



Musculoskeletal Disorders in Adolescent Students with Low Vision and Hearing Impairment

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ABSTRACT

Aims: MusculoSkeletal Disorders (MSDs) are one of the most common problems of students which if not prevented and treated can lead to physical and psychosocial disorders. The aim of this study was to compare MSDs in two groups of students with special needs who suffering from low vision and hearing impairment.

Method and Materials: A cross-sectional study was conducted with of 62 students aged between 10-15 years old in Hamadan in 2019-2020 . Of these participants, 32 students living with hearing impairment and 30 students living with low visions. Demographic questionnaires and Nordic musculoskeletal disorders were used to collect data. SPSS software version 23 was used to analyse data through two-sample independent t-test, chi-square test and logistic regression.

Finding: Tottaly 62 students took part in the study. The mean age of Low Vision Students (LVS) and Hearing Impairment Students (HIS) was $12.101.47 \pm$ and 12.47 ± 1.64 years respectively. Of all students with low vision 10 individual (33.3%) and of all students with hearing impaiement 10 individuals (31.3%) were suffering from MSDs. The most MSD affected areas in HIS was lumbar (15.6%) and in LVS was shoulder (16.7%). The results showed that MSDs did not differ significantly between the two groups of LVS and HIS ($P > 0.05$).

Conclusion: This study showed that at least one-third of LVS and HIS suffered from MSDs. The need for therapeutic and educational strategies in the field of ergonomics interventional program for health promoting of these students with special needs should be considered.

Keywords: MusculoSkeletal Disorder, Hearing Impairment, Low Vision, Adoloscent Student.

Introduction

The blindness and deafness constitute the largest group of the disabled individuals [1]. Deafness is a kind of sensorineural disorder reported by more than 120 million people all over the world [2]. Hearing-impaired has affected about 15-26% of the world population. According to the previous evidence, deafness widely affects the development of emotional, social, and cognitive functions [3]. In a deaf person, the hearing disorder prevents the successful process of the verbal information obtained by hearing and impact the process of the individuals' socialization [4]. In fact, the existed evidence suggests that these children experience various physical and emotional problems [5]. The

limitations created by disability lead to physical, mental, and social consequences in deaf children [6]. Studies have shown that infants and children with inborn hearing disorder usually are affected by vestibular dysfunction in both ears and posture control dysfunction [7]. Due to the significant role of vestibular system in reaching the motor development milestone and keeping balance, children affected by sensorineural hearing disorder and inborn or early vestibular dysfunction report delayed motor development especially in gross motor skills [8]. Patel et al. (2017) compared the balance performance in children with and without hearing disorder and they concluded that the

children affected by hearing disorder have a significantly poorer balance performance than healthy children [9]. Zwierzchowska et al. (2007) concluded that about all of the deaf children aged between 10-16 years old had posture control dysfunction in sagittal and frontal planes and the main disorders were observed in scoliosis and kyphosis [10]. Daneshmandi et al. (2016) investigated the relationship between the physical posture and physical fitness. They concluded that in deaf people, there is a relationship between Body Mass Index (BMI) and kyphosis, peak oxygen consumption and dorsal scoliosis, uneven shoulders and rounded shoulders, muscle endurance and dorsal scoliosis and forward head, muscle power and dorsal and lumbar scoliosis, lumbar and hamstring flexibility and uneven shoulders and rounded shoulders, trunk flexibility and kyphosis, dorsal and lumbar scoliosis and forward head [11].

According to the World Health Organization (WHO) report, there are about 38 million blind people in the world and about 110 million people are affected by severe visual impairment and these numbers are increasing. More than 90% of the people with visual disabilities live in developing countries. The prevalence of blindness in developing Asian countries has been reported about 0.3-4.4% [12]. It has been reported that the lack of visual and auditory information can lead to the delayed recognition of the physical dysfunction and in this regard, deaf and blind children are different from normal children [13]. Zetterlund et al (2009) suggested that a relationship exists between visual and musculoskeletal problems [14].

Overall, studies show that complaints such as muscle fatigue, anesthesia, back pain, shoulder pain, and neck pain are some of the symptoms of skeletomuscular disorders that occur in about half of the students during their education period [15-17].

Usually, these students refer to therapists complaining about spinal pains [18]. The occurrence of the first symptoms of back pain has been reported in 10.5-year-old girls and 12.5-year-old boys. More than 55% of students carry the bags that are heavier than the normal weight (10-15% of the body weight). It can cause spine injury and skeletomuscular pains in them [19, 20]. Vikat et al. reported that neck pain and shoulder pain in 15% of the cases and back pain has been reported in 8% of the cases in the age of 12-18 years [21]. Moreover, Diepenmaat et al. and Duatc et al studied the students of 12-16 years and their findings were similar the mentioned results [22]. Despite the difference between the involved areas and the extent of involvement in different studies, most of the researchers agree that the prevalence of skeletomuscular disorders and especially back pain increases with the students' growth. Meanwhile, these disorders are more prevalent in girls than boys [23]. Regarding the investigation of the hearing-impaired and low vision adolescents in this study, it aims to compare the musculoskeletal disorders in both groups of adolescent students and also the relationship with some of the routine factors.

Method and Materials

This research is a cross-sectional study. The population includes adolescent students suffering from hearing-impaired and low vision living in Hamadan, Iran in the academic year 2019-2020. In this research factors such as musculoskeletal disorders, demographic characteristics and quantitative/qualitative contextual variables in the students were studied. The sample included 62 students out of the 108 hearing-impaired and low vision students of 10-15 years who were selected by census sampling. After obtaining the approval of Hamadan University of Medical Sciences and getting an ethics code,

the necessary arrangements were done by informing department of education in Hamadan province, exceptional education organization, and the managers of the included schools. Then, the parents of the the students were called and asked to fill a written consent letter for participation of their children in the study.

The inclusion criteria included filling the informed consent form by the parents, the students' verbal consent, no chronic rheumatologic and neurological diseases in the students, and no record of accidents causing musculoskeletal restraints, no record of fracture or dislocation of the limbs over the past one year, no continuous attendance in sport programs or occupational therapy over the past six months. The students who were affected by an accident, trauma, and disease or did not have proper cooperation were excluded from the study. First, an informed surveyor evaluated the students' height, weight, and bag weight by using a digital scale (Diamond, A04-200g) and a tape measure. To fill the Nordic questionnaire, the students were asked the questions in the presence of their parents so that the parent could modify or complement the answers in the case of necessity. Despite the researchers' referring to the schools once a week in three weeks and, finally 62 hearing-impaired and low vision students filled the questionnaires. In this study Nordic questionnaire was used which is a standard scale evaluating the musculoskeletal disorders. This questionnaire was designed by Kuorinka et al. in the Scandinavian Professional Health Institute in 1978. The reliability and validity of the Persian version of this questionnaire have also been approved [24]. Nordic questionnaire is widely used in most of studies investigating work related injuries. This questionnaire consists of three parts that evaluate the intensity of pain, irritation, and anesthesia in different parts of the body

over the past twelve months and the past week and also the extent of inability to do the daily activities such as occupational, recreational, and home activities caused by skeletomuscular disorders over the past twelve months.

Another questionnaire was used for evaluating the demographic variables related to musculoskeletal disorders in hearing-impaired and low vision students. The studied demographic factors included gender, age, the students' weight, height, their bag weight, duration of carrying their bags (min), the period of using the same bag (month), the way of going to school (school services, the family's vehicle(Car), or on foot), the type of their sitting position in the home while doing their assignments (proportional desk and bench for their age and size, appropriate chair and table, usual sitting), the time of feeling pain (while carrying their bag or other times, always, no pain), duration of watching TV and using computer (hour), the parents' education, and the number of times of checking the weight of the students' bags, bag type(backpack or double sided, one-sided shoulder bag or backpack, handbag, father's education(diploma and lower,university education), mother education(diploma and lower,university education) and parents often check the weight of the bag (week;y). Data analysis was done by SPSS 23. The descriptive data were reported in terms of frequency, mean and standard deviation of the students' information and their bags properties. The properties of the studied population were addressed by descriptive statistics. Kolmogorov-Smirnov test was used for studying the explanatory properties of the variables. Regarding the normality of the variables, t-test were used for comparing the means in terms of the students' different characteristics. The relationship between the qualitative variables was studied by Chi-

square. The logistic regression was used for investigation effect of related factors

Finding

Totally, 62 participants (32 hearing impairment students, 30 low vision students) were studied. The mean age of the participants of low vision students and hearing impairment students were (12.47 ± 1.64) and (12.10 ± 1.47) respectively. The majority of participants used double sided backpack (56.7%) in low vision students and 34.4% in hearing impairment students.

Regarding the MSDs, the results of the study showed that about one-third of the students (32.5 % in hearing-impaired students, 33.3% in low vision students) complained these disorders. The highest involved area of MSDs was lumbar (15.6%) in the hearing-impaired students and shoulder (16.7%) in the low vision students. There were no significant difference in the prevalence of MSDs between both groups of students under study (Table 1). The proportion of bag weight towards student weight were 0.09 ± 0.03 in hearing-impaired students and 0.08 ± 0.03 in low vision students (Table 2).

The results of the univariate test of independent t-test and chi-square tests (Fisher's exact test if necessary) showed variables such as bag type and bag weight had significant relationship with the MSDs. Therefore, logistic regression was used to investigate the effect of these variables (Table 3). Accordingly, with an increase of one unit in the weight of the bag, MSDs in the studied students increased up to 2.42 times and this effect was statistically significant ($P < 0.05$).

Furthermore, the odds of MSDs in students using a handbag were 6.66 times of the odds of MSDs in students using a backpack and this difference was also statistically significant ($P < 0.05$). The odds of MSDs in students using a handbag were 1.22 times

of the odds of MSDs in students using a one-sided shoulder bag. This difference was not statistically significant ($P < 0.05$) (Table 3).

Discussion

According to this study among the students with low vision and hearing impairment, the most prevalent chronic skeletomuscular disorders were in the lumbar in the students with hearing impairment and in shoulders in low vision students. Although the pain areas were different in the two groups, chi-square did not show any significant difference between the two groups in terms of MSDs. Meanwhile, one-third of studied students reported MSDs in at least one area. As a research with similar findings, Alghamdi et al. (2018) studied the high school students of Dammam (Saudi Arabia) and they reported that 40% of the female students had shoulder and neck pains [25]. Jennine et al. studied musculoskeletal pains in the students of New Zealand and they observed these pains in 77.1% of the students [15], while Linton et al. reported this rate 30-65% [26]. Shamsodini et al. studied MSDs in elementary and junior high school students of Tehran, and they reported the prevalence of these pains in different areas including shoulder (37.9%), neck (28.5%), and waist (17.4%) [27]. Fatemi et al. in Lorestan reported that 49.99% of the girls and 67.71% of the boys have posture deformities in their limbs [28]. Daneshmandi et al. (2016) studied the physical endurance of the blind and deaf children. They found that MSDs involve waist and shoulder (kyphosis, lordosis, and rounded shoulder) in blind children, and cause spine deviation and involvement of back and pain (kyphosis and dorsal scoliosis) and shoulder (uneven shoulders and forward head) in deaf children [11]. To justify the results of the present study, it seems that this condition is caused by the compensatory posture resulted from their balance disorder. In the low vision students,

Table1) Distribution and comparison of studied qualitative variables between two groups of students

Variables		Hearing-impaired		Low Vision		Test Statistics	P_value
		Frequency	%	Frequency	%		
Sex	Female	16	50	10	33.3	1.76	0.184*
	Male	16	50	20	66.7		
Way of going to school	By car	23	71.9	28	93.3	4.885	0.027*
	On foot	9	28.1	2	6.7		
Bag type	Backpack (double sided)	11	34.4	17	56.7	4.54	0.103*
	Shoulder bag (one sided)	11	34.4	4	13.3		
	Handbag	10	31.3	9	30		
Type of sitting in home	Propor desk and bench	0	0	1	3.3	1.15	0.800**
	Appropriate desk and bench	2	6.3	2	6.7		
	Usual sitting	30	93.8	27	90		
Time of feeling pain	While carrying bag	0	0	2	6.7	2.98	0.437**
	Other times	1	3.1	2	6.7		
	Both (always)	10	31.3	6	20		
	No pain	21	65.6	20	66.7		
Father's education	Diploma and lower	27	84.4	26	86.7	0.07	0.798*
	University	5	15.6	4	13.3		
Mother education	Diploma and lower	27	84.4	26	86.7	0.07	0.798*
	university	5	15.6	4	13.3		
Complaint of musculoskeletal pain	Yes	10	31.3	10	33.3	0.03	0.861*
	No	22	68.8	20	66.7		
Parents often check the weight of the bag(weekly)	Yes	4	12.5	3	10	0.09	0.756*
	No	28	87.5	27	90		
Different parts of body involved in MSDs	Shoulder	3	9.4	5	16.7	4.57	0.863**
	Wrist	1	3.1	0	0		
	Back	0	0	1	3.3		
	Lumbar	5	15.6	3	10.0		
	Knee	1	3.1	0	0		
	Nothing	20	62.5	20	66.7		
	Neck	2	6.3	1	3.3		

*Chi-square test **Exact fisher test

the most prevalent musculoskeletal pains were reported in the shoulder. This finding can be justified by the heavy bags carried by low vision students due to using braille books. Other findings suggest that there is a significant

relationship between musculoskeletal pains and the bag weight , bag type and the time of feeling the pain in the students with low vision and hearing impairment. Unlike the low vision students, the way of going to

Table 2) Comparison of studied quantitative variables in two groups of students

Variables	Hearing-impaired		Low Vision		Test Statistics*	P_value
	Mean	SD	Mean	SD		
Age(year)	12.47	1.64	12.10	1.47	0.92	0.357
Duration of carrying bags (min)	22.41	9.96	17.23	7.09	2.34	0.023
Duration of TV / computer watching (hrs)	2.53	0.76	1.33	0.47	7.46	<0.001
Duration of using the same bag (mon)	29.96	9.62	19.70	9.10	4.31	<0.001
Student weight (kg)	37.50	6.29	35.50	4.86	1.46	0.156
Bag weight (kg)	3.50	1.36	3.03	1.27	1.38	0.170
Student height (cm)	141.59	9.77	142.83	9.67	0.50	0.618
BMI	18.82	2.94	17.41	2.94	2.24	0.029
Bag weight/ Student weight	0.09	0.03	0.08	0.03	1.12	0.265

*Independent sample t-test

Table 3) Logistic regression for fitting prevalence of musculoskeletal disorders

Variables	B	S.E	Wald Statistics	P_value	Exp(B)
Constant	-3.38	1.32	6.61	0.010	0.034
Bag weight	0.88	0.32	7.43	0.006	2.42
Backpack (double sided)	-1.92	0.93	4.31	0.038	0.15
Shoulder bag (one sided)	-0.20	0.79	0.07	0.80	0.816
Handbag	--	--	--	--	--

school and the parents' education had also a significant relationship with skeletomuscular pains in students with hearing impairment. Meanwhile, there was no significant relationship between pain and duration of carrying the bag and gender in any of the groups. As a similar study, Regiani B et al. (2018) studied MSDs in university students using a cell phone and they approved the simultaneous occurrence of pain while using cell phone [29]. Furthermore, the findings of previous studies emphasize that carrying heavy bags to school can cause MSDs [30, 31] and heavy bags can be considered a risk factor for these disorders such as back pain [31, 32]. Calve et al. (2018) reported that the way of carrying the bag (on shoulder, by hand, backpack on one shoulder, backpack on both shoulders, and backpack with

crossing strap) does not have any significant relationship with the prevalence of back pain in school students. This finding can be due to the use of backpacks with two straps by most of the students [33]. This finding is contradictory to the present study in which, the students using single-strap backpacks and carrying their bag by hand reported higher prevalence rates of contradictory disorders than the student using backpacks with two straps. This finding seems to be rational regarding the standards of weight distribution by two-strap backpacks and their symmetric load.

Delele et al. (2018) stated that there is a low relationship between the weight of the school bags and the distance of going to school [34]. However, several studies have emphasized that MSDs are more prevalent in the children

who have to carry their bags for a longer period of time [34-36]. This difference can be due to the different times and distances between the home and school in different studies. The different results of both groups (the students with low vision and hearing impairment) in this study can be due to the fact that low vision students usually go to school with one of their family members because of the obstacles in the path and so they can help the students to carry their bag. However, students with hearing impairment report more severe musculoskeletal pains due to walking to school and carrying heavy loads and sometimes using non-standard bags [11]. Educated parents usually check their children's bags. However, this is even more important for students with low vision, because low vision students have to carry heavy braille books and voice recorders.

In addition to the above-stated facts, studies have shown that non-mechanical factors also can increase the risk of musculoskeletal pains in school students. One of these factors is the students' perception of their bag weight regardless of its real weight and they may feel too heavy [33, 36]. Since the subjects of this study were students with vision and hearing impairment, these disorders can also lead to improper understanding of the effective factors and an increase in musculoskeletal disorders.

In addition to strong points of this study, the research limitations included lack of cooperation by some of the students and their parents in this study. Furthermore, small sample size and self-reporting were other limitations of the study. However, many other valid studies support the findings of this study that suggested that the musculoskeletal disorders in students with low vision and hearing impairment is prevalent and there is a relationship between this disorder and the weight and type of the students' bags.

Conclusion

Although, this study suggested that musculoskeletal disorders are prevalent among students with low vision and hearing impairment and there is a relationship between this disorder and the weight and type of the students' bags. However, further studies in larger samples and different age groups can be effective in obtaining more accurate results. It is especially important for children with sensory disabilities, because these students receive excessive support from their parents. On the other hand, the fear of injury also leads to the decrease in their activity and participation in adolescence games and sports. All these factors can intensify the MSDs and their irreparable consequences in adulthood.

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Author contribution: SSM designed and conducted the study and also wrote the manuscript. SAH was scientific advisor of the study, HAH was supervisor of the study. NSH analysed and interpreted the data. All authors took part in reading and approving the manuscript.

Conflict of interest: The authors declared no conflicts of interest for this study.

Ethical Permission: All ethical principals were considered in this study. All participants were satisfied to be studied and signed the consent form. This study was deprived of a research project approved under the PhD research code 9710256421 and with the Ethical Code of IR.UMSHA.REC.1397.747.

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