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THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGIES ON CHILDREN'S HEALTH

UTICAJ INFORMACIONIH I KOMUNIKACIONIH TEHNOLOGIJA NA ZDRAVLJE DJECE

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Ključne reči

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Abstract

Introduction: A disbalance between dimensions of school furniture and antropometry of the body is considered to be one of the main reason that leads to discomfort and musculoskeletal disorders in various parts of child's body. Time spent on a computer involves muscular activity of low level in the area of the neck, shoulder girdle and back, which as a consequence can have muscle strain, compression and inflammation of peripheral nerves, as well as reduced blood circulation. **Goal:** To explore the influence of information and communication technologies on children's health through scientific review of literature. **Material and methods:** Non-experimental qualitative research about influence of information and communication technologies on children's health by using relevant databases. **Results and discussion:** The results showed that using modern technology considerably more presents a detriment to children, especially in the field of health than it presents a benefit to them. The most of the authors agreed that the main problems are related to locomot aparat. Inadequate posture while sitting over computer, the children take incorrect positions, that manifest in a bad posture after some time. **Conclusion:** In researching the influence of information and communication technologies on children's health, the outlined evidences based on the discussion of the attitudes and opinions of other authors lead to the conclusion that there is a wide range of harmful consequences on children's health because of an ever-increasing and more frequent use of computers, tablets, consoles and mobile phones.

INTRODUCTION

Information and communication technologies (ICT) are basic, indispensable part of modern society. The use of smartphones among younger generation has suddenly increased. Considering the fact that the children are still physically developing, there are legitimate concerns about long term impact of such exposures on their musculoskeletal health^[1].

New technological progress has inspired new way of compact, portable and personalised ICT devices such as touch-screen smartphones, tablets and computers. Mobile phones

can be useful in a wide range of physical environments at the time of acquiring position range. In other words, everything can be considered as an ICT work environment nowadays^[2]. The studies about the position of school children while using ICT as a work environment were mostly at school. A disbalance between the dimensions of school furniture and the antropometry of the body is one of the main reason that leads to pain and musculoskeletal disorders in various parts of the child's body. There is limited research about postural risks connected with children's IT use at home^[3].

When they are at home, children will probably use their mobile phones to spend their free time and social activities. At home they take several different positions when using ICT, and use information and communication technologies longer than when they are at school [4]. For example, the researches suggests that tablets can speed up preschool education, such as literacy. Unfortunately, we don't know so much about physical consequences during the use of tablets in children [5].

Labaratory studies show extreme angles of the cervical part of the neck spine and a deeper head flexion. The surveys in adolescents show a bigger risk of neck pain, lower part of the spine as well in eyes after a long use of information and communication technologies [6].

Time spent on the computer involves a muscular activity of a low level in the area of the neck, shoulder girdle and back, which has a consequence can have a local muscle tension, a compression and inflammation of the peripheral nerves and a reduced blood circulation. In addition to pain in eyes and locomotor system sedentary way of life that brings modern age causes lower physical activity in children, that brings wide range of chronic diseases during the life. With increased number of children that use mobile ICT devices at home, it is very important to evaluate their influence on body posture, so the appropriate guidelines for healthy use of mobile technologies can be developed [7,8].

The goal of this research was to examine risk factors of the musculoskeletal disorder development connected with a long use of information and communication technologies by reviewing scientific literature.

MATERIAL AND RESEARCH METHODS

The research is a non-experimental (qualitative) research, i.e. a scientific review of literature. In creating this paper, various databases were used, including Pub Med, Google Scholar, Medline, using the keyword "information and communication technologies", "children", "health" and "postural deviations". The research is limited to articles published in the Serbian, Croatian and English languages.

RESULTS

In a research of young children (0-4 years old) from rural areas with a low income in the USA, 97% of children used mobile phones and two-thirds of four-year-old children owned their own tablet [9]. In a research of children in Singapore, over 60% of children from 18 to 24 months use mobile technology every day [10].

Two-thirds of American high school children aged 16-18 years reported that they use their ICT devices more than 4 times a day [11]. The Hong Kong students, 12 to 16 years old, reported that they used computers 2,5 hours per day on average [12]. However, it has been observed that even young children use information and communication technologies. More than a quarter of children, 4 to 6 years old, in the USA use computers 64 minutes a day on average [13], and more than a half of five-year-olds in Australia use computers every week [14].

The abduction of the upper arm during the ICT technology use was 13,6 degrees higher compared to the situations when the ICT technology is not used ($p < 0,001$). The average

elevation of the shoulder was 10,2 degrees higher compared to the situations when the IT technology is not used ($p = 0,001$). The average head flexion during ICT technology use was 18,6 degrees higher compared to new ICT technology ($p < 0,001$) and 16,4 degrees higher compared to the situations when the IT technology is not used ($p < 0,001$). The average torso flexion during the old ICT technology use was 5,7 higher compared with the new ICT technology ($p = 0,011$), while the medium value of lateral torso bending while using the old ICT technology was 1,6 degrees higher when compared with the situations when the ICT technology is not used [4].

In a research in Thailand most smartphones users reported some form of musculoskeletal disorder in the upper part of body: torso flexion (82,74%), shoulder contraction (56,61%), elbow flexion (65,16%), finger and wrist bending (22,40%), hand supination to support the device (21,62%), upper part of the back flexion (67,50%) and lower part of the back flexion (43,23%), that are acquired while using smartphones [15].

The respondents reported that they used smartphones $5,36 \pm 2,48$ year, with the duration of use of smartphones $1,16 \pm 1,36$ hours constantly, in total $6,73 \pm 3,12$ hours per day. The respondents reported mainly sending messages in a sitting position (73,30%) for social networking purposes such as Facebook and Line application (86,70%). In addition, respondents also reported use of other devices (90,00%), especially laptops (63,30%) for which they reported they have used them in previous $5,08 \pm 3,52$ year, used $1,81 \pm 1,21$ hours constantly and in total $3,48 \pm 1,78$ per day. The results of Nordic Questionnaire (SNQ) showed that musculoskeletal disorders are the biggest in the neck (90,00%), than in the shoulder 73,30%, the upper part of the back 63,30%, the wrist 36,70% and the lower part of the back 30,00%. The musculoskeletal disorders were less spread in the hip bone and quadriceps 13,30%, the knee 13,30%, the ankle 10,00% and the elbow 6,70% [16].

The Harris and Straker report that 60% of students has discomfort while using the laptop, and 61% has discomfort while carrying the laptop. Three of the children reported that the pain got worse, moving from 2 to 3 on the VAS scale (Visual Analogue Scale). Other 12% ($n = 8$) did not have any pain at the beginning, but had pain (2 on the VAS) at the end of computer use [17].

Compared with watching TV, while playing on a tablet device children have a bigger torso flexion (median 12,8, 95% CI: 6,2, 19,3, $p < 0,001$), lateral head bending (6,9, 95% CI: 10,5, 2,3, $p = 0,002$), head bending (33,3, 95% CI: 23,4, 43,4, $p < 0,001$) upper arm bending (6,6, 95% CI: 2,2, 11,0, $p = 0,003$) and a bigger medium upper arm abduction (5,9, 95% CI: 1,1, 10,7, $p = 0,016$). Compared with the game Toy, while playing it children have bigger medium torso flexion (9,6, 95% CI: 3,1, 16,2, $p = 0,004$), medium lateral chest flexion left (3,0, 95% CI: 0,2, 5,7, $p = 0,030$), medium head flexion (11,6, 95% CI: 1,6, 21,6, $p = 0,023$), and medium upper arm flexion (11,1, 95% CI: 6,8, 15,3, $p < 0,001$). The muscular activity was bigger while playing with a tablet device than while watching TV (the median distinction of 10,6% of the submaximal contractions 95% CI: 1,6, 19,5, $p = 0,021$), but lower while playing with tablet devices com-

pared with toys (14,9% of the submaximal contractions 95 % CI: 23,8, 6,0, $p \sim 0,001$) [18].

The research in Dublin shows that eight children reported discomfort on the BDC (Body Discomfort Chart) at the beginning of the class before the intervention (VAS 1). Three children reported back pain, one child reported neck pain and four of them reported lower extremities pain. The average intensity of pain was $0,9 \pm 1,5$. Fourteen children reported pain during classes (VAS 2). The most common area of reported pain was in the back ($n=4$). The average intensity of pain that students reported after the class was $1,8 \pm 1,5$. The Wilcoxon test showed a significant difference between the intensity of reported pain in children before and after the class ($p = 0,04$) [19].

The results of Nordic Questionnaire (SNQ) showed that musculoskeletal disorders are the biggest in the neck (90,00%), than in the shoulder 73,30%, the upper part of the back 63,30%, the wrist 36,70% and the lower part of the back 30,00 %. The musculoskeletal disorders were less spread in the hip bone and quadriceps 13,30 %, the knee 13,30%, the ankle 10,00% and the elbow 6,70% [20].

The Jones and Orr study shows that 28%, 40%, and 41% of students reported a discomfort in hands, a neck/back pain and a pain in the body, respectively, after using the computer. The carpal tunnel syndrome was reported by 4% of respondents. The evidence reveals that from 30% to 60% of school children report some form of musculoskeletal discomfort, and they think it got worse by computer use [21].

DISCUSSION

A lot of changes in children's behaviour that parents see, simply show normal distancing that adolescent mostly show when they are teenagers. Computer addiction can be viewed as a phase of intensive computer use and its potential that all IT devices produce. A lot of children will pass this phase and will integrate IT device use in everyday life [2].

The children that use information and communication technologies on different locations can be exposed to risks on their health, especially on locomotor system. More researches are needed to evaluate postural risks among children that use unconventional working surfaces of IT technologies in home environment, with the goal to develop suitable strategies to reduce musculoskeletal problems [3].

IT tasks on paper produced positions that are less natural, but changeable than tasks that are based on electronic. The tasks that are not IT considered positions similar to new IT tasks, but in bigger variation. The variation of muscle activity is similar between the types of IT in the right and left upper trapezius muscle. The tasks that are not IT created more variations of muscle activity in the right forearm extensor group, compared to new and old IT tasks. Different IT tasks create different degrees in posture and muscle activity [4].

Adjusting the height of computer screen and the height of the table resulted in an increase in head tilting, neck flexion, viewing angle, activity of cervical spine and a trend in the activity of the right upper trapezius. Bigger head flexion represents the normative values of children's inclination of the cervical spine [8].

The ergonomic risk in smartphone users and the assessment of connection of pain in musculoskeletal system is high and that is a result of two key factors: body posture and muscle use. The position of the neck, back and lower extremities had a combined effect on the musculoskeletal system of the neck. The results of the RULA test showed that there is a high risk of pain in the musculoskeletal system if the ergonomic measures are not applied [16].

The posture of school children was examined with RULA test, and for marking the place and intensity of pain, body discomfort chart was used (body discomfort chart - BDC) and visual analogues scale was modified (visual analogue scale - VAS). The most of the children adopted positions of unacceptable level while they are working on a computer. The posture deteriorated over time. Bad posture is connected with discomfort. The children that reported discomfort had higher average grade (5,0) than those who didn't report the discomfort (4,4). The type of the computer task influenced the posture of the children. 16% of the children reported pain, especially when using the mouse. These results show that children at the age of 9 can develop musculoskeletal symptoms in the period of computer use for a short time [17].

Experimental research of potential consequences of information and communication technologies use on locomotor system showed that in seven-day record, average daily time that child spend on mobile phone is 85,1 minutes, ranging from 10-161,7 minutes every day. 5 from 10 respondents were familiar with recommendations for an average daily time on IT from 60 minutes. 5 parents stated in the record that they children do not use tablets. From 5 parents that stated that they children use tablets, average use of IT was 153,2 minutes every day. Based on the evidences, it is important to understand that new technologies and its way of use have big differences on children's health [18].

In non-conditioned logistic regression analyses adjusted to the age, gender and race, frequent users of desktop computers (daily or almost daily) had NUE symptoms (neck or upper extremity), i.e. a higher degree of neck and upper extremities pain in contrast with users who used the computer less frequently. Those who used computers for a long time without a break had higher NEU (neck or upper extremity) symptoms. Obesity and wearing glasses or contact lenses also were connected with the symptoms [22].

The research that was conducted by the method of observation, photography and checklist found that from 120 students only 32 (26,67%) were found sitting with their thighs parallel to floor, and 38 students (31,67%) was found with legs standing leaning on the floor, the soles of the feet of 34 girls (56,7%) were on the floor while they were sitting on computer. It was also seen that only 14 students (11,67%) work in recommended angle of the shoulder joint, elbow and wrist. It was very astonishing fact that 104 students (86,7%) had smaller angle from 90 degrees for shoulder, elbow and wrist. As computer use becomes more intense, both at school and at home, the consequences of these disbalance of furniture and children resulting in bad positions can become serious [23].

By means of a quantitative analysis of the sedentary posture in school children, it is confirmed a higher head fle-

xion while carrying a laptop in contrast with a desktop computer. It is also confirmed that head flexion is significantly smaller in younger children compared to older children. The type of IT technology that a child uses to communicate, as well as their age and sex affect the child's posture. The children that were reading from books have a smaller angle of head and flexion while watching compared to reading from a laptop. Reading from a laptop was connected with bigger head bending, neck bending and a bigger angle of watching compared to reading from a desk computer [24].

Epidemiological and laboratory studies showed that children have at least similar risk from musculoskeletal disorders and problems with vision as adults and problems of musculoskeletal system and vision will remain in adulthood. Long time sitting at desk and working on the computer can strain m. trapezius, causing pain and even a headache. Myalgija m. trapezius can be caused by prolonged work at the computer keyboard that is on the table. If m. trapezius is not in adequate position, the muscle can lengthen or shorten and affect blood and oxygen flow. That will lead to muscle fatigue and discomfort, causing pain [25].

The type of the computer task influenced the posture of the children. 16% of the children reported pain, especially when using the mouse. These results show that children at the age of 9 can develop musculoskeletal symptoms in the period of computer use for a short time [26].

The current findings suggest the possibility that a sedentary way of life and low physical activity lead to higher musculoskeletal disorders. Based on the evidences, it is important to understand that new technologies and their use carry a big risk for children's health [27].

Musculoskeletal disorders connected with the use of a child computer are not only a concern for young people, but also affects the potential for higher musculoskeletal disorders in adults [28].

The respondents that usually watched TV till noon and late at night during the weekend have a bigger chance to be intense IT device users. 24% of girls and 10% of boys in the "intense" categories of IT devices were at a higher health risk that can be connected with a metabolic syndrome and cardiovascular diseases [29].

The connection between musculoskeletal disorders, computer working area and keyboard are significant, but suggest that students have higher risk for musculoskeletal disorders without ergonomically designed furniture [30].

Certain computer activities, such as using mouse or joystick, significantly predict musculoskeletal disorders using multiple logistic regression. Many parents confirm that they have difficulties to move children from the computer (46%) and that their children spend less time outdoors (35%) [31].

There is more and more evidence that psychosocial factors connected with home and work environment play the leading role in musculoskeletal disorder development. Psychosocial factors that are connected with musculoskeletal disorders of the upper extremities include: an increase in labour demands, monotonous work, dissatisfaction, low social support and conditions such as depression, stress and anxiety [32].

CONCLUSION

By researching the influence of information and communication technologies on children's health, the outlined evidence from the discussion of the attitudes and opinions of other authors lead to the conclusion that a lot of risk factors affect children's health because of an ever-increasing and more frequent use of computers, consoles, tablets and mobile phones. It can be concluded from this paper that using modern technology considerably more presents a detriment to children in the field of health than it presents a benefit to them.

By a means of a multidisciplinary approach, using ergonomic preventive measures when using computers, different educational content, as well as with various physical activities as a part of various school activities and by following scientific achievements, it will be possible to enable children to have a comfortable, cheerful, painless, and most importantly a healthier way of life while using information and communication technologies as an indispensable factor of modern life.

Sažetak

Uvod: Neusaglašenosti između dimenzija školskog namještaja i antropometrija tijela smatra se glavnim uzrokom koji dovodi do nelagode i mišićno-koštanih tegoba u raznim dijelovima dječjeg tijela. Vrijeme provedeno na računaru uključuje mišićnu aktivnost niskog nivoa u predjelu vrata, ramenog pojasa i leđa, što može imati za posljedicu lokalno naprezanje mišića, kompresiju i upalu perifernih nerava, kao i smanjenu cirkulaciju krvi. **Cilj:** Ispitati uticaj informacionih i komunikacionih tehnologija na zdravlje djece kroz naučni pregled literature. **Materijal i metode:** Neeksperimentalno kvalitativno istraživanje o uticaju informacionih i komunikacionih tehnologija na zdravlje djece u kojem su korištene relevantne baze podataka. **Rezultati i diskusija:** Rezultati su pokazali da moderne tehnologije mogu mnogo više oduzeti djeci, prvenstveno na polju zdravlja, nego što im može donijeti korist njihova upotreba. Većina autora je zaključila da se najveći problemi odnose na lokomotorni aparat. Neadekvatnim položajem prilikom sjedenja za računarom, djeca zauzimaju nepravilne položaje, koji se nakon određenog vremena manifestuju lošim držanjem tijela. **Zaključak:** Istražujući uticaj informacionih i komunikacionih tehnologija na zdravlje djece, navedeni dokazi navode na zaključak da je širok spektar štetnih posljedica na zdravlje djece zbog sve veće i češće upotrebe računara, tableta, konzola za igrice i mobilnih telefona.

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