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The Impact of a Physical Activity Program on Dynamic Balance and Some Kinematic Properties of Gait in Students with Visual Impairments at King Abdul Aziz University

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Abstract: King Abdul Aziz University has a large number of students with special needs (1024 male and female students), including 508 students with visual impairments. The university seeks to provide these students with the necessary services to help him perform their tasks easily. Gait and walking are two important mobility elements that provide autonomous mobility to students with visual impairments at the university. They may also cause problems to these students including injuries because of tripping, colliding, or falling, thus exposing the students to mild to moderate injuries. The severity of such injuries increases with the decline in stability and increase in body weight. Blind persons face problems in moving safely, because of the lack of knowledge about the surrounding environment they move within. This is known as orientation and mobility skills.

The present study aims at identifying the effect of a physical activity program on dynamic balance and some kinematic properties of gait in students with visual impairments in King Abdul Aziz University through identifying the effect of the proposed program on the level of dynamic balance, kinematic properties of gait, and some physical variables in the research sample. The researchers applied the experimental method as it is suitable to the nature of this study. They used an experimental one-group design with pretest/posttest measurements. The research sample was purposively selected from B1-B2 blind students (12 students). A physical program was applied for three months. It had three 90-minute weekly training sessions. The researchers conducted the first and second exploratory study to determine the adequacy of the proposed motion stability exercises to the research sample. The study found an improvement of the participants' balance levels on MFT balance device posttest measurement by 16.32 percent; a slight improvement in the step length, stride speed, and cadence; and a reduction in stance time. These properties, which are associated with an improvement in balance, should improve further with the consistency in physical activity, which will increase visually impaired students' confidence in their movement and enable them to enter all the university facilities without fear of falling. Additionally, there was an improvement in all physical variables due to practice, especially the strength test (push-up) by more than 100%. The participants also lost weight and their balance level improved (walking on a Swedish bench) by 69 percent. The researchers recommend that sporting activities for students with disabilities should be amplified; awareness lectures should be held about the importance of sports and dangers of obesity for persons with visual impairments; and the architectural setting at universities and other educational institutions should be adapted.

تأثير برنامج للنشاط البدني على الاتزان الديناميكي وبعض الخصائص الكينماتيكيه أثناء الخطو للطلاب ذوي الإعاقة البصرية بجامعة الملك عبد العزيز

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الكلمات المفتاحية: النشاط البدني، الاتزان الديناميكي، الخصائص الكينماتيكيه

ملخص البحث: تضم جامعة الملك عبد العزيز بين طلابها عدد كبير من الأشخاص من ذوي الاحتياجات الخاصة تصل إلي (1024) طالب وطالبة منهم (508) طلاب من ذوي الإعاقة البصرية وتسعى الجامعة إلي تقديم كافة الخدمات التي تساعدهم على أداء مهماتهم بكل يسر. حيث يعتبر الخطو والمشي من أهم السمات الانتقالية لتوفير استقلالية التحرك للطلاب ذوي الإعاقة البصرية بالجامعة وقد يتسبب في مشاكل كبيرة قد تصل لحد الإصابات بسبب الاصطدام او العرقلة والسقوط على الأرض، ومن ثم تعرضهم للعديد من الإصابات التي تتراوح من البسيطة الي المتوسطة، وقد تزيد حده هذه الإصابات كلما قل الاتزان أو ذاد وزن الجسم. يواجه المكفوفين مشكلات في القدرة على الحركة بأمان من مكان إلى آخر، بسبب عدم معرفتهم بالبيئة التي ينتقلون فيها وهذا ما يعرف بمهارة التعرف والتنقل تهدف الدراسة للتعرف على تأثير برنامج للنشاط البدني على الاتزان الديناميكي وبعض الخصائص الكينماتيكيه أثناء الخطو للطلاب ذوي الإعاقة البصرية بجامعة الملك عبد العزيز من خلال التعرف على: تأثير برنامج النشاط البدني المقترح على معدل الاتزان الديناميكي. والخصائص الكينماتيكيه للخطو، وعلى بعض المتغيرات البدنية لعينة الدراسة. أستخدم الباحثان المنهج التجريبي نظرا لملائمته لطبيعة الدراسة وقد استخدم نموذج من نماذج التصميمات التجريبية لمجموعة واحدة بإتباع القياسين القبلي والبعدي. اختيارات عينة الدراسة بالطريقة العمدية من الطلاب المكفوفين فئة (B1-B2) وعددهم (12) طالب. تم تطبيق برنامج بدني لمدة لمده ثلاث أشهر بواقع ثلاثة تدريبات اسبوعياً مده الوحدة التدريبية 90 دقيقه بالصالة الرياضية بإجمالي ستة وثلاثون (36) وحدة تدريبية ، قام الباحثان بإجراء الدراسات الاستطلاعية الأولي والثانية بغرض التعرف على مدى مناسبة برنامج تدريبات الاتزان الحركي المقترحة لعينة الدراسة، كانت أهم النتائج تحسن معدل الاتزان على جهاز (MFT) لعينة الدراسة بالقياس البعدي بنسبة (16.32 %) وجود تحسن ولو طفيف في طول وسرعه وايقاع الخطو وكذلك انخفاض زمن الارتكاز ومع استمرار ممارسه النشاط البدني ستتحسن الخصائص أكثر مع ارتباطها بتحسن الاتزان مما يعطي ثقة للطلاب ذوي الإعاقة البصرية في التحرك وتمكينهم من الولوج لكافة مرافق الجامعة دون خوف من السقوط وكذلك وجود تحسن ملحوظ في كافة المتغيرات البدنية وخصوصا اختبار القوة (الانبطاح المائل) بنسبة أكثر من 100% نتيجة الممارسة مع فقدان عينة الدراسة جزء من الوزن، وتحسن معدل الاتزان (المشي على مقعد سويدي) حيث كان التحسن بنسبة 69%. أوصي الباحثان بتعظيم ممارسة الأنشطة الرياضية للطلاب ذوي الإعاقة وعمل ندوات تثقفية عن أهمية الرياضة ومخاطر السمنة لدى الأشخاص ذوي الإعاقة البصرية، وتهيئة البيئة العمرانية للجامعات وكافه مؤسسات التعليم.

Introduction

Persons with disabilities have gained the attention of various inclusive development programs in the Kingdom of Saudi Arabia (KSA) in general, as they constitute an integral part of society's human force and diversity, when they are well-educated, qualified, trained, prepared, and have their abilities developed according to structured scientific programs. Centers for persons with disabilities in higher education institutions are essential and important authorities to overcome the obstacles facing these students during their college years, by facilitating mobility and involvement in university life easily, informing them of their rights and duties, as well as their needs and requirements of those needs.

Developing the skills of students with disabilities is not only limited to academic skills, but it also includes the efforts to develop their social growth skills. However, a single educational strategy or training method cannot be applied to develop all the required skills or address the problems faced due to the diversity of their needs. (8)(19)

The World Health Organization (WHO) (2018) stated that persons with visual impairments constitute about 4% of the Middle East population. The number of citizens who suffer some form of visual impairment in KSA is approximately one million persons, including 150 thousand persons with total blindness. Through general observations, most these students suffer obesity or overweight due to lack of activity. (34)(35)

Performing physical activities has become a requirement that is linked to the individual's preventative health, as well as to the psychological and social aspects of his/her life. Nevertheless, for persons with visual impairment, performing physical activities may be more important, as it is preventative as well as rehabilitative, as their lack of movement is directly linked to their disability. Therefore, physical activities aim at providing the individual with the motor skills and mastering those skills so that the individual can utilize them effectively and normally. The effect of visual disability on the individual's fitness level is great, as changes in the nature of motor performance of the person with blindness occur as a result of the decline in his/her motor performance in terms of relative motion as he/she fears to hit an object or fall. Additionally, they often get physical deformities during their development. They may also be subject to obesity and overweight and their associated well-known health risks. (2)(6)(7)(25)

Research Problem

Students with special needs at King Abdul Aziz University are 1024 male and female students, including 508 students with visual impairments. The university aims at providing these students with adequate services to help them perform their academic tasks easily.

The landscape design of King Abdul Aziz University contains wide green areas and gardens between buildings, which requires the movement of students from one building to another within the university campus and students' hostel. Students with special needs encounter a variety of service-related problems both inside and outside the university campus. These problems include transportation, mobility, elevators, stairs, and the necessary equipment's and devices. Gait and walking are the most important mobility properties that provide students with visual impairments with autonomy. They may cause injuries due to collision, stumbling, and falling, consequently they may be exposed to various mild and moderate injuries. The severity of such injuries increase with the increase in their weight and the decline in their balance.

The rate of injuries due to falling and losing balance among blind students is high due to overweight and reduced balance.

Developing sporting programs for blind persons is essential as it helps them improve their functioning and achievement level. Moreover, sports are crucial for strengthening the blind persons' body, improving their overall endurance, mastering their exploration process, widening their experiences, developing moral values, and keeping their motor balance. The sporting activity also develops the blind person's ability to acquire knowledge through other senses during movement (walking, running) (5).

Blind individuals face problems in safe mobility from one place to another because of their lack of knowledge about the environment they move to, this is known as orientation and mobility skills, where the blind persons make bodily movements such as moving their hands, turning around the place where the disabled person is, and other typical behaviors (7)(8).

The researchers emphasize that blind persons is one of the disadvantaged groups in society, which has not received their rights in many domains. The society's view is still confined to social and medical care only. However, blindness and visual impairments are disabilities that cause difficulties in performing most physical activities, as these practices rely heavily on sight especially in the feedback that helps the person who perform any physical activity modify their motor responses to move in the correct direction. Consequently, the blind person's motor responses, especially their dynamic balance, will be affected, which may make them unable to acquire the motor skills of the various sporting activities correctly.

As noted in the aforementioned paragraphs, the researchers conducted the present research to attempt to identify the effect of some physical activity exercises on the dynamic balance and some kinematic properties of gait in students with visual impairments.

Research Objectives:

This research aims at identifying the effect of a physical activity program on the dynamic balance and some kinematic properties of gait in students with visual impairments at King Abdul Aziz University by identifying:

1.The effect of the proposed program on the level of dynamic balance.

2.The effect of the proposed physical program on some kinematic properties of gait.

3.The effect of the proposed physical program on some physical variables in the research sample.

Research Hypotheses:

1.There are statistically significant differences between the pretest and posttest measurements in the dynamic balance test of the research sample.

2.There are statistically significant differences between the pretest and posttest measurements in the movement and mechanics of gait in the research sample.

3.Improvement rates between the pretest and post test measurements exist in the physical tests of the research sample in favor of the posttest measurements.

4.Improvement in the research sample's body mass index (BMI) occurs in favor of the posttest measurements.

Research procedures

Research method:

The researchers applied the experimental method to achieve the research objectives and test the research hypotheses, as it is suitable for the nature of the present

study. They used an experimental design on one experimental group using pretest/posttest measurements.

Research sample:

The research sample was purposively selected from the population of blind students (B1-B2 category). It consisted of 12 students. The researchers set the following criteria for selecting the research sample:

1. The student's weight ranges from 90 to 130 kg.
2. They have the ability to step without assisting equipment.
3. They do not need to wear special shoes or correction tool during gait
4. The student does not have any disability other than the visual impairment.

Table 1: Description of the research sample

	Measurement Unit	Mean	SD	Median	Skewness
Age	Year	20.32	0.52	19.4	0.25
Height	Cm	1.733	0.049	1.7	0.812
Weight	Kg	97.33	3.14	97.5	-1.086
Balance	point	4.908	0.116	4.9	-0.189

Table 1 shows that the skewness falls between ±3, which indicates that the research sample is homogenous in terms of age, height, weight and balance variables.

Data collection tools:

Research devices:

1. Tanita device to measure height, weight, and calculate BMI.
2.

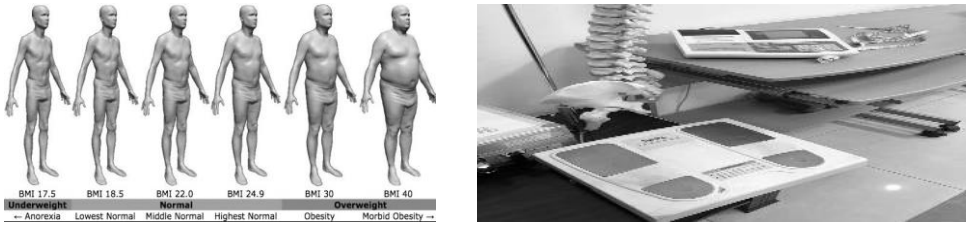

Figure 1. Tanita device to measure the BMI

3. MFT-Balance 1.7 to measure the dynamic balance.

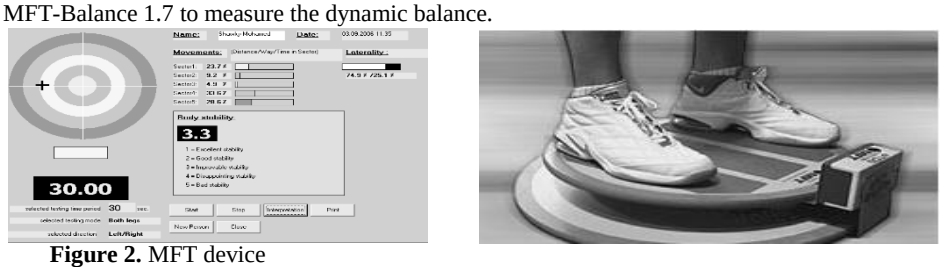

Figure 2. MFT device

4. MAXTRAQ motion analysis software

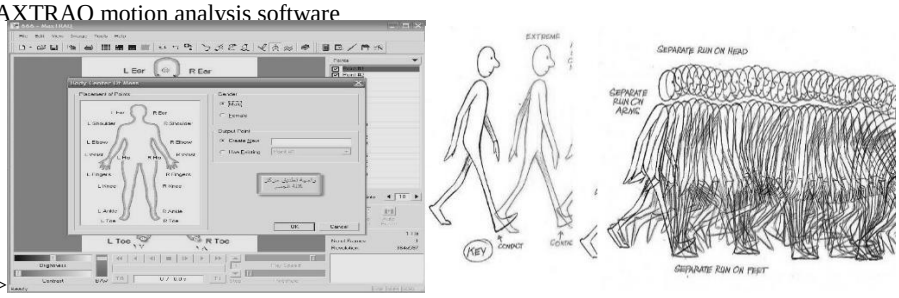

Figure 3. MAXTRAQ motion analysis software

5. A gymnasium: the gymnasium of King Abdul Aziz University was used. The gym is equipped with the most updated and safe devices suitable for visually impaired students.

Literature review:

The researchers reviewed some scientific references and foreign previous studies that were available to them. These references emphasized the importance of sports for persons with disabilities in general and blind persons in particular. The studies of Al-Shandawily (2019), Ibrahim (2018), Ratib (2005) emphasized this. Park (2015) also agreed on the same point (2)(5)(4)(31)

Dynamic Balance is a physical element related to the nervous system. It is also an important element in the human motion in general and motion of blind persons in particular. The following studies agreed on this point:

Olin, Rougier (2009), Onambélé (2008), Paillard, Noé (2006)(21)(22)(23).

In their study titled: "Balance in Blind Subjects: Cane and Fingertip Touch Induce Similar Extent and Promptness of Stance Stabilization" Sozzi and her colleagues (2018) used a force platform to measure the degree of feet pressure on the ground when identifying surrounding objects. They found a decrease in the level of stance stabilization in the condition where information supporting the blind persons' senses were lacking (28).

Ong and colleagues (2018) sought to identify the effect of exercising in alleviating eye diseases such as glaucoma and retinopathy and their risks in their study titled: "Physical activity, visual impairment and eye disease" (14)

In Campayo-Piernas and colleagues' study titled: "Role of vision in sighted and blind soccer players in adapting to an unstable balance task", they conducted an experiment on 28 blind and sighted footballers using the force platform and EMG to test their balance. They found that blind persons' muscular activation was double the sighted persons' activity to keep their balance.

Parreira, Grecco, and Oliveira (2017) conducted a review titled: "Postural control in blind individuals", and they noted that postural control requires the interaction between three sensory systems to keep good balance. In case of persons who are born blind, the problem is greater as they lack the visual input which undermines their postural control abilities (39).

In a study by Haeele, and Zhu (2017) titled: "Experiences of individuals With Visual Impairments in Integrated Physical Education: A Retrospective Study", blind individuals between 21 and 48 years old were studied to analyze the effect of exercising on their self-acceptance and positive feelings (15).

Boschsler and colleagues (2013) found that changing light and background color contrast are the most effective variables in improving stepping and ascending in individuals with low vision in their study titled: "Kallie Recognition of Ramps and Steps by People with Low Vision" (33).

A study titled: "Low vision and dynamic stability of gait", Hallemans and colleagues (2010) conducted a biomechanical analysis of a 13-27 year-old blindfolded participants. Results showed shortened steps, trunk flexion, and lower cadence (16).

In Callisaya's and colleagues' study (2010), it was found that gait variables may be an important indicator about falling risks, but its variables were poorly understood. The spatial and temporal gait variables were recorded with GAITRite walkway. Regression analysis was used to represent the association between age and gait variables adjusting for weight, height, and chronic disease (13).

Al-Shandawily (2008) investigated the effect of physical education lessons on the improvement of hearing and direction of motion in blind students. The study aimed at identifying the effect of lessons on hearing and the impact on the blind individual's motion. It found that physical education lessons had a positive effect on hearing and the direction of motion in elementary stage blind students (1).

Scheffer and colleagues (2008) noted that reduced physical activity results in mental problems directly associated with falling, including fear of falling (FOF), lack of self-efficacy, avoidance of physical activities, and lack of self-confidence. Fear of falling became one of the characteristic symptoms of this syndrome, and was recognized as a health problem ever since (37).

Other researchers agreed that aids and accurate measuring devices should be made available to construct and develop sporting programs and to ensure accurate results (3)(9)(36).

Research steps:

1.Height and weight were measures, BMI was calculated using Tanita device.

2.MFT-Balance 1.7 device was used to measure the sample's dynamic balance.

3.MAXTRAQ motion analysis software was used to photograph and make full motion analysis of the step. A 10-meter safe pathway was determined and the students were directed from the start to finish lines. A step midway the walking path was selected for analysis to ensure acceleration and good tempo.

4.Pretest measurements in physical variables (frontal stability, lateral stability, some physical variables, vertical jump, walking) from 7-9 January 2019, in the studied variables. All measurements were taken in a standard manner.

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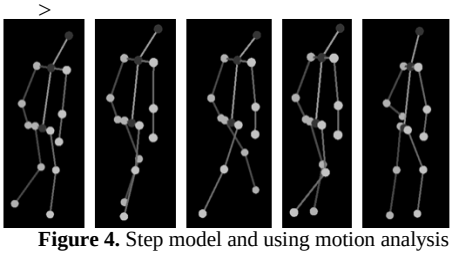

Figure 4. Step model and using motion analysis

5.A 3-month physical program was applied. It consisted of three 90-minute training sessions per week at the gymnasium (a total of 36 training modules). After the warm-up, 20 minutes were allocated for motor balance exercises. The training size of motor balance exercises in the program was 720 minutes (20min. x 36 modules). Each exercises was 30-45 seconds with 20-30 second rest intervals. Each set was repeated 2-3 times, with 45-60 second rest intervals between sets. Intensity and volume of physical exercises was determined by time and repetitions. The exercises were performed with equipments (compatibility ladder, cones, Swedish seat, treadmill, ergonomic bike, safe weight training devices) and without equipment. Training took place from Sunday 13 January 2019 through Thursday, 4 April 2019 (attachment 5).

6.After the training program ended, the researchers photographed the sample again to observe the changes in kinematic variables of gait and conduct the posttest measurements regarding the studied variables from Sunday, 7 April 2019 through Tuesday 9 April 2019.

7.Research findings analysis and writing the final report.

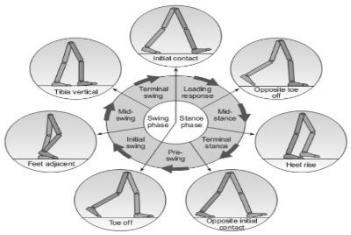

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Figure 5. Technical phases of the step cycle

8.The researchers conducted the first and second exploratory studies from 15-19 December 2018 to identify the adequacy of the motor balance exercises program for

the research sample, the safety and accuracy of used equipment and devices, participants' understanding of the MFT-balance device test of frontal and lateral motor balance (attachment 2).

Resultsb

Whittle (2007) noted that two main issues should be taken into consideration in order to analyze the step process accurately: the step cycle, and the displacement of the individual's center of gravity which is the foundation for assessing the gait stability.

Table 2: T-test value of special and temporal walking standards in the pretest and posttest measurements of the research sample (N = 12)

Variables	Measurement unit	Pretest measurements		Posttest measurements		Difference in means	Calculated t value
		Mean	SD	Mean	SD		
Step length	m	102.2	10.04	93.11	7.01	9.13	0.008*
Stride speed	m/sec	0.82	0.12	0.54	7.01	0.28	0.007*
Stance time	Step/min.	6.178	6.47	4.513	0.16	3.374	0.008*
Cadence	%	68.00	2.59	70.04	13.18	2.04	0.004*

p = 0.05

Table 2 shows clear differences between the spatial and temporal variables of gait. As the measurements indicate a strong statistical significance between the pretest and posttest measurements in favor of the posttest measurements ($p<0.05$) as follows:

- Step length was greater in the posttest measurement by 9.13cm.
- Visually impaired participants had a lower stride speed in the pretest measurement compared to the posttest measurement by 0.28 seconds.
- The stance time shows that the number of steps per minute in the pretest measurement was lower during free gait and the difference between the two means was 3.374 step/min.
- The pretest measurement was higher than the posttest measurement in terms of cadence by 2.04%.

Table 3: Significance in differences between the pretest and posttest measurements in the research sample's dynamic balance variables (N = 12)

Variable	Measurement unit	Pretest Mean	Posttest mean	SD	Significance of difference	(t) value	%
Dynamic balance on the MFT device	Point	4.9	4.1	0.60	0.55	2.91*	16.32

* Tabular t (p = 0.05 and freedom level = 9) = 1.833>

Table 3 shows statistically significant differences between the means of the pretest and posttest measurements in the dynamic stability test in favor of the posttest measurement, as calculated t value was greater than tabular t (p = 0.05).

The test requires adequate muscular strength in order to control all the body joints in general and feet in particular, especially the ankle joint that carries the greater burden in stabilizing the body posture on the device base.

Basnett, et al. (2013), Jungwirth (2006), Schriener (2010), and Patel, Shende and Khatri (2013) agreed that stability exercises using MFT balance boards helped strengthen the working muscles in the lower limb joints, consequently improving the ability to control the ankle joint on the device resulting in the improvement of dynamic balance test scores (11)(18)(24)(27)

Table 4: Significance of differences between the means of the research sample's pretest and posttest measurements (N = 12)

Variables	Measurement Unit	Pretest mean	Posttest mean	SD	Difference mean	Calculated t	Improvement rate
Balance	Point	4.9	4.11	1.7	0.79	15.43*	16.32%
Weight	kg	98.16	90.27	2.7	7.09	8.71*	7.27%
BMI	BMI	32.32	29.96	0.9	2.36	8.71*	7.24%

*Tabular t (freedom level = 10; p = 0.01)= ±2.76

Table 4 shows a statistically significant difference in the studied variable in favor of the posttest measurements. The findings show an improvement in balance on the MFT device. Balance witnessed great improvement in the posttest measurement (16.32%) compared to the pretest measurement. The researchers note that psychological factors and confidence played a major role in this result.

The research sample's weight improved in the posttest measurement (7.27%) compared to the pretest measurement. This is a good result in three months. The researchers attribute this logical result to the application of a regular aerobic physical activity program.

With the reduction in the participants' weight, their BMI also declined, as they are related, by 7.24% in favor of the posttest measurement.

Table 5. Correlation coefficient between balance and some kinematic variables in the research sample (N = 12)

Variables	Balance
Step length	0.091
Stride speed	0.522*
Frontal stance time	0.166*
Cadence	0.910

The correlation between balance and some kinematic variables, namely step length, stride speed, frontal stance time, and cadence was calculated using Pearson's correlation coefficient. As table 5 demonstrates, there is a significant correlation between balance and frontal stance time ($p < .01$; $r = .166$), and a strong significant correlation between balance and stride speed ($p < .01$; $r = .522$).

The researchers note that such a correlation is reasonable because the shorter stance time results in a faster stride, as the amount of motion and kinetic energy is utilized without stopping for a long time during stance. However, the findings did not show a significant correlation between balance and the other kinematic variables. The researchers think that this maybe due to the fact that the improvement was mild so it did not result in a significant association, but it does not deny the improvement in the results.

Table 6. Correlation coefficient between balance and some physical variables (N = 12)

Variables	Balance
Aerobic endurance	-0.002
Muscle strength – inclined plank	-0.419
Sit ups	0.647*
Vertical jump	0.148
Balance walking on a Swedish seat	0.800*

As shown in table 6, there is a strong significant correlation between balance and sit ups ($p < .05$; $r = .647$), and balance walking on a Swedish seat ($p < .05$; $r = .800$). However, the findings did not show a significant association between balance and the other variables as shown in table 6. The researchers explain the non-significant correlation between balance and aerobic endurance, inclined plank, and vertical jump by the participants' weight, which constituted an obstacle in walking and running for a long distance; weakness in the arm muscles to carry the body weight in the inclined plank position; and weakness in the leg muscles that led to the inability to perform the quick explosive power required for vertical jump. Despite this, there was mild improvements in these variables.

Table 7. Means of the pretest and posttest measurements of the body's center of gravity trajectory on the vertical and horizontal axes during gait (N = 12)

Vertical trajectory (m/sec)		Horizontal trajectory (m/sec)		Duration
Posttest	Pretest	Posttest	Pretest	
-0.2	-0.7	0.22	0.1	0.04
0	-0.1	0.42	0.21	0.12
0.3	0.5	0.59	0.34	0.2
0.7	1.3	0.67	0.47	0.28
0.9	2.2	0.73	0.59	0.36
0.8	2.3	0.81	0.7	0.44
0.5	1.7	0.89	0.8	0.52
0.2	0.8	0.91	0.8	0.6
-0.1	-0.1	0.95	0.7	0.68
-0.3	-1.2	0.99	0.64	0.76
-0.5	-2.1	1.01	0.61	0.84
-0.18	-1	1.03	0.64	0.92
0.2	0.6	0.99	0.74	1
0.4	1.8	0.91	0.8	1.08
0.6	2.9	0.79	0.8	1.16

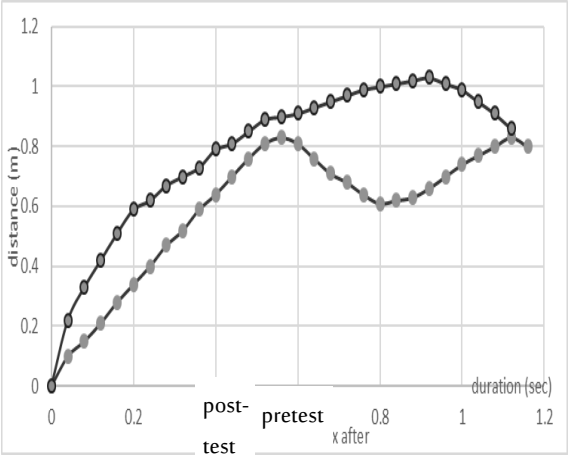

Figure 6. Means of the pretest and posttest measurements of the body's center of gravity trajectory on the horizontal axis

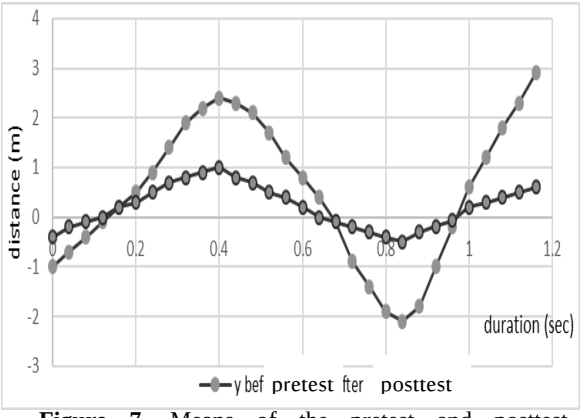

Figure 7. Means of the pretest and posttest measurements of the body's center of gravity trajectory on the vertical axis

Table 7 and figure 6 present the means of pretest and posttest measurements of the body's center of gravity trajectory on the horizontal axis of a step in the research sample. They show almost a regular improvement and flowability of horizontal displacement during performance. This is primarily related to cadence of gait. This is a rational result of the walking/running on the treadmill workout int eh proposed program, which compelled the visually impaired students to move with regular speed for durations up to 25 minutes per training module.

Figure 7 shows the means of pretest and posttest measurements of the body's center of gravity on the vertical axis. There was no great fluctuations in the raising and lowering the body's center of gravity during gait, thus reducing the waste in energy and attaining adequate balance for all body parts (38).

Table 8: Differences between the means of pretest and posttest measurements of the research sample (N = 12)

Elements and dimensions	Pretest mean rank	Posttest mean rank	Z	Significance
Balance	.00	6.50	*-3.071	.002
BMI	7.00	1.00	*-2.981	.003
Height square	1.00	2.00	-.447	.655
Height	.00	.00	.000	.99
Weight	.00	6.50	*-3.066	.002
Aerobic endurance (12 min)	.00	6.50	*-3.061	.002
Muscle strength – inclined plank 1 min. (repetitions)	.00	6.50	*-3.076	.002
Sit ups 1 min. (repetitions)	.00	6.00	*-2.950	.003
Vertical jump (cm)	.00	6.50	*-3.068-	.002
Balance walking on a swedish seat (3m/sec)	.00	6.50	*-3.071	.002
Frontal stance time	3.00	7.20	*-2.589	.010
Cadence (step/min.)	2.00	6.00	*-2.121	.034
Stride speed (m/sec)	.00	6.50	*-3.059	.002
Step length (cm)	.00	6.50	*-3.064	.002

The researchers used Wilcoxon Signed Rank to study the significance in differences between the pretest and posttest measurements of the research sample. The previous table shows statistically significant differences in the physical aspects of the kinematic variables, as there was a noticeable significant improvement after the research sample participated in the proposed aerobic program ($p<.05$, Z …), with the exception of height and height square. These findings point out the importance of applying the proposed physical activity program. The researchers note that the non-significant correlation between the program and height and height square is due to the fact that these variables and fixed values.

Discussion

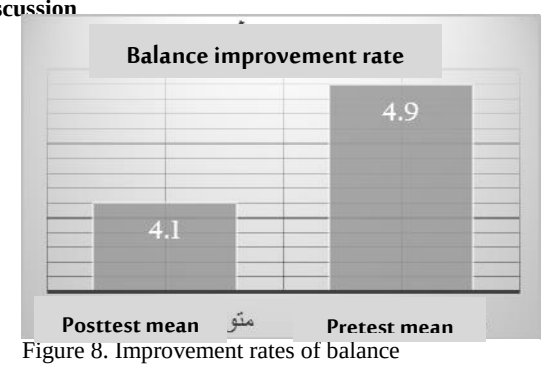

Figure 8. Improvement rates of balance

A. Balance rate:

Balance as measured by the MFT device, improved in the research sample by 16.32%. According to the program's standards, balance levels were categorized according to the test results.

Between 4 and 5 points is below average balance, while bad balance is 5 and higher. With reference to the tables and the students' pretest and posttest measurements, we note that the pretest measurement was 4.9, almost in the bad balance zone. In the posttest measurement the balance rate improved to 4.1; at the low end of the below average zone. Although the change in balance rate did not affect the test, the improvement in balance rate is promising. This is consistent with Aydoğ et al. (2006), Campayo-Piernas et al. (2017), and Stones (1987) (10)(26)(30). Thus, the first hypothesis is supported.

B. Kinematic properties of gait:

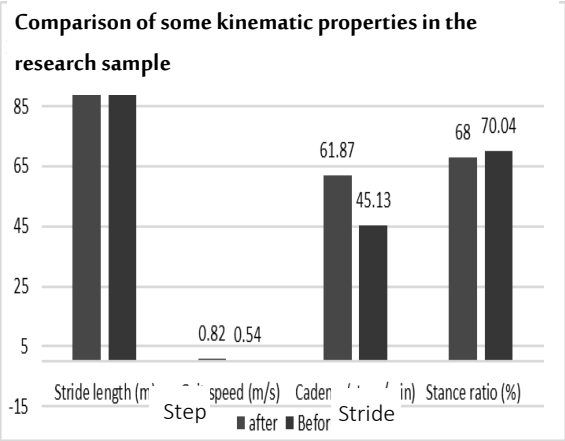

Figure 9. Comparison of some kinematic properties of gait in the research sample's pretest and posttest measurements>

Figure 9 shows a slight improvement in the step length, stride speed, and cadence. It also shows a decline in stance time. With consistency in exercising, these properties will further improve as they are associated with the improvement in stability, which leads to an increase in visually impaired students' confidence to move and accessibility to all the university facilities without fear of falling. Providing the students with means of safety and integrity as well as using the white cane should be taken into consideration. This is consistent with the studies by Jayakody (2019), and Crowston (2018) (17)(29). Thus, the second hypothesis is also supported.

C. Physical variables:

Table 9: Results of the research sample's pretest and posttest physical tests (N = 12)

	Walking on a Swedish seat (3m)	Vertical jump (cm)	Sit ups (repetitions)	Inclined plank (repetitions)	Endurance (running 12 min)
Pretest	3.05	31.3	24.33	5.66	16.8
Posttest	1.8	41	34.83	12.25	12.6

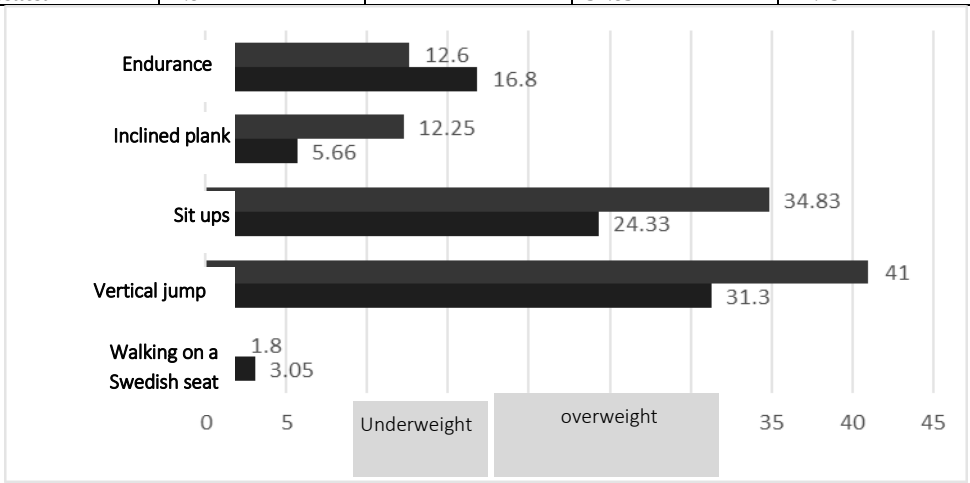

Figure 10. Research sample's pretest and posttest physical tests results

Table 9 and figure 10 demonstrate a remarkable improvement in all physical variables, particularly the strength test (inclined plank), which improved by more than 100 percent due to practice, weight loss, and the efficiency of the proposed program. Additionally the balance variable (walking on a Swedish seat) also improved by 69 percent, an excellent result. The psychological aspect plays a vital and direct role in attaining these results. Thus, the third hypothesis is also supported

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D. Body Mass Index (BMI):

The participants' BMI improved by 7.24 percent in the posttest measurements. The participants' BMI declined from extremely obese to moderately obese. This gives motivation to the students to proceed with the program in order to become better. It also enhances the role of sport as a regular habit in their daily life. Parrieira (2017), Schlenstedt (2015) and Steib (2017)(20)(21)(25) emphasized this point in their studies. Thus, the fourth hypothesis is also supported.

Figure 11. Improvement in the BMI

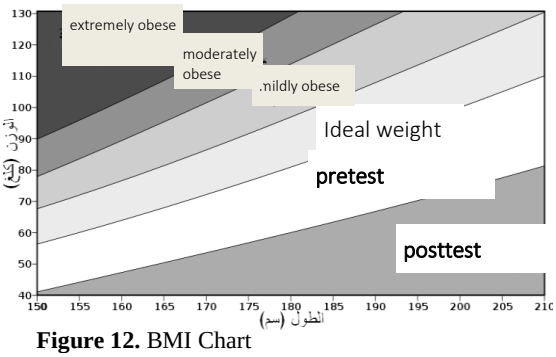

Figure 12. BMI Chart

Conclusions

- This research found that visually impaired students walk in short, less frequent steps, which leads to a reduction in stride speed, an increase in stopping rate, and more draining of energy.
- The training program, which was tailored for students with visual impairments, was effective in improving gait variables, and reducing falling risk.
- The dynamic balance level improved with physical activity.
- BMI declined with exercising.
- The psycho-social state and morale of visually impaired students improved with the performance of physical activity.
- Development of collaboration, fun, and autonomy occurred in participants.

Recommendations

- Practicing sporting activities should be expanded in students with disabilities. Awareness lectures should be held about the importance of sport and risks of obesity for persons with visual impairments.
- University campuses and all educational facilities should comply with King Salman Center for Disability Research conditions.
- A physical fitness and health course should be added as a compulsory course for students with disability in their

preparatory year.

- A specialized instructor who can deal with disabled students effectively should be available at the gym.
- A special gym for disabled persons should be established according to the international conditions.
- Special paths for visually disabled persons should be added in parks and footpaths in governmental and non-governmental establishments and airports, in order to empower and provide them with mobility to run their errands.
- Further research on the effect of physical activities on the temporal and psychological states of persons with visual disabilities should be conducted.

References:

Al-Hadidy, M. & Al-Khatib, J. (2005). *Strategies for Teaching Students with special Needs*, 1st ed. Amman: Darul Fikr

Al-Shandawily, A.A. (2008) *The effect of proposed physical education lesson on the improvement of hearing and motion direction in blind students.* Unpublished Ph.D. Thesis, Faculty of Physical Education for Boys, Helwan University

Al-Shandawily, A.A. (2019). *Direction and Motion in the Visually Impaired*. 1st ed. Cairo: Book center for publication

Al-Syoufy, A.A. (2012). *Kinetics*, 1st ed. Cairo: Dar Fikrah

Al-Waznah, T.H. (2001), *Disability, Habilitation, Basics, and Principles*, 2nd International Conference for Disability and Habilitation, Prince Salman Center for Disability Research, Riyadh

Aydoğ, E. et al. (2006), Dynamic postural stability in blink athletes using biodex stability system. *Int J Sports Med*; 27(5): 415-418

Basnett, C.R. et al. (2013), Ankle dorsiflexion range of motion influences dynamic balance in individuals with chronic ankle instability. International *Journal of Sports Physical Therapy*, 8(2): 121-128

Bochsler, T.M., et al. (2013), Kallie Recognition of ramps and steps by people with low vision, PMID: 23221068

https://www.who.int/mediacentre/factsheets/fs311/ar / 2016. https://www.who.int/ar/news-room/fact-sheets/detail/blindness-and-visual-impairment.2018

Callisaya, M.L. et al (2010) Ageing and gait variability: A population-based study of older people. *Age and Ageing*, 39(2), 191-197

Campayo-Piernas, M., et al. (2017) Role of vision in sighted and blind soccer players in adapting to an unstable balance task. *Exp Brain Res*, 235(4): 1269-1279

Crowston, J.G., Loprinzi, P.D., & Ramulu, P.Y. (2018), Physical activity, visual impairment and eye disease, *Epub Ong*

Fricke, TR, et al. (2018), Global Prevalence of Presbyopia and Vision Impairment from Uncorrected Presbyopia: Systematic Review, Meta-analysis, and Modelling, *Ophthalmology*

Haeele, A., & Zhu, X. (2017), Experiences of individuals with visual impairments in integrated physical education: A retrospective study. *ResQ Exerc Sport*, PMID: (4)88: 425-435

Hallemans, A., et al (2010), Low vision affects dynamic stability of gait, *Gait Posture*, 32(4): 547-551. doi: 10.1016/j.gaitpost.2010.07.018.

http://www.visionaware.org/info/everyday-living/recreation-and-leisure/sports-and-exercise/exercise-5866/1235

Ismail, N. (2000). *The effect of rhythmic exercises on the visual performance and some psycho-physiological variables (anxiety/vestibular sense) and the positive effect on physical variables (balance/coordination Foreign and Online References*

Jayakody, O. et al. (2019), Gait Characteristics and Cognitive Decline: A Longitudinal Population-Based Study, *J Alzheimers Dis*. 71(s1): S5-S14

Jungwirth, I. (2006), Verbesserung Der Ballfuerung Durch Propriozeptionstraining Mit – MFT – Platten Bei Fussballspielern, Dplomarbeit, European Academy of health professionals, Hall in Tirol.

Kevinel & Deweave (1995) Developmental disabilities definitions and policies, in *Encyclopedia of Social Studies*, 19th ed., Washington: NASW press

Kwafha, T. & Abdul Aziz, O. (2003). *Introduction to Special Education*, 1st ed. Amman: Darul Masirah

Olin, C. & Rougier P (2009), As opposed to normal subjects, eyelid position does not interfere with postural behavior in blind subjects, *Neurophysiol Clin*. 39(6): 295-302

Onambélé, G.L. et al. (2008), Neuromuscular and balance responses to flywheel inertial versus weight training in older persons, *J Biomech*. 41(15): 3133-8

Ong, S.R. et al. (2018), Physical activity, visual impairment, and eye disease, doi: 10.1038/s41433-018-0081-8

Paillard, T, & Noé (2006), Effect of expertise and visual contribution on postural control in soccer, *Scand J Med Sci Sports*, 16(5): 345-348

Park, S.J., et al. (2015), Extent of Exacerbation of chronic conditions by visual impairment in terms of health-related quality of life, *JAMA Phthalmol*

Parreira RB, Grecco LAC, and Oliveira CS (2017) Postural control in blind individuals: A systematic review. *Gait Posture*, 57:161-167

Patel, S.K., Shende, M.L. & Khatri, S.M. (2013), MFT a new diagnostic tool to check the balance in normal healthy individuals, *Journal of Dental and Medical Sciences*, 5(6): 14-18

Rogow, S.M. (1988), *Helping the visually impaired child with developmental problems: Effective practice in home, school, and community*, New York: Teachers **College Press**

Ryad, O. (2005). *Disability Sports: Medical and Sports Basics*, Cairo: Dar Al-Fikr Al-Araby

Saleh, A.I. (2018). *Physical Education for Disability Challengers*, 1st ed., Cairo: Book center for publication.

Scheffer, A.C., et al. (2008) Fear of falling: measurement strategy, prevalence, risk factors and consequences among older persons. 37(1): 19–24

Schlenstedt, C., et al. (2015), Resistance versus balance training to improve postural control in Parkinson's Disease: A randomized rater blinded controlled study, *PLoS One*, 10(10): e01405842015

Schreiner, P. (2010), *Gleichgewicht der Schluessel zur Perfektion am Ball*, IFJ96, Deutschland, Gerd Thissen

Sozzi, S., et al. (2018), Balance in blind subjects: Cane and fingertip touch induce similar extend and promptness of stance stabilization, *Front Neurosci*, 12:6392018

Steib S., et al. (2017), Perturbation during treadmill training improves dynamic balance and gait in Parkinson's disease: A single blind randomized controlled pilot trial, *Neurorehabil Neural Repair*, 31(8): 758-768

Stones, M.J. & Kozma, A., (1987), Balance and age in the sighted and Blind, *Arch Phys Med Rehabil*

Whittle, M. W (2007), *Gait Analysis: An introduction*, 4th ed.