Physical fitness of deaf females

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Summary

Study aim: The aim of the study was to examine the differences in physical fitness between deaf female soccer players and their deaf peers who did not practise any sport.

Material and methods: The research involved 13 deaf female soccer players and 16 deaf untrained girls. Physical fitness was assessed by a jump test and the Eurofit test. In the jump test, each participant performed an akimbo counter-movement jump (ACMJ), a counter-movement jump (CMJ) and a spike jump (SPJ) on a force plate. The following trials of the Eurofit test were performed: flexibility – sit-and-reach; static strength – hand grip; functional strength – bent arm hang (arm and shoulder muscular endurance); explosive strength – standing broad jump; and trunk strength – sit-ups (abdominal muscular endurance).

Results: Soccer players jumped significantly higher than untrained females in the ACMJ, CMJ, and SPJ, and developed significantly higher power of the CMJ. Relative power developed in the ACMJ and SPJ did not differ between the examined groups. Soccer players were physically fitter than girls who did not play any sport. Significant differences between the groups were observed for all measured trials except for the bent arm hang.

Conclusions: Hearing loss does not significantly determine the physical development or physical fitness of deaf people. Playing sports improves the physical fitness of deaf people in comparison with untrained deaf people.

Key words: Hearing impairment – Soccer players – Jump – Power – Eurofit test

Introduction

Nearly 900,000 people have been estimated to suffer from hearing problems in Poland. In the literature, most studies concern a comparison of physical fitness of deaf people and their hearing peers [10, 17, 21].

While the English-language literature relating to deaf people is very rich [13], the same cannot be stated with reference to publications by Polish authors. Scientific reports have most often concerned people aged 3–19 years, especially those aged 6–16 years, and the assessed parameters have been anthropometric characteristics, ability to maintain balance, motor characteristics, and quality of life [11, 13]. Research proves that deaf children of both sexes are less physically fit than their hearing peers in terms of static and dynamic balance, coordination, speed of movement, strength and power, spirometric parameters, and quality of life [7, 8, 18, 21]. In several studies, no significant differences between deaf and hearing girls were found [5, 10, 11]. The analysis of available literature has

shown that there are very few publications regarding deaf people aged 16–25 years or deaf athletes [12, 17]. Moreover, there are no studies comparing deaf people practising and not practising sport.

The aim of the present study was to examine the differences in physical fitness between deaf female soccer players and their deaf peers who did not practise any sport.

Material and methods

The study was approved by the Bioethics Committee of Collegium Medicum of the Nicolaus Copernicus University in Toruń, Poland (No. KB 330/2014). Each participant (or their legal guardian in the case of underage participants) provided their written informed consent and was informed about the study procedure. The study was performed in accordance with the Declaration of Helsinki. The inclusion criteria required the participants not to have suffered from any limb or spinal injury for 3 months prior to the study.

The research involved 13 deaf female soccer players (age: 23.6 ± 4.3 years; body mass: 62.6 ± 8.4 kg; body height: 164.2 ± 4.2 cm) and 16 deaf girls who did not play any sport (age: 17.9 ± 2.8 years; body mass: 56.3 ± 10.0 kg; body height: 161.3 ± 6.3 cm).

Physical fitness was assessed by a jump test and the Eurofit test.

The power of lower extremities and the height of the rise of the centre of body mass (COM) during vertical jumps were measured using a force plate (JBA Zb. Staniak, Poland). The MVJ v. 3.4 software package (JBA Zb. Staniak, Poland) was applied in the assessments [2]. Absolute peak power ($P_{\max}$ [W]), relative peak power ($P_{\max} \cdot \text{mass}^{-1}$ [$\text{W} \cdot \text{kg}^{-1}$]), and maximum height of rise of the body COM (h [m]) were calculated from the recorded ground reaction force of the platform [4]. Each participant performed 9 vertical jumps on the force plate, 3 jumps of each kind. The characteristics of each jumping test were as follows:

- akimbo counter-movement jump (ACMJ): a vertical jump from an upright standing position with hands on the hips and a counter-movement of the COM before the take-off;
- counter-movement jump (CMJ): a vertical jump from a standing erect position, preceded by an arm swing and a counter-movement of the body COM before the take-off;
- spike jump (SPJ): a vertical jump performed with a 3–4-step run-up before the take-off; the participant's task was to take off and land on the platform.

The participants were asked to jump as high as possible in each trial. There were 5-second breaks between each ACMJ and CMJ and 1-minute breaks between the

SPJs. There was also a 1-minute break between each series of jumps. The jump with the highest elevation of the body COM was chosen for statistical analysis.

Motor development was evaluated using selected tests of the Eurofit European Physical Fitness Test for children and youth aged 6–18 years [1, 3, 15]. The following trials of the Eurofit test were performed: flexibility – sit-and-reach (SAR) (reaching forward as far as possible from a seated position); static strength – hand grip (HGR); functional strength – bent arm hang (BAH) (arm and shoulder muscular endurance); explosive strength – standing broad jump (SBJ); and trunk strength – sit-ups (SUP) (abdominal muscular endurance).

The analysis of variance (one-way ANOVA) was used to compare the study results. The significance of differences between means was evaluated post hoc with the Scheffé test. The level of statistical significance was set at $p = 0.05$. All computations were performed with the Statistica software (v. 13.0, StatSoft, USA).

Results

The results of the jump tests are shown in Table 1. Soccer players jumped significantly higher than untrained females in the ACMJ, CMJ, and SPJ, and developed significantly higher power of the CMJ. The relative power developed in the ACMJ and SPJ or the maximal power output in the SPJ did not differ between the examined groups.

The obtained results of the Eurofit test are presented in Table 2. Soccer players were more physically fit than girls who did not play any sport. Significant differences

Table 1. Mean values ($\pm$ SD) of the height of rise of the centre of body mass (h), maximal power output ($P_{\max}$), and relative maximal power output ($P_{\max} \cdot \text{mass}^{-1}$) during akimbo counter-movement jumps (ACMJ), counter-movement jumps (CMJ), and spike jumps (SPJ) on a force platform in deaf soccer players and deaf untrained girls

Variables	Untrained females $n = 16$	Soccer players $n = 13$	F	p	η^2
$P_{\max_{\text{ACMJ}}}$ [W]	1009.7 ± 310.2	$1267.6 \pm 251.0^*$	5.87	0.02	0.18
$P_{\max_{\text{ACMJ}}} \cdot \text{mass}^{-1}$ [$\text{W} \cdot \text{kg}^{-1}$]	17.97 ± 4.50	20.24 ± 4.64	1.79	0.19	0.06
h_{ACMJ} [m]	0.237 ± 0.061	$0.310 \pm 0.046^*$	12.78	0.01	0.33
$P_{\max_{\text{CMJ}}}$ [W]	1061.7 ± 299.0	$1546.1 \pm 282.4^*$	19.78	0.00	0.42
$P_{\max_{\text{CMJ}}} \cdot \text{mass}^{-1}$ [$\text{W} \cdot \text{kg}^{-1}$]	19.10 ± 4.99	$24.59 \pm 4.94^*$	8.77	0.01	0.25
h_{CMJ} [m]	0.274 ± 0.068	$0.351 \pm 0.068^*$	9.18	0.01	0.25
$P_{\max_{\text{SPJ}}}$ [W]	1644.9 ± 435.1	1820.9 ± 398.9	1.26	0.27	0.05
$P_{\max_{\text{SPJ}}} \cdot \text{mass}^{-1}$ [$\text{W} \cdot \text{kg}^{-1}$]	29.81 ± 9.33	29.18 ± 8.15	0.04	0.85	0.00
h_{SPJ} [m]	0.281 ± 0.051	$0.368 \pm 0.043^*$	23.83	<0.001	0.47

* – significantly different from values in deaf soccer players, $p < 0.05$.

Table 2. Mean values ($\pm$ SD) of the results obtained in the Eurofit test in deaf soccer players and deaf untrained girls

Variables	Untrained females n = 16	Soccer players n = 13	F	p	η^2
Flexibility [cm]	18.7 $\pm$ 10.0	30.1 $\pm$ 4.9*	14.08	<0.001	0.34
Hand grip right [N]	28.2 $\pm$ 6.2	37.8 $\pm$ 6.1*	17.61	<0.001	0.40
Hand grip left [N]	26.9 $\pm$ 5.4	37.8 $\pm$ 5.7*	27.81	<0.001	0.51
Bent arm hang [s]	4.4 $\pm$ 6.7	7.6 $\pm$ 3.9	2.26	0.14	0.08
Standing broad jump [cm]	125.7 $\pm$ 33.2	191.0 $\pm$ 11.5*	45.51	<0.001	0.63
Sit-ups [n]	18.7 $\pm$ 3.7	23.2 $\pm$ 2.6*	13.36	<0.001	0.33

* – significantly different from values in deaf soccer players, $p < 0.05$.

between the groups were observed for all measured trials except for bent arm hang.

Discussion

The subject literature has most frequently compared various aspects of physical fitness of hearing and deaf people [10, 11, 17, 21]. However, the reported results are ambiguous. Some studies indicate that the physical fitness of deaf children is lower than that of their healthy peers, regardless of sex [7, 8, 18, 21]. Other research suggests that deaf girls are fitter than their hearing peers or the differences are statistically insignificant [5, 6, 10, 11]. There are no papers in the literature describing the physical fitness of deaf athletes as compared with their deaf peers who do not practise any sport. The aim of our study was to compare the physical fitness of deaf female soccer players and their untrained deaf peers.

The results of the Eurofit test showed significant differences between the groups of deaf girls who played soccer and who did not practise any sport for all measured motor characteristics except for the bent arm hang test, which may be due to a shorter time spent on exercising active muscle groups in these trials among soccer players. Zwierzchowska and Grabara [20] observed significant relationships between the degree of hearing loss and the motor skills of children and adolescents in all motor tests. According to these authors [20], their experiment does not prove that hearing loss determines motor development. As reported by Zwierzchowska et al. [19], deafness significantly affects the level of coordination skills, but the good results obtained in some tests can be explained by the excellent compensation of deafness by other senses.

The ACMJ, CMJ, and SPJ trials, apart from testing jumping ability and power, may also evaluate coordination. In a study by Szulc et al. [17], deaf female soccer players developed significantly lower power and relative power of lower limbs during SPJ, with a significantly

greater lowering of the body COM in the arm swing phase as compared with hearing female soccer players. The ACMJ, CMJ, and SPJ height values were insignificantly higher among deaf female soccer players than in the hearing ones. In our study, deaf female soccer players jumped significantly higher than untrained girls in the ACMJ, CMJ, and SPJ, and developed greater power in the CMJ. The relative power in the ACMJ and SPJ or the maximal power in the SPJ did not differ between the studied groups. The jump heights among deaf female soccer players in the present study were greater than those observed in deaf female athletes in a report by Szulc et al. [17]. The CMJ test results obtained by the deaf female soccer players in our study are higher than those noted by Struzik and Pietraszewski [16] among female soccer players of the highest competition class (0.290 ± 0.04 m) and by Sedano et al. [14] among female soccer players of a higher and lower league (0.261 ± 0.05 m and 0.273 ± 0.06 m, respectively). Also, in a study by Haugen et al. [9], female soccer players from the Norwegian national team and from the first Norwegian league obtained lower CMJ heights (0.307 ± 0.04 m and 0.281 ± 0.04 m, respectively) than the deaf female soccer players in our research. In turn, the untrained girls in our study jumped lower than both deaf and hearing female soccer players evaluated by other authors. Comparing the results of our research with the data from the literature, we can quote Maszczak [11], stating that “Hearing loss does not significantly determine the physical development or physical fitness of deaf children, it merely indicates a longer way to achieve the same physical fitness results as compared with hearing children”.

Conclusions

1. Hearing loss does not significantly determine the physical development or physical fitness of deaf people.
2. Playing sports improves the physical fitness of deaf people in comparison with untrained deaf people.

Conflict of interest: Authors state no conflict of interest.

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