 low vision children with a mean age of 9.7 years, Atasavun Uysal and Aki (2012) found significant differences in terms of writing speed, legibility and visual motor control in favor of the children with normal sight. They concluded that visual motor control is associated with the speed of writing performance in low vision children.

Atasavun Uysal and Duger (2011), compared the motor skills of 30 low vision, 30 near or totally blind and 30 normal-sighted children aged 7-14 years, and reported that normal-sighted children had the highest scores in all the tests that evaluated running, balance, upper extremity coordination, response speed, upper limb dexterity and in the total motor score.

In another study by Basakci Calik (2009), comparing the motor skills of 15 blind and 15 low vision children with an average age of 12.6 years, when the scores of balance, bilateral coordination, manual dexterity, strenght, running speed and agility tests were compared, a significant difference was found in favor of those with low vision. The motor skills of these children were restricted due to loss of vision and motor performance was adversely affected.

Different types of motor skills were compared in 23 children with visual impairment, aged 7-10 years and 25 age-matched children with normal vision. The children with visual impairments showed poorer performance in hand-eye coordination, single hand speed, and catching in static and dynamic balance compared to their normal peers (Houwen, Visscher, Lemmink, and Hartman, 2008).

Bouchard and Tetreault (2000) evaluated the motor performance of 30 normal-sighted and 30 low vision children aged 8-13 years. The children with low vision were seen to be weaker than the normal-sighted group and had poor gross and fine motor skills. It was stated that skills could be improved in schools with activities such as running, and gardening games for gross motor skills and painting, and paper cutting for fine motor skills. Other studies have also shown that motor skills can be improved with appropriate rehabilitation programs for low vision children (Ganesh, Sethi, Srivastav, Chaudhary and Arora, 2013; Atasavun Uysal, and Duger, 2012).

The results of this study demonstrated that the inadequacy of visual perception of the children with low vision negatively affected the development of gross and fine motor skills, and the difference between the groups was significantly high. Therefore, the evaluation of children with low vision should be started early and this will reduce the economic burden on society by enabling maximal use of the remaining vision (Britto, Poongothai, Mamta, Van Dijk, and Jesudasan, 2005).

This study can be considered of value as the first study to examine the effect of visual perception on motor skills in low vision children. That the tests used for evaluation were specific to these children, the visual examinations were performed by a specialist ophthalmologist updating the visual acuities of low vision children, thereby ensuring that the children feel comfortable and confident in school and the fact that there was a control group of healthy, age-matched, normal-sighted children are the strengths of this study.

Limitations of the study could be said to be that sample of low vision and healthy children sample were taken from a single school and small sample size.

Conclusions

Visual perception was found to affect gross and fine motor skills, and if these skills do not develop, the child will not become independent in daily activities, so it is important that early evaluations are made

and education is managed accordingly. Visual developments in children with low vision who are attending schools for the visually impaired will have an impact on the possibility of these children being included in schools of healthy children attend. Therefore, the presence of physiotherapists is absolutely necessary in schools that provide education for visually impaired children as they will assist in evaluating the inadequacies of these children and making the necessary interventions.

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Declaration of Conflicting Interests

The authors report no conflicts of interest.

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