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PUPILS WITH COCHLEAR IMPLANT IN PHYSICAL EDUCATION CLASS: REVIEW OF RECENT SCIENTIFIC DATA AND GUIDELINES FOR DEVELOPMENT OF INDIVIDUALIZED EDUCATION PROGRAMS

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Review paper

Abstract
A comprehensive review of the existing scientific literature provides an insight into the size of the population and various anthropological features of children with a cochlear implant (CI) who are integrated in aregular school system. Technical characteristics of a CI are shown together with the potential of technical tools such as FM systems (frequency-modulated) and their use in physical education (PE) classes. Integration of recent findings on various characteristics of children with a CI (medical, physical, communication, speech and language), specifics of motor activities listed in standard PE curriculum and features of the CI device itself has made it possible to establish elaborate guidelines for the creation of individualized education programs(IEP) for children with a CI in the inclusive education setting. The proposed guidelines will enable PE teachers to prepare for teaching children with CI and to modify curriculum and teaching strategies in accordance with individual characteristics of pupils with CI, and in respect of their diverse special education needs (SEN). It is suggested that IEPs are created through the adjustment of the curriculum content and teaching methods, application of the security measures as well as by technical adjustment of teaching using the FM system.

Key words: *curriculum; hearing impairment; teaching methods; special education needs*

Introduction

Hearing impairment is one of the most common congenital disorders (Marn, 2005). Although the prevalence data varies due to the differences in methodological approaches, it is presumed that hearing impairment occurs in 1 to 4 out of 1000 newborn children (Marn, 2012; Mahulja-Stamenkovic & al., 2005; Van Naarden & at al., 1999). The prevalence of hearing disorder in population increases with the process of aging. Hearing loss is congenital in 80% of the children (Marn, 2005), and in 50% of the cases the causes are genetic (Barišić & at al., 2004). The neural risk factors also contribute to a hearing loss. The latter occurs postnatal in 20% to 30% of the cases as a consequence of illnesses or traumatic head injuries. (Kekić & at al., 2003; Fonseca & at al., 1999; Davis & at al., 1997; Kittrell & Arjmand, 1997). Hearing impairment can affect the individual development in various ways, depending on the etiology, age, severity and type of damage, quality of care, age at which rehabilitation began, suitability of rehabilitation methods, cognitive make-up of each affected individual, along with diverse social and environmental factors. Cochlear implantation (CI) is one of the methods of sensorineural hearing loss management. Since 1996 about 500 implants have been installed in Croatia, and according to the reports, approximately 16 children per year in Croatia require a cochlear implantation (Marn, 2005). 70% of them were fitted with a CI between ages 1 to 5. In recent years, the children are most frequently surgically operated in accordance with thecurrent standards, up to the age of three. Thus it can be concluded that there are currently about 350 children, or 12,5 classes with 28 pupils (NN 74.99), with a CI.

In other words, since there are 887 primary schools in the Republic of Croatia (MZOS 2012), every second to third school on average is attended by a child with a CI. Since the contemporary Croatian school systems presumes inclusion of children with special education needs(SEN) it is necessary to create a number of activities to foster the inclusion of the children fitted with CI into a regular Croatian school (HNOS, 2006), Zakon o odgoju i obrazovanju u osnovnoj i srednjoj školi (NN 87/08), Nacionalni okvirni kurikulum (2011), National Strategy of a Single Politics for Disabled People 2003 - 2006 (Vlada RH 2003, NN 13/03), National Strategy of Equalisation of Possibilities for Persons with Disabilities 2007 -2015 (Vlada RH 2007, NN 63/07), as well as National Plan of Activities for the Rights and Interests of Children 2006 – 2012 (AZOO, 2006), provide a series of measures for inclusion of children with special educational needs in the regular educational system. The aforementioned measures can be merged as: professional teacher development, inter-agency collaboration and cooperation with the civil sector, curriculum modernization, mobile support services and more. When working with SEN students in aregular elementary school system, the focus should be put on the development of individualized educational programs/curriculums (IEP). Specially developed programs presume individualized work according to the pupil's needs and capacities, as well as the evaluation of the pupil's advancement, counseling with professional associates and constant cooperation with parents or guardians. A development of such an IEP is based on the assessment of various skills, interests and needs, along with the evaluation of

abilities which need to be developed in students with SEN (HNOS, 2006). The stages of development of an IEP are: initial assessment, decision on the educational subjects and contents, determining the level of the content acquisition, time dimension (short- and long-term goals and tasks), selection of methods, procedures, equipment and apparatus, and finally monitoring and evaluation of the pupil's achievement. More frequent monitoring of the program's efficiency is recommended due to the possible need for program modification (HNOS, 2006). Children with hearing impairment can often face various difficulties in the development of their motor skills. However, studies indicate that early cochlear implantation can improve the level of motor development (Schlumberger at al., 2004; Wright at al., 2002; Reich & Lavai, 2009). An overview of the existing studies fields no results regarding papers containing methodological instructions on the adaptation of methods and curriculum contents in physical education (PE) classes to meet the needs of pupils with CI. Currently there are only general guidelines described in the Croatian National Educational Standard (HNOS, 2006), specifying certain adjustments, mostly regarding the removal of the external part of the device. The only guidelines found in international literature are limited instructions by a group of authors on the applied kinesiology and sport (Hilgenbrinck at al., 2004). Since the hearing impaired children as well as those with CI are a particularly heterogeneous group, scanty instructions cannot cover their numerous individual differences, which ultimately affects their capability of active and successful participation in PE class. Therefore, a comprehensive insight into a multi-factorial nature of this complex issue is required for an appropriate adaptation of curriculum so to enable these children to develop their full potential.

Cochlear Implants

Cochlear implant (Figure 1) is one of the greatest technological achievements of the modern medicine. Unlike conventional hearing aids, which are suitable for all types of hearing loss and which amplify a specific frequency range, cochlear implants are exclusively installed in cases of sensory-neural hearing loss caused by cochlea defects ie auditory sensory cells located in the inner ear and cochlear implant directly stimulates the auditory nerve. The device converts the auditory signals into electrical impulses, which bypass the damaged hearing cells through electrodes implanted in cochlea and sends them through auditory nerves to the auditory cortex responsible for the perception of sounds and speech. CI consists of the external and internal part. The external part is fitted behind the ear, on the skull bones, and it consists of a microphone, speech processor, transmitter coil and a magnet. The internal part is fitted under the skin behind the ear and it consists of a receiver with an inner magnet and electrodes, implanted into the cochlea, which stimulate the auditory nerve fibers (Figure 1). Current models of cochlear implants have a multi-channel electrode which can transmit more sound information.

Use and Operation of the Cochlear Implant and Speech Processor

The external part of the device, microphone, captures sound waves and transmits them to the speech processor. The processor filters and analyzes the sounds and converts them into coded digital signals before sending them to the transmitter. The outer coil-transmitter is attached with a magnet and connects to a receiver which is surgically implanted under the skin behind the ear. The receiver captures the digital signals sent by the transmitter and decodes them into analog electrical impulses which are then further transmitted through electrodes placed in a narrow flexible tube which is inserted into the cochlea. Depending on the type of the implant, there are up to 24 electrodes. They are stimulating auditory nerve, and the brain interprets receiving impulses as sound stimuli. The entire process occurs in a matter of milliseconds, which enables real-time hearing (http://www.cochlear.com).

Figure 1. The external part of a CI (model The Cochl0ear™ Nucleus® 5 Sound Processor CP810) Picture taken from www.cochlear.com

The speech processor is the size of a standard ear amplifier and it is most commonly worn behind the ear and the coil and the microphone, as well as the attached cables, can visually be covered by hair. Nowadays, for children who attend physical education classes it is the most common way of wearing the processors. In some models the speech processor can be placed around the waist, on the back or in a pocket. Previously, young children would often wear their processors in a bag on their backs in order to protect the device from possible damage.

Motor Skills and Speech and Language Characteristics of Children with Cochlear Implants

A CI is a technical device which enables people with hearing impairment to notice and recognize sound stimuli, but further (re)habilitation helps them to hear and understand a language. Since the first implants in 1970s the device has undergone multiple transformations and numerous improvements.

But it is still not possible to use cochlear implants to help every person with sensory-neural deafness to hear better and master language and speech in equal manner. (Re)habilitation yields the best results after implantation in infancy or early childhood and in cases of acquired hearing loss in children who are implanted immediately after the loss of hearing. Implantation in later childhood, or even later, mostly achieves limited rehabilitative results. In order to master the language and learn to speak, the child implanted with a CI must be sufficiently exposed to the speech input, and through interaction with other people gradually acquire language comprehension and production. Other than that, it is important to encourage the child to master a complex non-verbal communication system from the very birth. A CI does not provide a complete auditory experience. A sound stimulus received by the CI is different from a natural sound stimulus, hence requiring a lengthy rehabilitation process during which the brain structures learn to recognize and interpret the incoming stimuli. In addition, continious device fitting is required. For this reasons, hearing and speech training presents the most complex and longest phase of the rehabilitation process. It is conducted gradually and lasts for many years, and the results can improve even 10 years after implantation (Beadle at al., 2005). The usual scope of rehabilitation of children with CI in recent years is the scope of unexpected content listening. Unfortunately, such listening (perceiving and understanding) is not always possible because it depends on numerous factors. The cochlear implant does not restore normal hearing ability, although it is highly beneficial in sound perception and language comprehension (Hilgenbrinck at al., 2004). The studies show a noticeable diversity of speech comprehension level in children with CI (Osberger at al., 1991; Staller at al., 1991).

Some studies of speech perception indicate that a successful recognition of words and common phrases can be diminished without the aid of lip-reading, even after intensive auditory and language training (Miyamoto at al., 1991; Staller at al., 1991). Furthermore, children with CI differ considerably among themselves in the achieved expressive language ability, vocabulary, morpho-syntax, narrative skills and the quality of articulation. Although children with CI show better results in speech production than the profoundly hearing impaired children treated with other types of hearing aids, they still heavily rely on visual cues such as sign language, gestures and lip-reading (Ivasović, 2002). Speech comprehension in children with CI may also vary considerably in the course of a day on account of mental exertion due to focused listening in harsh conditions. One of the biggest limitations in PE class for children with CI is accurate hearing in noisy conditions and spatial determination of the sound source. These restrictions primarily result from unilateral implantation (implantation in one ear) which is universal for almost all the children with CI in Croatia.

In addition to speech and language skills, children with CI may differ from the hearing children in regard to mastery of their motor skills (Kutz at al. 2003). Studies indicate that the children with hearing disabilities have a less developed motor skills and more frequent motor difficulties (Rajendran & Roy, 2011; Shall, 2009; Savelsbergh at al., 1991; Siegel at al., 1991; Wiegersma & Van der Velde, 1983). This phenomenon can be the result of a diminished vestibular system stimulation, whose proper functioning is necessary for motor development, in particular for the development of postural control (De Kegel at al., 2012).It seems that auditory deprivation can lead to atypical development of specific motor abilities because certain parts of motor and language system share common cortical processing resources (Horn at al., 2006). While the process of surgical implantation carries a certain risk of vestibular structure micro-damage (Melvin at al., 2009; Filipo at al., 2006) which can lead to motor deficits, it has been shown that the cochlear implantation generally has a positive effect on the motor skills development, on account of enabled auditory stimulation and the positive impact of CI on the self-esteem development (Incesulu at al., 2003). In other words, apart from creating a foundation for a desirable verbal development, early implantation can also improve non-verbal and motor capabilities (Schlumberger at al., 2004; Buchman at al., 2004). A detailed description and integration of knowledge on different anthropological characteristics of children with CI (medical, physical, communicative and verbal) is necessary for understanding the impact of hearing loss on the motor development of children, but also on the specific needs of pupils with CI in PE classes.

Individualized Eductional Programs Curriculum in Physical Education Class

Individualized approach to pupils with SEN calls for a creation of individualized curriculum plans. HNOS (2006) recommends creation of individualized educational programs (IEP) for all pupils with special educational needs who are attending regular elementary schools. The developed programs can have different levels corresponding to pupils' needs and can contain objectives, methods, timelines, evaluations and list of persons responsible for implementation. The programs should be created by teachers, school experts (speech and language terapist, psychologist) and other professionals involved in the rehabilitation process while the parents/ caregivers of children with SEN need to be acquainted with IEP. New forms of work that enrich existing, and which can be conducted outside the school, may also be planned. The individualization of activities in PE class indicates optimal adjustment of curriculum content and methods based on the individual characteristics of pupils with CI. For a quality adaptation it is necessary to analyze development of pupils anthropological characteristics and health status.

According to Findak (1999) this adjustment enhances the pupil's initiative and creativity, and, as a group of pupils is not simply a sum of equal individuals, the teacher becomes an associate and advisor to their pupils. Fortunately, there is usually no need for hearing impaired children with CI to be observed from a standpoint of health status inadequacy and deficiency in anthropological characteristics required to perform daily motion activities. However, mainly because of the technical operation of CI in terms of hardware and software system characteristics, there exists a significant need for individualization of education processes and procedures involving all children with CI. As a practical implication of the analysis of this complex issue and its observation from various interdisciplinary aspects, there arises the possibility of the development of various guidelines and creation of comprehensive principles for individualization of physical education curriculum. The individualization of activities in PE class for children with CI will largely be reflected in the following:

- Adaptation of teaching methods
- Measures ensuring a safe teaching process in PE class
- Adaptation of curriculum activities and topics
- Technical adjustment with the help of an FM system

Adaptation of Teaching Methods

Teaching methods consist of different principles and methods used for instruction. There are different wayss for method application, and, in children with a CI in PE class, the most important is the relationship between the pupil and the teacher who carries out physical exercise. Particularly regarding the verbal and informational component of interaction and visual and spational interrelationship between pupils and teachers. Considering the fact that the aforementioned interrelationship structure is defined as a known work method physical education for children with CI is mainly to be adapted with regard to teaching methods. The adjustments are primarily related to the verbal and informational components, specifically to the methods of oral presentation and the methods of preparing and solving motor tasks. Teacher's vocabulary in oral task presentations should be simple and comprehensible for the children with CI. Such vocabulary will certainly be understandable for other children as well. The speaking should be slower and clearly articulated, with breaks after each logical unit, but still within the limits of the natural speaking rate and manner. It is necessary to frequently ensure that the pupil fully understood the instructions. This is best done in a way that requires the pupil to explain the procedure in their own words, especially in cases when the pupil does not seem to follow the given instructions. It is not desirable to suppose that the pupils with CI understood the instructions based solely on their confirmation, as people with comprehension difficulties generally do not recognize their own mistakes in interpretation. The position between the teacher and the pupil should be such that the speech processor, located behind the pupil's ear, is closer to the teacher in order to better receive the teacher's voice. In this reciprocal relation, the placement of the pupils with CI in relation to other students is also essential, as the environmental noise must be lower than the volume of the teacher's voice. During the teacher's presentation it is necessary to ensure discipline in the class so that the noise does not overwhelm the volume of the teacher's voice. This approach should be incorporated through all the steps of the oral presentation process – description, explanation, correction and motor movement analysis – but also in the implementation of all other methods, such as learning and training methods, as they include the elements of verbal and spatial interrelation between the pupils and teachers. This primarily refers to the general preparatory exercises, learning new motor movements, elementary games and error correction.

Measures Ensuring a Safe Teaching Process in PE Class

Considering that the PEis a very dynamic process which takes place in a variety of material conditions, with an abundance of various types of movement, it can be assumed that as such it may represent an increased risk for the children with CI. This risk can be a possible loss of the external device or its damage as well as a possible head injury. In order to protect the device, its removal is sometimes required and therefore it is necessary to provide a place for a safe storage. In such cases it is necessary to store the device in its original case and put it under safe supervision of teachers. Occasionally, it is necessary to briefly remove device, for example due to electrical discharges caused by friction in which cases it is desirable that the device is given to the teacher for safekeeping. The provided chassis is the size of a cell phone, with a tape that can be put around the neck so that the teacher has free hands. The children with a CI perceive the external processor as a part of their bodies (Ivasovicć 2002) or as a part of the personality so every separation they experience emotionally. Thus it is necessary to accept responsibility, support and assistance offered by the teacher, the person in who, especially smaller children, have utmost confidence. Particular preventive measures include the short-term removal of the external part of the device during the pupil's contact with the coated surfaces which can generate electricity; for example during the landing on a mat in activities such as long jump, high jump and sloped surface slides. In these cases the external device is removed briefly, just during the performance of the activities. It is mandatory to remove the external part of the device in all situations where there is a possibility of sustaining a head blow by a flying projectile like a heavy and fast ball or collision with other pupils.

Such possibility is the most frequent in sports games such as soccer, handball and basketball. It is important to note that the pupils with CI cannot hear anything after the removal of the external part of the device, which makes the communication more difficult and affects the child's ability to perceive danger. It is possible to consider the exclusion of the children with CI from those, possibly dangerous activities. Students could be included in similar activities instead, such as games in a controlled environment, with technical and tactical situational tasks in which they cannot come into uncontrolled and potentially dangerous situations. In addition, in PE classes which are attended by the children with CI it is necessary to respect all the usual precautions required to ensure the teaching process, as described in Findak (1999, 159). The following measures are singled out for children with CI:

- Wearing prescribed equipment, clothing and footwear that does not slide;
- Avoid wearing any decorative or clothing elements that can cause or intensify injuries in a collision with another pupil;
- Teachers should examine the exercise space in order to make sure it is safe;
- Playgrounds, trails and start-up areas must not be slippers and uneaven, and landing areas must be soft and the sand must be raked in order to remove all hard items;
- Ball tossing can be carried out only from one side of the field, and the balls can be retrieved only when the last one has been thrown;
- Smaller exercise apparatus such as rods, cones, hoops etc, should be smooth, but not slippery;
- The devices used must not be placed near walls, radiators, sticks or any other devices in the hall;
- Mats should be placed under and around the devices, and thicker foam mats should be used for leaps from greater heights;
- It is desirable to use magnesium when working on the devices, for example when working on a high bar, parallel bars or rings;
- The class should be orderly and disciplined, as irresponsible and flippant attitude may lead to accidents;

Adaptation of Curriculum Activities and Topics

Previous PE program recommendations for students with disabilities were related to the development of individual programs in regard to anthropological characteristics of pupils and the conditions in which the activity is performed. When preparing the physical education program the teacher should get help from the child's rehabilitation team, speech therapist and school doctor as well as the child's therapist, in case the pupil is still involved in a rehabilitation program (HNOS, 2006). The specifics for students with hearing impairment in the current HNOS recommendations are related to a few basic guidelines:

- Before the class or a sports activity it is necessary to warn the pupils about removal of hearing aids;
- Face the students when giving new instructions or use hands to express certain signs;
- Present and slowly explain every new exercise;
- Students with hearing impairment do not have any motor limitations so additional motivation to engage in physical activities is recommended in order to develop self-confidence and improve communication skills (HNOS 2006).

These general guidelines do not cover all the special characteristics of children with CI and they are not sufficiently in line with their unique needs. The children with CI are a subgroup of children with hearing disability, and due to a specific way of hearing impairment management their needs and characteristics are somehow different from the needs of other hearing impaired children without CI. While children with severe hearing impairment without CI can have severe difficulty in language acquisition, especially if nonverbal communication is not encouraged early on, early implantation with CI ensures the basic prerequisites for a successful mastery of language and speech. Some children with CI are nearly indistinguishable from their hearing peers in language, speech and motor skills, while others can continue to have more or less pronounced difficulties in different developmental domains. Auditory ability, defined as the ability of detection, discrimination, recognition and identification of acoustic stimuli, including speech, varies significantly among the users of the cochlear implants (Ivasović, 2002). As in other children with hearing loss, the outcome is affected by numerous factors. Due to significant difference in the outcome, but also in the different characteristics of each individual child, it is necessary to develop individualized PE programs for children with CI in collaboration with the child's rehabilitation team.

Taking into account the nature of hearing impairment treated with a CI, specifics of the device and the characteristics of motor activities performed in PE classes we propose that the activities in the PE class curriculum for Grades 1-8 should be divided into two broad groups:
a) Non - recommended activities and
b) Activities for which it is recommended to remove the processor.
Such division would cover numerous characteristics of children with CI and reduce a potential risk to a minimum. On the other hand, such two-fold pre-made solutions, which are adapted to the specific needs of children with CI, can be proposed to physical education teachers. In this way a child is enabled to actively and successfully participation PE classes and thus to meet the requirements of the curriculum. Through their active participation in PE classes they can themselves contribute to a further development of their motor skills and abilities.

In *non-recommended topics* the main sources of danger are possibility of damage to the device, the risk of software errors caused by electrical discharges and the increased risk of head injury. The basic characteristics of the movement dynamics *in activities for which it is recommended to remove the processor* are one-leg and two-leg successive jumps and negative gravitational position which can cause the magnet to slip off the child's head. In movements which contain one-time jumps the removal of the external processor is not necessary as it is not likely to come off. There is a greater likelihood of releasing the magnet that is fitted to the skull, which, while not being detrimental to the device, can frustrate the child and interfere with the successful performance of the motor action. In such situations, a pupil quickly returns the magnet that has fallen from his head and continues with the execution of the activity, which is considered to be less troubling than the complete removal of the device. The possibility of the magnet falling from the child's head depends on the individual characteristics which differ from child to child: the pressure of the magnet on the scalp, the location of the internal implant, strength of the clasp, compensatory movements of the head to prevent the fall of the magnet, individual subjective psychological tolerance to the fall of the magnet, communication barriers, etc. Due to these circumstances, removal of the processor before performing the curricular activities should be left to the individual decision of the child. The compensation for both groups of activities are adapted motion structures or alternative topics, such as sports games in a controlled environment. The adapted motion structures involve all structures of motion that resemble the basic biomechanical structures, and isolate the aforementioned obstacles for the successful performance of an activity. Secondarily, these are the structures of motion whose execution generates the same influence on the anthropological status of the child.

The main characteristic of sports games in a controlled environment is a technical and tactical task which resembles the realistic situational conditions whilst minimizing the possibility of a direct conflict with a teammate and the possibility of a direct hit to the head with sports equipment. Tables 1 and 2 list the PE activities for Grades 1-8. Table 1shows non-recommended activities and a recommendation for substitute activities, whereas Table 2 lists the activities for which it is recommended to remove the processor.

Table 1. Non-recommended activities and the recommended substitute activities in PH curriculum for Grades 1 to 8.

Grade	Non-recommended activity	Substitute Activity
1	Short rope skipping with both feet in place	Different tasks with a hula hoop
1	Free game with a reduced number of players in the designated area (3:3, 4:4) (S)	Free game with a reduced number of players in the designated area (1:1) (S)
2	Short rope skipping in motion	Different tasks of threading the ball around the body
2	Rhythmical connection of one and two legged leaps	Rhythmical connection of one and two legged forward steps
3	Rhythmical run over obstacles up to 30cm in height	Rhythmic changes in the direction of walking and running
3	Long rope skipping	Different tasks of threading and throwing the ball
3	Free game (H)	Free game with a reduced number of players in the designated area (1:1) (H)
4	Mini-handball	
4	Mini-basketball	Elemental hoop-shooting games (1:1) (B)
4	Mini-soccer	Elemental goal shooting games (1:1) (S)
5	Forward roll in the dominant side	Forward fall
6	Running header without jump (S)	Chest control (S)
7	Shoulder throw technique from kneeling position	Defense – overstepping
8	Fosbery flop	Leaps on elevated mats with three steps of run-up
8	Lateral throw technique with head and arm grip from kneeling position	Counter technique – folding with back arm and torso grip
8	Basketball 3:3 or 5:5	Basketball 1:1

S-soccer; H- handball; B- basketball

Technical Adjustment Using an FM System

There are three basic disruptive factors in speech perception: a distance from the speaker or the source of sound, increased noise level (background noise) and reverberation effect (echo effect). These hindering factors are particularly common in class discussions, class exams, group or project work, teaching in large class, during school breaks or classes held in acoustic spaces (Ivasović, Habel & Ratkajec, 2011). These hindering factors significantly aggravate the process of listening and diminish language comprehension for all the children with hearing loss, including those with CI.

Straining during the listening process leads to a pronounced mental fatigue, prompting children to stop actively following educational content, instructions, etc. Decreased attention and focus caused by fatigue and listening difficulties can frequently lead to poor educational achievements, despite the child's high level of motivation and good learning potential. FM system is a technical aid that helps the pupils with CI understand the teacher and the other pupils in unfavorable listening environments (class/gym/open space). FM system helps achieving a better signal to noise ratio, or more accurately, increases the volume of the speaker's voice while at the same time minimizing the impact of the background noise.

Table 2. Activities in PH curriculum for Grades 1 to 8 for which it is recommended to remove the processor.

Grade	Activities for which it is recommended to remove the processor	Device removal
1	Free run over the obstacles up to 20 cm in height	I-D-R
1	Leaps and jumps over the marked areas	I-D-R
1	Leaps in variable stances along Swedish bench	I-D-R
1	Left and right side rolling	I-D-R
1	Threading in various ways	M-R
2	One and two legged leaps in place, movement with tasks	I-D-R
2	Long jump with a run-up	M-R
2	Leaps on an elevated area up to 40 cm in height, various jumps	I-D-R
2	Backward roll down a slope	I-D-R
2	Handstand wall climb	I-D-R
3	High jump from straight run-up with left and right leg take off	M-R
3	Leap into a crouching press on an elevated area up to 60 cm in height, straight jump	I-D-R
3	Backwards roll	I-D-R
3	Pulls alongside a slope	M-R
3	Side handspring	I-D-R
4	Skips	I-D-R
4	High jump from curved run-up with left and right leg take off	M-R
4	Jumps from a springboard, straight jump	M-R
4	Forward and backwards roll connection, variable	I-D-R
4	Front lever on rings	M-R
5	Back-up rise to handstand on rings	M-R
5	High jump using scissors jump technique	M-R
5	Long jump using hang technique	M-R
5	Tuck jump from springboard	M-R
5	Backward pullover mount on low rungs	I-D-R
5	Handstand alongside a vertical surface	I-D-R
5	Inverted hang on rings	M-R
6	Straddle jump	M-R
6	Hurdles	I-D-R
6	One and a half step long jump	M-R
6	Somersault on a soft mat base	M-R
6	Basic leaps using a mini trampoline	I-D-R
6	Front tuck vault	M-R
6	Forward and side fall	M-R
7	Jump shot (H)	I-D-R
7	High jump using scissors jump technique from a curved run-up	M-R
7	Somersault on a soft mat base using a propelling apparatus	M-R
7	Variants of handspring	I-D-R
7	Back-somersault from a support position on rings or rungs	M-R
8	Leaps using various gymnastics apparatus	I-D-R
8	Half-somersault on an elevated soft mat area using a propelling apparatus	M-R
8	Cossack jump	I-D-R
8	Pirouette, right and left	I-D-R
8	Exercises on the ground	I-D-R
8	Choreography with/without props	I-D-R

M-R = mandatory removal, I-D-R = individual decision to remove the device

The FM system consists of two physically separate parts – a receiver and a transmitter with a microphone. The receiver is carried by a child with hearing impairment, and it is attached to the exterior part of the cochlear implant. The transmitter, a small device resembling a cell phone, is worn around the neck by the speaker (teacher or another pupil – speaker) while holding a presentation, discussing or answering questions. Its wearing is inconspicuous and undemanding. Due to the nature of the device itself, the transmitter must be transferred from speaker to speaker, because otherwise the child with a CI will have extreme difficulty in following the conversation. The directional microphone is located on the transmitter and it is set roughly at a distance of 20 cm from the speakers lips. The speaker's voice is transmitted to the receiver by radio waves and converted into sound amplified by a CI or another type of hearing aid. In order to avoid disturbing sounds and noises, it is important that rustling clothing or items such as a stopwatch or necklaces are not in contact with the transmitter. Upon the completion of the class or during the breaks, when the teacher leaves the class/gym, the transmitter must be removed and shut down so that the child does not receive unwanted signals and background noise. Since the unfavorable conditions for listening, such as increased noise levels, reverberation and acoustic effects are typical for the gym and PE classes, it is recommended to use the FM system whenever possible. Although its application is very simple, the teachers should be informed and trained in the FM system use.

Conclusions

The children with cochlear implants represent a subgroup of children with hearing disabilities. Their SEN, due to a different way of hearing impairment management, differ from the characteristics and needs of other children with hearing disabilities but without a CI.

In the individualization of the PE curriculum attention should be paid to all common features describing a broader group of children with a hearing loss and to all specific features of the children with CI as well as to numerous individual characteristics of each child. Following a thorough review of the existing literature, this paper shows that general and individual traits are based on a complex interaction of diverse factors and that high quality individualization of PE classes can begin only after taking into account numerous general and individual characteristics of a child with CI, individual rehabilitation results, technical features of the device itself and peculiarities of motor movements. Specific guidelines for the individualization of PE classes have been drafted on the basis of integration of various insights and individualization is implemented by adaptation of curriculum contents and teaching strategies and through measures securing a safe training as well as through technical adjustments of teaching with the help of the FM system.

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UČENICI S KOHLEARNIM IMPLANTATOM NA NASTAVI TJELESNE I ZDRAVSTVENE KULTURE: PREGLED ISTRAŽIVANJA I UPUTE ZA IZRADU INDIVIDUALIZIRANIH NASTAVNIH PROGRAMA

Sažetak

Opsežnim pregledom postojeće znanstvene literature dan je uvid u veličinu populacije i različita antropološka obilježja djece s kohlearnim implantatom(CI) koja su uključena u redoviti obrazovni sustav. Prikazane su tehničke osobitosti CI kao i mogućnosti naprednih tehničkih pomagala, poput sustava frekvencijske modulacije(FM) i njegove uporabe u nastavi tjelesne i zdravstvene kulture(TZK). Integracija recentnih spoznaja o različitim obilježjima djece s CI (medicinskim, tjelesnim, komunikacijskim i jezično-govornim), karakteristikama strukture motoričkih gibanja te osobitostima samoga uređaja omogućila je i oblikovanje sveobuhvatnih smjernica za izradu individualiziranih obrazovnih programa za djecu s kohlearnim implantatom u inkluzivnome okružju. Navede će smjernice nastavnicima tjelesnog odgoja omogućiti pripremu za poučavanje djece s kohlearnim implantatom i modifikaciju nastavnih sadržaja i tehnika poučavanja u skladu s individualnim obilježjima učenika i specifičnim edukacijskim potrebama učenika s kohlearnim implantatom. Individualizacija programa TZK ponajviše se ogleda u prilagodbi sadržaja i metoda rada, primjeni mjera osiguranja nastavnoga procesa te u tehničkoj prilagodbi nastave s pomoću FM sustava.

Ključne riječi: *nastavni kurikulum; oštećenje sluha; metode rada, posebne odgojno-obrazovne potrebe*

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