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Research Article

# The level of self-esteem of deaf children: Can participating in dance lessons with vibrational headphones improve it?

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ABSTRACT

Self-esteem is an important predictor of mental health and psychological functioning. Deaf children have limited ability to listen to music and to dance. These activities are important elements of modern adolescents' life. Their inability to participate increases the sense of exclusion in young deaf people and negatively affects their self-esteem. This study aims to verify whether the level of deaf children's self-esteem will change after participating in experimental dance lessons with vibrational headphones. The experiment involved 28 deaf children aged 9–13 years old who attend special schools for deaf children in Poland. Children from the experimental (E) group participated in two dance lessons each week for a period of four months. To allow for the reception of acoustic vibrations of music, vibrational headphones were used, which reinforce the so–called bone conduction of music. To measure the level of self-esteem, a Polish adaptation of the Rosenberg Self-Esteem Scale was administered. The results of two way ANOVA showed a significant interaction ($p < 0.001$) between self-esteem and the groups and tests. A significant increase in the level of self-esteem among the children in the E group ($d = 0.87$) and the decrease in self-esteem of the control ($d = -1.13$) group were found. This study shows that participating in dance lessons with the use of vibrational headphones may support positive self-esteem among deaf children.

## Introduction

Self-esteem is a crucial component of human beings' psychological well-being and life satisfaction (Rosenberg, 1965). In addition, self-esteem, as an element of emotional well-being, is one of the dimensions of quality of life (Knox & Muros, 2017). A global report on disability (World Health Organization, 2011) has highlighted the need to undertake both research and interventions aimed at improving quality of life and its dimensions among people with disabilities.

Studies concerning the self-esteem of deaf and hard of hearing (D/HH) persons recorded a lower self-esteem level among deaf children and youth compared with their hearing peers (e.g. Lesar & Smrtnik Vituli, 2014). The main causes of lower self-esteem in D/HH children are difficulties in communication and the inability to form peer relationships (Fellinger et al., 2012).

Self-esteem is defined as a multidimensional construct based on the subjective self-assessment of individual cognitive, physical, and social skills (Dzwonkowska, Lachowicz-Tabaczek, & Łaguna, 2008). Different dimensions of self-esteem have been defined and explored, such as body image (Muth & Cash, 1997) and body satisfaction (Frost & McKelvie, 2004). Changes in these areas affect the level of self-esteem.

Analyzing the effect of physical activity on dimensions of self-esteem and global self-esteem, Sonstroem and Morgan (1989) proposed the Exercise Self-Esteem Model. The authors hypothesized that while engaging in physical activity, there may be positive changes in dimensions of self-esteem, which in turn affect the level of global self-esteem. They also indicated that in relation to physical activity, self-esteem can be influenced by self-efficacy. This finding is in line with Noordstar, van der Net, Jak, Helders, and Jongmans (2016) who found that self-esteem was positively related with athletic competence. Based on the Exercise Self-Esteem Model (Sonstroem & Morgan, 1989), we tested the influence of experimental dance classes in which vibrational headphones were used to determine components of self-esteem for deaf children.

### *Self-esteem and physical activity of D/HH people*

In the field of research on mental and physical functioning of deaf

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people and people with disabilities, the connection between their self-esteem and physical activity was also investigated (Nemček, 2017; Uchida, Marsh, & Hashimoto, 2015). Nemček (2017) found that the status of self-esteem in physically active people with disabilities was higher compared with inactive individuals. Also, Uchida et al.'s (2015) study confirmed a positive relation between high-performance physical activity of D/HH athletes and components of their self-esteem.

Scarpa (2011) emphasized that participating in organized forms of physical activity allows children with disabilities to experiment with new challenges. Moreover, it provides them the opportunity to confront expectations regarding skills and movement capabilities with real abilities and develops their authentic and adequate self-esteem. Participating in sport and leisure activities is also associated with experiencing both successes and failures in social-exposure situations. Positive social exposure may increase a person's improved belief in their level of physical condition and movement skills and, consequently, raise self-esteem (Haugen, Ommundsen, & Seiler, 2013). It can be assumed that acquisition of new motor skills can promote an increased participation of D/HH children and young people in recreational and sport activities. In turn, an increased level of physical activity can lead to positive changes in somatic parameters and, consequently, affect the growth of levels of partial self-esteem in the area of physical attractiveness, followed by global self-esteem of D/HH children (Lu et al., 2015).

*Application of vibration, dance, and music in therapy of D/HH people*

An injury to the ear triggers a compensation mechanism, which increases the development of the functioning of other senses, particularly sight and sensation (Nanayakkara, Wyse, Ong, & Taylor, 2013). The body's recognition of a vibration perception mechanism and changes in the human body under the influence of these vibrations contributed to the search for a possibility of their use in therapy (Alves Araujo et al., 2017). In an experiment investigating changes occurring in a brain under an influence of vibrations, Ma et al. (2016) observed the stimulation of the somatosensory part of the cerebral cortex in hearing patients undergoing dosed vibrations. The induced stimulation activated the auditory cerebral cortex of study participants. Similar results were obtained among D/HH persons (Herren, Schmid, Rogan, & Radlinger, 2018; Schürmann, Caetano, Hlushchuk, Jousmäki, & Hari, 2006). In turn, Hökelmann and Blaser (2006) reasoned that a vibrating transmitter attached to headphones used in their research with deaf children generated vibrations which, through transmission to the scalp and the skull bone (parietal bone), and then through the skull into the vitreous body of the eye, reached the trigeminal nerve, generating action potential.

Some authors emphasized that sources of vibrations used in the therapy and training can be platforms, vibrating equipment, but also music (Nanayakkara et al., 2013; Tranchant et al., 2017). Sound is a wave that generates vibrations; therefore, music can be a source of vibrations perceived by different parts of the body. This is particularly important for D/HH who can experience music only through a sensory perception of vibrations. In Nanayakkara et al.'s (2013) work with deaf children, they used a vibrating chair, which vibrated to the rhythm of music, to conclude that deaf people could perceive music through vibrations. Also, Hökelmann and Blaser (2006) conducted an experiment in which D/HH children participated in dance lessons with music and reinforced vibrations. The aim of their study was to assess the impact of activities using the Audiva High Pitch Training System on selected coordination and rhythmizing skills among D/HH children. A positive impact for deaf people participating in dance classes on their psychomotor development and the level of socialization and integration was also found by other researchers (e.g. Kurková & Jayne Maertin, 2014; Tsimaras et al., 2010).

Dance lessons can have positive effects on people's physical and mental health like dance therapy or dance movement therapy (DMT) (Burkhardt & Brennan, 2012; Muro & Artero, 2017). Each of these forms properly applied may constitute an educational or therapeutic means of supporting the mental and physical health (Bernardi, Bellemare-Pepin, & Peretz, 2017). Dance is an important and effective means of supporting education, development and rehabilitation, especially for children (Duberg, Möller, & Sunvisson, 2016). Dance develops children's emotional expression ability, helping them to represent themselves through their body and not only with words (Kourkouta, Rarra, Mavroeidi, & Prodromidis, 2014). This is particularly important for D/HH children because most cannot express their emotions with words or recognize them in other's speech. Allowing this expression can positively affect their self-esteem. It seems that dance might be one branch of art therapy in deaf children.

Presented reports suggest that dance, music and vibrations can be a source of positive emotional, psychological, and social changes among D/HH children.

## Objectives and hypothesis

The main objective of this study was to ascertain whether participation of deaf children in experimental dance lessons using vibrating headphones would precipitate positive changes in their self-esteem. Experimental and control groups were compared. We hypothesized that the self-esteem of deaf children participating in a special program of dance lessons using vibrational headphones would improve compared with children in the control group.

## Methods

### *Participants*

The study involved 28 deaf children with significant (71–90 dB) or profound (91–119 dB) sensorineural hearing loss (International Bureau for Audiophonologie, 1996) from Poznan, Poland. Participants were recruited from the same grade level of randomly selected schools and educational centers for deaf children in all public special schools in the Poland. The sample unit was a school class. The average age of the participants was 11.3 years ($SD$ = 1.0): the minimum age was nine years and eight months and the maximum age was 13 years and five months. The participants were randomly divided into an experimental group (E), which consisted of eight girls and six boys, and a control group (C) consisting of eight girls and six boys.

### *Study design*

The protocol of the study was approved by the Local Bioethics Committee of Karol Marcinkowski University of Medical Sciences in Poznan, Poland (decision no. 340/09). The experiment lasted 16 weeks. Before starting the experiment, the children's parents were given information concerning the purpose and organization of the experiment, and they gave their written consent for their children to participate in the study.

Children from the E group participated in dance lessons in which the Audiva High Pitch Training System vibrating headphones (Borowiec, 2011) were used to strengthen vibrations emitted by music. Children did not use cochlear implants and hearing aids during experimental lessons.

Dance lessons were held twice a week as a part of two of the four school hours of physical education classes (PE). During the experiment, in the E group there was a total of 64 lessons: 32 dance lessons and 32 PE classes. The PE classes included eight volleyball lessons, eight basketball lessons, eight gymnastics lessons, and eight athletics lessons. The dance lessons were supervised by a dance instructor and a physical education teacher who used sign language. After a 5-minute warmup to the rhythm of music, 16 new movements of choreography were taught. Fifteen minutes was devoted to learning the new steps. During this time, the short motion complexes were repeated in time with the music,

and then combined. For the lesson's remaining 10 min, the children perfected the entire choreography and danced it several times on their own. The teacher guided the children by calculating the rhythm, encouraging them to feel as if they were on stage or in the music video. The presented structure of classes ensured that each student would have constant physical activity for 40 min.

The choreography used during the dance classes in the experiment was based on funky hip-hop dance technique. The musical background was "Work It" by Missy Elliott. The song was characterized by a regular clear rhythm at 120 BPM (beats per minute).

During the experiment, the children in the C group participated only in PE classes with no dance lessons. The PE classes were held four times a week. The total number of PE classes was 64 and consisted of 16 volleyball lessons, 16 basketball lessons, 16 gymnastics lessons, and 16 athletics lessons.

*Outcome measures*

In both groups (E and C), before the first and after the last experimental dance lessons and PE classes, the pre-tests and post-tests were conducted. As part of the pre-tests and post-tests the children filled out questionnaires that were a Polish adaptation of the Rosenberg Self-Esteem Scale (Dzwonkowska et al., 2008; Łaguna, Lachowicz-Tabaczek, & Dzwonkowska, 2007). The Rosenberg's Self-Esteem Scale (Rosenberg, 1965) is a point-based scale that is one of the most common methods for self-esteem measurement. The questionnaire consists of 10 questions and answers on a point-based scale of 1–4 (1, "I strongly agree"; 4, "I strongly disagree"). The minimum point value participants can obtain is 10 and the maximum is 40. Each child who filled in the questionnaire was assisted by a teacher interpreting the written statements to sign language. The teacher interpreting the commands into sign language in the E group and in the C group used strictly fixed signs, which were the same every time. The Rosenberg Self-Esteem Scale has been shown to be reliable in the studies of deaf people (e.g. Bat-Chava, 2003; Crowe, 2003; Kobosko et al., 2018; Lu et al., 2015; Nemček, 2017). In Kobosko et al. (2018) Cronbach alpha's for all investigated deaf and hard-of-hearing subjects was 0.88 and in the subgroups with different hearing loss and etiology ranged from 0.86 to 0.91. Similarly in the deaf and hard-of-hearing people examined by Crowe (2003) Cronbach alpha's ranged from 0.77 to 0.88. However in the Bat-Chava's (2003) study the reliability of the RSES in hard of hearing people with Cronbach alpha's was 0.64. In present study the Cronbach alpha's value was 0.81.

*Apparatus used in the experiment - the Audiva High Pitch Training System*

As part of the experiment, the E group was equipped with the Audiva High Pitch Training System headphones (Borowiec, 2011), in which a vibrating transmitter was installed in the middle of the strip that connects the headphones. The vibrating transmitter vibrates to the beat of music played through the headphones and moves the surface nerves of the skin and the tissue that covers the skull. Vibrations expanded hearing experience on the level of vibration, enhancing "bone hearing." The headphones have a frequency range from 1000 up to 9000 vibrations per second, which is the frequency range in which the hearing effect and the stimulation in the brain of hearing-impaired individuals are optimal.

The children using the headphones were equipped with music receivers placed in a bag and worn on a belt, which allowed them to move freely in the room and ensured synchronization of music among all the children wearing the headphones. Music volume in each handset and the strength of vibrations had a separate adjustment bar on the belt.

*Statistical analysis*

To determine the effect of the intervention on self-esteem, pre-test and post-test self-esteem scores were compared between the experimental and the control groups using a two-way repeated measures analysis of variance (ANOVA). The Tukey's post-hoc tests were used to identify specific differences between the groups (E and C) and a significant interaction between the groups and the time (pre-test and post-test).

To describe differences related to angular velocities, effect sizes were calculated as the difference between means divided by the pooled standard deviation. Using Cohen's (1998) criteria, an effect size $\geq 0.20$ and $< .50$ was considered small, $\geq .50$ and $< .80$ medium, and $\geq .80$ large.

Statistical significance was set at $p \leq .05$ for all statistical procedures. Statistical analyses were performed with Statistica 13.1 software (StatSoft, Inc., USA).

## Results

Basic statistical characteristics of the analyzed variables showed that before the start of the experiment (pre-test) the level of self-esteem for the children from groups E and C was similar, respectively $M = 29.0$, $SD \pm 1.80$ and $M = 29.2$, $SD \pm 1.85$. The level of self-esteem at the end of the experiment (post-test) in group E was equal to $M = 31.2$, $SD \pm 2.12$ and group C's average value was $M = 27.5$, $SD \pm 1.22$.

We observed no differences in self-esteem between boys and girls in the pre-test ($p = .722$) and the post-test ($p = 0.802$). Thus, in the subsequent model gender was excluded in the analysis.

Table 1 presents the results of a two way ANOVA of the groups (E and C) and the time (pre-test and post-test). Statistical analysis of self-esteem indicated that there was no effect between the investigated time (pre-test, post-test). However, an effect between groups (E and C) was observed ($p = .003$). There was also an interaction between group (E and C) and time (pre-test, post-test) ($p < .001$).

The post-hoc tests revealed that this significant difference was due to the post-test differences between the groups ($p < .001$). Children in the E group presented higher self-esteem after the experiment compared with those in the C group. In both groups, self-esteem differed significantly between the post-test and the pre-tests (E group $p = .007$, C group $p = .045$). According to Cohen's (1998) criteria, the size effect between the pre-test and the post-test was large, equaling $d = .87$ in the E group and $d = -1.13$ in the C group.

## Discussion

The results obtained in the study confirmed the hypothesis that deaf children participating in the experimental dance lessons with the use of vibrating headphones (E group) achieved a significant improvement in self-esteem compared with children in the C group who participated in PE classes only. Moreover, the results noted in the post-test after the end of the experiment in groups E and C differed significantly in favor of group E.

In attempting to explain the positive changes in self-esteem in the E group, which took part in dance lessons using vibrating headphones, it should be noted that physical activity with music is usually not available to D/HH children. However, deaf children are quite interested in music and dancing. Studies indicate that D/HH children can experience

**Table 1**
Results of Two-way ANOVA of Self-Esteem in Relation to Group (Experimental and Control) and Time (Pre-test and Post-test).

| Source | *SS* | *df* | *MS* | *F* | *p* | *Observed power* |
|---|---|---|---|---|---|---|
| Group | 42.9 | 1 | 42.9 | 11.1 | .003 | 0.89 |
| Time | 0.9 | 1 | 0.9 | 0.36 | .555 | 0.09 |
| Group x time | 54.0 | 1 | 54.0 | 22.1 | < .001 | 0.89 |
| Error (group) | 100.6 | 26 | 3.9 | | | |
| Error (time) | 63.6 | 26 | 2.5 | | | |

the pleasure of music perception, but they perceive it differently than hearing people (Nanayakkara et al., 2013; Tranchant et al., 2017). In our experiment, the participation in dance lessons likely provided the children from the E group with an opportunity to participate in music and dance and perceive themselves in a manner similar to the cultural patterns available to their hearing peers. This participation could reduce their sense of otherness, and thus become a factor with a positive impact on their self-esteem (Rusu & Rusu, 2017).

In the studied group E, the increase in self-esteem can be also attributed to the fact that dancing is, in general, one of the most popular forms of physical activity among girls and teenage girls (Anderson, Leyland, & Ling, 2017; Pelclová, Frömel, Skalik, & Stratton, 2008). It was noted that intensive modern dance classes and aerobics improved cardiorespiratory endurance, changed participants' weight and body composition in a positive manner, which contributed to increasing the girls' subjective feeling of physical attractiveness (Bartholomew & Miller, 2002). According to the Exercise Self-Esteem Model (Sonstroem & Morgan, 1989), also presented in this study, participation in dance lessons could improve some individual dimensions of self-esteem among children from E group.

The positive relationship between participation in dance classes and self-esteem can also result from the fact that dancing provides the opportunity to express emotions and feelings (Kurková & Jayne Maertin, 2014). Expressing emotions and feelings with the help of the body and feeling confident with body language might be very important for positive self-esteem. For example Strassel, Cherkin, Steuten, Sherman, and Vrijhoef, (2011) found positive therapeutic effects of dance therapy and DMT related to improvements in quality of life, self-esteem, or coping with disease for people with disabilities According to Mecums (1998), dance therapy is the psychotherapeutic use of movement and dance to support the body's intellectual, emotional, and motor functions. The theory of dance therapy assumes that the body and mind interact so that a change in movement affects functioning of human and movement reflects personality (Mecums, 1998). The dance program applied in the experiment did not include the strict character of therapy understood as dance therapy or DMT. However, to a certain extent, though, experimental dance classes could have a therapeutic dimension for deaf children because of the choreography, which is based on rhythmic music evoking positive and joyful emotions. The use of this type of music was based on Hopyan, Gordon, and Papsin's (2011) research, which indicated that D/HH persons with auditory implants recognize whether the musical line of the song referred to positive or negative emotions.

In addition, the choreography used in the experiment contained moments in which the children decided for themselves what and how to dance, depending on their internal needs. Moreover, the instructor suggested that a given sequence of movements has the same expression as in the music video, on the stage, or at home in front of the mirror when no one is watching. The instructor's suggestion provoked the participants to empathize with a certain role and express particular attitudes and emotions. According to some reports, emotions are evoked by interoceptive and proprioceptive feedback from the body and our conscious feelings result from our perception of this somatic experiences (Damasio & Carvalho, 2013). Perhaps these factors gave the experimental dance lessons a therapeutic dimension that influenced the obtained results.

Another factor that could affect the present study's results is that the experimental classes were held in mixed class groups. This enabled children to meet new peers and create new friendships. Reports showing that one way to improve self-esteem among D/HH people is to participate in physical activities associated with establishing friendships and obtaining social support (e.g. Rusu & Rusu, 2017). The positive influence of social relations established in the course of taking part in organized physical activities on the feeling of isolation among people with disabilities, which Shapiro and Martin (2010) also emphasized.

For children in the C group who participated only in PE classes, the level of self-esteem decreased. These results might be related to the fact that the decrease in self-esteem is characteristic for children in early adolescence (Phillips, Spears, Montgomery, Millings, & Sayal, 2013). During this period, children start to experience physical changes in their bodies, including an increase in the percentage of body fat (Wertheim & Paxton, 2012), which moves them away from societal ideals of thinness in girls and muscular and athletic silhouette in boys. This discrepancy between the cultural ideal and personal appearance can lead to a decrease in self-esteem (Fenton, Brooks, Spencer, & Morgan, 2010). Studies on the association between maturation and self-esteem in deaf people reveled that perceived physical appearance, self-esteem, and life satisfaction were positively associated (Lu et al., 2015). In deaf young adolescents maturation makes decrease in self-esteem (Jambor & Elliott, 2005).

However, a few studies analyzing somatic development and maturation of deaf indicated accelerated puberty in deaf children when compared with their hearing peers (Abolfotouh, 2000; Umławska & Krzyżanowska, 2009; Umławska, 2006). Therefore, it may be possible that in the present study the hormonal changes may no longer have an effect on the results; however, this factor was not analyzed.

In summary, the results obtained in the present study in the E group indicate that it is possible to undertake interventions that prevent a decline in self-esteem among D/HH children. One such intervention might be dance activities with vibrating headphones conducted in our experiment, which will provide children with impaired hearing with an opportunity to experience music through vibrations and participation in dance classes.

## Conclusions

We confirm the hypothesis that the use of dance lessons with music using vibrating headphones may prevent a decrease in self-esteem among deaf children, as well as develop a positive self-evaluation. Therefore, steps should be taken to supply institutions involved in therapy, rehabilitation, and education of D/HH people with devices that enable reception of music through vibrations and participation in dance classes.

With regard to future research, the influence of the participation of D/HH children in dance lessons with the vibrational headphones on selected dimensions of self-esteem should be investigated.

### *Strengths and limitations*

The present study has strengths and some limitations. The small group size used in the experiment gave the research a pilot character. However, the results still constitute a justification for continuation of the research on the possibility of improving the self-esteem of D/HH children through participation in dance lessons using vibrating headphones. Also, we did not assess the biological age of the examined children. However, biological age and hormonal changes associated with puberty could have been a factor that influenced the results of our research. It should be considered in future studies.

An advantage of the manuscript is the original nature of this subject. The obtained data enriches our knowledge about self-esteem among D/HH children participating in special programs of exercise, specifically using vibrational headphones during dance lessons. The Polish version of the Rosenberg Self-Esteem Scale used in the tests is a tool with proven reliability and validity (Łaguna et al., 2007), which allows for an assessment of the results as credible. The popularity of this scale makes it possible to compare the results with the results from other research.

## Conflicts of interest

The authors have no conflict of interests to declare.

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