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Original Article

Fitness level of deaf students compared to hearing students in Jordan

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Abstract:
This study assessed the fitness level of 10-13 year-old deaf students in Jordan. 75 hearing males (mean ± SD, 11.0 ± 0.6 y; 144 ± 7.0 cm; 37.6 ± 9.0 kg), 73 hearing females (mean ± SD, 11.3 ± 0.7 y; 147 ± 9.0 cm; 36.2 ± 10.6 kg), 49 deaf males (mean ± SD, 12.0 ± 1.6 y; 146 ± 11.0 cm; 36.4 ± 7.9 kg) and 31 deaf females (mean ± SD, 11.2 ± 1.7 y; 144 ± 12.0 cm; 40.6 ± 11.7 kg) volunteered for study. Students performed five tests (Push-Up, Sit-Up, Sit and Reach, 4 x 10m Shuttle-Run and 1 Mile-Run). Males performed better in all the tests, with the exception of the Sit and Reach test. Hearing students performed better in Push-Up, Sit-Up and 1 Mile-Run tests than deaf students. Hearing females performed better in 4 x 10m Shuttle-Run than deaf females (13.44 ± 0.76 vs. 14.42 ± 1.25). However, deaf students performed better in Sit and Reach test than hearing students (23.9 ± 6.2 vs. 22.5 ± 6.3). We concluded that deaf students should exercise more and should be included in ordinary schools to benefit of the exercise programmes in these schools; especially as deaf students can perform equally to hearing students if given the chance.
Key words: Deaf, Push-up, Sit-up, Sit and Reach, Shuttle-run, 1 Mile-run.

Introduction

Physical fitness is the ability to perform daily activities with vitality and having less chance of developing chronic diseases (Jackson et al., 1990; Bouchard et al., 2007; American College of Sports Medicine (ACSM), 2010). Physical fitness may be considered to involve two components: *health-related fitness* which includes body composition, cardiorespiratory fitness, muscular endurance, strength and flexibility and *skill-related fitness* which includes agility, reaction time, speed, power and balance (Jackson et al., 1990; Bouchard et al., 2007; ACSM, 2010). It has been indicated that sedentary individuals have higher chances for developing inactive-related diseases such as cardiovascular diseases, obesity, type 2 diabetes and hypertension (Bouchard et al., 2007; Wilmore et al., 2008; ACSM, 2010), which given the relationship between activity and fitness in children (Rowlands et al., 1998), infers that a higher the level of physical fitness may lower the opportunity for developing these diseases.

It has been indicated that children with disabilities (i.e., hearing impairment, visual impairment, physical disability and chronic medical) are less active and have a low fitness level (Longmuir and Bar-Or, 1994; Longmuir and Bar-Or, 2000). The results of the study by Longmuir and Bar-Or (2000) showed that youth with hearing impairment are the most active group compared to youths with other disabilities. However, it has been indicated that children with hearing impairment have higher percent of body fat than their hearing peers (Winnick and Short, 1986; Shephard et al., 1987; Goodman and Hopper, 1992). It has also been indicated that the fitness level of hearing impaired youths were lower compared to their hearing counterparts in some components of fitness such as strength (Sit-Up), grip strength and balance (Campbell 1983; Winnick and Short, 1986; Goodman and Hopper, 1992).

Therefore, the aim of this study was to assess the physical fitness level of deaf students in Jordan compared to their hearing counterparts and whether gender affected these findings. As most deaf students in Jordan study in specialized schools for deaf individuals, we hypothesized that the physical fitness level of deaf students would be lower compared to their hearing counterparts, regardless of gender.

Method

Participants

Seventy five hearing male students (mean ± SD, 11.0 ± 0.6 y; 144 ± 7.0 cm; 37.6 ± 9.0 kg), 73 hearing female students (mean ± SD, 11.3 ± 0.7 y; 147 ± 9.0 cm; 36.2 ± 10.6 kg), 49 deaf male students (mean ± SD, 12.0 ± 1.6 y; 146 ± 11.0 cm; 36.4 ± 7.9 kg) and 31 female deaf students (mean ± SD, 11.2 ± 1.7 y; 144 ± 12.0 cm; 40.6 ± 11.7 kg) volunteered to take part in the study. Inclusion criteria for hearing students were: 1, age of

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10-13 years old; 2, healthy and do not have diseases; 3, not used to the exercise tests which performed in the study (i.e., Push-Up, Sit-Up, 4 X 10m Shuttle Run, Sit and Reach and 1 Mile Run); 4, providing parents signed informed consent. Inclusion criteria for deaf students were the same alongside that they do not have other disabilities accompany their deafness. Hearing students were recruited from ordinary-governmental schools. Deaf students were recruited from specialized schools for deaf students. Deafness means a severe to profound hearing loss which does not allow the person to use the remaining hearing for communication and processing information even with using augmentation devices (Ellis and Karasinski, 2009; Lieberman, 2011). This study was conducted with ethics approval from the Faculty of Physical Education at the University of Jordan.

Procedures

Each student (hearing and deaf) completed five exercise tests. On the first day, all basic and anthropometric measurements were taken (age, height and weight) and parents signed informed consent. On the second day, students performed four exercise tests (i.e., Push-Up, Sit-Up, 4 X 10m Shuttle-Run and Sit and Reach) conducted in the schools and in random order. On the third and the last day, students performed an endurance exercise test (1 Mile-Run (1609m)). This was performed on a separate and last day of testing in order not to affect the results of the other exercise tests. The 1 Mile-Run exercise test was performed at the track of the Faculty of Physical Education at the University of Jordan in order to standardize the distance (1609 m). Each student ran 4 laps and 9 meters. Students were told to avoid any vigorous exercise (with the exception of the previous day's testing) during the 48 hours prior to the exercise tests and before the endurance exercise test. Proper warming up and stretching exercises were performed by all the students before each exercise test.

Exercise tests

Each student (hearing and deaf) performed five exercise tests. In the second day students performed 4 exercise tests in a random order. These exercise tests are:

1. Push-Up test:

The aim of this exercise test is to measure strength and muscular endurance for the upper back and the upper arm muscles. Students were told to lie prone, with arms at shoulder width or a little bit wider, the palm of the hands facing forward, feet close together and look forward. At the start students were told to extend their arms fully (180° in the elbows' joints) while keeping the body in the straight position and to flex the elbows until the upper arm was parallel with the floor (90° in the elbows' joints). This was counted as one repetition. Students were told to do as many repetitions as possible in one minute (60 seconds). Hearing students were verbally encouraged and deaf students were encouraged using sign language and body language. Only precise repetitions were counted. The exercise test was terminated if any part of the students' body touched the floor except the feet and the palms of the hand or if the 1 minute duration was finished. A stopwatch (S1XL (BK)) was used to count and control the time. For normal students a verbal order was given for the starting point (ready and go). For deaf students a flag was used to give them the starting point by swinging the flag in front of them. The researchers demonstrated the exercise test in front of the students, until the students were totally satisfied that they could perform the test.

2. Sit-Up test:

The aim of this test is to measure strength and muscular endurance of the abdominal muscles. Students were told to lie on their back, put their arms in a cross position on the chest, put their feet on the floor and to bend their knees. The distance between the heel of the feet and the buttocks for all students was around 30 cm. The feet of the performer student were anchored by another student. At the start, students we told to curl up to touch their knees by the elbows and lie down on their back (starting position). This was counted as one repetition. Students were told to do as many repetitions as possible in one minute (60 seconds) and verbal encouragement was offered for hearing students. Deaf students were encouraged using sign language and body language. Only precise repetitions were counted. For example, if the students moved his/her arms from the crossing position this repetition was not counted. Also if the elbows did not touch the knees this was not counted. The test was terminated after 1 min. A stopwatch (S1XL (BK)) was used to count and control the time. For hearing students a verbal order was given for the starting point (ready and go). For deaf students a flag was used to give them the starting point by swinging the flag in front of them. The students performed the Sit-Up exercise test on a mat (200 x 100 x 4 cm). Before the exercise test was started the researchers performed the exercise test in front of the students until the students were confident that they could perform the test.

3. Sit and Reach test:

The aim of this exercise test is to measure flexibility (i.e., the range of motion in a specific joint) of the lower back and the hamstring muscles (Kirkendall et al., 1987). A box with the measurement scale was placed on the floor against a wall. The 23 cm mark on the measurement scale was level with the student's feet. Students were told to remove shoes before the test and place their feet against the box. Students were not allowed to flex their knees. Another student was told to press the knees against the floor for the student who was performing the exercise test in order not to flex the knees. Students were told to place one hand on the top of the other hand and to face the palms of the hands down, bend forward and reach as far as possible toward the 23 cm mark. Students were given three attempts and to hold the hands in the farthest position for 1 second. Hearing students were verbally encouraged and deaf students were encouraged using sign language and body language. The students performed the Sit and Reach exercise test on a mat (200 x 100 x 4 cm) which was placed underneath the box. Before the exercise test was started the researchers performed the exercise test in front of the students until the students were totally satisfied that they could perform the test.

4. 4 X 10m Shuttle-Run test

The aim of this exercise test is to measure speed and agility. Two lines were drawn on the ground 10 meters apart. The width of these lines was 1 meter. Two blocks of wood (5 x 5 x 10 cm) were put behind one of these lines. The students were told to run from the starting line to get one of the two blocks and put it behind the starting line and run back to get the second block and run through the starting line. Students had the chance to run in sport shoes or run barefoot. The students were told to finish this distance as quick as possible. Verbal encouragement was given to normal students. Deaf students were encouraged using sign language and body language. If the student threw the first block, he/she was asked to do the exercise test again. If the block fell down from the student while running he/she was asked to do the exercise test again. Two stopwatches (S1XL (BK)) were used and the average time of the two stopwatches was recorded. Time was recorded in seconds and milliseconds. Before the exercise test was started the researchers performed the exercise test in front of the students until the students were totally satisfied that they could perform the test.

5. 1 Mile-Run test:

The aim of this exercise test is to measure cardiorespiratory fitness. This exercise test was performed on the last day in order not to affect the results of the other exercise tests. This exercise test was performed at the track of the Faculty of Physical Education at the University of Jordan. The distance of the track is 400 meters. Therefore, students had to run 4 laps and 9 meters. The students started running 9 meters before the starting line. The students ran in groups of 10 students. The researchers and Bachelor students who were registered in the Special Physical Education Course counted the laps. Stopwatches (S1XL (BK)) were used to count and control the time. Hearing students were verbally encouraged to finish the distance as quickly as possible and were told about the distance that had elapsed. Deaf students were encouraged to finish the distance as quick as possible using sign language and body language and were told about the distance that had elapsed using sign language.

Data analysis

A series of two factor ANOVAs (Group; hearing students and deaf students x Gender; male and female) were used to assess whether there was a significant difference in these exercise tests between hearing students and deaf students and between male and female and whether performance on the various tests moderated by gender (Field, 2009). Alpha was set at P 0.05. Data were analyzed using Statistical Package for Social Sciences (SPSS) for Windows, PC software, version 16.

Results

Table 1: Shows the results of the five exercise tests for both hearing students and deaf students (i.e., Push-Up, Sit-Up, Sit and Reach, 4 x 10m Shuttle-Run and 1 Mile Run). Values are (Mean ± SD).

Student/Exercise test	Push-Up	Sit-Up	Sit & reach (cm)	Shuttle-Run (s)	1 Mile-Run (min.s)
Hearing male students	16.1 ± 10.2*°	37.0 ± 9.9°	21.6 ± 6.6	12.92 ± 0.86*	9.38 ± 1.29*°
Hearing female students	12.9 ± 7.8°	39.3 ± 7.8°	23.4 ± 5.9*	13.44 ± 0.76	11.36 ± 1.38
Deaf male students	14.7 ± 7.2*	28.5 ± 11.3	22.7 ± 7.0°	12.88 ± 1.07*°	10.13 ± 2.13*°
Deaf female students	7.8 ± 5.3	24.3 ± 9.8	25.8 ± 4.1*°	14.42 ± 1.25	12.53 ± 1.58

* Significant difference between male students and female students
° Significant difference between normal students and deaf students

Push-Up Test

Two way ANOVA showed that males performed better in the Push-Up exercise test compared to their female counterparts ($F_{(1,224)} = 18.63$, $P < 0.05$). It also showed that hearing students performed better in the Push-Up exercise test compared to their deaf counterparts ($F_{(1,224)} = 7.63$, $P < 0.05$). There was no significant group x gender interaction on the Push-Up results ($F_{(1,224)} = 2.48$, $P > 0.05$). (Table 1)

Sit-Up Test

Two way ANOVA showed that hearing students performed better in the Sit-Up test compared to their deaf counterparts ($F_{(1,224)} = 75.22$, $P < 0.05$). There was no significant difference between male and female in the Sit-Up exercise test ($F_{(1,224)} = 0.53$, $P > 0.05$). There was a significant interaction between group x gender on the Sit-Up results ($F_{(1,224)} = 5.83$, $P > 0.05$). Post hoc analysis using independent-sample t-test with Bonferroni adjustment ($P = 0.0125$) showed that deaf male students performed better than deaf female students in the Sit-Up exercise test ($P = 0.088$).
(Table 1)

Sit and Reach Test

Two way ANOVA showed that deaf students performed better in the Sit and Reach exercise test compared to their hearing counterparts ($F_{(1,224)} = 4.09$, $P < 0.05$). Two way ANOVA showed that females performed better in the Sit and Reach test compared to the males ($F_{(1,224)} = 7.98$, $P < 0.05$). There was no significant group x gender interaction for the Sit and Reach exercise test results ($F_{(1,224)} = 0.67$, $P > 0.05$). (Table 1)

Shuttle Run Test

Two way ANOVA showed that males performed better in the 4 x 10m Shuttle-Run exercise test compared to their female counterparts ($F_{(1,224)} = 59.60$, $P < 0.05$). Two way ANOVA showed that hearing students performed better in the 4 x 10m Shuttle-Run exercise test compared to their deaf counterparts ($F_{(1,224)} = 12.38$, $P < 0.05$). There was a significant group x gender interaction for the 4 x 10m Shuttle-Run results ($F_{(1,224)} = 14.98$, $P < 0.05$). Post hoc analysis using independent-sample t-test with Bonferroni adjustment ($P = 0.0125$) showed that hearing female students performed better than deaf female students in the Shuttle-Run test ($P = 0.000$). (Table 1)

1 Mile Run Test

Two way ANOVA showed that males performed better in the 1 Mile-Run exercise test compared to their female counterparts ($F_{(1,224)} = 85.17$, $P < 0.05$). Two way ANOVA showed that hearing students performed better in the 1 Mile-Run exercise test compared to their deaf counterparts ($F_{(1,224)} = 13.98$, $P < 0.05$). There was no significant group x gender interaction for the 1 Mile-Run exercise test results ($F_{(1,224)} = 2.07$, $P > 0.05$). (Table 1)

Discussion

This is the first study in Jordan to compare physical fitness of deaf students to their hearing counterparts. Hearing students performed better than deaf students in the Sit-Up exercise test. These findings are in agreement with Campbell (1983) and Winnick and Short (1986), who observed that hearing subjects performed better in the Sit-Up exercise test than hearing-impaired and deaf subjects. However, Pender and Patterson (1982) did not observe a significant difference in Sit-Ups between hearing subjects and their hearing-impaired peers.

Hearing students outperformed deaf students in the 1 Mile-Run exercise test, which is in agreement with the findings of Bressett (1971) and Campbell (1983). They reported better endurance abilities for hearing subjects compared to hearing-impaired peers. In contrast, Pender and Patterson (1982) reported better cardiorespiratory endurance in deaf students compared to hearing students. Hearing students performed better in the Push-Up exercise test than deaf students. Bressett (1971) and Campbell (1983) also reported better leg strength for hearing students than deaf subjects. Similarly, Goodman and Hopper (1992) reported better grip strength for hearing subjects compared to deaf peers.

Hearing female students performed better in 4x10m Shuttle-Run exercise test than deaf female students, which is in agreement with the observations of Campbell (1983). Our findings of better performance in the 4x 10m shuttle run test for deaf male students, than their hearing male peers are in agreement with Pender and Patterson (1982) who also observed better agility performance for deaf subjects. However, our findings of better performance in the Sit and Reach exercise test for deaf students are in contrast with Winnick and Short, (1986). In their study, hearing female students were more flexible than their deaf peers. The flexibility findings in this study are in agreement with Wiegersma and Van Der Velde (1983) and are not surprising as the Sit and Reach exercise test is not affected by visual and vestibular disorientation of hearing impairment and deaf subjects (Winnick and Short, 1986; Goodman and Hopper, 1992).

It is well established that hearing students have better balance than hearing-impaired and deaf students (Pender and Patterson, 1982; Campbell 1983; Wiegersma and Van Der Velde, 1983; Goodman and Hopper, 1992). In the current study balance was not measured. Therefore, we cannot exclude the effect of balance on Sit-Up, Push-Up and 1 Mile-Run. As these exercise tests can be affected by visual and vestibular disorientation which in turn will affect balance (Winnick and Short, 1986).

With the exception of the flexibility measurement, the lower physical fitness of deaf students compared to their hearing peers is not surprising, as most of deaf students in Jordan study at special schools for deaf students. This in turn will limit opportunities to benefit from exercise programmes offered to hearing students in the ordinary-governmental schools. The second potential interpretation for these differences is that sign language is not very well known by the public in Jordan. This will in turn make it more difficult for hearing instructors to work with deaf students. In fact, one of the schools from which we recruited some deaf participants for the study, did not have a physical education teacher or indeed a teacher who is familiar with sign language was delivering the physical education classes. Furthermore, in most deaf schools, physical education classes are delivered by deaf instructors and these instructors may be less likely to learn new techniques in physical activity and training compared to hearing instructors due to the sign language limitation.

Conclusions

Physical fitness of deaf students was significantly lower compared to their hearing counterparts in the Push-Up, Sit-Up and 1 Mile-Run exercise tests. The results also revealed that hearing female students performed better in the 4 x 10m Shuttle-Run exercise test compared to their deaf female students. However, the results showed that deaf students performed better than hearing students in the Sit and Reach exercise test. Therefore, based on these findings we strongly recommend that deaf students in Jordan in the age of 10 – 13 years old to be more active during their life. Being more active will be reflected in higher level of physical fitness and this should in turn be reflected by a lowering of inactive-related diseases, such as obesity, type 2 diabetes, cardiac diseases, hypertension and dyslipidemia. Given that deaf students may perform equally to hearing students if given the chance (Lieberman et al., 2004; Lieberman, 2011), we also recommend that deaf students be included in normal/ordinary schools to benefit from enhanced quality of physical education in these schools.

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