

GOALBALL AS A MECHANISM OF IMPROVEMENT OF PHYSICAL FITNESS FOR STUDENTS WHO ARE VISUAL IMPAIRED

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ABSTRACT

This study is to investigate the effect of goalball on general and specific physical fitness among visually-impaired students. A total of 30 participants (13 - 19 years old) consist of 15 males (B1: 5, B2: 8, B3: 2) and 15 females (B1: 6, B2: 8, B3: 1). There is a significant difference in the curl-up test between trial 1 (T1) and trial 2 (T2) on male (T1: 28.93 ± 15.70 , T2: 39.67 ± 24.95). There is no significant difference for females (T1: 28.20 ± 17.16 , T2: 27.80 ± 22.78). However, there is a significant difference among the male and the female on Isometric Push-up (T1: 38.73 ± 4.90 , T2: 39.73 ± 1.03) and female (37.27 ± 6.19 ; 37.80 ± 5.80), Sit and Reach for male, (T1: 23.10 ± 6.67 , T2: 25.10 ± 6.65) and the female, (T1: 25.33 ± 3.66 , T2: 26.93 ± 3.86), and handgrip strength for male (28.89 ± 6.23) and the female, (24.02 ± 4.25). While for the sound localization test, there is a significant difference in T1 between the classification group for males ($p < 0.05$) and no significant difference in T2 between classification ($p > 0.05$). For females, there were no significant differences in T1 and T2 between classifications ($p > 0.05$). In the spatial orientation test, there is no significant difference was observed between the classification of both genders in terms of T1 and T2 ($p > 0.050$). The present study suggests that goalball considered an effective option to improve physical fitness among persons with blind and visually impaired.

Key words: Physical fitness, sound localization, spatial orientation, visually-impaired, goalball

INTRODUCTION

Goalball is a Paralympics goal-type sport for visually impaired and blind people (Ikeda et al. 2019). Goalball is played by three players in each team. The use of the place is a standard gym with touch marks. Players can identify and know their position and direction that they will be facing. The physical object is a 3-pound goalball, the same as basketball. Furthermore, the bell inside it allows the player to listen and to detect it in depth (Bolach et.al., 2012). Çolak et.al., (2004) reported that goalball is an effective option to improve the motor skills of children with visually impaired but do not expect any miracle. Previous studies do mention about the benefit of goalball towards children with visually-impaired such as improving general fitness (Karakaya et.al., (2009); Çolak et. al., 2004), improving aerobic capacity (Gulick & Malone, 2011), improving postural stability (Aydoğ, et.al., (2006), assist in psychological strategy (Stamou et.al., 2007) and enhance to strengthen upper limbs by emphasizing throwing techniques (Bowerma et.al., (2011)). However, there are limited studies been conducted related to evaluating the game performance analysis towards enhancing physical fitness.

Generally, most children with visually impaired have lower levels of fitness, some of them possess the fitness level that is higher compared to their sighted peers (Caliskan et.al., (2007)). This been highlight by Short and Winnick (1986), and Houwen et.al., (2010) discover that persons with blind and visually impaired may have lower fitness compare to their sighted peers. Previous studies revealed that lack of visual acuity can cause many health-related problems such as reduce physical work, problems with the posture, difficulties to detect and recognize the location, space and implements, depressions and facing problems with balance. (Abolfotouh & Telmesani, 1993). They also reported that the lack of visual acuity can lead to low capacity of physical work, posture problems, difficulty in oriented teeth, depressions and problems with the calculations. Some of them, in daily activities, with a lack of eyesight can affect a person's vision is a different way in what they are doing. Among these conditions may have a little impact, while others may have a greater impact on daily living. It showed that 80% or more that children with blind are not at par following the health-related physical fitness components (Lieberman & McHugh, 2001).

PROBLEM STATEMENT

Previous studies have been executed to identify motor fitness and certain important aspects such as isokinetic strength, aerobic ability, body composition, postural stability, and static balance, throwing performance, and game performance in goalball players of different ages, sexes and skill levels (Goulart-Siqueira et al 2018). However, few studies are describing the physical fitness components of elite adult players. For instance, Gulick and Malone (2011) validated a field beep test for evaluating the aerobic capacity of Paralympic female athletes and showed a low aerobic capacity of these athletes. The visual impairment will give a negative effect especially on children. We can see most of them are poor motor skill development that influenced the lifestyle because limited by physical ability. When poor motor skills and limited movement, there will not be able to do too many activities and this will decrease the health and physical fitness. Limited functional abilities of children who are visually-impaired to perform daily activities and poor level fitness decrease opportunities to learn and improve their motor skills.

There is also limited study documented on the beneficial effect of training in Goalball on fitness. It is very important to have an excellent mechanism of physical fitness at the same time keep and improve adequate fitness levels to the optimal health of the athletes in Goalball in their regular physical activities. As an active athlete, the level of achievement in physical fitness is essential as when they play goalball, they can predict to know how far they have improved in physical fitness between them. However, this game also allows them to the movement that using limb upper body and lower body to execute such as attacking, with a ball to the opponent goal, catching a ball, even doing a block to survive and lay the whole body.

Given this important very little information on the physical fitness components of goalball players, this study been conducted a study with the objective is to investigate the effect of goalball on overall general and specific physical fitness among students with visually-impaired. Are there is a significant difference in overall general and specific physical fitness among the goalball players?

METHODOLOGY

Sample

This study will employ a purposive non-randomize sampling technique. A total of 30 participants consists of 15 males and 15 females (13-19 years old). The participants were divided into 3 groups for males: B1 (5), B2 (8) and B3 (2), whereas for the females, they also been divided into 3 groups: B1(6), B2(8), B3(1). The participants were selected based on they do not have other disorders or impairment except being visually impaired. The participants were informed of the study procedure, purposes and all gave their informed consent through their respective teacher, parents or guardians. Participants were classified into 3 categories according to the International Blind Sports Association (IBSA) classification rules 2018 as follows: B1- Visual acuity is less than LogMAR 2.60, B2- visual acuity ranges from LogMAR 1.50 to 2.60 (inclusive); and/or the visual field is constricted to a diameter of fewer than 10 degrees, B3 - visual acuity ranges from LogMAR 1 to 1.40 (inclusive); and/or the visual field is constricted to a diameter of fewer than 40 degrees. (IBSA 2018).

Instrumentation

The study uses several test protocol and procedures to evaluate the general fitness of the participants as below:

Test 1: Curl-up test was used to measure abdominal endurance, where this test requires subjects to perform as much according to their abilities. The participants should be lying on her back with their knees about 135 degrees or by comfort, soles of the feet should establish their presence to the floor. Both hands should be straight being placed on the floor and to also climber looks up above. The measuring strip is placed on the mat under the participant's legs so that their fingertips are just resting on the nearest edge of the measuring strip. The feet cannot be held or rest against an object. Keeping heels in contact with the mat, the participants curl up slowly, sliding their fingers across the measuring strip until the fingertips reach the other side, then curls back down until their head touches the mat. Movement should be smooth. The total number of the correct curl up action been recorded.

Test 2: Sit and reach test was used to measure back and hamstring flexibility, where participants have to sit on the floor. The shoes should be removed, soles of the feet are placed flat against the box and both knees should be locked and pressed flat to the floor. With the palms facing downwards, and the hands-on top of each other or side by side, the participant reaches forward along the measuring line as far as possible. Ensure that the hands remain at the same level, not one reaching further forward than the other. After some practice the participant reaches, reaches out and holds that position for one-two seconds while the distance is recorded. The nearest centimeter (cm) or half-inch was recorded as the performance.

Test 3: Isometric push-up test was used to measure upper limb endurance. Participants are required to hold in a push up position up to 40 seconds. The assistant is allowed to help put and ensure that the participant's body in the correct position but not allowed to help by holding the body from falling.

Test 4: The handgrip strength test was used to measure the grip strength of the participants. The only dominant hand will be measure and maximum handgrip force. Three attempts will be counted and recorded. Participants have to adjust their grip width by using the Dynamometer (Takei, Japan) to get a better grip. During the tests carried out, the position of the arm, the hand, and body position should standardize. The participant stands with shoulder adduct and neutrally rotate, elbow flexed at 90° resting on

the table surface and the forearm in neutral and wrist in 0–30° extension. The test is performing by squeezing calibrated hand dynamometer as forcefully as possible with the dominant hand. 3 trial on the dominant hand and the best score was recorded.

Test 5: Sound localization test is to test on hearing sensitivities and important in goalball. The participant will be in the starting position in the center of the goal line. Meanwhile, both ball medicine will be hung on the left and right of the goalpost and noted by the assistant. Next, the 3rd ball also was placed in the middle at a distance of 3 meters or 3 meters on the line. The ball will be driven or move in 5 times and the participant takes in the position of defensive position where the direction of the moving ball and locates it again. Task performance time and its correctness are evaluated. This test is also done while the participant wearing the opaque goggles. A quiet atmosphere is essential so that the participant can hear the ball while moving to focus and get a good result. The time is taken (minutes) to perform the task been recorded.

Test 6: Spatial orientation test is the ability to identify the location or origin of the detected in direction and identified a particular in goalball. The test was performed by the participant, in a position of crawling on the beginning and eyes closed using tease blindfold. The participant line should be at the beginning. Each line is already indicated by the string with tapes. After the "start" signal, the participant should be as fast as possible to find the third-meter line, and return to the starting line. Next, they will look for the six-meter line and again return to torch the starting line. The time is counted with a 0.1-second accuracy. The time is taken (minutes) to perform the task been recorded.

Procedures

The study was approved by the Ministry of Education, Malaysia and also the ethics committee of Faculty of Sports Science, Universiti Teknologi MARA, Shah Alam. The participants are grouped according to their gender and classification. The procedure and the procedure of the study are explained in detail to the participants. The teachers and assistants will help them in understanding the session. Consent with the medical sheet and profile score sheet was distributed and filled by the participants with the help from the teachers and the assistants. Participants in the B1 category been assisted by their friends from other categories that have better eye sighting. The warm-up and stretching session for 10-15 minutes were organized to the participants. Then the participants will be directed to each test station to understand more by listening to the explanation and watch the demonstration (for B1, been assisted by their friends). Allow more time and space for the participants to complete the tests and this to make sure it does not affect the result.

Data analysis

The IBM SPSS 24 software package was used for the statistical analyses. A descriptive statistic was used to describe the participants. The results are presented as means \pm SD and percentage.

RESULTS

Table 1: Descriptive Data of Goalball Participants

Variables	Male			Female		
Classification	B1(n=5)	B2(n=8)	B3(n=2)	B1(n=6)	B2(n=8)	B3(n=1)
Age (year)	16.20 \pm 0.83	16.25 \pm 1.90	14.50 \pm 2.12	16.17 \pm 2.04	14.25 \pm 1.38	14.00 \pm 0.00
Height (cm)	161.60 \pm 6.95	158.50 \pm 4.84	168.50 \pm 3.53	148.00 \pm 4.14	149.00 \pm 5.68	166.00 \pm 0.00
Weight(kg)	54.40 \pm 9.04	54.50 \pm 18.43	53.00 \pm 7.07	43.00 \pm 6.89	47.93 \pm 11.98	48.00 \pm 0.00

Table 1 shows the mean \pm SD for age shows the male participants for group B1: 16.20 \pm 0.83, B2: 16.25 \pm 1.90, B3: 14.50 \pm 2.12 and the female participants for group B1: 16.17 \pm 2.04, B2: 14.25 \pm 1.38, B3: 14.00 \pm 0.00. For height, it shows the male participants for group B1: 161.60 \pm 6.95, B2: 158.50 \pm 4.84, B3: 168.50 \pm 3.53 and the female participants for group B1: 148.00 \pm 4.14, B2: 149.00 \pm 5.68, B3: 166.00 \pm 0.00. Mean \pm SD for weight also showed the male participants' group B1: 54.40 \pm 9.04, B2: 54.50 \pm 18.43, B3: 53.00 \pm 7.07 and the female participants' group B1: 43.00 \pm 6.89, B2: 47.93 \pm 11.98, B3: 48.00 \pm 0.00.

Table 2: Descriptive Data of Goalball Participants in General Physical Fitness.

Class	n	Mean ± SD		Isometric Push-Up		Sit and Reach		HandGrip (Max)	
		Curl-Up		T1		T2			
		T1	T2	T1	T2	T1	T2		
Male									
B1	5	18.20±18.39	24.00±22.47	36.20±8.49	39.20±1.78	23.10±6.67	25.10±6.65	26.39±3.54	
B2	8	31.00±9.89	43.75±23.86	40.00±0.00	40.00±0.00	22.125±7.49	23.563±7.83	29.95±7.41	
B3	2	47.50±10.60	62.50±17.67	40.00±0.00	40.00±0.00	25.75±0.35	28.00±2.12	30.90±7.77	
Total	15	28.93±15.70	39.67±24.95	38.73±4.90	39.73±1.03	22.933±6.50	24.667±6.78	28.89±6.23	
Female									
B1	6	20.67±15.04	14.83±8.75	37.00±7.34	37.17±6.94	25.33±3.66	26.93±3.86	23.73±4.06	
B2	8	33.00±18.60	32.25±23.72	37.13±6.08	38.00±5.65	20.73±8.49	21.66±8.68	23.69±4.62	
B3	1	35.00±0.00	70.00±0.00	40.00±0.00	40.00±0.00	30.00±0.00	30.00±0.00	28.40±0.00	
Total	15	28.20±17.16	27.80±22.78	37.27±6.19	37.80±5.80	23.19±7.04	24.32±7.23	24.02±4.25	

Table 2 shows the overall performance of the participants on general physical fitness. It includes male and female participants for categories (B1, B2 and B3). The test was with 2 trials namely trial 1 (T1) and trial 2 (T2) by the participants with mean ± SD. The handgrip strength test was performed 3 times and the maximum achievement was recorded.

Table 3: Difference of Special Fitness Test among Groups of Visually Impaired Participants.

Sound Localization

Gender		Classification	Mean rank	X ²	df	P-value
Male	Trial 1	B1 (n=5)	13.00			
		B2 (n=8)	5.50	9.43	2	0.009
		B3 (n=2)	5.50			
	Trial 2	B1 (n=5)	11.60			
		B2 (n=8)	6.00	4.95	2	0.840
		B3 (n=2)	7.00			
Female	Trial 1	B1 (n=6)	8.67			
		B2 (n=8)	7.56	0.22	2	0.894
		B3 (n=1)	7.50			
	Trial 2	B1 (n=6)	9.00			
		B2 (n=8)	8.00	2.11	2	0.349
		B3 (n=1)	2.00			

Spatial Orientation

Gender		Classification	Mean rank	X ²	df	P-value
Male	Trial 1	B1 (n=5)	8.40			
		B2 (n=8)	7.88	0.71	2	0.965
		B3 (n=2)	7.50			
	Trial 2	B1 (n=5)	7.80			
		B2 (n=8)	7.63	0.47	2	0.792
		B3 (n=2)	10.00			
Female	Trial 1	B1 (n=6)	10.17			
		B2 (n=8)	6.63	2.64	2	0.307
		B3 (n=1)	6.00			
	Trial 2	B1 (n=6)	10.50			
		B2 (n=8)	6.13	3.82	2	0.194
		B3 (n=1)	8.00			

Table 3 shows the performance of participants on special physical fitness. It shows that the changes in the time taken by the male participants (B1: 5, B2: 8, B3: 2) and the female participants (B1: 6, B2: 8, B3: 1) on both test and between trial. For sound localization test, mean \pm SD for the male participants (T1: 1.05 ± 0.40 , T2: 0.70 ± 0.32) and the female participants (T1: 1.06 ± 0.29 , T2: 0.92 ± 0.31). In spatial orientation test, the male participants recorded (T1: 30.53 ± 6.93 , T2: 24.90 ± 0.68) and for the female participants recorded (T1: 32.10 ± 4.08 , T2: 28.90 ± 3.50).

There was a significant difference among the male participants on sound localization test df (2) = 9.43, p = 0.009 with a mean rank T1 score of 13.00 for B1, 5.50 for B2 and 7.00 for B3. There were no significant differences among the male participants' df (2) = 4.95, p = 0.84, with a mean rank T2 score of 11.60 for B1, 6.00 for B2 and 7.00 for B3, meanwhile, there were no significant differences among the female participants' df (2) = 0.22, p = 0.894 with a mean rank T1 8.67 for B1, 7.56 for B2 and 7.50 for B3. There was also no significant difference among the female participants' df (2) = 2.11, p = 0.349 with a mean rank T2 score of 9.00 for B1, 8.00 for B2 and 2.00 for B3.

There was no statistically significant difference among the male participants on spatial orientation test df (2) = 0.71, p = 0.965 with a mean rank T1 score of 8.40 for B1, 7.88 for B2 and 7.50 for B3. There was no significant difference among the male participants' df (2) = 0.47, p = 0.792 with a mean rank T2 score of 7.80 for B1, 7.63 for B2 and 10.00 for B3. There was also no significant difference among the female participants, df (2) = 2.64, p = 0.307 with a mean rank T1 score of 10.17 for B1, 6.63 for B2 and 6.00 for B3. There was no significant difference among the female participants' df (2) = 3.82, p = 0.194 with a mean rank T2 score of 10.50 for B1, 6.13 for B2 and 8.00 for B3.

DISCUSSION

To the best of our knowledge, this is one of the several studies that focus on evaluating different physical tests in the field regarding goalball athletes of one or both sexes. Findings from the current study could serve as reference values for further evaluation and monitoring the level of fitness of goalball players (Goulart-Siqueira et al 2018).

The curl-up test is to measure abdominal strength and endurance where it gives strength in back support and core muscle. The results obtained in the present study revealed that there is a decrement in T2. This finding contributes to the factor that some of the subjects are less determined to do their best. The male participants showed more determination and this can have been seen as the male participant achieve a higher score than the female participants. This is because of the encouragement given by the assistant to be more enthusiastic and achieving more scores than T1. This may have a significant impact on the score obtained because they are very active. By performing movements that require core muscles like abdominal, it should have a durable core endurance that is not easy to fatigue for a short period. Based on the past study by Eveland *et. al.*, (2009), there is a significant positive correlation ($r = .20$) observed on muscular fitness (the combination of sit-and-reach and curl-up). This results in inconsistent with Sekendiz *et.al.*, (2007) findings. They revealed that there is a significant interaction effect for group and measurements indicating that there was a significant difference between pre-test and post-test of endurance only for the exercise group.

The sit and reach test is to measure the flexibility of the lower back and hamstring muscles. Stodden *et. al.*, (2009), shows that 51% of men and 61% of women achieved equal to or greater than average. Kendall *et. al.*, (1982) use sit and reach test for trunk-curved sit-up and lowering test. They revealed that there is no significant correlation was found on the leg lowering test and either of the two sit-up tests. The study indicates this leg lowering test appears to provide lower scores. Wells and Dillon (1952) reported that this test is now widely used as a test for flexibility. Based on the current study, indicate that it was recorded an increment by both the male and the female participants for trial 2 compared to trial 1. There was a significant difference between the participants and this is because they use to exhibit movement patterns that increase their range of motion. Flexibility is very important for a goalball player because this sport involves athletes using the upper, lower body and core muscles to make attacking and lying down in a defensive position. However, for those who have a more fat bound body, it is difficult for them to perform the task but show a significant difference. Furthermore, those who possess congenital defects but are active can have the same level of physical fitness, lung function and explosive leg strength as active as their sighted peers (Singh & Singh, 1993). The study also reported that playing goalball has a tremendous impact on the participant's level of fitness. Therefore, the characteristics of this sport assist in increasing the level of flexibility of the upper limb. The current study consistently in line with the study by Lieberman *et.al.*, (2010) revealed that the male percentage score is higher in sit and reach test compare to the female.

The Isometric push-up test uses to measure upper body strength without the use of the resistance of own bodyweight. Target muscles are the chest and abs, triceps, back and middle back. This isometric push-up test has many different types which are better known as push-ups, as well as one of the fitness tests used by authors, coaches, trainers and athletes to assess upper body fitness and to monitor progress during strength and fitness training. The current study shows that the male and female participants improved on T2. Not many studies have been done on isometric push up tests to compare the result with the past study.

The handgrip strength is important for sports that involve catching, throwing or lifting. It can be influenced by several factors including age, sex, posture, forearm, wrist and more (España-Romero *et. al.* 2008). Generally, those with a strong grip tend to be strong overall, so this test is often used as a general test of strength. The current study shows the male participants are stronger than the female participants. The data was obtained on the dominant hand because of the usage of the hand, while playing regardless of any sport. Furthermore, the dominant hand would certainly be stronger than non-dominant hands and it can also be reinforced with a handgrip test (Bolek, 1982). A previous study by Atan and Ayca, (2015) on 38 visually impaired male students,

shows no statistically significant difference was observed between two groups in terms of an initial (right hand, $p < 0.05$) and (left hand, $p < 0.05$). After the three-month of training, the right-hand grip strength values in the exercise group were found statistically higher than those in the control group ($p < 0.05$). A comparison of two measurements revealed a statistically significant difference in favor of the post-test ($p > 0.05$). After the three-month of training, no statistically significant difference was observed between two groups (Left hand, $p > 0.05$). Players try to score goals using the ball similar to basketball. This might be the reason for the higher grip strength in the goalball players.

The findings on the current study on spatial orientation and sound localization show good results among the male and female participants. This is consistent with the previous study by Krzak *et al.* (2015), which shows that the spatial orientation and sound localization tests showed better results in the goalball group compared to the control group ($p < 0.001$). The time recorded for spatial orientation test performance and sound localization test performance was significantly shorter than in the control group. Additionally, it is also worth noting that subjects with a good physical fitness level or experience in goalball sports also affect the results. This test has its advantages as it can test skills relate to fitness skills to goalball players. There is some problem occur in terms of reference regarding these two special tests since very limited literature and journals. While comparison with other sports is challenging and maybe unnecessary due to several technical and tactical differences (Link *et al.* 2018), further studies should verify the best physical and technical training protocols to improve these abilities.

CONCLUSION

It has been justifying that the game of goalball does possess evident in personal and social benefits. Persons with the blind and visually impaired show can play the sport to assist them in enhancing their level of fitness and special features. Goalball is a game for the blind and present results support strongly emphasize enhancing motor skills for persons with blind and visually impaired. But more studies need to be conducted especially on other aspects of goalball such as throwing ability because of it very important in training young athletes in goalball.

PRACTICAL IMPLICATIONS

Goalball is a fast-growing game globally. Those persons with visually-impaired can engage with goalball and show their potential talent to represent states or countries at the international scene. The coach who deals with goalball needs to have some knowledge of dealing with persons with visually-impaired so that it will make it easier for them to train the athletes.

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