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DAUGAVPILS UNIVERSITĀTES ZINĀTŅU DAĻA
SCIENCE DEPARTMENT OF DAUGAVPILS UNIVERSITY

DAUGAVPILS UNIVERSITĀTES 63. STARPTAUTISKĀS ZINĀTNISKĀS KONFERENCES RAKSTU KRĀJUMS

PROCEEDINGS OF THE 63rd INTERNATIONAL SCIENTIFIC CONFERENCE OF DAUGAVPILS UNIVERSITY

A. DAĻA. DABASZINĀTNES

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Daugavpils Universitātē docētāju un studējošo zinātniskās konferences notiek kopš 1958. gada. Konferencēm ir starpdisciplinārs raksturs un tajās piedalās gan studējošie, gan docētāji, gan arī ievērojami zinātnieki no dažādām pasaules valstīm. Daugavpils Universitātes 63. starptautiskās zinātniskās konferences pētījumu tematika bija ļoti plaša – dabas, veselības aprūpes, humanitāro un mākslas un sociālo zinātņu jomās.

Zinātnisko rakstu krājumā ***Daugavpils Universitātes 63. starptautiskās zinātniskās konferences rakstu krājums = Proceedings of the 63rd International Scientific Conference of Daugavpils University*** apkopoti 2021. gada 15.–16. aprīlī konferencē prezentētie materiāli.

Daugavpils Universitātes 63. starptautiskās zinātniskās konferences rakstu krājums tiek publicēts 3 daļās: A. daļa. *Dabaszinātnes*; B. daļa. *Sociālās zinātnes*; C. daļa. *Humanitārās zinātnes*.

The annual scientific conferences at Daugavpils University have been organized since 1958. The themes of research presented at the conferences cover all spheres of life. Due to the facts that the conference was of interdisciplinary character and that its participants were students and outstanding scientists from different countries, the subjects of scientific investigations were very varied – in the domains of natural sciences, health care sciences, humanities and art, and social sciences.

The results of scientific investigations presented during the conference are collected in the collection of scientific articles ***Proceedings of the 63rd International Scientific Conference of Daugavpils University.***

Proceedings of the 63rd International Scientific Conference of Daugavpils University are published in three parts: part A. *Natural sciences*; part B. *Social Sciences*; part C. *Humanities.*

SATURS / CONTENTS

VESELĪBAS APRŪPES ZINĀTNE / HEALTH CARE SCIENCE

VESELĪBAS APRŪPES ZINĀTNE / HEALTH CARE SCIENCE

IMPACT OF DIFFERENT SKIN DISINFECTANTS ON THE SKIN HYDRATION LEVEL

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Abstract

Impact of different skin disinfectants on the skin hydration level

Key Words: skin hydration, skin disinfectants, glycerine, hyaluronic acid, dermatology

Objectives: Hand-hygiene and skin disinfection has become one of the main measures to slow down the spread of the COVID-19. However, alcohol-based skin disinfectants may weaken the skin barrier function inducing skin dryness, promoting eczema and therefore decrease the compliance. Skin damage due to intensive hand hygiene measures during the COVID-19 pandemic has been reported (Erdem et al., 2020). The objective of this study is to evaluate impact of different skin disinfectant formulations in the form of sprays and gels on the skin hydration level.

Materials and methods: Volunteers (N = 16) applied 4 different skin disinfectants on certain areas of the forearm 5 times over the 24 hours period: spray A (with glycerine), spray B (without glycerine), gel A (with hyaluronic acid), gel B (without hyaluronic acid). Upper arm was untreated and used as a site for the control measurements. Instrumental assessment to evaluate skin hydration level was performed using Corneometer® on the forearm and upper arm area before, 1 hour and 24 hours after the first application. Between-group differences were assessed by independent T-test. P value < 0,05 was considered statistically significant.

Results: Statistically significant increase in skin hydration level 24 hours after first application was observed in the area with spray A application (12,36 %, SD = 18,08) compared to the area with spray B application (-3,14 %, SD = 22,24), p = 0,039. Statistically significant increase in skin hydration level 1 hour after first application was observed in the area with spray A (22,91%, SD = 31,65) application compared to the control area (3,79%, SD = 16,41), p = 0,043.

Conclusions: Spray A (with glycerine) application improves skin hydration level immediately after 1 hour compared to the untreated area and after 24 hours compared to the spray B (without glycerine) therefore use of it could enhance compliance with skin disinfection and reduce skin damage.

Kopsavilkums

Dažādu ādas dezinfekcijas līdzekļu ietekme uz ādas hidratācijas līmeni

Atslēgvārdi: ādas hidratācija, ādas dezinfektanti, glicerīns, hialuronskābe, dermatoloģija

Ievads: Roku dezinfekcija un higiēnas ievērošana ir kļuvusi par vienu no svarīgākajiem līdzekļiem, kā apturēt COVID-19 izplatību. Spirta bāzes ādas dezinfekcijas līdzekļi var mazināt ādas barjeras funkciju, radot ādas sausumu, veicinot ekzēmas attīstību un tādējādi mazinot līdzestību to lietošanā. Pētījumos ir ziņots par ādas bojājumiem intensīvās roku higiēnas dēļ COVID-19 pandēmijas laikā (Erdem et al., 2020). Šī pētījuma mērķis ir novērtēt dažādu ādas dezinfekcijas līdzekļu, spreju (šķīdumu) un želeju formā, ietekmi uz ādas hidratācijas līmeni.

Materiāli un metodes: Brīvprātīgie (N = 16) aplicēja 4 dažādus ādas dezinfekcijas līdzekļus noteiktos apvidos uz apakšdelmu ādas piecas reizes 24 stundu laikā: spreju A (satur glicerīnu), spreju B (bez glicerīna), gēlu A (satur hialuronskābi), gēlu B (bez hialuronskābes). Augšdelma āda, kur netika uzklāti līdzekļi, kalpoja par apvidu kontroles mērījumiem. Instrumentālais novērtējums ādas hidratācijas pakāpes noteikšanai tika veikts, izmantojot Corneometer® uz apakšdelma un augšdelma ādas pirms, 1 stundu un 24 stundas pēc pirmās dezinfekcijas līdzekļu aplikācijas. Procentuālās hidratācijas pakāpes izmaiņas starp kontroles un pētāmo apvidu, kur tika aplicēts dezinfekcijas līdzeklis, tika analizētas ar neatkarīgo izlašu T-testu. P vērtība < 0,05 tika uzskatīta par statistiski ticamu.

Rezultāti: Statistiski ticami izteiktāks hidratācijas pakāpes pieaugums 24 stundas pēc pirmās aplikācijas tika novērots apvidū, kur aplicēts sprejs A (12,36 %, SD = 18,08) salīdzinot ar spreju B (-3,14 %, SD = 22,24), p = 0,039. Statistiski ticami izteiktāks hidratācijas pakāpes pieaugums 1 stundu pēc pirmās aplikācijas tika novērots apvidū, kur aplicēts sprejs A (22,91%, SD = 31,65) salīdzinot ar kontroles apvidu (3,79%, SD = 16,41), p = 0,043.

Secinājumi: Spreja A (satur glicerīnu) aplikācija uzlabo ādas hidratācijas pakāpi 1 stundu pēc aplikācijas salīdzinot ar ādu, kas nav saņēmusi spreja A aplikāciju, kā arī pēc 24 stundam salīdzinot ar spreju B (nesatur glicerīnu), līdz ar to spreja A lietošana varētu veicināt līdzestību, izmantojot ādas dezinfekcijas līdzekļus, un samazināt ar to saistīto ādas bojājumu.

Introduction

COVID-19 (Coronavirus Disease-2019) pandemic with more than 162 million confirmed cases as of 17 May 2021 (WHO Coronavirus (COVID-19) Dashboard) has been global public health concern for more than a year now and has led to extensive use of hand disinfectants given its contagious nature. Together with face masks and social distancing, appropriate hand hygiene is one of the cornerstones preventing the transmission of the infectious agents and spreading of the disease (Jing et al., 2020).

Proper hand hygiene is one of the essential infection control strategies. Hand hygiene measures include handwashing and use of hand sanitizers. Hand disinfectants are commercially available in various types and forms. Regarding types of delivery systems skin disinfectants have been formulated as gels, foams, creams, sprays and wipes (Jing et al., 2020).

Most effective hand sanitizer products are alcohol-based formulations containing 62%–95% of alcohol due to their ability to denaturate the proteins of microbes and inactivating viruses, by dissolving the lipid membranes (Jing et al., 2020). Nevertheless, there are some concerns with regard to this formulation in terms of skin toxicity due to high alcohol content (Erasmus set al., 2010). Frequency of hand disinfection and associated adverse skin reactions following the extensive use of hand sanitizers have increased significantly among health care workers after the COVID-19 outbreak (Guertler et al., 2020).

Skin is the first line of defence against microorganisms. It provides protection against external environment and prevents excessive loss of water from the body. The barrier function of the skin primarily is provided by the uppermost epidermal layer – *stratum corneum* (Jing et al., 2020). Hydration of the skin is an important indicator for the maintenance of a proper skin barrier function (Milani et al., 2017).

Stratum corneum and its ability to attract water has a vital role providing skin hydration. Daily skincare, comorbidities, drugs, local pH change and environmental factors (humidity, temperature, ultraviolet radiation) can affect *stratum corneum*, induce damage and therefore impair its ability to maintain proper hydration level. Skin can become dry, rough and loose it's radiance (Baumann et al., 2019). Main pathophysiological mechanisms responsible for the development of dry skin include loss of intercellular lipids (ceramides) and loss of natural moisturising factor which possess the ability to attract water (Jungersted et al., 2008; Rawlings et al., 2005).

If the skin barrier function is impaired, skin may lose the ability to attract the water which can lead to skin dehydration. Impaired skin barrier function is characterised by the transepidermal water-loss (TEWL) which results in reduced level of water in *stratum corneum* and altered keratinocyte desquamation. Clinically it manifests as skin dryness and roughness. Also, if the skin barrier is weakened microorganisms, allergens and irritants may reach the dermis more easily and

this may lead to development of eczema, contact dermatitis and atopic dermatitis (Baumann et al., 2019).

The most commonly reported skin reactions with the use of alcohol-based hand sanitizers are irritant contact dermatitis and allergic contact dermatitis which manifest with dryness, pruritus, erythema and bleeding (Jing et al., 2020). Skin disinfectants may damage skin through several mechanisms: denaturation of the stratum corneum proteins, alteration of intercellular lipids, decrease in corneocyte cohesion and reduction of stratum corneum water-binding capacity (Löffler et al., 2007).

Drying and irritant effects of alcohol-based skin disinfectants may reduce the compliance. The adverse effects associated with the use of skin disinfectants can be prevented by selecting products with a less irritating agents and moisturizing skin after hand sanitation (Jing et al., 2020). Alcohol-based skin disinfectant formulations containing humectants or emollients can be used to reduce the drying effect of alcohol (Kantor et al., 2017; Rotter, 2001). Glycerine and hyaluronic acid and are well-known substances able to improve skin hydration level (Milani et al., 2017).

Glycerine is safe and relatively inexpensive humectant which increases the skin water content and therefore improve the recovery of the skin barrier function (Tasar et al., 2021). It affects the viscosity of the formulation while providing moisturization of the skin. Important to note that in excessive amount it may reduce the germicidal activity of the alcohol (Villa et al., 2021). Glycerine addition to alcohol-based skin disinfectant formulations has been recommended by World Health Organisation (WHO, 2010) and European Academy of Dermatology and Venereology Task Force on Contact Dermatitis (Balato et al., 2020).

Hyaluronic acid is a naturally occurring linear polysaccharide composed of disaccharide units containing N-acetylglucosamine and glucuronic acid. It is one of the main constituents of the extracellular matrix and possesses a large water-binding capacity having the ability to bind 1000 times of its volume in water (Allemann et al., 2008), therefore it is responsible for hydration of the skin and increases its moisture content. It is known that ageing is associated with progressive decline in epidermal concentration of hyaluronic acid (Neudecker et al., 2000). Additionally, to hyaluronic acid's hydration properties it also has been found as a beneficial agent in wound healing and inflammatory processes. *In vivo* and *in vitro* studies has demonstrated its ability to affect the cell signalling process thereby regulating cell growth, differentiation, adherence, and collagen synthesis (Surazynski et al., 2009). *In vitro* it has been shown that ethanol downregulated collagen metabolism in skin fibroblast (Donejko et al., 2015) therefore adding hyaluronic acid to alcohol-based disinfectant formulations may potentially reduce alcohol induced adverse effects.

The objective of this study is to evaluate impact of different skin disinfectant formulations in the form of sprays and gels on the skin hydration level.

Materials and Methods

Volunteers (N = 16) applied 4 different skin disinfectants on certain areas of the forearm 5 times over the 24 hours period: spray A (with glycerine), spray B (without glycerine), gel A (with hyaluronic acid), gel B (without hyaluronic acid). Upper arm was not treated and used as a site for control measurements.

Instrumental assessment to evaluate skin hydration level was performed using Corneometer$^{®}$ CM 825 (Courage & Khazaka, Germany) which measures the change in the dielectric constant due to skin surface (*stratum corneum*) hydration changing the capacitance of a precision capacitor.

Measurements were made on the forearm and upper arm area before, 1 hour and 24 hours after the first application. On every assessment each area was measured 3 times and the mean value was used for the data analysis. Throughout all the assessments room temperature of $22 - 23°$ C and relative air humidity level of $40 - 60$ % was maintained. Volunteers were resting prior to the measurements for 20 min in the climatized room.

Between-group percentual changes were assessed by independent T-test. P value $< 0,05$ was considered statistically significant.

Results

Statistically significant increase in skin hydration level 24 hours after first application was observed in the area with spray A application (12,36 %, SD = 18,08) compared to the area with spray B application (-3,14 %, SD = 22,24), p = 0,039 (figure 1).

Statistically significant increase in skin hydration level 1 hour after first application was observed in the area with spray A (22,91%, SD = 31,65) application compared to the control area (3,79%, SD = 16,41), p = 0,043 (figure 2).
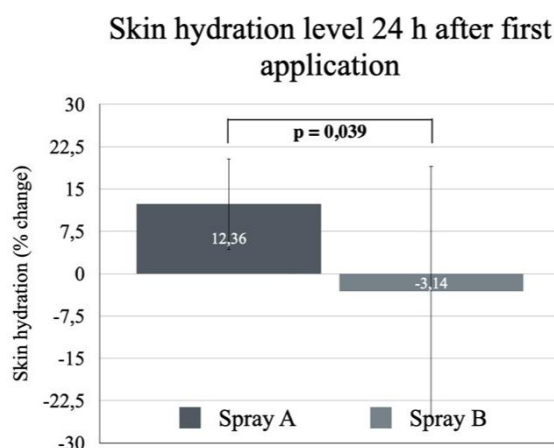
Figure 1. **Percentual changes of the skin hydration level 24 hours after first application with spray A (with glycerine) and spray B (without glycerine)**

9
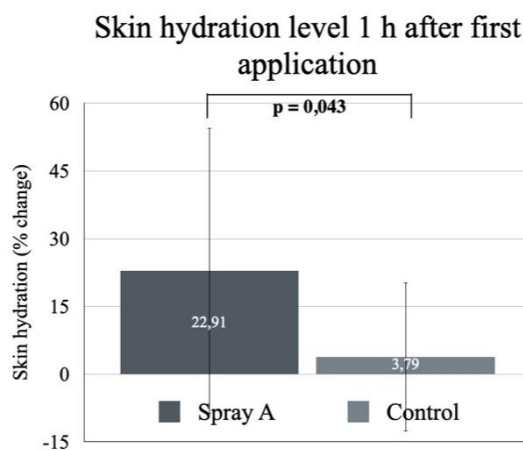
Figure 2. **Percentual changes of the skin hydration level 1 hour after first application with spray A (with glycerine) and non-treated control area**

Discussion

Hand hygiene has crucial importance in prevention of spreading the infections and COVID-19 pandemic has emphasised this. Even though alcohol-based skin disinfectants are proven to be effective tool to break the chain of transmission of the pathogens, lack of acceptance and low compliance have been found due to the excessive drying effect (Tasar et al., 2021). Therefore, it is important to find compromise in skin disinfectant formulations to stop the transmission of pathogens meanwhile maintaining adequate skin barrier function and keeping the skin healthy. Skin hydration is a crucial component in maintaining a healthy skin (Milani et al., 2017). The aim of this study was to evaluate how different skin disinfectant formulations can impact skin hydration level.

Statistically significant increase in skin hydration level 24 hours after first application was observed in the area with spray A application (with glycerine) compared to the area with spray B (without glycerine) application and 1 hour after first application compared to the non-treated control area. Our results are in accordance with findings of other researchers as glycerine as a potent humectant has demonstrated similar effects in different studies.

Topical glycerine has shown improvement of skin hydration in an aquaporin-deficient mouse skin model (Hara et al., 2003). Houben et al examined skin tolerance to six alcohol-based hand gels applied in the forearm area containing different concentration of glycerine. Hydrating effects were more striking for the gels with an elevated glycerine concentration (Houben et al., 2006).

Pittet et al tested the skin tolerability and user acceptability of three alcohol-based formulations and found that there was a higher tolerance and skin condition improvement with formulations containing glycerine, while formulation containing isopropyl myristate caused more dryness and irritation (Pittet et al., 2007). Results were measured by visual assessment of skin integrity as well as by questioners made to the study group participants. These findings may indicate improved skin barrier function as it has been concluded that glycerine accelerates the

recovery of the skin barrier function acting as barrier stabilizing and moisturizing compound (Rawlings et al., 2005).

The determinants of *stratum corneum* water content are believed to include the water permeability of the epidermis, the water-retaining properties of the *stratum corneum*, and the rate of evaporative loss from the skin surface (Hara et al., 2003). TEWL is observed higher in skin with weakened barrier function and correlates with decreased skin hydration level. In our study we measured skin hydration level, but it may indirectly indicate the state of the skin barrier function. As the hydration level was improved with the application of skin disinfectant containing glycerine, we could assume that the TWEL was reduced, and addition of glycerine has improved the skin barrier function.

Although hyaluronic acid possesses hydration properties in our study, we didn't observe statistically significant improvement in hydration level of the skin treated with skin disinfectant in the form of gel with added hyaluronic acid. Polaskova et al have found that differences exist among the tested active ingredients, like glycerine and hyaluronic acid, in their ability to moisturize the skin and these differences are dependent not only on the type and concentration of the active substance used but also on the type of vehicle in which they are applied – gel or emulsion. Emulsions demonstrated better skin hydration effected compared to the gel formulations (Polaskova et al., 2015). As glycerine was formulated in the form of spray and hyaluronic acid in a form of gel this could also make an impact on hydration effect.

Ethanol may induce cytotoxicity in skin cells by enhancing the effects of pro-inflammatory cytokines. *In vitro* hyaluronic acid has reduced the amount of pro-inflammatory cytokines released into the media both in human A431epidermoid skin cells and in mouse fibroblasts (Neuman et al., 2011). It also has a role in keratinocyte proliferation, which is essential in normal epidermal function and during reepithelialisation in tissue repair (Papakonstantinou et al., 2012). These findings may indicate hyaluronic acid's beneficial use as an additive in alcohol-bases skin disinfectants, but more studies have to be conducted.

The main limitation of our study was the small study sample. Also study length could be prolonged evaluating skin hydration level changes over weeks. Additionally, to better evaluate skin barrier function measurements of TEWL could be made and visual evaluation of the skin could be done by taking photographs. Main advantage of the study methods used was the fact that outcomes were determined in an objective manner by means of instrumental device, in non-invasive manner, which was cost-effective, quick and gave reproducible results.

Conclusions

Spray A (with glycerine) application improves skin hydration level immediately after 1 hour compared to the untreated area and after 24 hours compared to the spray B (without glycerine)

therefore use of alcohol-based skin disinfectant containing glycerine could enhance compliance with skin disinfection, modulate behaviour around hand hygiene improving frequency of hand disinfection, and reduce skin damage, possibly by regeneration of the skin barrier.

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DOMINANT HAND TEMPERATURE CHANGES RELATED TO COMPUTER MOUSE PAD DESIGN AND BODY MASS INDEX DURING PROLONGED SEDENTARY WORK

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Abstract

Dominant hand temperature changes related to computer mouse pad design and body mass index during prolonged sedentary work

Key Words: *body mass index (BMI), computer mouse pad, ergonomics, sedentary behaviour, wrist hypothermia*

Introduction. Prolonged sitting has been associated with the impairment of microvascular dilator function of the upper limbs with a decrease in blood flow. Ergonomic mouse pad including wrist support could minimize the risk of health disturbances related to impaired blood supply in hands while working with computer.

The aim of this study was to explore an association between body mass index (BMI) and wrist surface temperature in dominant hand while using 4 different types of computer mouse pads.

Material and methods. 4 volunteers, sedentary occupation workers with their dominant right hand were selected. Each volunteer was asked to work with four different mouse pads on different days for three continuous hours. The skin surface temperature of the right wrist was measured with high-resolution medical digital infrared camera *ICI ETI 7320 Pro* at the start and after every 15 minutes of the experiment. Temperature changes were evaluated in association with BMI of study participants.

Results. Wrist surface temperature decreased in all participants, regardless of BMI, however at different paces. A strong correlation with BMI and wrist temperature was found when using Wristband2 ($r_s = 0.701$, p<0.01), slightly weaker positive correlation – for Wristband1 ($r_s = 0.484$, p<0.01) and standard mouse pad ($r_s = 0.499$, p<0.01), while strong negative correlation ($r_s = -0.808$, p<0.01) was found in a person with the lowest BMI (21.9). On the contrary, no correlation was found between the average temperature of the right wrist surface and volunteer with the highest BMI (31.2).

Conclusions. Higher BMI is associated with higher wrist surface temperature when using a computer mouse for prolonged periods. Low BMI is associated with faster and more prominent decrease in wrist surface temperature due to a thinner fat heat-insulating layer. Mousepad design is associated with extent of changes in wrist surface temperature.

Kopsavilkums

Atslēgvārdi: *datorpeles paliktnis, ergonomika, ķermeņa masas indekss (ĶMI), mazkustīga uzvedība, plaukstas hipotermija*

Ievads. Ilgstoša sēdēšana tiek saistīta ar augšējo ekstremitāšu mikrovaskulārās dilatācijas traucējumiem, tādējādi samazinot asins cirkulāciju rokās. Ergonomisks datorpeles paliktnis ar plaukstas locītavas balstu varētu samazināt darba pie datora izraisīto veselības traucējumu risku, kas saistīti ar samazinātu asinscirkulāciju.

Mērķis bija izpētīt saistību starp ķermeņa masas indeksu (ĶMI) un dominējošās rokas virsmas temperatūras izmaiņām, izmantojot 4 dažāda dizaina datorpeles paliktņus.

Materiāli un metodes. Pētījumam tika atlasīti 4 brīvprātīgie, mazkustīga darba veicēji ar dominējošo labo roku. Katram brīvprātīgajam tika lūgts trīs stundas ilgi nepārtraukti strādāt ar datoru, izmantojot dažādās dienās četrus atšķirīga tipa datorpeles paliktņus. Labās plaukstas locītavas ādas virsmas temperatūra tika mērīta ar augstas izšķirtspējas medicīnisko digitālo infrasarkano staru kameru *ICI ETI 7320 Pro* sākumā un pēc katrām eksperimenta 15 minūtēm. Izmaiņas temperatūrā tika vērtētas saistībā ar dalībnieku ĶMI.

Rezultāti. Plaukstas virsmas temperatūra samazinājās visiem dalībniekiem neatkarīgi no ĶMI, tomēr ar dažādu ātrumu. Izmantojot Wristband2, tika atrasta cieša korelācija starp ĶMI un plaukstas virsmas temperatūru ($r_s = 0,701$, p < 0,01), mērena pozitīva korelācija – izmantojot Wristband1 ($r_s = 0,484$, p < 0,01) un standarta datorpeles paliktni ($r_s = 0,499$, p < 0,01), bet cieša negatīva korelācija – dalībniekiem ar mazāko ĶMI ($r_s = -0,808$, p < 0,01). Savukārt korelācija starp labās plaukstas virsmas temperatūru un dalībnieku ar augstāko ĶMI (31.2) netika atrasta.

Secinājumi. Augstāks ĶMI ir saistīts ar augstāku plaukstas virsmas temperatūru, ilgstoši lietojot datorpeli. Zems ĶMI ir saistīts ar ātrāku un izteiktāku plaukstas virsmas temperatūras pazemināšanos, ko izraisa plānāks zemādas tauku siltumizolējošais slānis. Datorpeles paliktņa dizains ir saistīts ar rokas virsmas temperatūras izmaiņu izteiktību.

Introduction

These days, we spend a lot of time on computer and other gadgets. Especially now, when our world has been changed by recent events due to pandemics, a lot of work is done on the computer and office work is transferred to the home environment and may not be as comfortable and ergonomically correct as possible. Working at a computer is mostly sedentary, keeping static posture and performing minimal movements, not requiring a lot of energy (Toomingas *et al.*, 2012). A sedentary lifestyle is known to be associated with many diseases such as diabetes, obesity, cardiovascular and musculoskeletal disorders (MSDs) (Toomingas *et al.*, 2012; Martínez-González *et al.*, 1999; Thorp *et al.*, 2011; Salmon *et al.*, 2011).

MSDs are typical for such professionals as journalists, typists, bank employees, secretaries, etc. Important to notice that wrist, hand, and finger joints in such work are most involved (Ramos *et al.*, 2020). Many studies investigated the appearance of MSDs have shown that prolonged work at the computer for three hours or more a day increased the risk of development of symptoms and diseases (Gerr *et al.*, 2002; Tornqvist *et al.*, 2009; Arvidsson *et al.*, 2008). Prolonged sedentary work without performing regular active rest reduces the microcirculation of blood in the hand, which, as a long-term outcome, can result in the previously mentioned health conditions (Toomingas *et al.*, 2012; Martínez-González *et al.*, 1999; Restaino *et al.*, 2015; Menéndez *et al.*, 2008; Thosar *et al.*, 2015). Every day, more and more ergonomic designs are invented on the market to make the workplace more comfortable and possibly reduce the formation of symptoms, injuries, and diseases (Reste *et al.*, 2015; Meijer *et al.*, 2006; Conlon *et al.*, 2008; Liu *et al.*, 2016).

A previous pilot study, the methodology of which we used in the current study, showed statistically significant differences in hand temperature by changing the hand position, using different computer mouses, i.e., changing ergonomic scenarios (Reste *et al.*, 2015). In this study, we used different types of mouse pads to observe the temperature dynamics. Thermography was the method for determining the temperature of the wrist. This method accurately detects skin temperature, is non-contact, and is widely used in MSD diagnosis (Ramos *et al.*, 2020; Reste *et al.*, 2015; Tirloni *et al.*, 2017; Ring *et al.*, 2012; Baritz *et al.*, 2013).

The aim of the study was to investigate wrist temperature changes in relation to volunteer BMI and design of computer mouse pads. In current study we test the hypothesis that the temperature of the dominant hand will be decreased after continuous work with a computer mouse while an ergonomically designed mouse pad might minimize the extent of temperature changes.

Material and Methods

Four healthy volunteers (2 males and 2 females) of age 24–42 years were selected for this study. The participants were chosen according to the following criteria: non-smokers, right-handed, without any musculoskeletal disorder, occupation required mainly continuous sedentary work with

a computer. Exclusion criteria were smoking, regular use of medications, fever, any pain in wrist or forearm. Participation in this trial was voluntary, all the participants were informed about the aim and course of the study and signed informed agreement. All the data received were processed and stored in anonymous way. The study was approved by the ethics committee of Rīga Stradiņš University.

Four different computer mouse pad designs were chosen for the trial. Three of them were designed as a band around the wrist (see Fig.1) with gel or harder material structure stuffed inside for wrist support. Individual size was chosen for each participant using a wristband like mouse pad. For study needs, original manufacturer name of each wristband type mouse pad was changed to an identification name with a number. Originally 'Uppo' named as Wristband1, 'Wrist Donut' named as Wristband2 and 'Duopad' named as Wristband3. Fourth mouse pad designed as a flat mat with a gel padding on one side. This mouse pad design is further named as 'Standard mouse pad'. The stand with the infrared camera was fixed on a stable table perpendicular to the participant's right wrist with the distance of 135 cm between. The participant was seated at the table in front of the camera in a comfortable, adjustable chair to work continuously for 3 hours. Right hand was placed horizontally on the table and participants were asked to surf the internet, imitating daily work on a computer. During that time no food or liquid consumption were allowed, participants visited the restroom in advance.

Figure 1. **Mouse pad designs tested in the study (photos made by author A. Grigorjeva)**

The wrist skin surface temperature of the participant's dominant hand was measured by a high resolution digital infrared thermal camera *ICI ETI 7320 Pro*, using manufacturer supplied, specialized imaging analysis software IR Flash Medical Version 2.14.14.4. (Infrared Cameras Inc.).

Camera's measurement sensitivity is 0.027°C, with spectral response of 8-14μm and video updating rate of 60 Hz (16 bit digital). To exclude any effects from the environment, the laboratory setting was under controlled conditions with mean air temperature 22.9 ± 0.38 °C, air flow velocity 0.03 ± 0.01 m/s and mean air humidity 31.3 ± 4.1 %. The microclimate conditions measured by a Testo 400 precision multifunction measuring device. Before the trial, each participant went through a thermal acclimatization period of 15 min. The methodology and materials used in this study were identical to the pilot study (Reste *et al.*, 2015).

There were no additional sources of heat or cold neither on the table, nor from the environment. Before every trial and after, images of the right and left forearm and wrist with the infrared camera were taken. Thermal imaging was done every 15 minutes during 3 hours. The trial was repeated with the same person on four different days using four different mouse pad designs.

After the trial, data of wrist skin measurements were collected and analysed by IR Flash Medical program Version 12 2.14.14.4. For this study, the dorsal surface of right wrist at the level of metacarpals was chosen as the main region of interest to calculate mean temperature. Next, all the calculated data were entered into Microsoft Excel program and transferred to the statistical analysis program IBM SPSS Statistics Version 27.0. For this data analysis, Spearman's correlation coefficient was calculated. Correlation between mean temperature of participant's right wrist dorsal surface and BMI was calculated, in parallel analysing the effect of different types of computer mouse pads. BMI was calculated for every study participant by formula BMI (kg/m^2) = weight (kg) / (height $(m))^2$. Each participant was identified by a number. Accordingly, participant's identification ID = 1, ID = 2, ID = 3, and ID = 4 was used. BMI of each participant ranged from 21.9 to 31.2 kg/m^2: respectively BMI for ID = 1 was 31.2, for ID = 2 − BMI 25.0, for ID = 3 − BMI 21.9, and for ID = 4 it was 25.3.

Results

In this study, two males and two females took part. As previously mentioned, their BMI was calculated, and their age varied from 24 to 42 years. Main interests of the study were not only wrist surface temperature dynamics and BMI, but also temperature changes caused by different mouse pad designs.

Current study has shown a decrease in temperature of the right hand in all four participants after continuous work with a computer mouse. The initial temperature of the wrist surface did not differ significantly in most of the participants, but overall, it was noticed that the mean temperature of wrist skin surface across the trials differed between the participants (p<0.001). Changes in temperatures can be seen and compared between mouse pad types in Figure 2. The lowest mean temperature of the right wrist was observed using Wristband1 mouse pad and the mean initial

temperature was 1°C lower than with the other three mouse pad types. Less prominent temperature decline during all the trials was seen using Standard mouse pad.

A moderate statistically significant negative correlation was observed between wrist skin surface temperature and time using Wristband1 mouse pad (Spearman's correlation coefficient $r_s = -0.486$, p<0.01), a Wristband2 mouse pad ($r_s = -0.533$, p<0.01) and a Wristband3 mouse pad ($r_s = -0.422$, p<0.01). In case of standard mouse pad, only weak negative correlation between wrist surface temperature and time was observed ($r_s = -0.318$, p<0.05). These results revealed that wristband type mouse pads have a more prominent decrease of wrist temperature over time than using a standard mouse pad with a gel base.
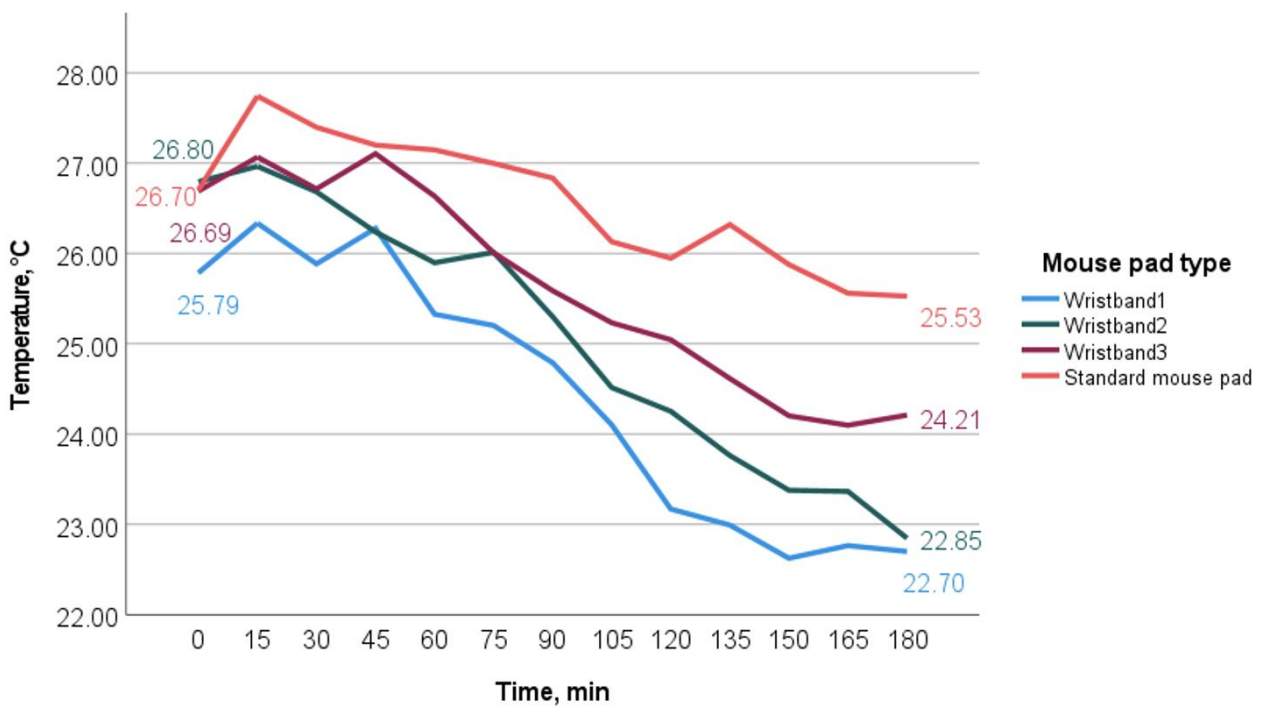
Figure 2. **Dynamics of mean wrist skin temperature over time using four different mouse pad designs**
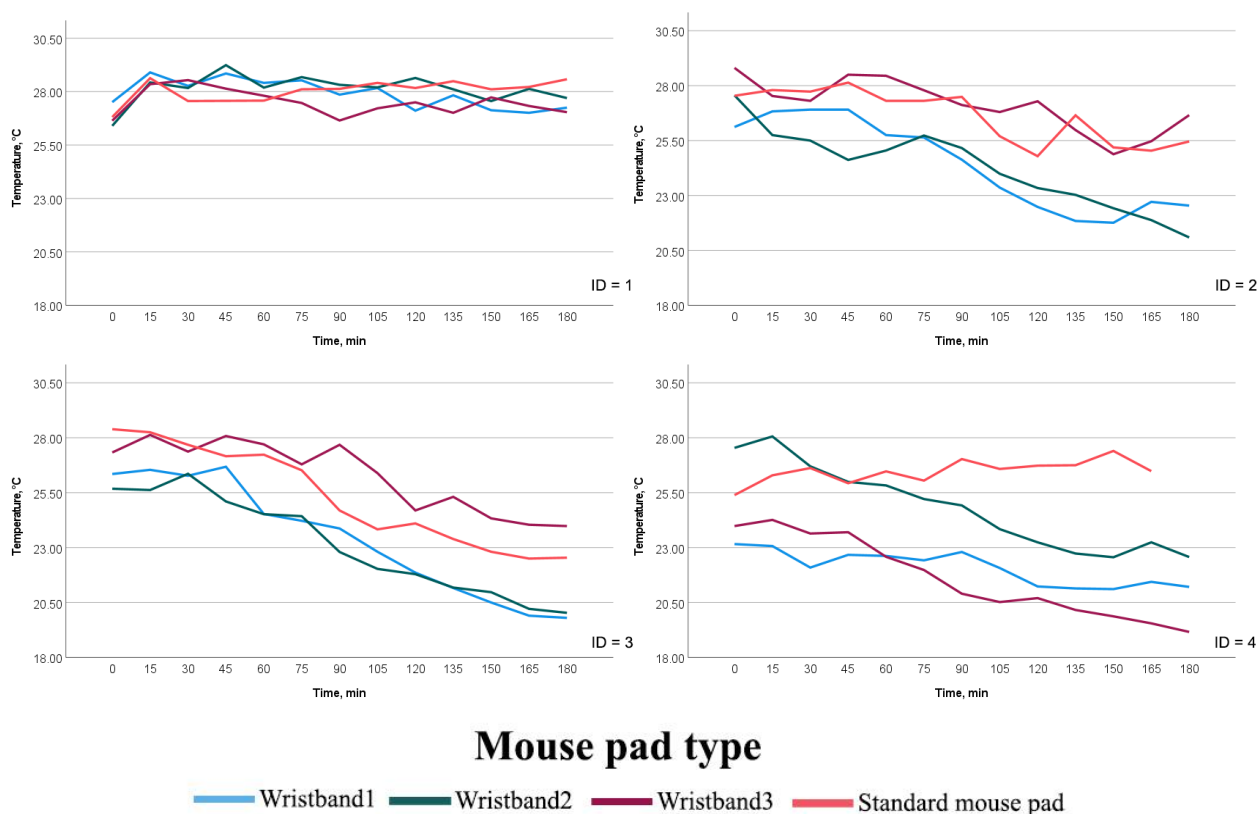
Figure 3. **Individual changes of wrist skin temperature over time using different mouse pad designs in each participant separately**

Evaluating results individually in every participant (see Fig. 3), largest differences were found in relation to BMI. Among the four participants, using different types of mouse pads over a three-hour period, it was observed that wrist skin surface temperature of the first participant (ID = 1) has not changed significantly. This perceptible difference could be explained by the fact that ID = 1 had the highest BMI (31.2) and it can be related to a thicker fat insulating layer. For comparison, in the participant ID = 3, whose BMI was the lowest (21.9), there was a significant wrist skin temperature decrease, most prominent during the 120–180 minutes. In the case of ID = 3, skin temperature significantly lowered during all four mouse pad trials. It might be related to a thinner fat insulating layer, thus causing more pronounced temperature loss.

Evaluating minimal temperature, it is worth to mention, that the lowest temperature after 3 hours 17.7°C was observed in the fourth participant (ID = 4, BMI = 25.3), while using the Wristband3 mouse pad. In this case, the wrist skin temperature was 4.92°C lower than the air temperature.

Analysing the relationship between BMI and mean wrist surface temperature across all study participants, while using different types of mouse pad, some differences were observed as well. In case of Wristband1, a moderately strong positive correlation between BMI and wrist temperature was found (r_s = 0.484, p <0.01). For Wristband2, there was a statistically significant strong

correlation (r_s = 0.701, p <0.01). While correlation was not found using the Wristband3 mouse pad. Also, for the standard mouse pad a moderately strong positive correlation between BMI and wrist mean temperature was found (r_s = 0.499, p <0.01). Opposite, a strong negative correlation (r_s = − 0.808, p <0.01) was found in case of participant with the lowest BMI (ID = 3, 21.9). On the contrary, no correlation was found in participant with the highest BMI (ID = 1, 31.2).

By visual reviewing and comparison of digital infrared images, notable wrist compression and mean wrist temperature drop was observed in all three types of bands like mouse pad trials. The highest compression was noticed using Wristband2 and the mean temperature drop after three hours was 3.9°C (see Figure 4). These vastly different results could be explained by the Wristband2 filling material properties distinguished by its low elasticity and hard filled material, which made it difficult to adapt the wristband shape to the individual shape of participant's hand and computer mouse usage habits. Moreover, all study participants noticed discomfort from compression and numbness of the right hand during the three-hour trial.
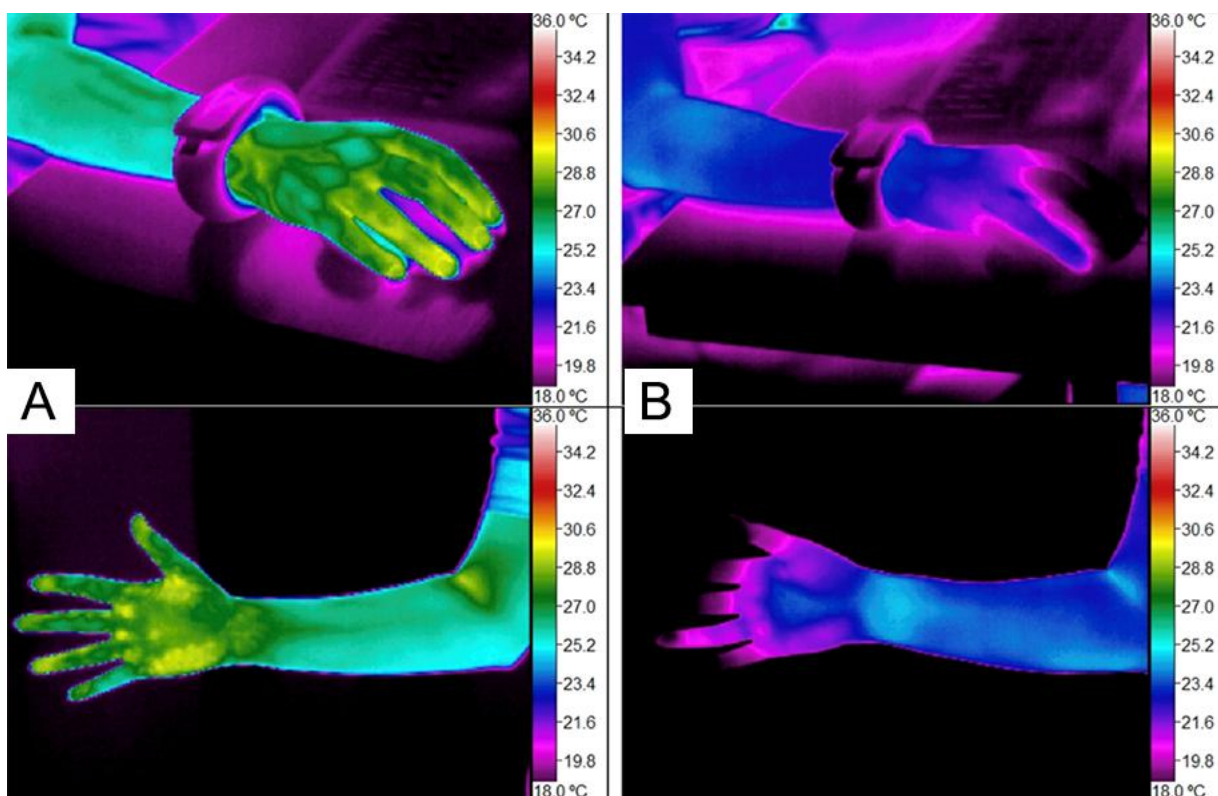
A − at the start of the trial; B − after 3 hours of the trial.

Figure 4. **Digital infrared images of the right hand, using Wristband2 mouse pad (participant ID = 2) (images made by authors A. Grigorjeva, J. Reste)**

To illustrate the effect of band like mouse pad and Standard mouse pad on wrist temperature, one set of thermograms is shown on Figure 4 and 5. Visual and quantitative evaluation of

thermograms before and after the trial in the same participant (ID = 2) using Wristband2 indicated notable wrist compression with a mean temperature drop by 3.01°C (Figure 4).

Meanwhile, using the Wristband1 and Standard mouse pad with gel base showed quite similar soft tissue compression but observed in the different areas of the palm base. Comparing all the mouse pads to each other, Standard mouse pad and Wristband1 showed a lower degree of compression. The slightest temperature decline on average by 1.1°C was observed in Standard mouse pad (see Figure 5).
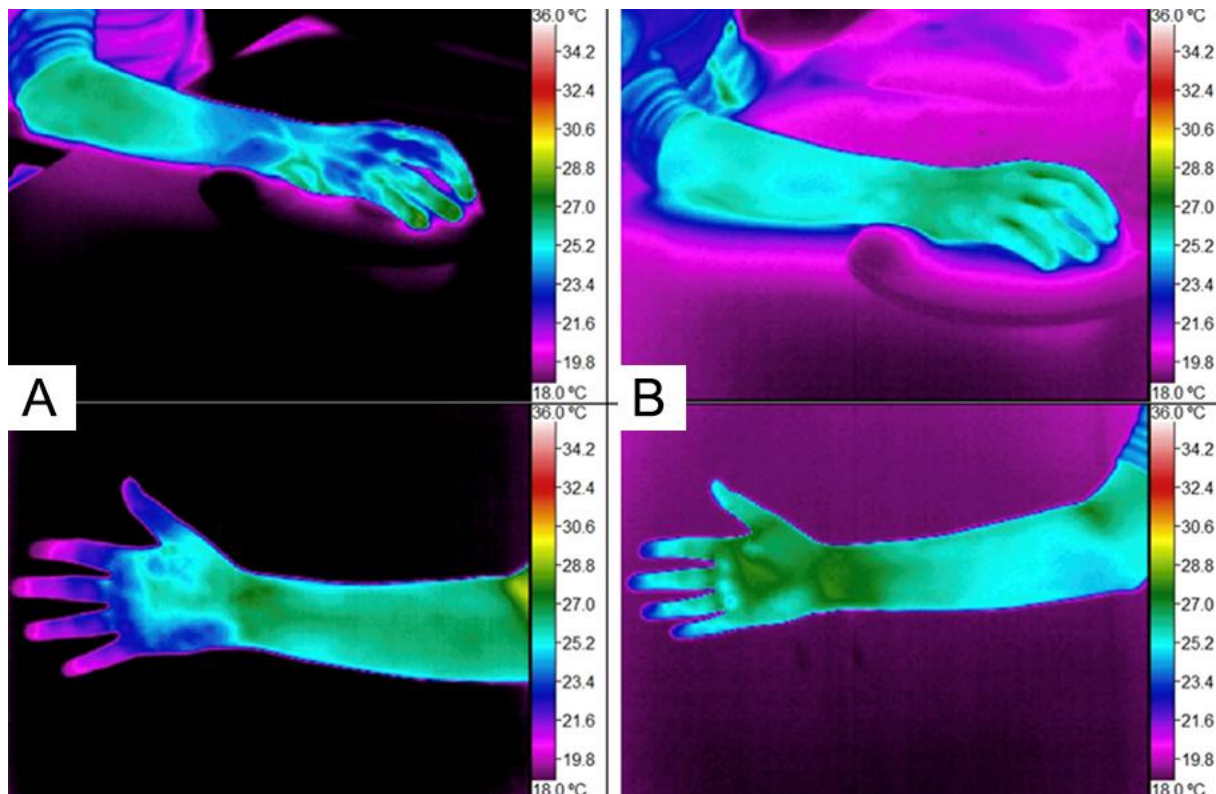
A − at the start of the trial; B − after 3 hours of the trial.

Figure 5. **Digital infrared images of the right hand, using Standard mouse pad (participant ID = 2) (images made by authors A. Grigorjeva, J. Reste)**

Even though the Wristband1 mouse pad showed mild soft tissue compression, more pronounced decrease in wrist skin surface temperature was observed compared to the standard mouse pad. Mean temperature drop using Wristband1 was by 2.48°C.

Discussion

In the current study decrease of hand skin surface temperature was observed in all participants already after one hour of continuous work with a computer mouse. Various factors can influence the temperature of the hand and human skin temperature in general. These factors include so called technical, individual, and environmental factors (Reste *et al*., 2015; Fernández-Cuevas *et al*., 2015; Hollnagel, 2014). During this study, the main factors that could influence the results were

environmental. To get more accurate measurement results air humidity, air temperature and air flow velocity were carefully monitored during every trial. Of no less importance individual factors are, which were controlled by fulfilling detailed selection criteria. Significant influential factors like tobacco use, regular use of medication, increased body temperature due to illness, and pain pre-existence in the hand or any musculoskeletal disorder were excluded. It is known that non-occupational risk factors for musculoskeletal and related soft-tissue disorders include age, gender, certain systemic diseases, obesity, ethnicity, and alcohol usage (Toomingas *et al.*, 2012; Martínez-González *et al.*, 1999; Thorp *et al.*, 2011; Salmon *et al.*, 2011; Punnett *et al.*, 1997). In the current study, normal BMI value was not the selection criterion. That showed the difference in temperature between participants with the lowest and the highest BMI (21.9 vs. 31.2). More stable wrist skin temperature during three hours of the trial was noticed in participant with the highest BMI.

This phenomenon can be explained by various thickness of the fat layer, which provides heat insulation, thus the temperature does not drop so quickly in case of reduced heat production as it is seen in sedentary behaviour. When other factors cannot be changed, ergonomic inventions come to the rescue, and appear on the modern trade market more and more every year. Plenty of mouse pads were designed, for instance, a thermo-insulation pad where temperature did not decrease and remained unchanged (Meijer *et al.*, 2006). Or simply designed comfortable palm rest to reduce discomfort, which on the contrary appeared in participants using mouse pads in this study (Conlon *et al.*, 2008). As shown previously (see Figure 1), quite different ergonomic mouse pad designs were tested in this study. Despite new coming solutions to prevent musculoskeletal and other related disorders and make the working place more convenient, wristband type mouse pads used in this trial showed quite notable soft tissue compression in the wrist area and would not be recommended to prevent wrist temperature reduction. Relatively better results were shown by a standard mouse pad with gel padding, it is not only named as the most comfortable to work with but also showed less prominent temperature decline in all four participants through three hours. Also, there is an importance to compare among the Wristband 1, 2 and 3. Wristband1 produced the least amount of soft tissue compression and is more promising among other wristbands not to cause excess movement in the wrist and to reduce pressure on the median nerve, which can lead to the carpal tunnel syndrome (Aboonq, 2015; Chiang *et al.*, 2017).

Nowadays, number of computer users is growing every day and that has a big impact on public and occupational health. Prolonged sedentary work on a computer causes microcirculation changes not only in the arm, but also in the lower extremities (Restaino *et al.*, 2015). These changes result in wrist hypothermia, which can be especially exaggerated by use of wristband-like mouse pad that compresses the hand soft tissues (Restaino *et al.*, 2015). Long-term work at the computer

results in the appearance of musculoskeletal symptoms; in order to prevent their occurrence, it is recommended to arrange a rest and stretch breaks from the computer (Menéndez *et al*., 2008).

After reviewing the previously mentioned research and comparable scenarios (Reste *et al.*, 2015), it turned out it is better to work with an ergonomic vertical mouse without a mouse pad than with a horizontal mouse with standard mouse pad with a gel base. Overall work with a vertical ergonomic mouse without a pad and a horizontal mouse without a mouse pad showed very similar temperature reduction results and are recognized to be a desirable choice in addition to a stretch break and active rest (Menéndez *et al*., 2008; Reste *et al*., 2015).

It should be noted that, despite a small number of participants (only four) a large amount of data for analysis was obtained, studied and showed statistically significant distinctions. So that it is important to utterly understand the physiological process of the blood microcirculation, temperature decrease and impact of sedentary work (Meijer *et al*., 2006; Punnett *et al*., 1997; Aboonq, 2015). Subsequent research in this area, through changing scenarios, methodology and measurements of large groups of people, will help to explore this topic deeper.

Conclusions

The design of the computer mouse pad has an effect on the hand temperature during prolonged work with a computer mouse. This leads to a decrease of the wrist skin surface temperature. Wristband like mouse pads caused a greater temperature drop and wrist soft tissue compression compared with the Standard mouse pad with gel base. The greatest soft tissue compression and the most pronounced decrease in wrist temperature was observed using the Wristband2, that could be associated with a firmer, inflexible material. Changes in the skin temperature of the wrist surface are associated with individual factors such as BMI and might be explained by the thickness of the heat-insulating fat layer in this area of the body. A higher BMI and a thicker layer of fat in the wrist area contribute to a more stable skin temperature when working with a computer mouse for continuous time. Further investigations on wrist skin temperature changes are needed.

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DROWNING ASSOCIATED RISK GROUPS IN A FIVE-YEAR TIME PERIOD IN RIGA AND RIGA PLANNING REGION: AGE AND SEASON

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Abstract

Drowning associated risk groups in a five-year time period in Riga and Riga planning region: age and season

Key Words: Swimming, drowning, risk factors, Riga, Riga planning region.

Objective: Drowning is the 3rd leading cause of unintentional injury of death worldwide. These deaths are often unintentional, classified as accidents and instantaneous. However, they are potentially preventable. There are several factors that could be associated with risk groups within our population. Aim of this study is to identify whether age and season determines higher chance an individual will drown.

Methods: A study was carried out involving fatal drowning victim cases from January 1, 2015 to December 31, 2019 at the State Centre for Forensic Medical Examination of the Republic of Latvia. All recorded data were analyzed using *MS Excel* and *IBM SPSS V26*.

Results: In total, 214 victim cases were included in this study. Mean age was 51. The 54.2% of drowning victims were in age group 35 to 64, of which majority was in age group 45 to 54, 24.3% were older than 65, 15.9% were 20 to 34, 4.7% were 15 to 19, 0.9% were below age of four. 45.3% of victims drowned in summer, 20.1% in autumn and in spring, 14.5% in winter.

People who drowned in summer were mostly older than 45. In spring, the most drowning cases were in age group "45-54". In autumn, the most cases were in group of people older than 65 which is at least twice as often comparing to other age groups in autumn. In winter, count of drowning cases were similar in all age groups from 20 to 65+ approximately 6 people in each group. Children under the age of 4 drowned in summer and spring. Teenagers from 15 to 19 mostly drowned in swimming season during summer but there were also incidents in autumn and spring.

Conclusion: People at the age of 45 to 54 being in water in spring, as well as older than 45 in summer statistically determines that these individuals have higher risk to fall into category of drowning victims. People older than 65 are also at risk in autumn.

Kopsavilkums

Prevalējošie riska faktori noslīkšanā no 2015. līdz 2019.gadam Rīgā un tās reģionā: vecums un gadalaiks

Atslēgvārdi: Peldēšana, noslīkšana, riska faktori, Rīga, Rīgas reģions.

Aktualitāte un mērķis: Skatoties negadījuma statistiku pasaulē, noslīkšana ir 3. vietā. Šie negadījumi ir neapzināti un pēkšņi, tomēr tie ir potenciāli novēršami. Ar noslīkšanas risku ir saistīti dažādi faktori, tādēļ pētījuma mērķis ir uzzināt, vai un kāds vecums un gadalaiks palielina noslīkšanas risku.

Metodes: Pētījumā tika iekļauti visi noslīkšanas gadījumi, kas tika fiksēti Valsts Tiesu Medicīnas Ekspertīzes centrā Rīgā un tās reģionā no 2015. gada 1.janvāra līdz 2019.gada 31.decembrim. Iegūtie dati tika analizēti izmantojot *MS Excel* un *IBM SPSS V26*.

Rezultāti: Kopā tika apkopti dati par 214 personām. Vidējais personas vecums bija 51 gads. 54.2% noslīkušo personu bija vecumā no 35 līdz 64 gadiem, no kuriem lielākā daļa bija vecumā no 45 līdz 54 gadiem. 24.3% bija vecākas par 65 gadiem, 15.9% bija vecumā no 20 līdz 34 gadiem. Jaunieši un bērni noslīka daudz retāk: vecumā no 15 līdz 19 gadiem noslīka vien 4.7%, vecumā līdz četru gadu vecumam tie bija 0.9%. Bērni vecumā no pieciem līdz 14 gadiem netika konstatēti. Lielākā daļa no noslīkšanas gadījumiem bija vasarā (45.3%). Pavasarī un rudenī noslīkušo skaits ir vienāds- 20.1%, tomēr ziemā noslīkšanas gadījumi samazinājās līdz 14.5%.

Personas, kas noslīka vasarā, lielākoties bija vecākas par 45 gadiem. Pavasarī visbiežāk noslīka personas vecumā no 45 līdz 54 gadiem. Rudenī dominē noslīkšanas gadījumi personām vecākām par 65 gadiem, kas vismaz uz pusi vairāk nekā citās vecuma grupās rudenī. Ziemā noslīkušo skaits ir diezgan vienlīdzīgs-sākot no 20 gadiem līdz pat vecākiem par 65 gadiem vidēji noslīka sešas personas katrā vecuma grupā. Bērni līdz četru gadu vecumam noslīka vasarā un rudenī. Jaunieši no 15 līdz 19 gadiem visbiežāk slīkst peldēšanas sezonā-vasarā, tomēr gadījumi tika konstatēti arī pavasarī un rudenī.

Secinājumi: Personas vecumā no 45 līdz 54 gadiem, peldoties pavasarī, un vecumā virs 45 gadiem, peldoties vasarā nosaka, ka šīm personām ir lielāks risks kļūt par noslīkšanas upuriem. Visaugstākais risks noslīkt rudens periodā ir personām vecākām par 65 gadiem.

Introduction

Drowning is the third leading cause of unintentional injury worldwide right after traffic accidents and unintentional falls. Every year approximately 320 000 people die from drowning. (WHO, 2020). Deaths associated with water are often unintentional, classified as accidents and instantaneous. Statistics is changing yearly and unfortunately it is often not possible to record all drownings due to other causes of death in water, such as suicide or murder in water. WHO director Margaret Chan (2014) said that 40 people drown every hour, it could be 480 deaths due to drowning every day.

Drowning rates in Latvia and Lithuania are the highest in Europe (six people per 100 000). Total drowning cases confirmed in EU in 2016 were 5 537, which is approximately one person per 100 000. Sweden was mentioned as the best example with very low drowning rates-one per 100 000, or even Netherlands-0.6, Italy-0.4 (European Commission, 2019).

In global drowning report WHO mentioned risk factors which can be identified as predisposing factors for drowning. First it is age of the victim. One of five drowned victims in the world is a child under the age of 14. For each drowned child, there are five children who are hospitalized (CDC, 2020). Half of the drowning cases are people under the age of 25. Drowning is among the top five leading causes of death in people younger than 14 years of age in 48 countries out of 85 that are identified (WHO, 2014). Latvia is one of them. Secondly it is summer season when people tend to spend more time outdoors near bodies of water. For example, in America in July drowning rate is six times higher than at the same year January (National Safety Council, 2020).

The aim of this study is to identify risk factors associated with drowning in Riga and Riga planning region from 2015 to 2020. Identify whether age and season determines higher chance an individual will drown.

Material and Methods

The study had been approved by the Ethics Committee of Riga Stradiņš University (Nr.6-1/10/2 (24.09.2020.)). In this retrospective study data from all drowning cases in Riga and Riga planning region was collected from the State Centre for Forensic Medical Examination of the Republic of Latvia (VTMEC). Data was collected from a 5-year period. The cause of death is determined by State appointed forensic expert. The five-year period was chosen because it could clarify risk factors that are currently relevant and important in near future.

Data collection

The data was gathered using person cards found in VTMEC archive. Inclusion criteria: cause of death was drowning (SSK-10 W69) and time period was from January 1st, 2015 to December

31st, 2019. In every case the conclusion of a forensic medical examination expert was taken as a data source.

Data analysis

Variables such as age, which was divided in groups based on publication and WHO data (WHO,2020;Clemens, T. et al.,2016; Quan, L., Cummings, P., 2003): 0-4;5-14;15-19;20-34;35-64;65+ (as well in more detail when it was necessary) and season were selected to describe the epidemiological situation of drowning and to judge possible risk groups in Riga and its region. Data was analyzed in a general way, anonymously using *MS Excel* and *IBM SPSS V26*. Statistical significance was tested with one-way ANOVA test. Data was defined statistically significant if $p < 0.05$.

Results

In total 214 victim cases were included in this study. Mean age was 51 (SD=18.8). The 54.2% of drowning victims were in age group 35 to 64 (n=116), 24.3% were 65+ (n=52), 15.9% were 20 to 34 (n=34), 4.7% were 15 to 19 (n=10), 0.9% were below the age of four (n=2). Teenagers 5 to 14 were not found in this time period (Figure 1).
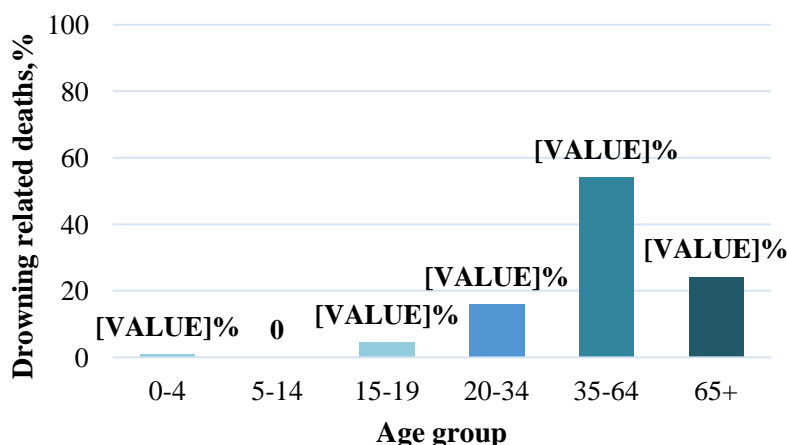
Figure 1. **Drowning related deaths in different age groups**

Looking in more detail at 35-64 age group (Figure 2), we can see that majority (44%) was in age group 45 to 54 (n=51), following by 55-64 group (32.8%, n=38) and 35-44 group (23.3%, n=27). Drowning victims in age group 45 to 54 was very close to age group 65+ (51 victims vs 52). We could say that these people are at risk of drowning.
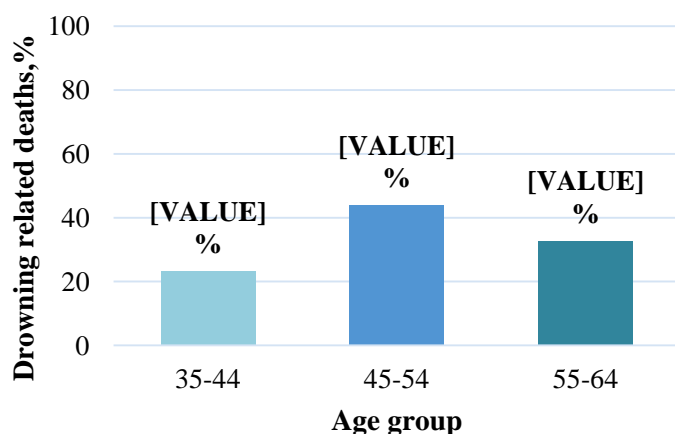
Figure 2. **Drowning related deaths in age group 35-64**

Most victims were found in summer season (45.3%, n=97) (Figure 3). Drowning victim count in autumn and spring was the same (20.1%, n=43), but incidence in winter was 14.5% (n=31).
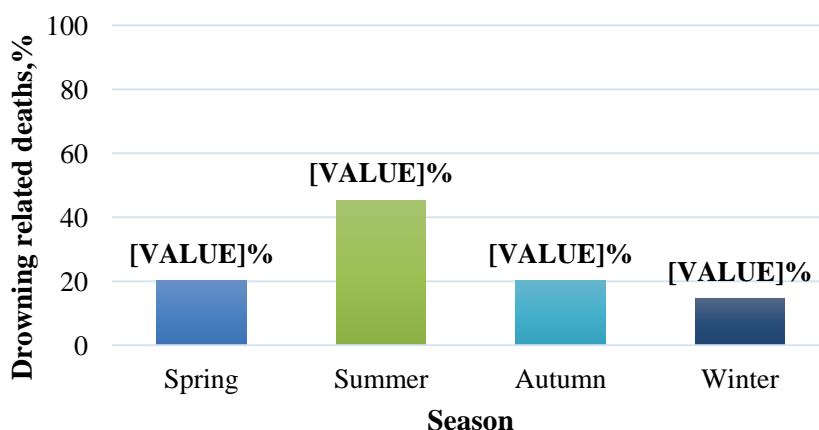
Figure 3. **Drowning related deaths by season**

May is the month when drowning victims were found more frequently compared to earlier months (9.8%, n=21) (Figure 4). An increase is found in July (15.9%, n=34) and August (16.4%, n=35). In September, the victim count is rapidly decreasing (7%, n=15) and being stable till the end of the year.
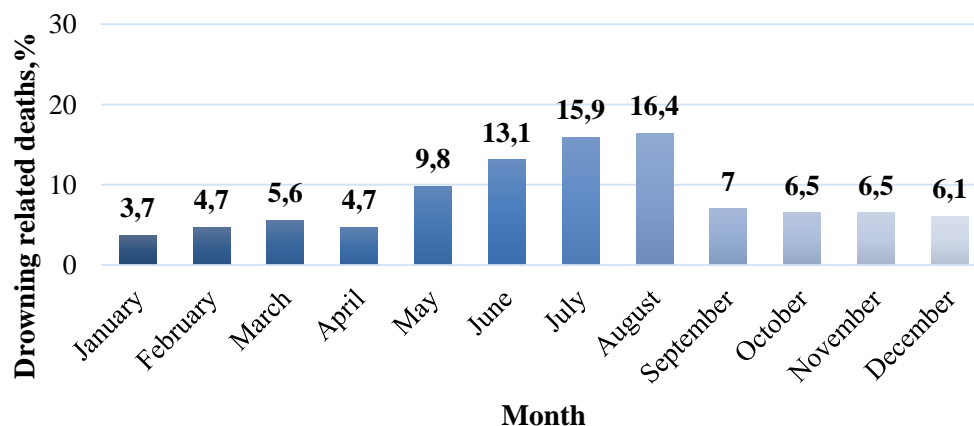
Figure 2. **Drowning related deaths by month**

Age group "35-64" was subdivided to include a breakdown of age groups in different seasons (Figure 5). People who drowned in spring, were mostly from age group "45 to 54" (n=16). It is worth mentioning people older than 65: ten people drowned, which is more often comparing with other age groups in spring. People who drowned in summer were mostly older than 45 (63 cases in total). Nevertheless 16 persons were in age group "20-34". Summer is a season when drowning cases were more often in all age groups compared to other seasons. In autumn, drowning was the highest in people older than 65 (n=14) which is at least twice as often comparing to other age groups in autumn. In winter, drowning was similar among all age groups from 20 to 65+ approximately six people in each age group. Children under the age of four drowned in summer and spring (one in each). Teenagers from 15 to 19 drowned mostly in swimming season during summer (n=9) with incidents in autumn (n=3) and spring (n=1).
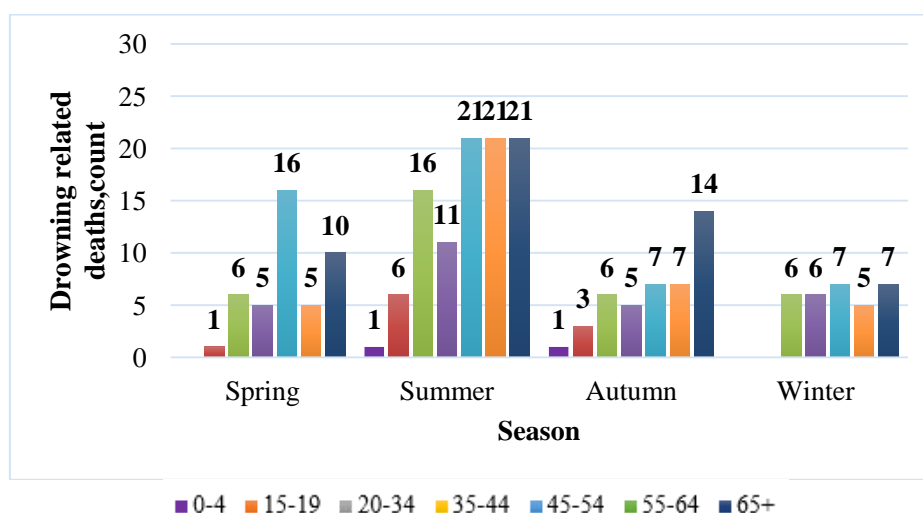
Figure 3. **Drowning related deaths in different seasons by age groups**

ANOVA testing found that mean age between seasons is not statistically significant (p=0.921). Mean age in all seasons was around 51.

Discussion

This study analyzed 214 cases of drowning at a five-year interval in Riga and its planning region, which could reflect the epidemiological situation in Latvia. Drowning rate in Riga in its planning region was approximately 4.2 deaths per 100 000 inhabitants but considering data seen on Latvian Centre for Disease Prevention and Control webpage (2019) and population size taken in this study, drowning rate should be higher: at least six deaths per 100 000. Various factors that could increase the risk of drowning were studied. It is important to understand which people are at risk of drowning, so that they can be educated about potential harm and protected appropriately.

Age is one of the most important risk factors which is associated with increased risk of drowning. WHO mentioned (2020) that children aged one to four years are most likely to drown. However, this study found that people aged 35 to 64, more precisely age group "45-54" and older than 65 drowned most often in Riga and its planning region. There were only two children who drowned under the age of four in a five-year period, which could indicate that parents in Riga and its region are aware of the risks near the water. It also could be explained by lack of direct access to close-by bodies of water such as ponds. Currently the situation in Riga and its planning region is better than many other cities in the world. Drowning rate for children under the age of four in Riga and its region was 0.4 deaths per 100 000, which is ten times lower than in the world in 2012 (10.1 per 100 000) (WHO,2012). No persons between the ages of five and 14 were found during the five-year period, which may indicate that children are being informed and cared for when playing near water. Drowning rate in adolescents and young people population between the ages of 15 and 34 was 3.6 deaths per year on 100 000 people. These people are of working age, which could mean that the time for water activities is limited. But over time precautionary rules are not followed, alcohol is consumed, and increasement in drowning rate becomes noticeable. Drowning rate between the ages of 35 and 44 was 3.8 deaths per 100 000 per year. The drowning rates increases significantly at the age of 45-54 to 7.6 deaths. This could be explained by alcohol consumption-the highest alcohol consumption in the world is at the age group "35-49" (13.4 liters of pure alcohol per person per year) (WHO,2019). The drowning rate is declining quite rapidly between the ages of 54-64 - 5.6 deaths, people older than 65 - 5.4 deaths per 100 000. With age, additional risk factors take place such as other diseases, medication and this is affecting drowning risk, mostly increasing it.

The season is a factor that affects people's access to water bodies. In spring we can see a peak increase in age group "45 to 54", which can be explained by people starting early their swimming season. In summer, it is quite logical that there are more people drowning cases than any other season, also age difference is very wide. It is because people tend to spend more time in nature. In

autumn there is an increase in drowning cases in age group "65+" which can be explained by poor situation analysis because of shorter day length. In winter drowning cases are the least compared to other seasons. No significant age differences were found between the seasons, which means that it is not possible to say that a season has a specific age trend.

To avoid drowning, WHO (2014) has developed ten research-based, proven, effective strategies, divided into three categories, also complemented by other sources (Mayo Clinic, 2020; CDC, 2019; AAP, 2020). This includes community-oriented strategies (e.g., installing barriers that control access to water bodies or teaching school-age children basic swimming skills), legal system oriented (e.g., developing a national water safety plan) and gives an idea about future possibilities (e.g., research based on specific risk groups in search of the best solutions). The importance of first aid is emphasized- CPR is the only method that can save a person pulled out of the water, rescue taking place for a person who has been under water for less than 10 minutes, shows that the possibility of rescue is high (Travers, A. H. et.al. 2015).

Conclusions

Drowning is a serious problem not only worldwide, but also in Latvia. Looking at the data only in Riga and its region over a five-year period, an average of 4.2 people drowned per 100 000. Possible safety measures and additional educational information should be aimed towards people above 45 and elderly over 65, as these are the groups that represent highest drowning victim count. As it could be expected, most drowning cases take place during summer, which could indicate that extra safety measures have to be installed around bodies of water during swimming season.

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THE IMPACT OF PHYSICAL ACTIVITY ON HEMOGLOBIN A1c (HbA1c) LEVEL

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Abstract

The impact of physical activity on hemoglobin A1c (HbA1c) level

Key Words: *Physical activity, International Physical Activity Questionnaire (IPAQ), HbA1c, diabetes mellitus*

Introduction. World Health organisation recommends at least 150-300 minutes per week of moderate-intensity aerobic physical activity for people with chronic conditions (WHO, 2018). Physical activity is one of the key points to get a normal HbA1c level for people with diabetes.

Aim. The aim was to study the level of physical activity of people with diabetes. And to know does the more often and more intensive physical activities automatically mean lower HbA1c level.

Materials and methods. A retrospective cross-sectional study, which surveyed 80 patients using a IPAQ questionnaire short version. Respondents were asked to evaluate their physical activities in the last 7 days. And using medical records from patient cards in GP practice. The obtained data were processed with Microsoft Office Excel 2010 and SPSS 21 programs.

Results. The study included 80 respondents with diabetes. 73.8% were females and 26.3% males. Respondents were divided into 3 parts depending on their physical activity level by IPAQ questionnaire. 27.5% (n=22) patients had low physical activity, 38.8% (n=31) moderate and 33.8% (n=27) had high- intense physical activity in the last 7 days. The mean HbA1c level for all patients was 6.6 (SD ± 1.46), lowest HbA1c was 4.70, the highest - 13.00. The mean HbA1c in group with low physical activities was 6.55 (p=0.446), in group with moderate physical activities 6.75 (p=0.885) and mean HbA1c in group with high- intense physical activities was 6.44 (p=0.176).

All respondents on average were sitting 4.9 hours in day (p<0.001), in group with low physical activities 5.9h, in group with moderate physical activities 5.6h, in group with high- intense physical activities 3.3h.

Conclusion. The results show that respondents who were in the group with low physical activity had higher HbA1c level - 6.55, but respondents who were in group with high- intense physical activities HbA1c level were lower - 6.44. This regularity is not found in the group with moderate physical activities, HbA1c level in this group is the highest - 6.75.

There was found a positive correlation between the intensity of physical activities and average sitting time per day. Respondents with higher level of physical activities and lower HbA1c level were sitting less hours per day.

Kopsavilkums

Fizisko aktivitāšu ietekme uz glikolizēta hemoglobīna (HbA1c) līmeni

Atslēgvārdi: *fiziskās aktivitātes, Starptautiskā aptauja par fizisko aktivitāti (IPAQ), HbA1c, cukura diabēts.*

Ievads: Cilvēkiem, kuri slimo ar hroniskām slimībām, Pasaules Veselības organizācija iesaka vismaz 150-300 minūtes nedēļā veikt vidējas intensitātes aerobās fiziskās aktivitātes (WHO, 2018). Fiziskās aktivitātes ir viens no svarīgākajiem priekšnosacījumiem, lai cilvēki ar cukura diabētu sasniegtu normālu HbA1c līmeni.

Materiāli un metodes: Šis ir retrospektīvs šķērsgriezuma pētījums, kurā tika aptaujāti 80 pacienti, izmantojot IPAQ anketas īso versiju. Respondentiem tika lūgts novērtēt viņu fizisko aktivitāti pēdējo 7 dienu laikā. Kā arī tika izmantota informācija no pacientu slimības vēsturēm. Iegūtie dati tika apstrādāti ar Microsoft Office Excel 2010 un SPSS 21 programmām.

Rezultāti: Pētījumā piedalījās 80 respondenti, kuri slimo ar cukura diabētu, no kuriem 73.8% bija sievietes un 26.3% vīrieši. Respondenti tika sadalīti 3 grupās, atkarībā no fizisko aktivitāšu līmeņa, izmantojot IPAQ anketas īso versiju. Pēdējo 7 dienu laikā 27.5% (n=22) pacientu bija zemas intensitātes fiziskās aktivitātes, 38.8% (n=31) mērenas intensitātes fiziskās aktivitātes un 33.8% (n=27) bija augstas intensitātes fiziskās aktivitātes. Visu pacientu vidējais HbA1c līmenis bija 6.6 (SD±1.46), zemākais HbA1c līmenis bija 4.70, bet augstākais 13.00. Vidējais HbA1c līmenis grupā ar zemas intensitātes fiziskajām aktivitātēm bija 6.55 (p=0.446), grupā ar mērenas intensitātes fiziskajām aktivitātēm 6.75 (p=0.885) un vidējais HbA1c grupā ar augstas intensitātes fiziskajām aktivitātēm 6.44 (p=0.176).

Vidēji visi respondenti sēžot pavadīja 4.9 stundas dienā (p<0.001). Grupā ar zemas intensitātes fiziskajām aktivitātēm, respondenti sēdēja vidēji 5.9 stundas dienā, grupā ar mērenas intensitātes fiziskajām aktivitātēm – 5.6 stundas, bet grupā ar augstas intensitātes fiziskajām aktivitātēm respondenti vidēji sēdēja 3.3 stundas dienā.

Secinājumi: Pēc rezultātiem redzam, ka respondentiem, kuri bija grupā ar zemas intensitātes fiziskajām aktivitātēm, bija augstāks HbA1c līmenis – 6.55, bet respondentiem, kuri bija grupā ar augstas intensitātes fiziskajām aktivitātēm, HbA1c līmenis bija zemāks – 6.44. Šī tendence nav vērojama grupā ar vidējas intensitātes fiziskajām aktivitātēm, kur vidējais HbA1c līmenis bija visaugstākais – 6.75.

Pozitīva korelācija tika konstatēta starp fizisko aktivitāšu intensitātes līmeni un laiku, ko cilvēki dienā pavada sēžot. Respondenti ar augstākas intensitātes fiziskajām aktivitātēm un zemāku HbA1c līmeni sēdēja mazāk stundu dienā.

Introduction

World Health Organization (WHO) recommends to do at least 150–300 minutes of moderate-intensity aerobic physical activity or at least 75–150 minutes of vigorous-intensity aerobic physical activity per week (WHO, 2018).

For adults aged 18 and older regular physical activity can reduce the risk of diabetes. To help prevent type 2 diabetes and its complications, people should be physically active (WHO, 2018).

Matheu Boniol et all study in 2017 concluded that physical activity - 100 minutes per week, reduced HbA1c by -0.14% on average. Following the WHO recommendations of 150 minutes per week of physical activity, HbA1c levels decrease by -0.21% on average. In patients with type 2 diabetes and prediabetes, HbA1c levels would decrease by -0.24% (Matheu Boniol et all, 2017).

Moderate increases in physical activity can significantly reduce both - blood glucose and HbA1c levels. However, it should be noted that without further physical activity, these benefits of HbA1c reduction are not maintained. The reduction in HbA1c levels depends more on the length of physical activity per week than on the type of physical activity (Matheu Boniol et all, 2017).

Long-term regular physical activity training was found to be helpful in improving glycemic control, body composition and cardiovascular fitness among patients with type 2 diabetes (Najafipour F, Mobasseri M, Yavari A, et al, 2017).

The practice of physical activity among people with diabetes is essential to achieve clinical goals and to prevent complications associated with the disease. However, some studies have shown that people with diabetes exercise less regularly compared to non-diabetics (Hamasaki, 2016).

Worldwide, around 1 in 3 women and 1 in 4 men do not do enough physical activity to stay healthy (WHO, 2018).

Every year in Latvia increases the number of patients with diabetes. In 2010 the total number of people with diabetes in Latvia was 71'737, but seven years later – in 2017 – 91'571 – according to Latvian Centre for Disease Prevention and Control. It is increase by 20'000 people in 7 years (Veselības statistikas datu bāze 2021).

Materials and methods

A retrospective cross-sectional study was made, which surveyed 80 patients with diabetes. Patients were from one general practicioner prctice with 3300 patients.

Author used a International physical activity questionnaire (IPAQ) short version to evaluate physical activity for respondents. In this questionnaire respondents were asked to evaluate their physical activities in the last 7 days. Due to the situation in the world, survey was made as telephone interviews.

The questionnaire had 7 questions - about walking and sitting time, and also moderate and high intense physical activities.

After patients answered and physical activity for each participant was expressed in MET-minutes/week.

MET score was derived for each type of activity:

- Walking MET-minutes/week = 3.3 * walking minutes * walking days;
- Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days;
- Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days.

Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores:

- High physical activity - at least 3000 MET-minutes/week;
- Moderate physical activity - at least 600 MET-minutes/week;
- Low physical activity - less then 600 MET-minutes/week.

So, each of respondents was in 1 of 3 groups – with high, moderate or low physical activity.

The questionnaire was adapted in Latvian according to protocol, described in the IPAQ website. This has been done by Dr.paed., Aivars Kaupužs. And the author has received permission to use this latvian-adapted IPAQ questionnaire in this study.

Also author used medical records from patient cards in general practitioner (GP) practice, to know the level of HbA1c.

The obtained data were processed with Microsoft Office Excel 2010 and SPSS 21 programs.

Results

Study included 80 patiets with diabetes. 73.8% (n=59) were females and 26.3% (n=21) males.

After counting total physical activity in MET-minutes/week per each participant, patients were divided in 3 groups – with low, moderate and high intense physical activity.

From all respondents 27.5% (n=22) was in group with low intense physical activities, 38.8% (n=31) - moderate intense and 33.8% (n=27) in group with high intense physical activities (Figure 1).

The mean HbA1c level for all patients was 6.6 (SD ± 1.46), lowest HbA1c was 4.70, the highest - 13.00.

The mean HbA1c in group with low physical activities was 6.55 (p=0.446), in group with moderate physical activities 6.75 (p=0.885) and in group with high- intense physical activities was 6.44 (p=0.176) (Figure 2).

All respondents on average were sitting 4.9 hours in day (p<0.001), in group with low physical activities respondents were sitting average 5.9h per day, in group with moderate physical activities - 5.6h per day and in group with high- intense physical activities 3.3h per day.
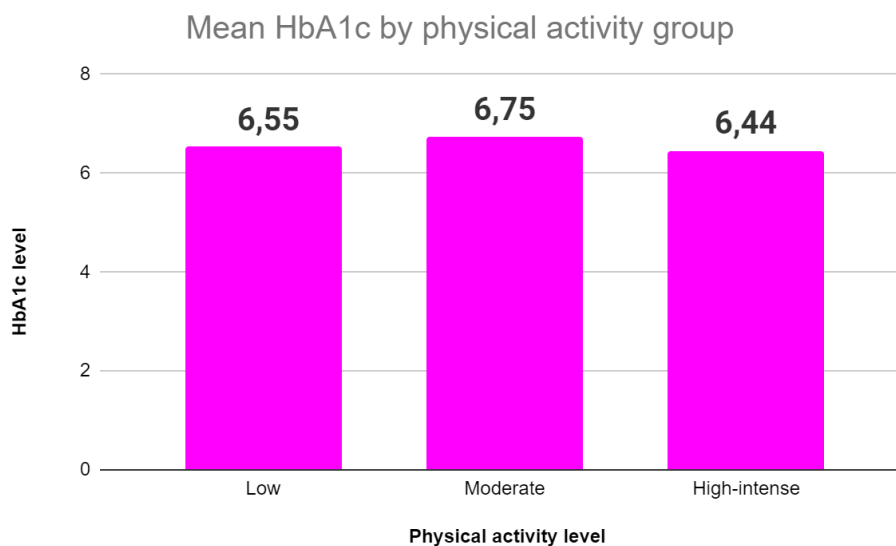
Figure 1. **Number of patients in each level of physical activity according to IPAQ**
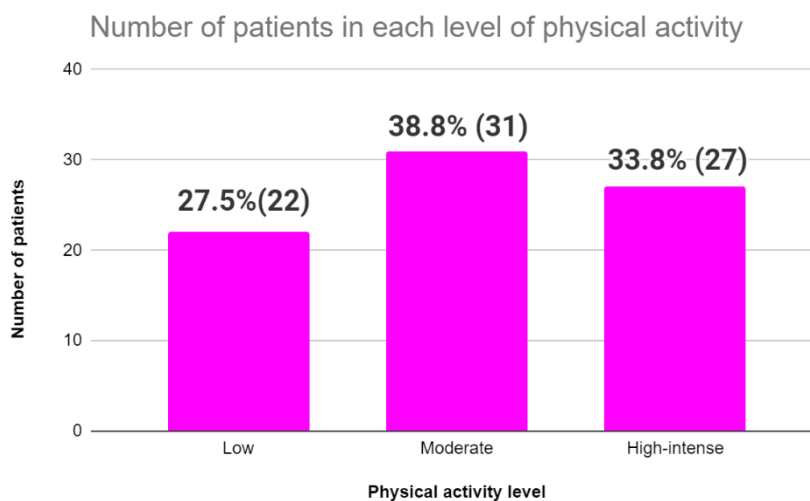
Figure 2. **Mean HbA1c by physical activity group**

Discussion

Worldwide, around 1 in 3 women and 1 in 4 men do not do enough physical activity to stay healthy (WHO, 2018).

People lifestyle becomes more physical unactive, so increases all diseases who are correlated with active lifestyle – cardiovascular diseases, obesity and also diabetes. It causes damage not only to people health, but also to economics, and this damage becomes greater every year. Disease prevention and healthy lifestyle will be more important in future like never before. People will have to take responsibility about their lifestyle.

In Latvia, 2010-2017 – the number of people with diabetes increased by 20'000 people and that's a huge number for Latvia.

In this research – for one third of people there was a low physical activity despite they all know their diagnosis and positive physical activity impact on their health. If people are not motivated to improve their health in relatively simple ways, the government should be more involved in health promotion and disease prevention and education.

Conclusions

The results show that respondents who were in the group with low physical activity had higher HbA1c level - 6.55, but respondents who were in group with high- intense physical activities HbA1c level were lower - 6.44. This regularity is not found in the group with moderate physical activities, HbA1c level in this group is the highest - 6.75

No statistically significant correlation was found between level of physical activity and HbA1c level.

Many participants admitted, that weather and national restrictions in our country affected their physical activity level.

There was found a positive correlation between the intensity of physical activities and average sitting time per day.

Respondents with higher level of physical activities and lower HbA1c level were sitting less hours per day - in group with low physical activities respondents were sitting average 5.9h per day, in group with moderate physical activities - 5.6h per day and in group with high- intense physical activities 3.3h per day.

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IMPACT ON THE SCORE CHART PREDICTIVE ABILITY BY USING LOW-DENSITY CHOLESTEROL LEVEL AS ONE OF ITS VARIABLES

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Abstract

Impact on the SCORE chart predictive ability by using low-density cholesterol level as one of its variables

Key Words: *SCORE, cardiovascular risk, low-density cholesterol*

Introduction. Accuracy of methods for identifying persons at high cardiovascular risk is of primar importance in the prevention of fatal cardiovascular diseases (CVD).

Objectives. To estimate whether using of low-density cholesterol (LDL) level as a variable instead of total cholesterol (TC) level increases predictive ability of the Systematic COronary Risk Evaluation (SCORE) chart.

Materials and Methods. This study was conducted at family doctor's practice in Riga estimating individual risk of 460 patients by the SCORE chart and calculating correlation with fatal CVD in the following 10 years. The level of LDL was taken as equal to TC if the difference between values was two units. Data processing and analysis was performed by Microsoft Excel, SPSS and the Spearman correlation coefficient.

Results. Correlation between calculated risk level and actual fatal CVD in the following decade using LDL level was slightly stronger than using TC level: 0.15 (p < 0.01) and 0.13 (p < 0.01). Among CVD patients, the traditional SCORE chart identified increased cardiovascular risk (> 5%) in 41%, however the alternative chart recognized by 2% more.

Conclusions. Replacing TC with LDL level slightly increased the SCORE chart predictive ability. Unfortunately, in both versions, correlation between calculated risk level and the real CVD events in the next 10 years appeared to be weak, and more than 50% of patients with fatal CVD were unidentified as a high-risk patients. But, even small improvements in the accuracy of the SCORE chart deserve attention and possible revision of it.

Kopsavilkums

Ietekme uz SCORE skalas prognozēšanas spēju izmantojot zema blīvuma holesterīna līmeni kā vienu no tās mainīgajiem

Atslēgvārdi: *SCORE, KVS risks, ZBL*

Ievads. Precīza augsta kardiovaskulāro slimību (KVS) riska pacientu identificēšana spēlē svarīgu lomu sirds-asinsvadu slimību profilaksē.

Mērķi. Novērtēt, vai, nomainot vienu no SCORE skalas mainīgajiem – kopējo holesterīnu (KH) – pret zema blīvuma holesterīnu (ZBL), pieaug tās prognozēšanas spējas.

Materiāli un metodes. Pētījums tika veikts ģimenes ārsta praksē Rīgā, aprēķinot 460 pacientu individuālo risku ar SCORE skalas palīdzību un tā korelāciju ar nākamajā dekādē notikušajām fatālām KVS. ZBL tika pielīdzināts KH līmenim, ja to vērtību starpība bija divas vienības. Datu apstrāde veikta ar Microsoft Excel, SPSS un Spīrmena korelācijas koeficientu.

Rezultāti. Korelācija starp aprēķināto riska līmeni un faktiskām fatālām KVS nākamajā desmitgadē, izmantojot ZBL līmeni, bija nedaudz ciešāka nekā lietojot KH līmeni, attiecīgi 0,15 (p < 0, 01) un 0,13 (p < 0, 01). Ar tradicionālās SCORE skalas palīdzību augsts (> 5%) KVS risks tika noteikts tikai 41% no visiem pacientiem, kuriem vēlāk attīstījās fatālas KVS. Savukārt, ar modificēto SCORE skalu tādu pacientu izdevies atklāt par 2 % vairāk.

Secinājumi. Aizstājot vienu no mainīgajiem (KH ar ZBL), nedaudz pieaug SCORE skalas prognozēšanas spēja. Diemžēl abās versijās korelācija starp aprēķināto kardiovaskulārā riska līmeni un reālajiem KVS gadījumiem nākamajos 10 gados izrādījās vāja, un vairāk nekā 50% pacientu ar fatālām KVS netika identificēti kā augsta riska pacienti. Tomēr pat nelieli SCORE skalas precizitātes uzlabojumi ir pelnījuši uzmanību ar iespējamu tās pārstrādi nākotnē.

Introduction

Despite significant progress in the management of atherosclerosis and its resultant complications, cardiovascular diseases continue to be the leading cause of mortality in the world and in Latvia (Centrālā Statistikas pārvalde 2020; Eurostat 2020). The world's biggest killer is ischaemic heart disease, causing 16% of the world's total deaths. Since 2000, the largest increase in deaths has been for this disease, rising by more than 2 million to 8.9 million deaths in 2019. Stroke

is the second leading cause of death, responsible for approximately 11% of total deaths, respectively (WHO 2020).

Cardiovascular diseases cause great damage to health systems as well as to economic even though they are largely preventable. It is reasonable to suppose that patients with fatal cardiovascular events account for most of these costs. Consequently, the development of more precise tools for identification of high-risk patients would be necessary to reduce the costs of cardiovascular disease by treating following risk factors - smoking, hypertension, diabetes, obesity, dyslipidaemia, elevated triglycerides, - and performing corresponding tests which can reveal initial signs of atherosclerosis (NCEP 2002).

The SCORE chart (the abbreviation of – Systematic COronary Risk Evaluation) – is a cardiovascular disease risk assessment system initiated by the European Society of Cardiology covering a wide geographic spread of countries at various levels of cardiovascular risks. In Latvia, the high-risk charts should be used. The SCORE estimates fatal CVS risk over a ten-year period basing on the following risk factors: gender, age, smoking status, systolic blood pressure and total cholesterol level. The SCORE chart authors warn that doctors always should keep in mind the fact that some factors, which are not included in the chart, may increase the calculated risk level. Risk may be higher than indicated in the chart in:

− sedentary or obese subjects, especially those with central obesity;

− those with a strong family history of premature CVD;

− socially deprived individuals and those from some ethnic minorities;

− individuals with diabetes - the SCORE charts should only be used in those with type 1 diabetes without target-organ damage, other diabetic subjects are already at high to very high risk;

− those with low HDL cholesterol or increased triglyceride, fibrinogen, apoB, Lp(a) levels and perhaps increased high-sensitivity CRP;

− asymptomatic subjects with evidence of pre-clinical atherosclerosis, for example plaque on ultrasonography;

− those with moderate to severe chronic kidney disease (GFR <60 mL/min/1.73 m2) (European Society of Cardiology).

As one can see, this prognostic tool includes only five risk factors basing on which the risk level gets calculated. The authors recommend considering some conditions that may have an impact on the made prognosis, although they are not presented as a variable of this chart.   In   the future studies, the SCORE chart extension should be performed by including other risk rising factors. Many researchers insist on CVD develoment connection with factors that are not so commonly mentioned in the context of cardiovascular deseases: prediabetes (Haffner 2003), duration and dosage of glucocorticosteroids use (***Pujades-Rodriguez et al 2020***), erectile

dysfunction (Raheem et al 2017; Zhao et al 2019), autoimmune inflamatory diseases (**Weber et al** 2021), complications during pregnancy (**Okoth et al 2020**), vaccination against influenza (**Chow et al 2020; European Society of Cardiology 2019**), sleep disorders (**Fan et al 2019; Daghlas et al 2019**), age of menopause (**Bernhardt, Lawson 2019**), level of D vitamin (**The North American Menopause Society 2019**), osteoarthritis (**Turkiewicz et al 2019**), antibiotics use in women (**Heianza et al 2019**), family hypercholesterolaemia (Nalivaiko M. et al 2018), migraine (**Adelborg et al 2018**), testosterone substituting therapy (**Cheetham et al 2017**), living in noise polluted areas (Seidler et al 2016), antiinflammatory drugs (Strēlnieks 2016.). The factors that diminish risk level should be also considered: use of antiagregants, statins, beta blocators, the level and time of physical activities in everyday life and others.

This study has concentrated just on one risk factor which previously hasn't been included in the SCORE chart as a variable. As it's known, **total cholesterol** level includes both: low-density lipoprotein (LDL or "bad cholesterol") and high-density lipoprotein (HDL or "good" cholesterol). It's well established that elevated low-density lipoprotein, the bad cholesterol, is currently considered to be the major risk factor for the development of atherosclerosis and can be used as an important predictor of progression of cardiovascular diseases (National Cholesterol Education Program. 2002). The second component of total cholesterol – HDL has been recognised as a CVD risk-reducing factor by the National Cholesterol Education Project Adult Treatment Panel III and plays opposite to LDL role in atherosclerosis pathogenesis. However, the elevation of HDL as a specific therapeutic target for the prevention and treatment of CVD has yet to be accepted on the same level as low-density lipoprotein (LDL)-reducing therapies (Choi et al 2006). It means that including HDL as a variable in the SCORE chart would not involve any essential improvements in CVD preventive methods. Nowadays there are known several HDL elevators, but they still are not widely used in family doctors' practise – at least in Latvia. Besides, the current HDL elevators - nicotinic acid, fibric acid derivatives, peroxisome proliferator activated receptor (PPAR) agonists and statins - also affect other lipid constituents which make interpretation of the clinical trials of these drugs difficult.

On the one hand, it is commonly accepted that the level of total cholesterol is quite precise and cheap method for cardiovascular risk assessment. On the other hand, LDL level as the risk indicator has greater accuracy, especially in that group of patients whose total cholesterol level could be misleading due to extreme high-density lipoprotein cholesterol values. Furthermore, low-density cholesterol is a conceptual achievement in that it more accurately identifies the pathogenic mechanism that caused injury to the artery. Therefore, the aim of this study was to estimate whether using of low-density cholesterol level as a variable instead of total cholesterol level increases predictive ability of the Systematic COronary Risk Evaluation (SCORE) chart.

Material and Methods

This retrospective cohort study was conducted at the family physician practice in Riga examining records of 460 patients corresponding to the SCORE chart criteria: a total of 165 men and 295 women in age of 40-65 years. The mean age was 57 years (SD 6,7). As the authors of the SCORE chart did not recommend using this table in patients whose CVD risk level is already high due to current conditions that themselves increase the risk of CVD developing, the following groups of patients were exluded from the study: individuals with all types of diabetes (in the case of type I diabetes, there were no patients without target-organs demages), anamnesis of miocardial infarctions and stroke, moderate to severe chronic kidney disease, severe atherosclerosis observed in ultrasound images or other important clinical manifestations of atherosclerosis. These conditions were considered exactly at the time of ten years ago - in 2010, at the period from which the level of risk of cardiovascular disease for the next decade was calculated. Further development of these diseases was not a factor to exclude the patient from the study.

Individual cardiovascular risk was assessed using the SCORE risk chart. The ten-year risk was categorized as low - if it was less than 5%, and high - if it reached 5 and more percents (marked in red in the figure) (see Fig.1.).
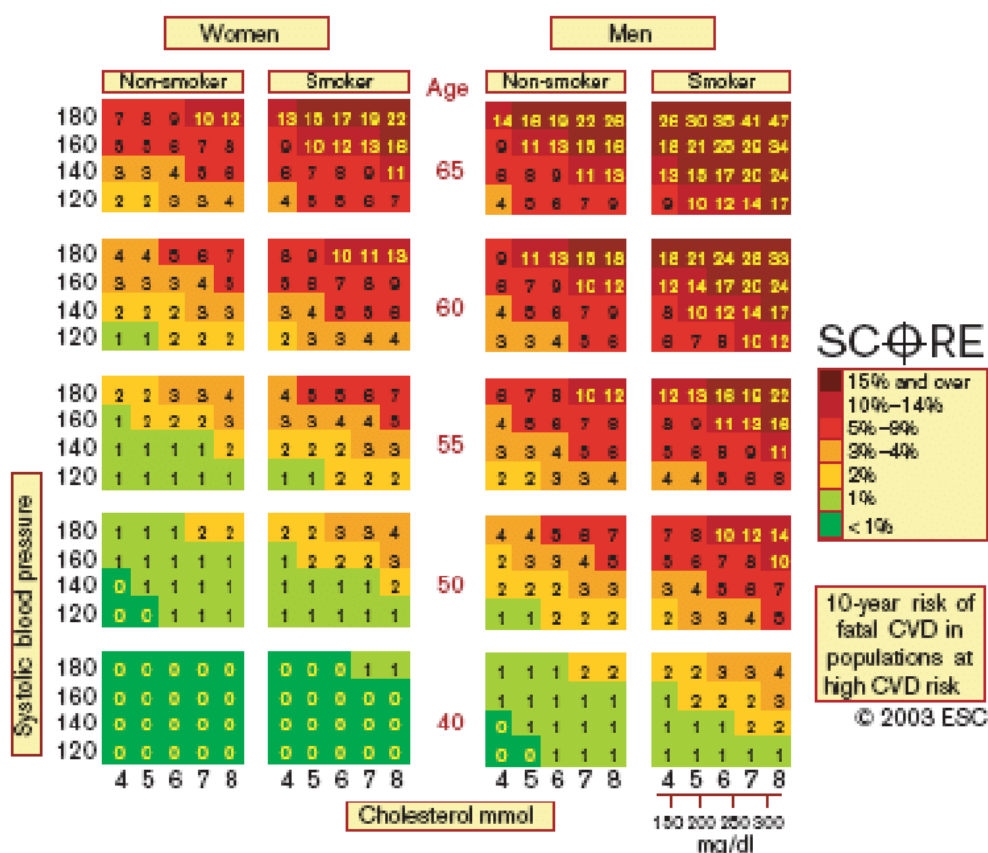

Figure 1. SCORE chart: 10-year risk of fatal cardiovascular disease (CVD) in population at high CVD risk based on age, gender, smoking, systolic blood pressure, and total cholesterol (www.escardio.org)

The same procedure was performed using the low-density cholesterol level as a chart variable instead of total cholesterol level. The level of low-density cholesterol was taken as equal to the level of total cholesterol if the difference between them was two units. This was done because the difference between normal level of these two indicators is usually two units. Differences in the predicted risk levels arose when the level values differed from each other by more or less than 2 units (due to the extreme value of high-density cholesterol) and therefore it scored a different number of points in the SCORE chart. A correlation was found between the estimated risk levels and fatal cardiovascular events (myocardial infarction, stroke, critical stenotic atherosclerosis proved by ultrasound or another test methods) that occurred over the next ten years in both SCORE chart variants. Data processing and analysis was performed using the Microsoft Excel, SPSS and the Spearman correlation coefficient.

Results

The correlation (r_s) between calculated risk level and actual fatal cardiovascular diseases in the next decade in the alternative version of the SCORE chart (using low density lipoprotein level) occured slightly stronger than in its traditional version (using total cholesterol level), respectively, 0.15 ($p < 0.01$) and 0.13 ($p < 0.01$).

Table 1. **Correlation between calculated risk level in 2010 and fatal CVD during next decade (2010-2020) in both SCORE chart versions**

SCORE chart version	Correlation (r_s) between calculated risk level in 2010 and fatal CVD during next decade (2010-2020)	p value
SCORE 1 (with total cholesterol level as a variable)	0,13	< 0.01
SCORE 2 (with low-density lipoprotein level as a variable)	0,15	< 0.01

During the analysed decade fatal CVD occured in 54 patients. Among these CVD patients, the traditional SCORE chart identified increased cardiovascular risk (> 5%) in 41%, however the alternative chart recognized by 2% more, namely 43% (see Fig. 2).
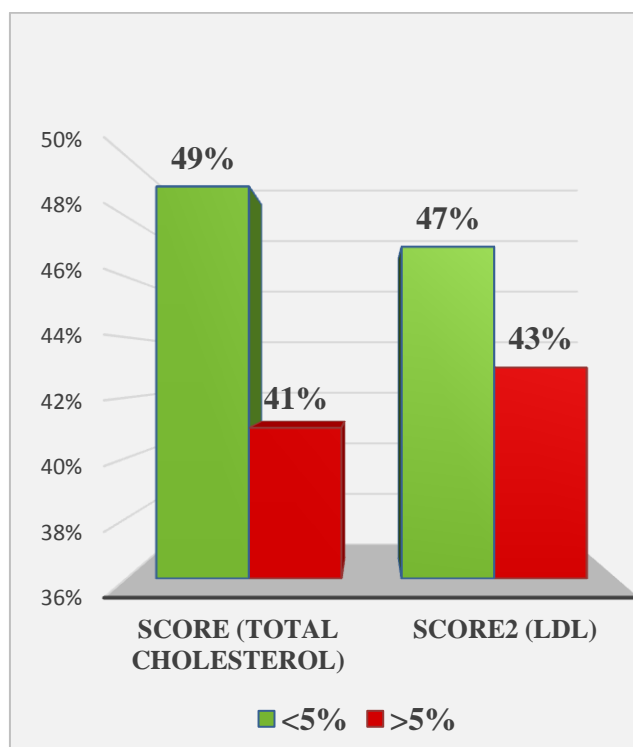
Figure 2. **Calculated risk level (%) in CVD patients by the traditional SCORE chart and its alternative version (replacing TH to LDL level)**

Discussion

The most interesting and most important fact that this study had revealed was not the answer on the stated question whether replacing of total cholesterol with LDL increases the SCORE chart predictive ability. Of course, as one can see, such innovation slightly improves the preciseness of CVD prognosis. But, unfortunately, the results shows that even this improvement (implementing low-density cholesterol level in the SCORE chart) can't solve the main problem of plenty nonidentified cases. Actually, more than a half of the CVD patients were not recognised as a high risk patients.

As it was mentioned before, the individuals with obviosly high CVD risk level (having diabetes, chronic kidney disease, severe atherosclerosis or previous anamnesis of miocardial infarction or stroke) were not included in the study. These factors were easy to recognize when analizing patients records. But there were some other factors mentioned by the SCORE chart authors, that could worsen the predicted risk level but were not taken into account when calculating the CVD risk level. And they were obesity (especially central obesity), a strong family history of premature CVD ($\leq$ 55 years in first-step relative men; $\leq$ 65 years in first-step relative women); socially deprived individuals and those from some ethnic minorities, increased triglyceride, fibrinogen, apoB, Lp(a) levels and perhaps increased high-sensitivity CRP (European Society of Cardiology). Undoubtedly, adipose tissue synthesizes and secretes biologically active molecules

that may affect cadiovascular risk factors. Decreases in visceral adipose tissue contribute to improvements in insulin sensitivity and blood pressure, and weight loss reduces serum levels of triglycerides and low-density lipoprotein cholesterol while increasing serum levels of high-density lipoprotein cholesterol. Reduction of risk factors suggests that the development of cardiovascular disease will be reduced by the improvement of insulin sensitivity and weight loss (Sowers 2003). Excluding patients with obesity from the study in order to accurately assess the prognostic ability of the chart was not possible because it would have reduced the cohort at least twice (obesity is a very common health problem in older patients in Latvia). But this risk factor should necessarily be included in future studies and propably in the improved SCORE chart in the future.

Premature cardiovascular deseases and death in relatives is consistently associated with elevated risks of early cardiovascular disease (Herolds un līdzautori 2017). This is another factor that may increse the estimated risk level but unfortunately has not been taken into account in this study. This information is not always recorded in the patient's history. Often, patients themselves do not know what diagnosis their relatives had. The inclusion of this risk factor in the SCORE chart will always face some difficulties because of this fact.

There is also accumulating evidence indicating that chronic sub-clinical inflammation as measured by such inflammatory markers as C-reactive protein (CRP) is associated with increased cardiovascular event risk (Taylor et al 2011). The rates of coronary death increases also with the triglyceride level (Criqui et al 1993). These are factors that can be easily and unexpensively identified and use as the SCORE chart variables.

Conclusions

Replacing one of the variables - total cholesterol with low-density cholesterol - slightly increases the SCORE chart predictive ability. Unfortunately, in both the SCORE chart version (using total cholesterol or LDL), the correlation between calculated cardiovascular risk level and tne real CVD events in the next ten years appeared to be weak. Actually, more than 50% of patients with fatal CVD that occured in the observed decade, were not identified as high-risk patients. In any case, even small improvements in the accuracy of this predictive method deserve attention and possible revision of the SCORE chart in the future.

For the development of a prognostic CVD risk chart with much more sensitive prognostic ability, it is recommended in future studies to investigate the effect of implementing in the SCORE chart a wider range of other significant risk factors that have been recognized as such in other studies.

Acknowledgement

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SPINAL MUSCLE TENSION DIFFERENCE BETWEEN STANDING ON HARD FLOOR AND STANDING ON THE ANTI-FATIGUE MAT, WEARING 3CM HIGH HEEL SHOES

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Abstract
Key Words: Ergonomic, muscle tension, anti-fatigue mat, sEMG, standing, heel
Objectives. This study focuses on comparing tension of spinal muscle *m.erectors spinae longissimus* bilateraly between standing on anti-fatigue mat and hard floor while wearing shoes with 3cm high heel.
Materials and methods. We tested ten healthy young participants, while standing for 10 minutes on hard floor and anti-fatigue mat each and wearing 3cm heel shoes. During these 10 minutes they were typing text on a computer standing on desk in front of them. Muscle tension in period of 1 minute from every take was measured. Muscles measured were *m.erector spinae longissimus* (MESL) bilateraly. Subjects were tested using surface electromyography with wireless electrodes (BTS FREEMG 1000, BTS bioengineering), and manufacturer-provided signal processing computer program. 10-second period with the smoothest measurement were analysed using Microsoft Excel and the SPSS statistics 26 program.
Results. The higher voltage in the muscles was observed while standing on the anti-fatigue mat. The effect was similar in both sides of MESL. Left MESL median on the floor was 8.89µV (interquartile range Q1-Q3 was 5.79-10.87), but on the mat it was 10.49µV (interquartile range Q1-Q3 was 8.18-12.88). Right MESL median on the on floor was 7.82µV (interquartile range Q1-Q3 was 7.18-17.63), but on the mat it was 10.86µV (9.49-23.90). Significance was found between standing conditions in both left MESL (p=0.005) and right MESL (p=0.005).
Conclusions. The study verified that *m.erector spinae longissimus* had significant response to the anti-fatigue mat. Electrical activity was released more prominently when standing on the anti-fatigue mat in comparison to standing on hard floor. The uneven surface of antifatigue-mat may be causing micromovements in order to gain stability. This way more micromovements are provoked causing improvement of spinal muscle microcirculation and nutrition flow and reducing fatigue.

Introduction

Nowadays, employees of many occupations work in a prolonged standing position. The literature has shown an association between prolonged standing and various health problems, especially lumbar and lower limb symptoms (Aghazadeh et al. 2014; Waters et al. 2014; Wiggermann et al. 2013). Prolonged standing increase skin temperature, leg volume and blood inflow which promotes *oedema* (Coenen et al. 2017).

Standing in static posture causes static muscle contraction, which leads to muscle fatigue and discomfort, in long-term causing musculoskeletal problems. Lack of joint movement and tissue compression during prolonged standing can contribute to cartilage degeneration and the development of rheumatic diseases (Speed et al., 2018). Based on a review of occupational health literature, musculoskeletal symptoms mostly appear after static posture for more than 20 minutes, but static standing longer than 4 hours per day as unsafe for health (Coenen et al., 2017).

Various interventions, which aim to make appropriate workplace for staff, are used to reduce health problems caused by prolonged standing. Flooring replacement, for example, using ergonomic anti-fatigue mats, is the common ergonomic solution (Aghazadeh et al. 2014; Speed et al. 2018; Waters et al. 2014). Although there are several studies that have identified a strong correlation

between softer flooring and subjective reduction of discomfort, the results of some studies are contradictory (Hui Lin et al. 2012). Evidence exists for the reduction of discomfort, but there is less certainty about the effect anti-fatigue mats has on physiological outcomes.

Anti-fatigue mats are especially effective in reducing lower limb discomfort because standing on a softer surface causes short muscle contractions that reduce muscle tension, improve blood circulation and reduce fatigue (Speed et al. 2018). However, regardless of the floor covering, prolonged standing in the workplace will cause fatigue, but this fatigue can be reduced by changing the position from time to time and observing ergonomics (CCOHS, 2020).

Anti-fatigue mats are designed to reduce fatigue for people who spend a long time standing on hard floorings, such as cement floors (CCOHS, 2020).

Anti-fatigue mats are very variable. They may differ in thickness, stiffness, compression. Also, they can be made of different materials, such as wood, rubber, vinyl (Aghazadeh et al. 2014). Their mechanism of action is to optimize the distribution of body weight on the feet and reduce pressure on the joints, providing cushioning, as well as creating an uneven surface, which forces the muscles to perform more micro-movements to maintain balance (Hui Lin et al., 2012; Speed et al., 2018). In the result static muscle contraction is reduced, the blood circulation in the muscles is improved and the pain that may be caused by insufficient blood supply is decreased (Speed et al., 2018). The literature describes the benefits of anti-fatigue mats in reducing discomfort and pain compared to hard surfaces, but few describe the micro-movements of muscles when standing on the mats compared to a hard floor.

Muscle fatigue

Muscle fatigue is defined as the maximum decrease in strength or energy in response to contractile activity. It can occur at different levels of the motor pathway and is usually divided into central and peripheral components. Peripheral fatigue is caused by changes in the neuromuscular junction or changes distal to it. Central fatigue occurs in the central nervous system, it is known as the changes in the nerve impulse to the muscle. There are many different fatigue classification methods. By duration, fatigue can be classified as acute and chronic. Acute fatigue can be quickly alleviated by rest or lifestyle changes, while chronic fatigue is a condition defined as prolonged fatigue that lasts for several months and is not reduced by rest. Fatigue can be classified as mental, which refers to cognitive or perceptual aspects, and physical fatigue, which refers to the functioning of the muscular system. (Muscle system fatigue is classified as physical fatigue.) Muscle fatigue is a common phenomenon that limits heavy and prolonged activity as well as athletic performance. Muscle fatigue can also limit daily activities (Wan et al., 2017).

The onset of muscle strength depends on contractile mechanisms. Therefore, if any of the cross-bridges are damaged, it can lead to muscle fatigue. Specific metabolic factors such as

hydrogen ions, lactate, inorganic phosphate, reactive oxygen species (ROS), osoromucoid (ORM) can also affect the development of muscle fatigue.

Anti- fatigue mats

Anti-fatigue mats are made to reduce fatigue in people who stand on hard floor, for example, cement floor, for prolonged period of time (Wan et al., 2017). These mats are very variable. They differ in thickness, density, softness, compression. Also, ergonomic mats are made from various materials like wood, vinyl or rubber (Canadian Centre for Occupational Health and Safety, 2015). Their mechanism of action is to optimize the distribution of body weight on the feet and reduce the load on the joints by providing cushioning. Also, these mats forms an uneven surface which forces the muscles to perform more micro-movements to maintain balance (Canadian Centre for Occupational Health and Safety, 2015) (Coenen et al., 2017). As a result, static load is reduced, blood circulation in the muscles is improved and pain, possibly due to insufficient blood supply, is reduced (Coenen et al., 2017).

So the aim of this study is to evaluate the effect of anti-fatigue mats on the micro-movements of the back muscles and to compare the differences in muscle micro-movements when standing on the anti-fatigue mat and on the floor.

Materials and methods

The permission of the ethics committee was obtained to perform the following experiment. Within the experiment, 10 volunteers, young and healthy participants were analyzed. Surface electromyograph electrodes were glued to each participant on the *m.erector spinae longissimus* on both sides of the back.

Participants were instructed to stand for 10 minutes on the floor and then stand for 10 minutes on an anti-fatigue mat. At first in shoes with a flat sole, then the task was repeated while standing in shoes with a 3cm high heel. During these 10 minutes they were typing text on a computer standing on desk in front of them.

Used equipment: computer, wi-fi router, anti-fatigue mat, book, computer, height-adjustable table, electromyograph with surface wireless electrodes and appropriate signal processing computer program (BTS FREEMG 1000, BTS Bioengineering). Disposable gel-coated electrode kit (certified for medical use in accordance with Regulation 93/42 / CEE as amended in 2007/47 / EC).

Research process. Electrodes were attached bilaterally to *m.erector spinae*. The participant was asked to put on shoes with a flat sole and stand in front of a computer desk. The task was to write text on a computer. And it starts in 10 min. time report. An adaptation period was given. When the participant was comfortable and started writing the text, 1 minute was taken. long surface electromyography recorded. When 10 min. after passing the participant was placed under the feet of the anti-fatigue mat and the previously given task was repeated. When 10 min. passed and 1 min.

long record was made, then the participant was asked to change the shoes to those with a 3cm high sole. Again, it was asked to repeat the previously performed tasks, the surface electromyograph was recorded for 1 min. on the carpet and on the floor. Data was exported and analyzed.

Data processing and analysis. Using a BSM EMG-analyzer program, only a 10-second segment was cut from the one-minute material with the smoothest possible measurement and no pronounced artifacts from which the mean modulus value was determined. The calculated values were tabulated using *MS Excel*, the data were coded according to the measured muscle group, as well as whether the measurement was performed on a carpet or floor (control). The units were changed from mV to µV. Data from *MS Excel* table transferred to SPSS program. The data were non-parametric - coded. Muscle groups in pairs (carpet control) were compared using the "Two related samples" test. The respective muscle tensions on both sides of the body were then compared.

Results

Data were obtained from 10 participants in the study. These data were collected and analyzed to evaluate the effect of floor surface on leg and back muscle micro-movements.

Analyzing the back muscles, it was found that in the analyzed muscles, the micro-movements are more prominent when standing on the mat compared to standing on the floor, as well as when standing in shoes with a 3cm heel, compared to standing in shoes with flat soles. A statistically significant difference between standing on the anti-fatigue mat and standing on the floor is observed in all analyzed muscles both when wearing shoes with a flat sole and a 3 cm high heel.

The median MESD (*m.erector spinae dextra*) when standing in shoes with a flat sole on the floor is 8.38µV, but on the mat it is 9.52µV (p = 0.007). The median MESD when standing in shoes with a 3 cm high sole is 7.82µV, but on the ergonomic mat 10.86µV (p = 0.005). The median MESS (*m.erector spinae sinistra*) when standing in shoes with a flat sole on the floor is 7.25µV, but on the mat 8.61µV (p = 0.013). The median MESS when standing in shoes with a 3 cm high sole on the floor is 8.89 µV, but on the ergonomic mat is 10.49 µV (p=0.007). No statistically significant difference was observed between MESS and MESD on both sides of the spinal muscle. Standing in shoes with a 3 cm high heel on a hard surface (p = 0.203) and on an anti-fatigue mat (p = 0.241). But standing in shoes with a flat sole on a hard surface (p = 0.215) and on an anti-fatigue mat (p = 0.233).

Discussion

Unfortunately, due to a global crisis, it was not possible to analyse more participants. In order to obtain more reliable results and to exclude as far as possible the probability of randomness and coincidence, more participants should be analysed. It would also be valuable to compare

participants of different ages, for example more elderly people with younger people in order to assess more valuable results of anti-fatigue mat impact on muscle micromovements.

It would be valuable to update our study, i.e. to analyse further data, such as comparing the muscles of the right and left legs. It would also be valuable to analyse the data for participants standing in shoes with a heel of 6 cm and 10 cm high etc.

Based on the data obtained and the data described in the literature, it is recommended to use anti-fatigue mats for people with frequent and prolonged static load to reduce the risk of developing muscle pain and musculoskeletal diseases.

Conclusions

The study verified that *m.erector spinae longissimus* had significant response to the anti-fatigue mat. Electrical activity was released more prominently when standing on the anti-fatigue mat in comparison to standing on hard floor. Also, when standing in shoes with a 3 cm sole, the micro-movements on the mat are more pronounced than when standing in shoes with a flat sole. No significant differences in micro-movement were observed between the left and right back muscles. The uneven surface of antifatigue-mat may be causing micromovements in order to gain stability. This way more micromovements are provoked causing improvement of spinal muscle microcirculation and nutrition flow and reducing fatigue.

Acknowledgement

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IMPACT OF BALANCE, GAIT AND COORDINATION TRAINING IN THE COMPLEX CARDIOREHABILITATION PROGRAM FOR GERIATRIC PATIENTS AFTER CARDIAC SURGERY (VALVE REPLACEMENT)

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Abstract

Key Words: balance training, cardiac surgery, cardiorehabilitation, valve heart replacement

After valvular cardiosurgery (with extracorporeal circulation), most geriatric patients develop vertebro-basilar insufficiency with balance problems or ataxia signs.

Our GOAL was to evaluate the possible impact of balance, gait and coordination training in the complex cardiorehabilitation (CR) algorithm of old patients after cardiac surgery.

MATERIAL AND METHODS

We observed 369 patients after cardiac surgery. Patients were randomized into three therapeutic groups. The control was done before, during and at the end of the CR course (of 10 treatment days), and one month after its end.

In all patients, we applied a complex cardio-rehabilitation (CR) programme of *physiotherapy and ergotherapy*; including cardio-training, respiratory exercises (predominantly for external and internal intercostal muscles); and goal-oriented activities (standing up, walking and climbing stairs). Group (gr) 1 received only this CR programme. In gr 2 we added *balance and gait training exercises*. In the next group (gr 3) we applied additionally *coordination exercises* for the upper and lower extremities.

The statistical ANALYSIS OF RESULTS demonstrates in all patients significant improvement of circulatory parameters; upgrade in cardiac functional parameters, enlargement in autonomy. We observed bigger amelioration in quality of life in the third group.

CONCLUSION: Balance and coordination training must be included in the CR-algorithm in geriatric patients after cardiosurgery.

Introduction

Cardiac rehabilitation – basic principles

Cardiac rehabilitation (**CR**) is a professionally supervised program to help people recover from heart attacks, heart surgery and percutaneous coronary intervention (PCI) procedures such as stenting and angioplasty (Cuccurullo, 2004; Gonzalez et al, 2004). Cardiac rehabilitation*, also called *cardio-rehab,* is a medically supervised program *for people who have had a heart attack, heart failure, heart valve surgery, coronary artery bypass grafting, or percutaneous coronary intervention* (Wenger et al., 1995). *Cardiac rehab involves* adopting heart-healthy lifestyle changes *to address* risk factors for cardiovascular disease. To help the patient to adopt *lifestyle changes*, the program includes exercise training, education on heart-healthy living, and counseling to reduce stress and help the patient to return to an active life.

According the *American Heart Association*: Cardiac rehab programs usually provide *education and counseling* services to help heart patients increase physical fitness, reduce cardiac symptoms, improve health and reduce the risk of future heart problems, including heart attack (Zolman and Tobis, 1968; Fletcher et al, 2001; DHHS, 2008).

General indication for CR is the cardio-vascular dysfunction or insufficiency (Exercise, 1994).

Concrete indications for CR include: *Heart attack; Heart condition* [such as coronary artery disease (CAD), angina or heart failure]; *Heart procedure or surgery* [including coronary artery bypass graft (CABG) surgery, percutaneous coronary intervention (PCI), including coronary angioplasty (balloon angioplasty) and stenting, valve replacement, or a pacemaker or implantable cardioverter defibrillator (ICD)].

Cardiac Rehabilitation *is an interdiscipline, between Cardiology, Cardiac Surgery, Physical & Rehabilitation Medicine* (Fletcher et al, 2001). For the staff, working in CR, different competences are needed: theoretical knowledge and practical skills – from different thematic fields.

A close collaboration between medical doctors – specialists is necessary. The Cardiac Rehabilitation involves a long-term commitment from the patient and a team of health care providers. The **cardiac rehab team** may include *doctors* (such as a family doctor, cardiologist, cardio-surgeon; physical & rehabilitation medicine specialist) *nurses, physical and occupational therapists, dietitians or nutritionists, and psychologists or other mental health specialists.* Sometimes a *case manager* will help. Some countries use the collaboration of a specialist in *Adapted Physical activity (APhA).* Working with the team is an important part of cardiac rehab.

Cardiac rehab is provided in an *outpatient clinic* or in a *hospital rehab center*.

The specificity of cardiac rehabilitation (CR) imposes the necessity of *individual approach*. The period of application is different: weeks, months or years, according the patient's needs.

Obligatory elements of CR are: *medication; regular physical activity; patient's education* – therapeutic councils, motor reeducation, smoking cessation; rational alimentary regimen, diet and weight reduction, control of the arterial hypertension; control of dyslipidemia; stress management (Pollack et al, 2000; Pescatello et al, 2004; Nelson et al, 2007).

According the initiatives of the World Health Organization (WHO) and the Societies of Cardiology and Cardio-respiratory rehabilitation, the month of February is considered as international Heart month, and the second week of February is considered as the week of Cardiac Rehabilitation, this year – 14-20 February 2021. The current year's slogan was: "Beating Strong, Living Long" (fig.1).

Figure 1. **Cardiac Rehabilitation week 2021**

Cardiorehabilitation procedures

Rehabilitation is a functional treatment, based on a detailed functional assessment.

For functional assessment we apply measurement of the arterial tension RR [mm Hg], Walking Tests [Physical capacity tests *(Exercise capacity) and Veloergometry].* Usually, for *functional evaluation* in clinical practice**,** we use different approaches in the acute and in the chronic stages. *During the acute stage* the assessment is done by the cardiologist or the cardiac surgeon. *During the sub-acute stage*, we apply *Sitting Rising test; Timed standing up & go (TUG / SUG)* test (for 3 meters) and the 5 meters walk test. *During the chronic stage*, we use *walk tests* assessment 12 minutes' walk test (12-MWT) or 6 minutes walk test (6-MWT); or veloergometry (*VET)*; Clinostatic Hypertension reaction and Orthostatic Hypotension reaction.

***For treatment*,** we apply a complex cardio-rehab programme, adapted to the individual patient*, including physiotherapy, ergotherapy; hydro / balneo / therapy or hydro-physiotherapy; climatotherapy; magnetotherapy.*

From the group of ***physiotherapeutic and ergotherapeutic methods*** we use [Shephard, 1997; Thomson et al, 2003; Holviala et al, 2006]:

✓ r*espiratory exercises;*

✓ *passive mobilizations;*

✓ *active exercises (aerobic);*

✓ *individual sessions or group sessions;*

✓ *exercises with devices (against the gravity and against dosed resistance);*

✓ *games, dances, tai-chi; tourism;*

✓ *mechanotherapy; treadmill, gladiator - for contra resistance exercises (especially for extremities, accentuating on lower extremities – cardio training);*

✓ *system HUBER MOTION.*

After valvular cardiosurgery (with extracorporeal circulation), many geriatric patients develop (latent) cerebro-vascular insufficiency in the vertebro-basilar system with balance problems or ataxia signs. For these problems, we must include other types of exercises.

Aim of the article

The general aim of our own systematic investigations in the field of cardiorehabilitation was to evaluate the prevalence of cerebro-vascular insufficiency in geriatric patients after *cardiac surgery with extracorporeal circulation* and to investigate the possible impact of ***balance, gait & coordination training*** in the complex cardiorehabilitation (CR) algorithm of these patients.

The goal of current article is to evaluate the possible impact of balance, gait and coordination training in the complex cardiorehabilitation (CR) algorithm of old patients after cardiac surgery.

Material and methods

We observed 369 patients after cardiac surgery (7-10 days after valve replacement - aortic, mitral or tricuspid). Patients were randomized into three therapeutic groups (123 per group). The control was done before, during and at the end of the CR course (of 10 treatment days), and one month after its end - using a battery of clinical methods and functional scales.

In all patients, we applied a complex cardio-rehabilitation (CR) programme of *physiotherapy and ergotherapy* (figures 2 and 3)*;* including cardio-training, respiratory exercises (predominantly for external and internal intercostal muscles); and goal-oriented activities (standing up, walking and climbing stairs). The found comprised diet and patient's education (figure 4).
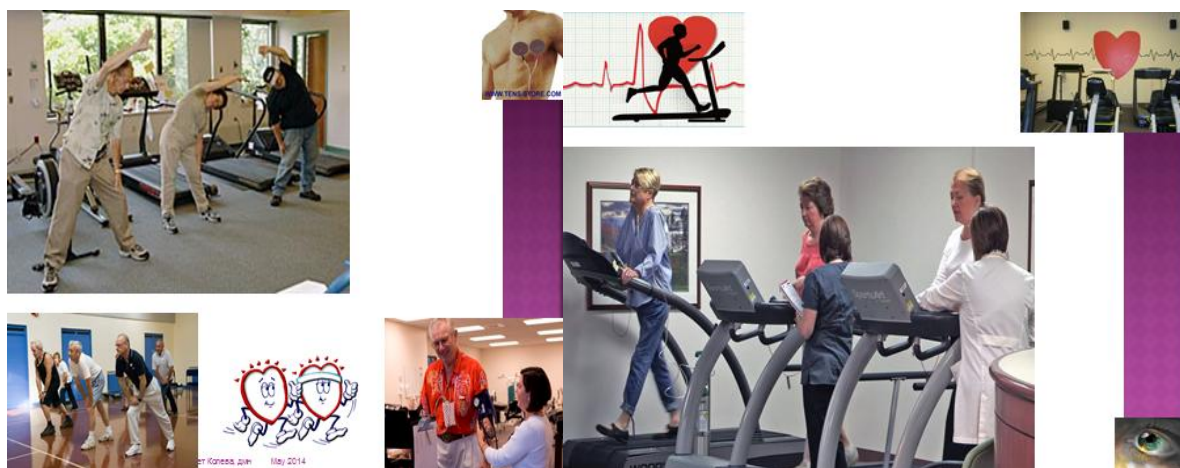
Figures 2 and 3. **Physiotherapeutic methods for CR – group exercises, treadmill**
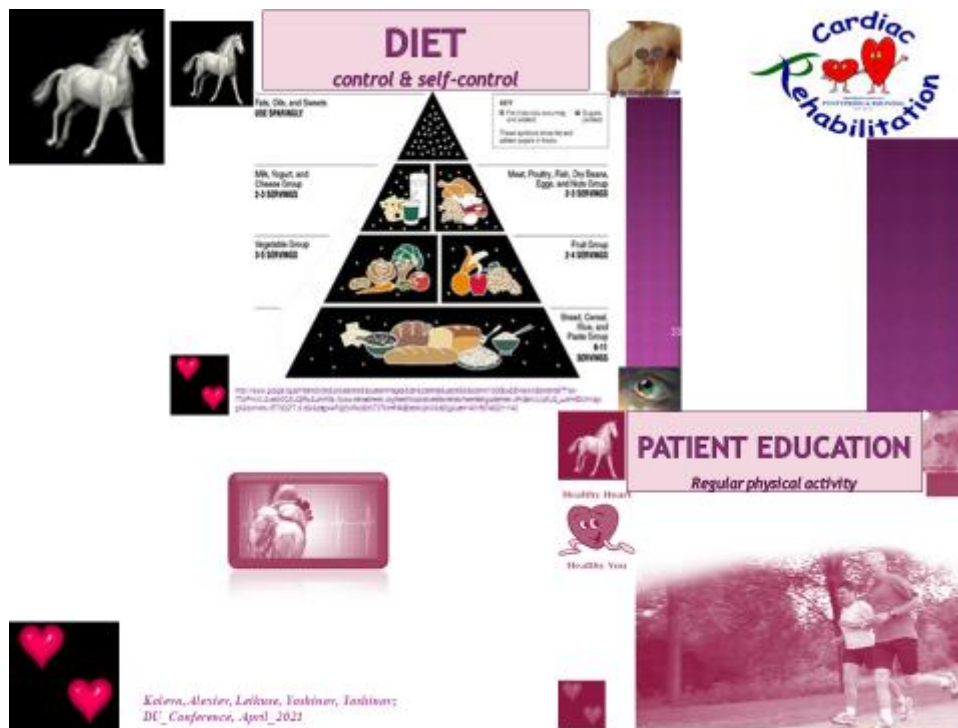
Figure 4. **Diet and Patient's education**

The control group (Gr 0) received only this CR programme.

In the experimental groups (E) we added *balance & gait training exercises (figures 5 and 6):*

➢ *In gr-E1 – only balance & gait training;*

➢ In the next group Gr-E2 we applied additionally *coordination exercises* for the upper and lower extremities.
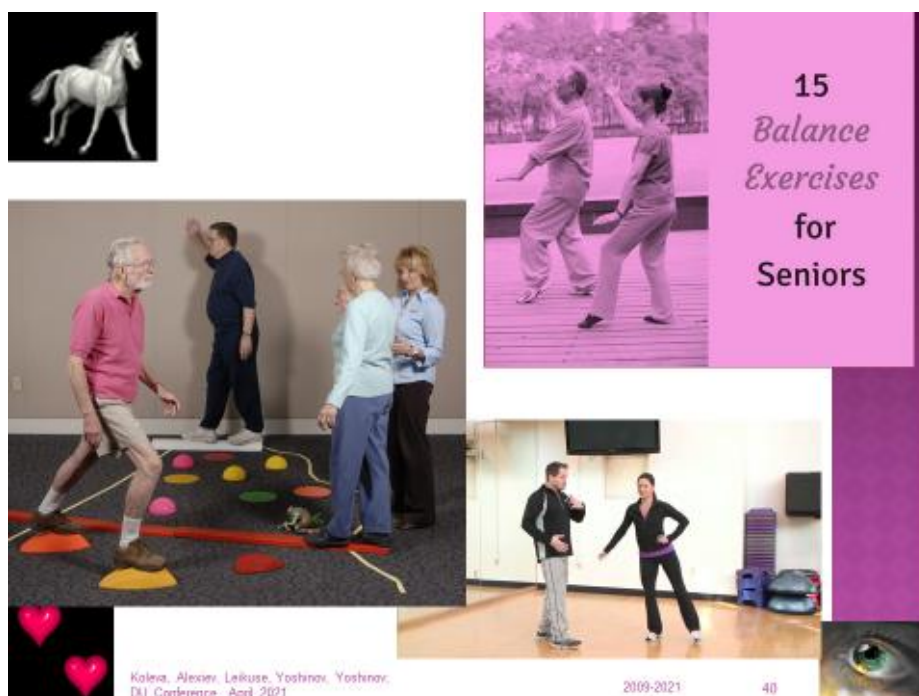

Figure 5. **Balance training**

Figure 6. **Specific Balance exercises for seniors**

Results

    The statistical analysis of the results of functional assessments demonstrates in all patients significant improvement of circulatory parameters (response of arterial tension and pulse to physical activity); upgrade in cardiac functional parameters (Holter-cardiography; Trans-Thoracic Echocardiography /ejection fraction/), enlargement in autonomy (Timed Up and Go test; Functional Independence Measure – subscales of Self-care, Transfers and Locomotion). We observed bigger amelioration in quality of life in the third group.

    Next figures illustrate our results. The improvement of circulatory parameters are presented in figures 7 and 8. We can observe the response of arterial tension and arterial radial pulse (heart rate) to physical activity.

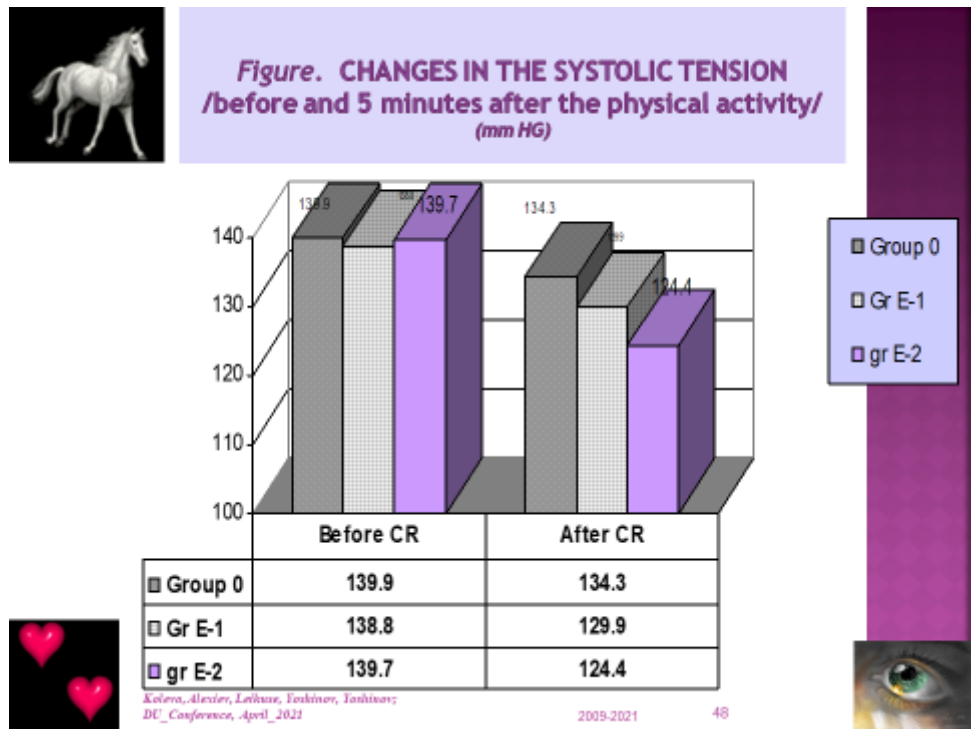Figure 7. **Changes in the arterial systolic tension**
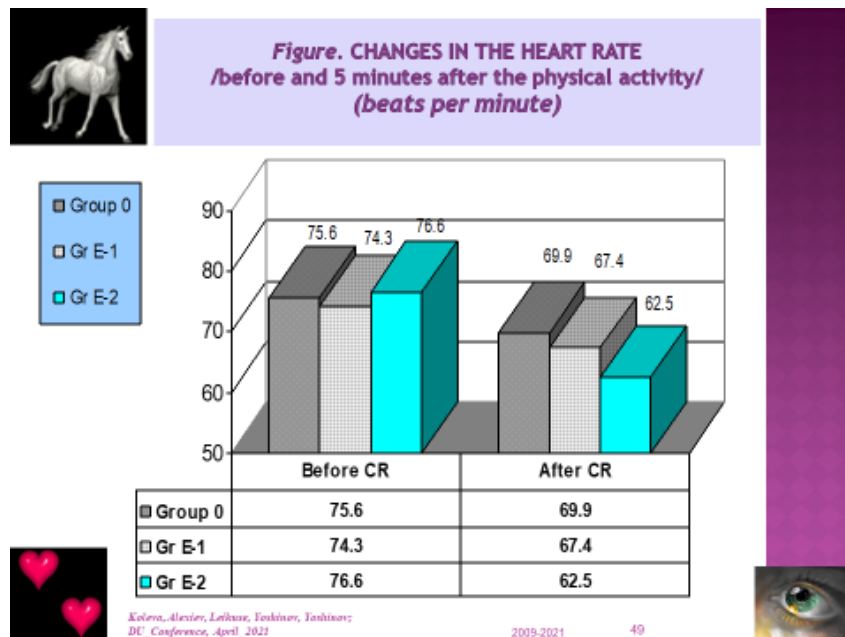
Figure 8. **Changes in the heart rate (arterial pulse measured)**

The upgrade in cardiac functional parameters, measured by Holter-cardiography and Trans-Thoracic Echocardiography /ejection fraction/ will be published in cardiological journals.

The enlargement in autonomy can be measured by the results of the Timed Up and Go (TUG) test (figure 9).
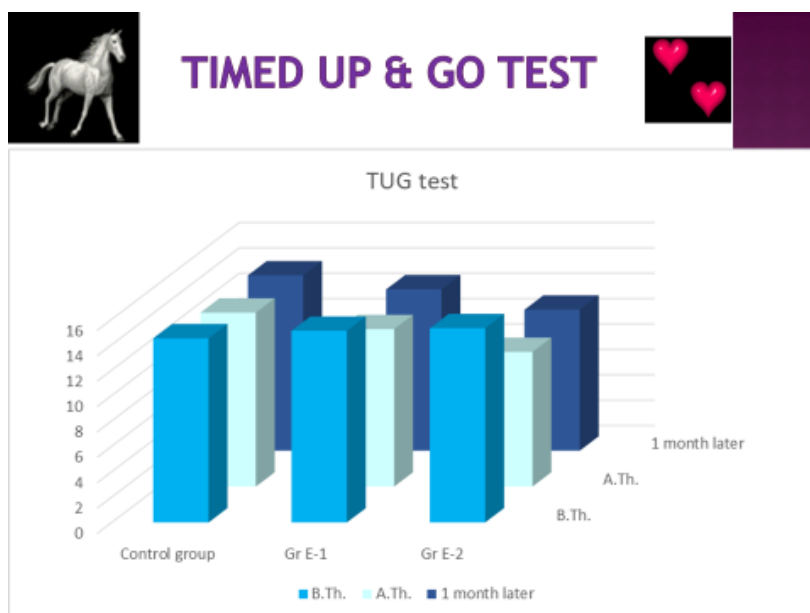
Figure 9. **Results of the TUG-test**

The amelioration of the quality of life after cardiorehabilitation programme is illustrated by the results of the WHO-5 Well-being index of Ohio university (Bech, 2004), presented in next figure 10. The results are stable one month after the end of the CR-program.
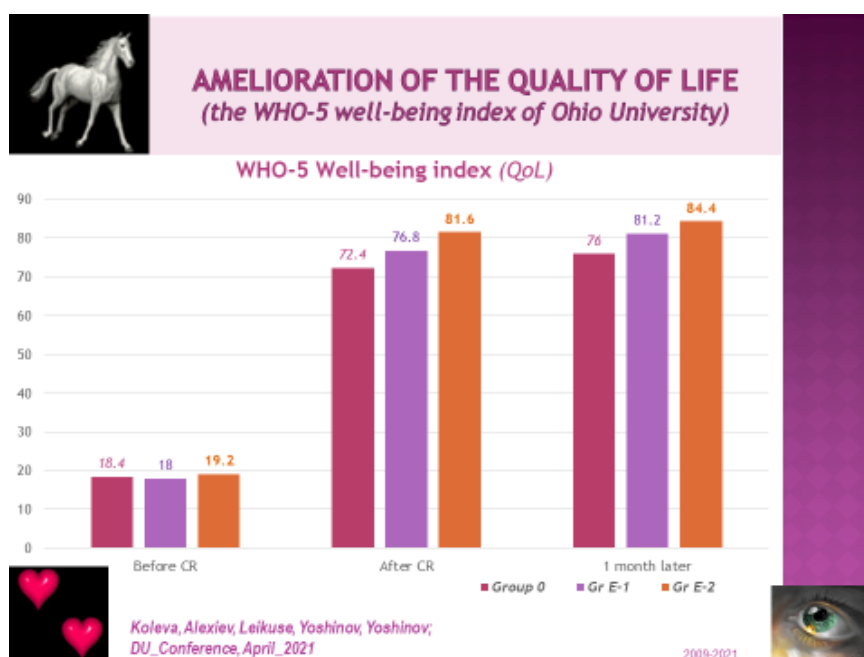
Figure 10. **Amelioration in the quality of life (WHO-5 well-being index)**

Discussion

Clinical practice demonstrates the importance of the early mobilization after cardiac operation for the functional recovery.

The upgraded cardio-rehab algorithm must include: *physiotherapy and ergotherapy* with functional activities, aerobic training; respiratory exercises; balance & coordination exercises; gait training.

Of course, this CR algorithm includes the obligatory elements of every rehabilitation algorithm, as follows: *diet; medication; control of risk factors; patient education; regular physical training; activities.*

The organization of the program of care of every cardiac or cardio-surgical patient must be monitored – *from the cardiosurgery or the intensive ward to the cardiorehabilitation unit* (fig.11).
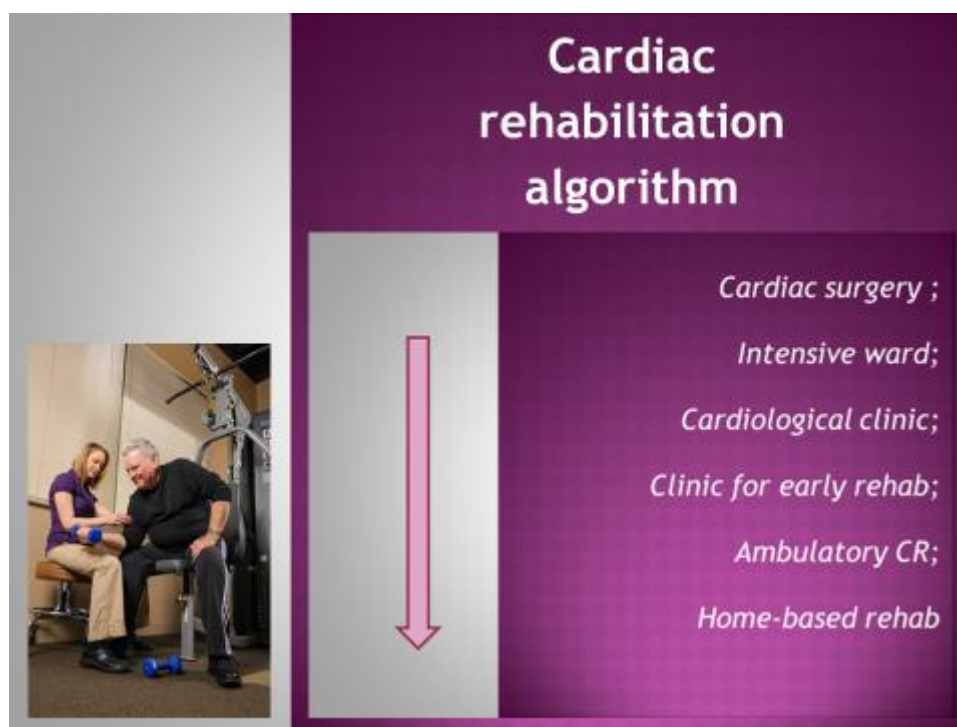
Figure 11.

***The benefits of the application of cardiorehab programmes*** include: clinical amelioration; regulation of dyslipidemia; smoking cessation; reduction of mortality of myocardial infarction; amelioration of the quality of life. Our results coincide with the data of many authors (Pollock et al, 2000; Rejeski and Mihalko, 2001; Nelson et al, 2007).

Conclusions

Cardiac rehabilitation improves the quality of life, reduce the need for medicines to treat heart or chest pain, decrease the chance to go back to a hospital or emergency room for a heart problem, prevent future heart problems, and even help the patient to live longer. Balance, gait & coordination training must be obligatory element of cardiac rehabilitation algorithm in geriatric patients after cardiac surgery requiring extra-corporeal circulation.

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IMPACT OF ROBOTIC REHABILITATION WITH LOCOMAT (HOCOMA SYSTEM) ON BALANCE AND GAIT STABILITY IN POST-TRAUMATIC PARAPLEGIA (A CASE REPORT)

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Abstract

Key Words: *paraplegia, balance, gait, neuromodulation, robotic rehabilitation*

During last years, we observe an increasing frequency of traffic accidents and the resulting neurological complaints.

We present a male patient of 21 years, transferred to our PRM Department one month after neurosurgery (thoracic stabilization) for an important vertebral thoracic fracture.

During clinical exam (at the admission), we observed a complete inferior paraplegia with total dependence in activities of daily living (ADL): impossible autonomic movements in the bed, the patient was only in lying position. The patient had urinary catheter and severe urinary infection, treated with antibiotics.

We applied a complex rehabilitation, including preformed physical modalities (electrical stimulations), gradual verticalization, individualized physiotherapeutic and occupational therapeutic program, accentuating on balance and gait training, ADL education. Six months after the traumatic spinal cord injury (SCI), we began with robotic rehabilitation with Locomat system (Hocoma).

We noticed significant improvement of the range of motion of the cervical spine, pain relief, balance stabilization, amelioration of autonomy in ADL. At the month nine after the SCI the patient have the capacity of autonomic verticalization with a walker and gait – without assistance.

We consider that every patient with post-traumatic inferior paraplegia must be included in a longterm physiotherapeutic and ergotherapeutic program, if possible – with robotic rehabilitation.

Introduction

Spinal Cord Injury

During last years, we observe an increasing frequency of traffic accidents and the resulting neurological complaints (World Health Organization, 2014). Clinical features depend on the level of the spinal trauma (Koleva, 2019). The most frequent levels of spinal cord injuries (SCI) are cervical and thoracal. In case of thoracal vertebral fracture the most common neurological consequence is the spastic paraplegia with loss of motor control and loss of sensibility in lower extremities, accompagnied by development of spasticity (figure 1).
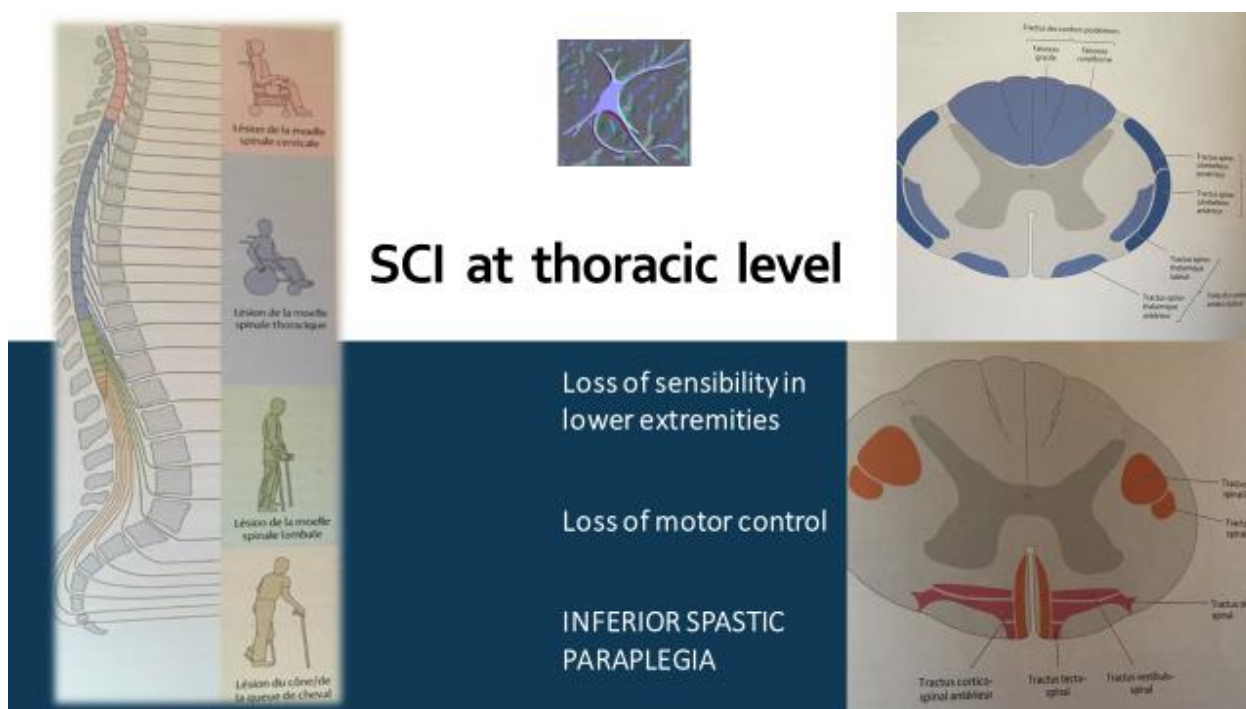
Figure 1. **Clinical features after SCI at thoracic level**

Neurorehabilitation

According the White Book on Physical and Rehabilitation Medicine (PRM) in Europe (White Book, 2018a), Rehabilitation is a functional therapy, based on a detailed functional assessment. Neurorehabilitation (NR) is an interdiscipline between Neurology, Neurosurgery, Physical and rehabilitation medicine (Koleva, 2009). The work (and the education) in this thematic field requires the coordinated activity of different members of the multidisciplinary and multi-professional neurorehabilitation team – medical specialists and health professionals (Koleva, 2011).

Practically, NR is a combination of detailed functional assessment and subsequent complex functional therapy, oriented to modulate neuroplasticity – through stimulation or inhibition techniques.

For functional assessment of patients in NR, we apply a lot of clinical and instrumental methods, specific neurological scales and the International Classification of Functioning (ICF, 2001) (Koleva, 2009).

In clinical NR-practice, the goal is always functional recovery and amelioration of the quality of life of neurological and neurosurgical patients. The autonomy of patients in clinical practice requires a specific training of activities of daily living (ADL), especially of Grasp and Gait (Koleva, Avramescu, 2017).

During the construction of the complex NR-algorithm we apply PRM-principles – multi-disciplinary team, holistic and patient-centred approach (White Book, 2018-b; Koleva, Yoshinov, 2020).

For treatment we use the SMART approach (specific, measurable, achievable, realistic and timebound) and we apply the 'rehabilitation puzzle' – a complex NR-programme with synergic combination of different physical modalities.

In NR-clinical practice, we apply many natural physical modalities (physiotherapy and ergotherapy; balneotherapy or balneophysiotherapy; cryo or thermo-agents; manual therapy; soft-tissue techniques) and preformed methods (functional electrostimulations /FES/, transcutaneous electroneurostimulation /TENS/, Deep Oscillation, low-frequency low intensity magnetic field, Ultrasound, Laser, etc.). We accentuate on some emerging methods, as exoskeletons, robotic NR, virtual reality (Koleva, Yoshinov, 2020).

The World Report on Disability of the World Health organization and the World Bank (WHO, 2011) defines the *goals of rehabilitation*: prevention of the loss of function; slowing the rate of loss of function; improvement or restoration of function; compensation for lost function; maintenance of current function. Modern rehabilitation has an *integrative and holistic approach to the patient,* based on the *International Classification, disability and Health (ICF, 2001)* and on clinical principles.

Current article presents the authors' opinion about the necessity of structuration of complex rehabilitation algorithms, including not only different traditional natural and pre-formed physical modalities, but too an adapted physiotherapeutic and ergotherapeutic programme with contemporaneous technology – Locomat (Hocoma) system, using locomotor training, robotic rehabilitation and virtual reality (Holden, Dyar, 2002; Barbeau, 2003; Huang, Krakauer, 2009).

Aim of the article

Our objective was to emphasize the potential of modern NR-methods: LOCOMAT robotic rehabilitation, in combination with the traditional for our country physiotherapy and electrical stimulation.

Case presentation

We present a male patient of 21 years, transferred to our PRM Department one month after neurosurgery (thoracic stabilization) for an important vertebral thoracic fracture.

During clinical exam (at the admission), we observed a complete inferior paraplegia with total dependence in activities of daily living (ADL): impossible autonomic movements in the bed, the patient was only in lying position. X-Ray, CT scan and Magnetic Resonance Imagery (MRI) of the spine after the traffic accident demonstrated fracture with dislocation of thoracic vertebras and ribs (fig.2). An urgent neurosurgical thoracic stabilization was realized (fig.3). The patient had urinary catheter and severe urinary infection, treated with antibiotics.
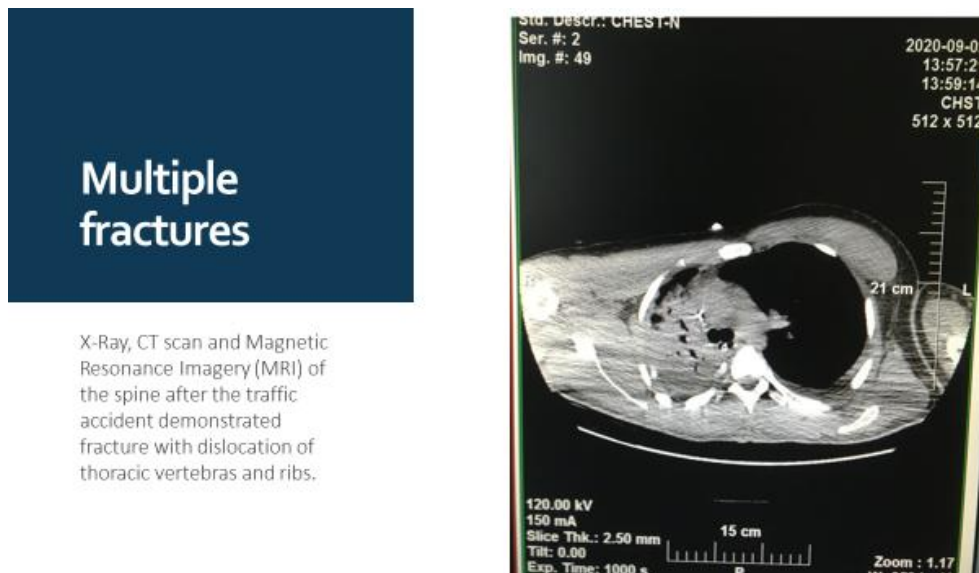
Figure 2. **Multiple fractures after the traffic accident**
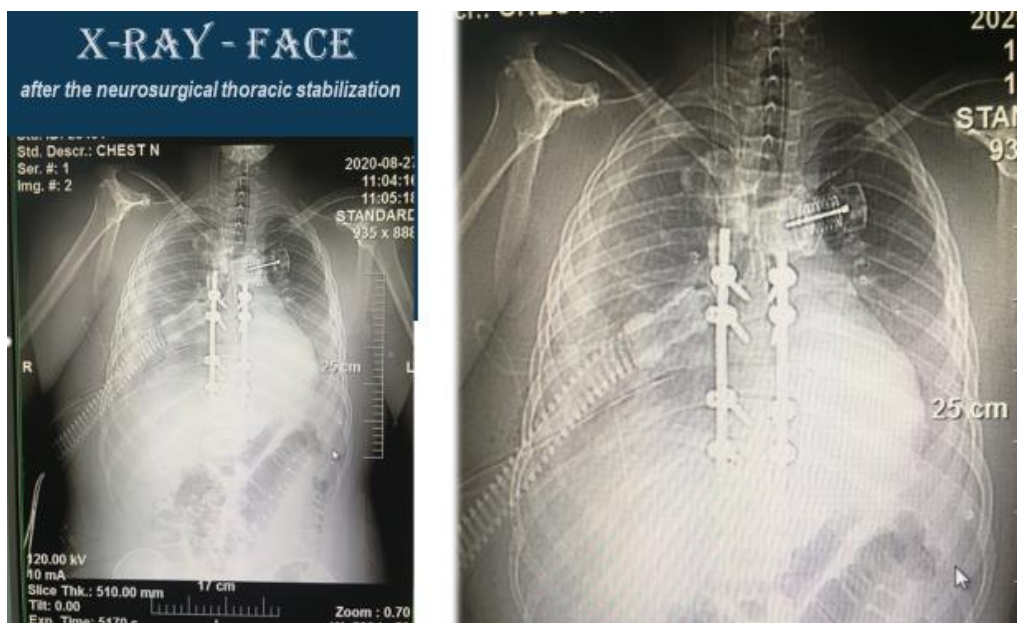
Figure 3. **X-Ray after the neurosurgical intervention**

Methods

We applied a complex rehabilitation, including preformed physical modalities (electrical stimulations), gradual verticalization, individualized physiotherapeutic and occupational therapeutic program, accentuating on balance and gait training, ADL education (figure 4).

Figure 4. **The Rehabilitation complex during the first months**

Six months after the traumatic spinal cord injury (SCI), we began with robotic rehabilitation with Locomat system (Hocoma), so the rehabilitation complex included electrical stimulations, physiotherapy, ergotherapy and robotic rehabilitation (figure 5).
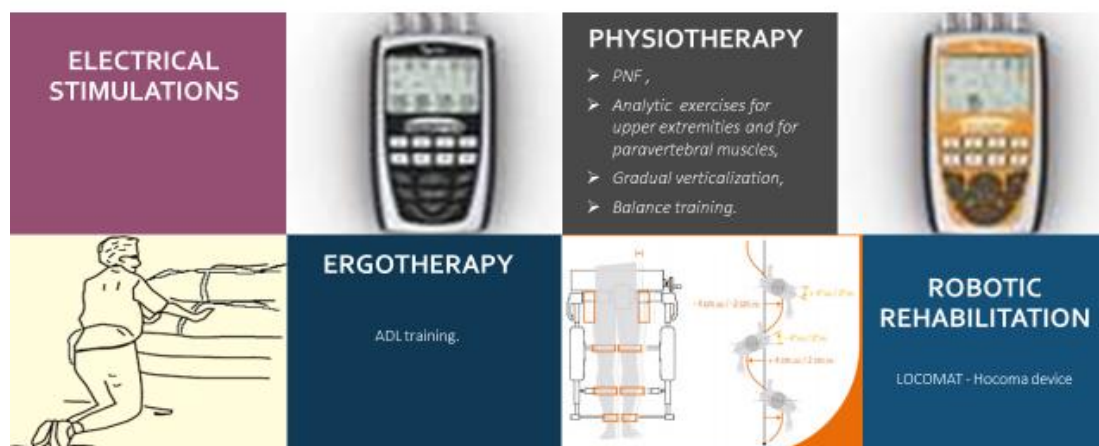
Figure 5. **The Rehabilitation complex after the sixth month of rehabilitation**

The individualized physiotherapeutic and occupational therapeutic program was based on traditional principles (Porter, 2003; Lennon, Stokes, 2009; Lamprecht & Lamprecht, 2018). We included proprioceptive neuro-muscular facilitation (PNF), analytic exercises for paravertebral and gluteal muscles and for trunk stabilization, stenght training of upper extremities, gradual

verticalization, training of the trunk control and of the balance, quadripedic locomotion (figure 6); training in activities of daily living (Koleva, Yoshinov, Yoshinov, 2019).

Figure 6. **Physiotherapy as element of the complex rehabilitation**

The robotic rehabilitation with Locomat system (Hocoma) began after the trunk stabilization and the initial balance training. Locomat sessions accentuated on balance and gait training (figure 7). The robotic sessions were realized three times weekly, for one hour, during 3 consecutive months.

Figure 7. **Gait training with the Locomat system**

Results and Discussion

We noticed significant efficacy of the rehabilitation: improvement of the range of motion of the cervical spine, pain relief, balance stabilization, amelioration of autonomy in activities of daily life. At the month 9 after the SCI the patient have the capacity of autonomic verticalization with a walker and gait – without assistance. Next figures demonstrate the changes in the distance +435% (fig.8), Duration changes +628% (fig.9), assessments of the range of motion of the hip and the knee (fig.10), reduction of spasticity (fig.11).
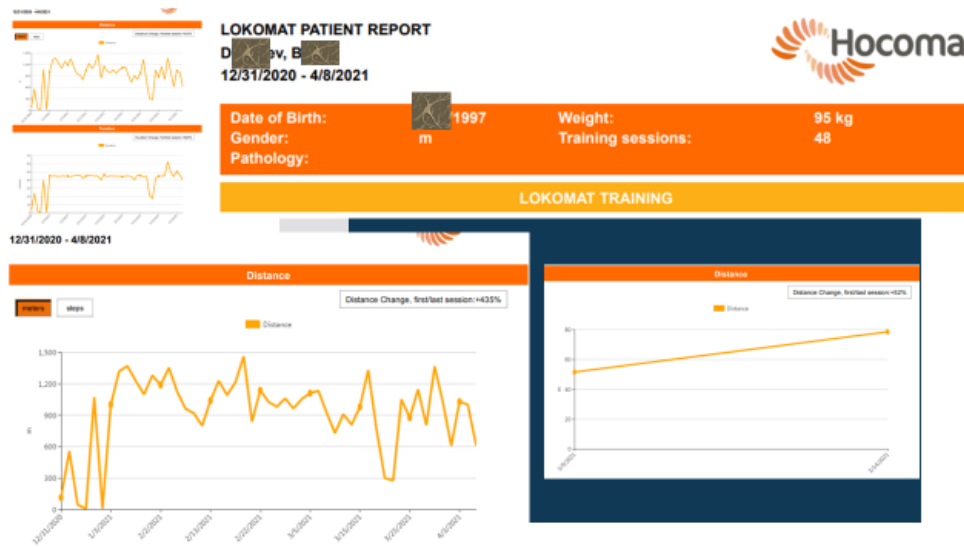
Figure 8. **Patient's report of the Locomat training - Gait distance evaluation**
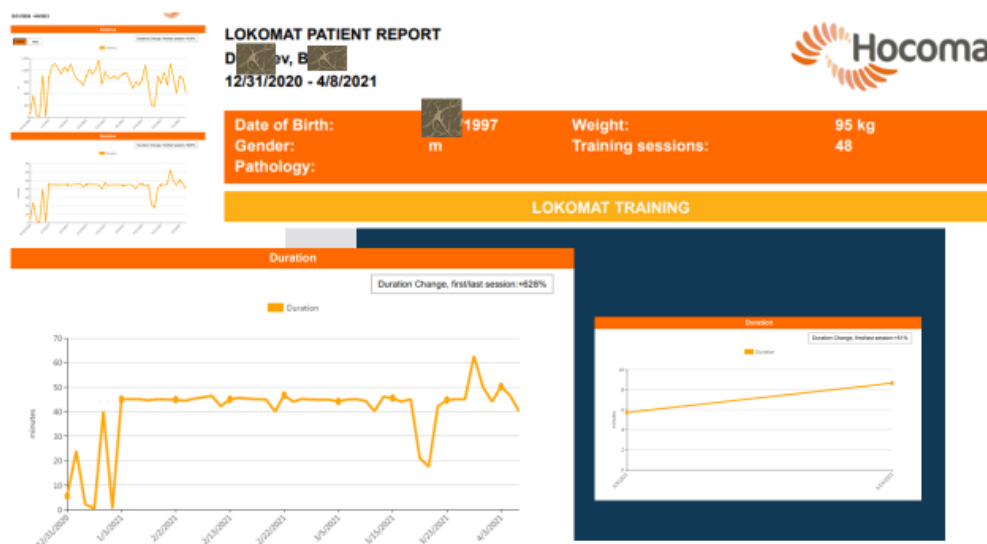
Figure 9. **Patient's report of the Locomat training – Duration changes**
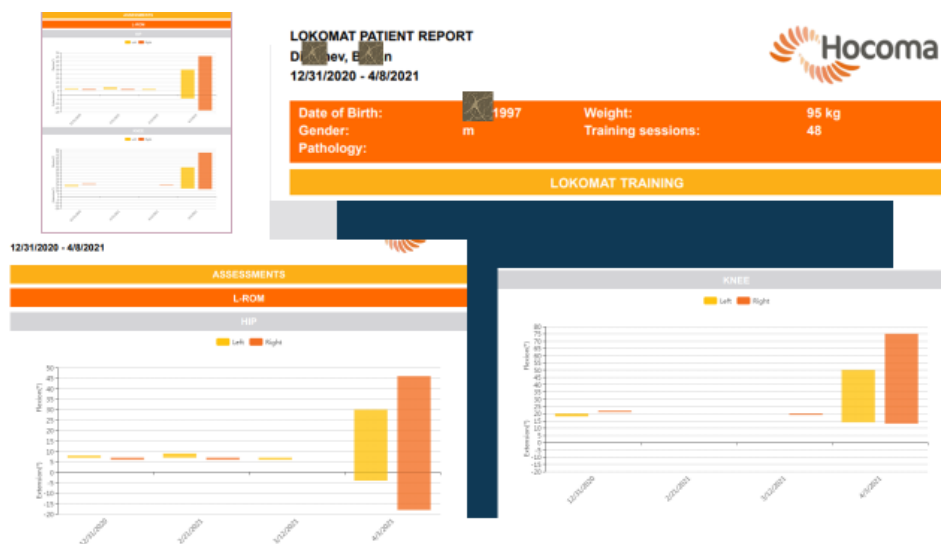
Figure 9. **Patient's report of the Locomat training – Gait distance evaluation**
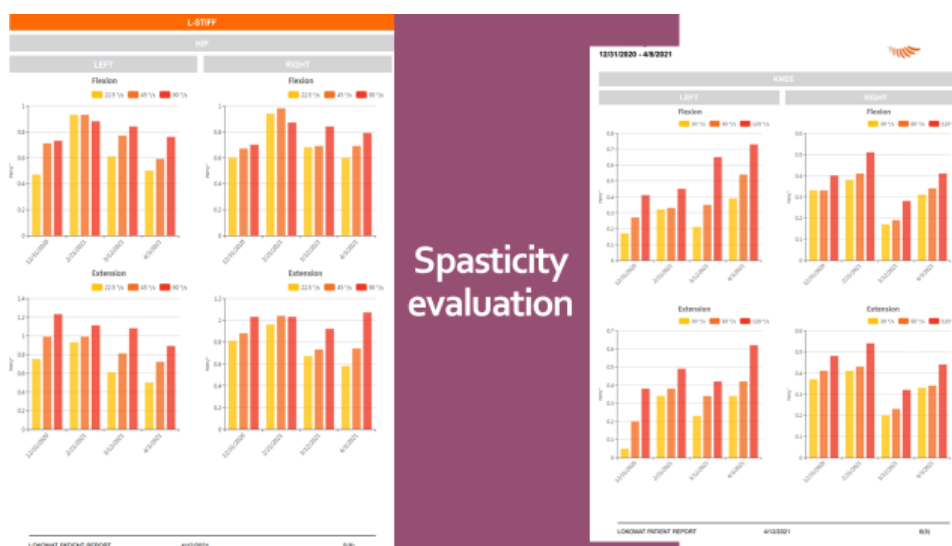
Figure 10. **Patient's report of the Locomat training – Spasticity evaluation**

Discussion - *Neuroplasticity and Neuromodulation*

> *"Any man could … be the sculptor of his own brain."*
> Santiago Ramón y Cajal

According Merriam Webster dictionary: "neuroplasticity is the adult brain's ability to adapt". According the medical dictionaries: "neuroplasticity is the brain's capacity to reorganize itself by forming new neural connections throughout life" (Schaffer, 2016). Neuroplasticity allows the neurons to compensate for injury and disease and to adjust their activities in response to new situations or to changes in their environment (Kramer, Erickson, 2007). Principal mechanisms of brain repair are based on brain plasticity (spontaneous recovery, input of "axonal sprouting" and

"mirror-neurons", use-dependent plasticity, synaptic or grey matter plasticity, white matter plasticity).

For patient adaptation to the "new" situation (of neuronal alteration), we use two types of modulation techniques: stimulation of some functions (e.g. motor and sensory functions) and inhibition of other (e.g. pain reduction). For stimulation, we apply training of the altered motor function (through movements and activities - use-dependent plasticity) and some compensatory mechanisms (bypass strategies, replacement of functions by aiding devices, adaptation of the environment to patient's needs). For inhibition, we apply pain management mechanisms: blocking the nociception and the neurotransmission, peripheral sympaticolysis, input the gate-control, peripheral and central desensitization, influence on the descending systems for pain control and activation of the encephalic blocking system of the central nervous system, activation of reflectory connections.

The "aim" of neuroplasticity is to optimize neural networks during phylogenesis, ontogenesis and physiological learning, and in case of a brain disease (Vaynman, Gomez-Pinilla, 2006).

Neuroplasticity is the pathophysiological basis for treatment of the cerebral lesions through physical training and rehabilitation, including goal-directed activities (Moore, Loprinzi, 2020). As we know: Rehabilitation is a functional therapy, based on a detailed functional assessment. Practically, every rehabilitation process is founded on neuroplasticity (training or use-dependent plasticity).

Based on our modest clinical practice (of 30 years) in the NR-field and our own results, we emphasize on the capacity of physical modalities for stimulation of neuroplasticity (especially on activity-induced plasticity), on the potential for functional recovery and amelioration of independence in everyday life of patients with diseases and conditions of the nervous systems.

Many NR tools have the potential to rewire cerebral functions and to excite the formation of new connections and pathways, respectively to stimulate the brain reorganization and adaptation to the 'new' situation (appearance of a damaged locus in the cerebral tissue), in other terms - to help functional recovery through potentiation of use-induced and use-dependent neuroplasticity:

➢ *From the field of physiotherapy:* Mirror therapy; Bimanual and bipedal exercises (training of the damaged and the healthy extremity, dominant and non-dominant); Regular physical activity (repetition of exercises with mild to moderate intensity);

➢ *From the domain of ergotherapy (occupational therapy):* Education of the person with disability trough task oriented (task-specific) activities; Art therapy, music-therapy; relaxation techniques (including sleeping).

➢ *From the field of preformed physical modalities:* transcranial electric stimulation (applying direct current), transcranial magnetic stimulation.
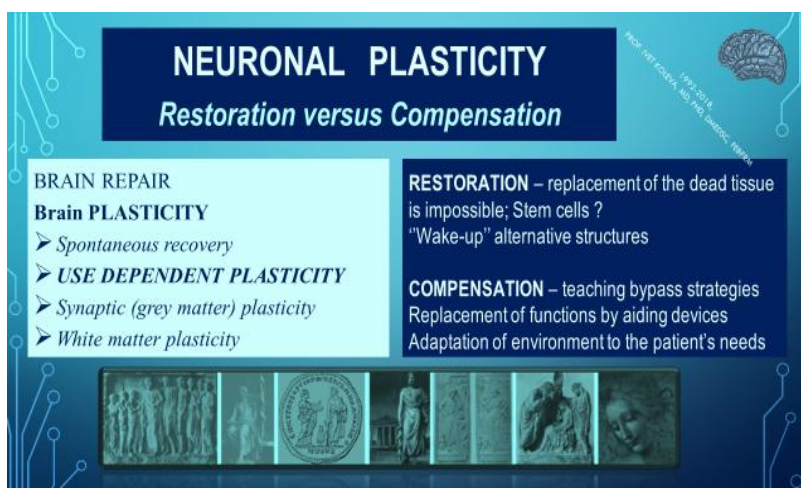
Figure 11. **Neuronal plasticity**

In cases with motor weakness, lack of mobility, and reduced range of motion (active or passive) we stimulate neuroplasticity through active exercises (including underwater training), Proprioceptive neuro-muscular stimulation (PNF); grasp training and goal-oriented activities; balance and gait training; functional electrostimulations; exoskeletons (with Hybrid-assistive limb); virtual reality training. Paralelly, we apply inhibitory techniques - oriented to pain reduction and regulation of the increased muscle tone (spasticity or rigidity): cryotherapy or thermotherapy; balneotherapy with mineral waters and peloids; manual therapy (joint tractions, mobilizations and manipulations); relaxing massage; post-isometric relaxation (PIR), stretching techniques; TENS, Deep oscillation, Magnetic field, Lasertherapy and Laserpuncture.

In every clinical case, we consider the balance between stimulation and inhibition, crucial for the clinical result and the efficacy of rehabilitation.

Neurorehabilitation with modern methods of evaluation and treatment is an important patient's right, recognized by United Nations in the Convention on the Rights of persons with disabilities (United Nations, 2007).

Conclusions

Systematic neurorehabilitation with modern information technologies ameliorates the quality of life of patients, using the activity-dependent neuronal plasticity.

We consider that every patient with post-traumatic inferior paraplegia must be included in a longterm physiotherapeutic and ergotherapeutic program, if possible – with robotic rehabilitation.

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PHYSICAL PREVENTION AND REHABILITATION ALGORITHMS IN OVERWEIGHT, OBESITY AND CELLULITIS

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Abstract
Key Words: *obesity, cellulitis; physical prevention, rehabilitation algorithm*
Overweight, obesity and cellulitis are considered as a serious health and cosmetic problem, with serious consequences on the quality of life.
Physical medicine and rehabilitation can be useful in the process of prevention and rehabilitation of these patients, applying different physical modalities.
In the complex prevention and rehabilitation algorithm, we include: physical activities and sports; exercises (analytic exercises for abdominal belt, for gluteal and femoral muscles); ultrasound-cavitation and phonophoresis with anticellulite gels; endermology (LPG technology); functional electrical stimulations; radio-frequency, VelaShape; diet and patient education.
We applied complex prevention and rehabilitation algorithms using a synergic combination of different physical factors: augmentation of the regular physical activity, exercises, one soft-tissue technique (lymphopressotherapy or post-isometric relaxation); two preformed modalities; one cryo or thermo-agent.
We present series of clinical cases suffering from overweight and cellulite; after application of a rehabilitation complex. Our results included: amelioration of the skin elasticity and of the "orange peel"; decrease of the body-mass index, reduction of the waist circumference).
We propose a hypothesis of the mechanisms of action of physical modalities on overweight, obesity and cellulitis.

Introduction

Overweight, obesity and cellulitis are considered as a serious health and cosmetic problem, with serious consequences on the quality of life (Burges, 2005).

Metabolic syndrome and visceral obesity are considered as the „edipemic of the last century".

According official statistics, over 50% of the European population is overweight or obese.

Obesity has reached epidemic proportions globally, with at least 2.8 million people dying each year as a result of being overweight or obese. Once associated with high-income countries, obesity is now also prevalent in low- and middle-income countries. Governments, international partners, civil society, non-governmental organizations and the private sector all have vital roles to play in contributing to obesity prevention (WHO, 2020).

Overweight and obesity are epidemic diseases affecting over 600 million adults worldwide and have been declared by the World Health Organization (WHO) as the leading global chronic health issues. (ISPRM / ESPRM Guidelines, 2020).

Physical prevention of these conditions can be useful.

Aim of the article

The general goal of our work in this field is to demonstrate the impact of physical modalities in the prevention and rehabilitation of overweight, obesity and cellulitis.

The concrete aim of current article was to compose a complex algorithm for physical prevention and rehabilitation, based on a detailed bibliographical analysis, litterature review and our modest clinical experience.

Metabolic syndrome

The key sign of metabolic syndrome is central obesity, also known as visceral, male-pattern or apple-shaped adiposity. It is characterized by adipose tissue accumulation predominantly around the waist and trunk (Antipatis, 2001).

Other signs of metabolic syndrome include high blood pressure, decreased fasting serum HDL cholesterol, elevated fasting serum triglyceride level, impaired fasting glucose, insulin resistance, or prediabetes (Oxford Handbook of Endocrinology and Diabetes, 2014). Associated conditions include hyperurikemia; fatty liver (especially in concurrent obesity) progressing to nonalcoholic fatty liver disease; polycystic ovarian syndrome in women and erectile dysfunction in men; and acanthosis nigricans.

Obesity

Obesity is defined as an excess of body fat, sufficient to adversely affect health (Antipatis, 2001).

Body mass index (BMI) and waist circumference, as a measure of fat distribution, are the most commonly used measures, but a clinical staging system is increasingly used to determine risk and management (Lavin, 2019). BMI is an imprecise measure of adiposity and does not account for fat distribution, which may better determine metabolic and cardiovascular risk at lower BMI.

In clinical practice we apply many scores for evaluation of obesity: Edmonton Obesity Staging System (fig. 1) and Body-Mass Index (ISPRM/ESPRM Guidelines, 2020), Waist circumference (Oxford Handbook, 2014) and Associated disease risk (fig. 2).

Edmonton Obesity Staging System (EOSS)

Stage 0 • No apparent obesity-related risk factors, physical symptoms, psychopathology, functional limitations, and/or impairment of well-being.

Stage 1 • Obesity-related subclinical risk factor(s) (borderline hypertension, impaired fasting glucose, elevated liver enzymes, etc.), mild physical symptoms (e.g. dyspnoea on moderate exertion), psychopathology, functional limitations, and/or impairment of well-being.

Stage 2 • Established obesity-related chronic disease(s) (hypertension, type 2 diabetes, sleep apnoea, osteoarthritis, reflux disease, polycystic ovary syndrome, anxiety disorder), moderate limitations in activities of daily living, and/or well-being.

Stage 3 • Established end-organ damage (myocardial infarction, heart failure, diabetes complications, incapacitating osteoarthritis), significant psychopathology, functional limitation(s), and/or impairment of well-being.

Stage 4 • Severe (potentially end-stage) disability/ies from obesity-related chronic diseases, disabling psychopathology, functional limitation(s), and/or impairment of well-being.

Figure 1. **Edmonton Obesity Staging System (EOSS)**

Figure 2. **Body-Mass Index, Waist circumference and Associated disease risk
(according Oxford Handbook, 2014; WHO, 2020)**

Obesity consequences

Many consequences of overweight and obesity are described (Williams textbook of Endocrinology, 2016):

✓ *mortality rates* rise steadily at BMI >5kg/m2. Obesity and physical inactivity have both independent and dependent effects on all-cause mortality.

✓ *loss of life expectancy*: BMI >35kg/m2 —5–7 years at age 45.

✓ *type 2 diabetes*: elevation in BMI, the dominant risk factor for development of diabetes. Relative risk (RR) in overweight men 2.4, women 12.4; at BMI 30kg/m2 >10; increased to 50–90-fold at BMI >35.

✓ *hypertension*: RR for overweight men 1.8, women 2.4.

✓ *dyslipidaemia*: moderate relationship with total cholesterol, closer relationship with triglycerides, HDL cholesterol.

✓ *stroke*: RR 1.2 for overweight and 1.5 for obese men and women.

✓ *asthma:* obese 2 ×, overweight 1.4 × more likely to develop asthma.

Some authors classified obesity consequences in the system of four M: Mental, Mechanical, Metabolic and Monetary (figure 3).

Figure 3. **The four M obesity consequences**

Cellulitis

Cellulite is a very common, harmless skin condition; prevalent in women. Inspection demonstrates dimpled or bumpy skin on the thighs, hips, buttocks and abdomen. It's sometimes described as having a cottage cheese or orange peel texture.

Authors described four clinical and histological phases (Goldman, 2010):

❖ *Pre-clinical phase 1* of lymphatic and venous stasis, and initial oedema*;*

❖ *Phase 2* of vasodilatation, with *oedema of the connective tissues* (with liquids rich in electrolytes and mucopolysaccharides) and increase of lipids;

❖ *Phase 3* of hyper-polymerization of mucopolysaccharides and hypertrophy of adipocytes, formation of *micronodules;*

❖ *Phase 4* of fibrosis, proliferation and sclerosis and formation of *macro-nodules.*

Physical activity for obesity

Regular exercise induces cardiorespiratory fitness and leads to a beneficial effect on other risk factors, with a reduction in blood pressure and improvement in lipid profile.

Recommendations include 225–300 min / week of moderate intensity exercise (equivalent to 7.5–10.5MJ, 1,800–2,500kcal) is recommended for weight loss maintenance (Pearson et al, 2002).

Physical modalities for treatment of obesity and cellulitis

Physical medicine and rehabilitation can be useful in the process of prevention and rehabilitation of these patients, applying different physical modalities (ISPRM / ESPRM Guidelines, 2020; Koleva, 2006, 2007):

➢ *from the group of natural physical factors: temperature; water and peloids; active exercises and massage (including vacuum massage, manual lymphatic drainage and lymphopressotherapy; sports and physical activities); and the corresponding parts of PRM (cryo- / thermotherapy; balneo- and peloido-therapy; physiotherapy and ergotherapy);*

➢ *from the pre-formed physical factors: electrical currents of low, medium and high frequency; electrostatic field (Deep Oscillation); phototherapy, including laser; ultrasound; and the correspondent parts of PRM (electrotherapy, lasertherapy, ultrasound-therapy).*

In the complex prevention and rehabilitation algorithm, we include: physical activities and sports; exercises (analytic exercises for abdominal belt, for gluteal and femoral muscles); ultrasound-cavitation and phonophoresis with anticellulite gels; endermology (LPG); functional electrical stimulations; radio-frequency, VelaShape; diet and patient education.

Physical methods

We use different physical methods (Koleva, 2006), as follows:

❖ *Analytic exercises, training of paravertebral muscles ("muscle belt" exercises, spine flexion /Williams/ and extension exercises /Superman exercises/), squats, specific exercises for abdominal press and for gluteal muscles, for femoral and brachial muscles; post-isometric relaxation, stretch techniques, manual massage; regular physical activity (10 000 steps daily, tourism, swimming and other sports or elements of sport); mechanotherapy;*

❖ *Hydro and balneotherapy, underwater exercises; thalassotherapy (sea water therapies);*

❖ *Peloidotherapy (fango, parafango, sea lye);*

❖ *Functional electrical stimulations; high frequency electric currents (diathermy, ultrahigh frequency, radar or radiofrequency).*

For some of the mentioned techniques, we need specific devices.

Specific devices

We apply specific devices for lymphatic drainage (Kutlubat et al, 2013; Mesencevova et al, 2017; Koleva, 2007):

✦ *the French system LPG-endermologie* (fig. 4),

✦ *the Velashape system* (a combination of bipolar radio-frequency, infra-red light and mechanical vacuum - fig. 5),

✦ *D-finitive Evo & endothermia* (combination of multi-polar radio-frequency, progressive vacuum rotation, red and blue LED-light diodes - fig. 6),

✦ Shock-wave therapy or *Adipo-wave* (fig. 7),

✦ *Miha-electrical stimulations* (with exercises),

✦ *Eximia* (with radiofrequency) and

✦ *the French system Cryologie* or Cryolipolysis (fig. 8).

Figure 4. **The French system LPG endermologie**

Figure 5. **The Velashape system**

Figure 6. **D-finitive Evo**
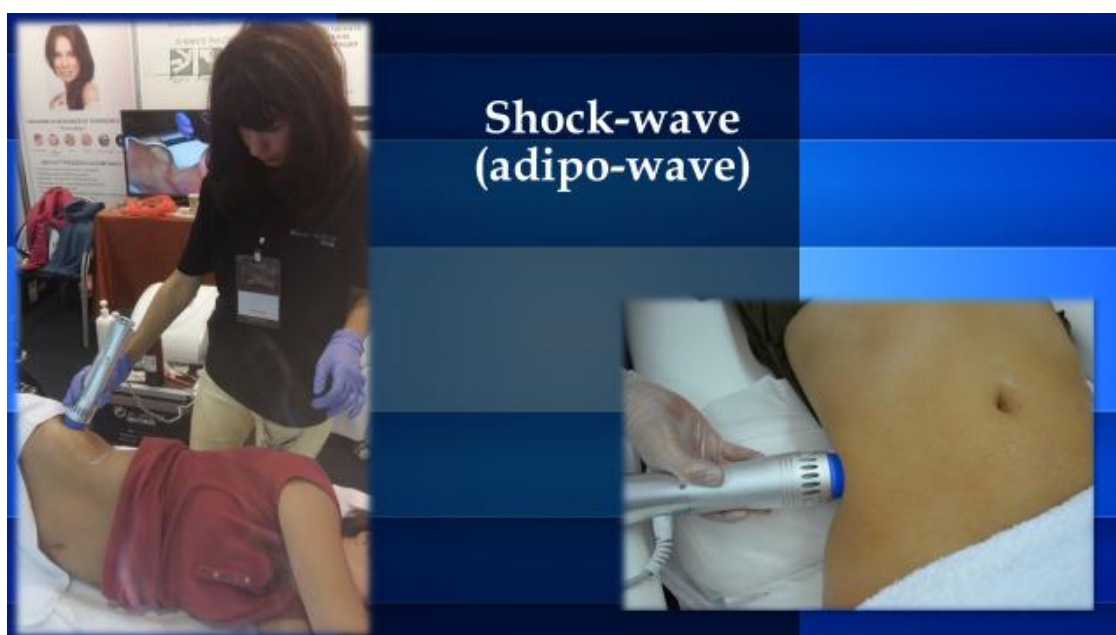
Figure 7. **Adipo-wave**
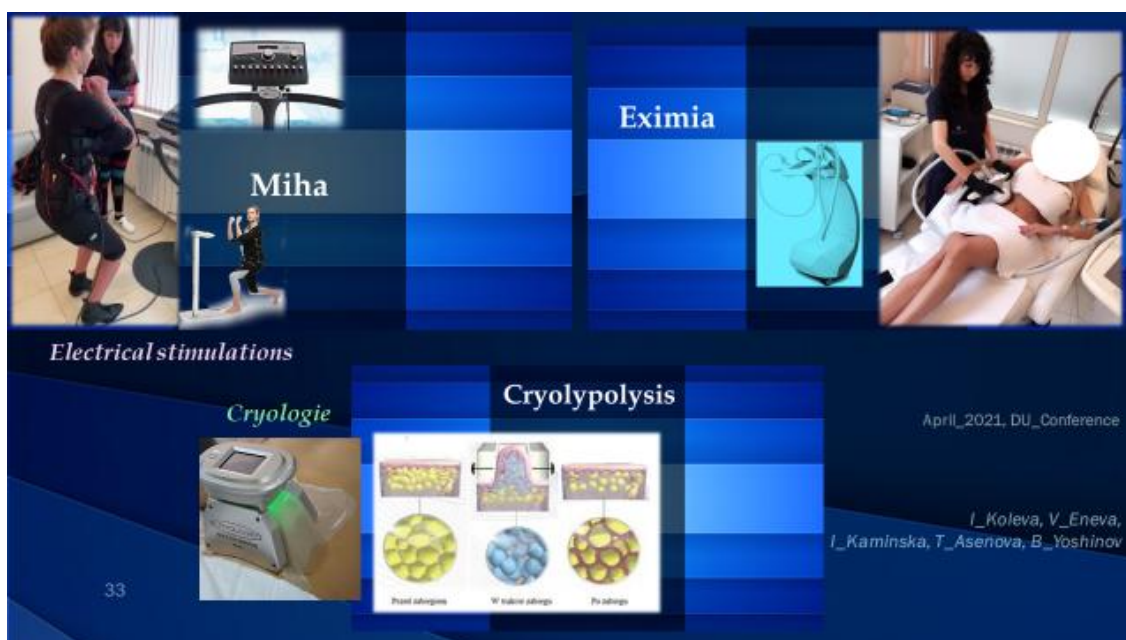
Figure 8. **Miha-electrical stimulations, Eximia and Cryolipolysis**

Our own experience

We applied these physical modalities and rehabilitation complex in patients with metabolic syndrome, obesity, cellulitis, after mesotherapy and after liposuction.

Usually, we apply complex prevention and rehabilitation algorithms using a synergic combination of different physical factors: augmentation of the regular physical activity, exercises, one soft-tissue technique (lympho-pressotherapy or post-isometric relaxation); two preformed modalities; one cryo or thermo-agent.

Material and methods

After the clinical exam and lab-analysis, for assessment we apply qualitative and quantitative methods, including BMI, centimetry and calipermetry (fig. 9).

Figure 9. **Calipermetry**

In the complex prevention and rehabilitation algorithm, we include: physical activities and sports; massage; exercises (including underwater exercises); laser-therapy, ultrasound - cavitation, ultraphonophoresis with anticellulite gels, high frequency ultrasound (HIFU); vacuum massage, lymphatic drainage and endermology using LPG techniques; electro-static field of Deep oscillation (DO) therapy and functional electrical stimulations (FES) with low frequency and middle frequency currents; high-frequency electric currents, including radio-frequency; diet, patient education.

Concretely, the complex programs comprised:

✓ *physical activities and sports;*

✓ *massage;* vacuum massage, lymphatic drainage and endermology using LPG techniques;

✓ *exercises (*including underwater exercises);

✓ *preformed factors*: Laser-therapy, Ultrasound - cavitation, ultraphonophoresis with anticellulite gels, HIFU; electro-static field of Deep oscillation (DO) therapy; functional electrical stimulations (FES) with low frequency and middle frequency currents; high-frequency electric currents, including radio-frequency;

✓ *diet,*

✓ *patient education*.

Results

Our comparative observations and evaluations demonstrate:

❖ **Stimulation of the trophic of the skin;**

❖ **Improvement of some anthropometric parameters:**

    o *decrease of the body-mass index,*

    o *reduction of the waist centimetry and*

    o *reduction of the calipermetric values of the skin folds;*

❖ **Modification of the blood serum lipids**

✓ *decrease of the levels of the total cholesterol, LDL-cholesterol and triglycerides,*

✓ *increase of the HDL-cholesterol).*

We present series of clinical cases suffering from overweight and cellulite; after application of a rehabilitation complex. Our results include: amelioration of the skin elasticity and of the "orange peel"; decrease of the body-mass index, reduction of the waist circumference). Next figures 10 and 11 present the reduction of the abdominal fat (fig. 10), of femoral and brachial cellulitis (fig. 11).
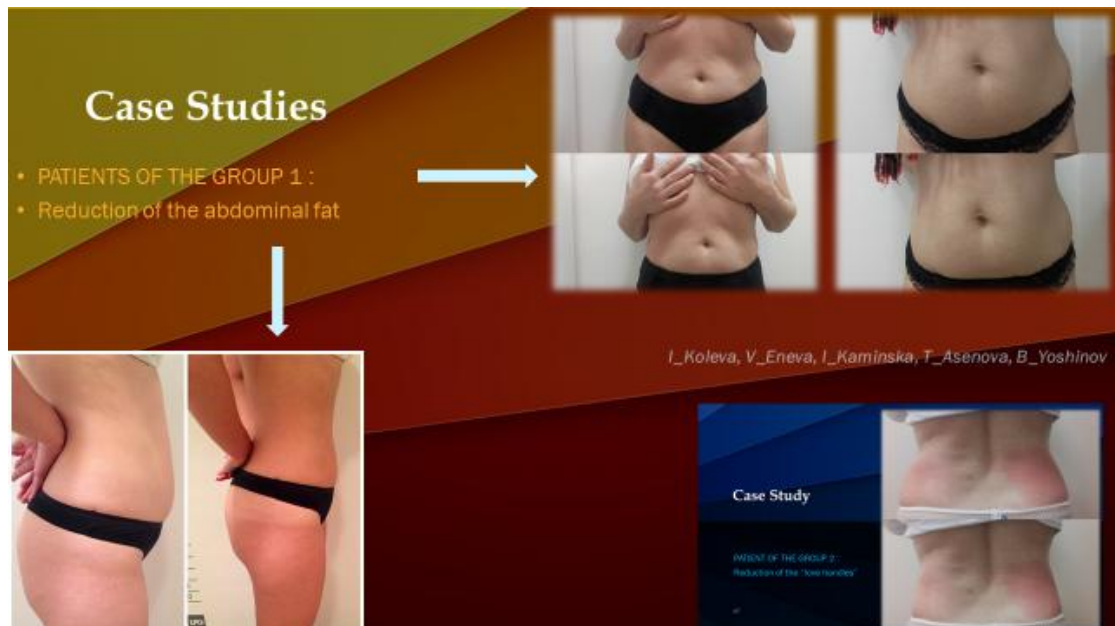
Figure 10. **Results – reduction of the abdominal fat and the "love handles"**
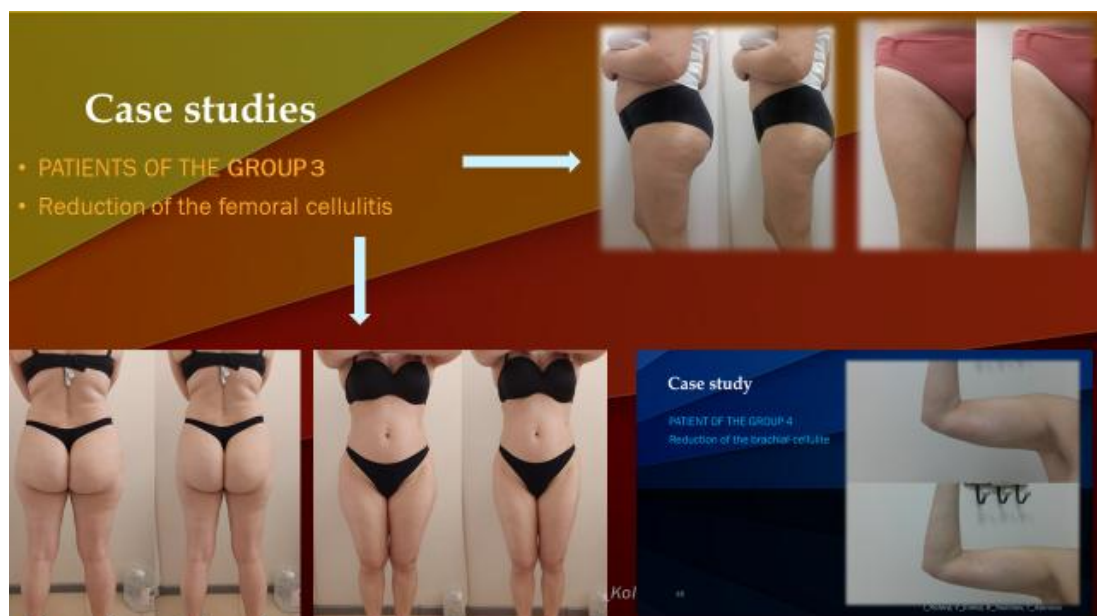
Figure 11. **Results – reduction of the femoral and brachial cellulitis**

Discussion*: Algorithms and Mechanisms*

We consider useful the synergic combination of *Diet, Basic physical activity & specific physical factors.* Our resuls demonstrated that in the **complex rehabilitation algorithm** we must include several physical modalities, as follows:

✓ *Physiotherapy & Ergotherapy* - 2-3 procedures: *augmentation of the regular physical activity, exercises, Other activities: dances, tourism, etc.;*

✓ *Soft tissue techniques -* One procedure: *Massage; Lymphatic drainage; Post-isometric relaxation, etc.;*

✓ *Cryo-/ Thermo-therapy - One cryo-/thermo-agent;*

✓ *Preformed modalities -* two preformed agents*: electrotherapy, ultrasound, LASER.*

We suggest an explanation of some **mechanisms of action of physical modalities** on obesity, cellulitis and consequences of liposuction. *Preformed physical factors* stimulate the metabolism, ameliorate the skin trophy (of epidermis, derma, hypodermis), provoque oedema reduction, stimulate the neurotransmission. *Natural physical factors* increase the energy output, stimulate the catabolic chains, regulate the balance between sympathicus and parasympaticus, provoque vasodilatation and oedema reduction. Our own hypothesis of the mechanisms of action of physical modalities on overweight, obesity and cellulitis is presented in figure 12.

Figure 12. **Mechanisms of action of physical modalities on obesity and cellulitis**

Conclusions

In conclusion, we must accentuate on the interests of application of rehabilitation. Physical modalities are: *easy to apply; atraumatic; well tolerated by patients / clients; cheap; they have*

important potential of combination with specific dermatologic and cosmetologic treatments, with diet & regular physical activity. A *multi-disciplinary team* will be included in the rehabilitation process.

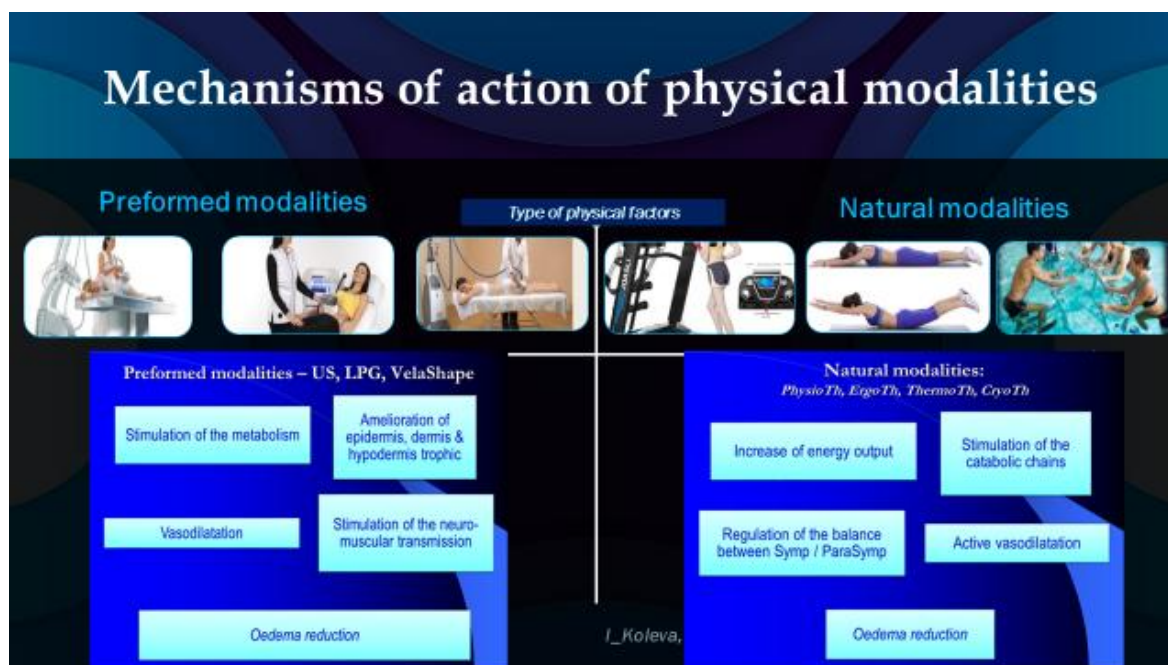Physical modalities can be very useful in the complex programs for prevention, treatment and rehabilitation – for patients with overweight, obesity and cellulitis. The systematic approach improve significantly the quality of life of these types of patients.

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EFFECTIVENESS OF THE LIPID-LOWERING THERAPY IN ACHIEVING THE TARGET LEVELS OF LOW-DENSITY LIPOPROTEIN CHOLESTEROL IN DIFFERENT CARDIOVASCULAR RISK PATIENTS IN ONE FAMILY PHYSICIAN'S OFFICE

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Abstract

Effectiveness of the lipid-lowering therapy in achieving the target levels of low-density lipoprotein cholesterol in different cardiovascular risk patients in one family physician's office

Key Words: *Low-density lipoprotein cholesterol, cardiovascular disease, lipid-lowering therapy, cardiovascular risk group*

Introduction. Low-density lipoprotein cholesterol (LDL-C) is a major causal factor in cardiovascular disease (CVD). It is important to optimize lipid-lowering therapy (LLT) to reach the target LDL-C level for each CV risk group.

Aim. To evaluate the results of LLT using the LDL-C target levels according to the European dyslipidemia guidelines. Materials and methods. Patients receiving LLT for at least 2 months with LDL-C measurement on a stable LLT dose were included. The statistical analysis was done by IBM SPSS.

Results. The study involved 104 participants - 39% women, 61% men. The mean age was 67.7 ± 8.1 years. According to the LDL-C target levels defined in the ESC/EAS 2019 and 2016 guidelines, 60.6% and 97.1% of participants attained these targets, respectively. Smoking ($p = 0.04$) and the very high CV risk group ($p = 0.02$) are associated with non-attainment of the LDL-C target levels.

Conclusion. The total number of patients who achieved the LDL-C target levels dropped after applying the new target levels defined by the 2019 ESC/EAS guidelines in comparison to the ESC/EAS 2016 guidelines. The lowest LDL-C target achievement rate was in the very high CV risk category. LLT should be optimized in all of the groups with particular emphasis on patients at very high CV risk and smokers.

Kopsavilkums

Lipīdu pazeminošās terapijas efektivitātes izvērtēšana zema blīvuma lipoproteīnu holesterīna mērķu sasniegšanā dažādu kardiovaskulārā riska grupu pacientiem viena ģimenes ārsta prakses ietvaros

Atslēgvārdi: *Zema blīvuma lipoproteīnu holesterīns, kardiovaskulārās saslimšanas, statīni, kopējs kardiovaskulārs risks*

Ievads. Zema blīvuma lipoproteīnu holesterīns (ZBLH) patoģenētiski ir viens no galvenajiem kardiovaskulāro (KV) saslimšanu izraisošiem faktoriem. Ir svarīgi pielāgot lipīdu pazeminošu terapiju tā, lai katrā KV riska grupā tiktu sasniegts ZBLH mērķis.

Pētījuma mērķis. Izvērtēt lipīdu pazeminošās terapijas rezultātus, izmantojot Eiropas dislipidēmiju vadlīnijas definētus ZBLH mērķa līmeņus. Materiāls un metodes. Pētījumā tika iekļauti 104 pacienti, kas divus un/vai vairāk mēnešus saņēmuši lipīdu pazeminošo terapiju un kuriem bija pieejami ZBLH rezultāti. Datu apstrāde tika veikta ar IBM SPSS programmu.

Rezultāti. 39% dalībnieku bija sievietes, 61% - vīrieši. Vidējais vecums bija 67.7 ± 8.1 gadi. 97.1% dalībnieku sasniedza ESC/EAS 2016 vadlīnijās definētus ZBLH mērķus, savukārt ESC/EAS 2019 vadlīnijās definētus mērķus sasniedza 60.6% dalībnieku. Smēķēšana (p=0,04) un piederība ļoti augstai KV riska grupai (p=0,02) ir statistiski ticami riska faktori ZBLH mērķa nesasniegšanai.

Secinājumi. Jaunākajās vadlīnijās (ESC/EAS 2019) definētie ZBLH mērķi ir stingrāki, tāpēc pacientu skaits, kas tos sasniedza, ir sarucis. Starp visām KV riska grupām procentuāli viszemākais mērķu sasniegšanas līmenis bija ļoti augsta KV riska grupā. Ir jāoptimizē lipīdu pazeminošā terapija, īpašu uzmanību pievēršot tiem pacientiem, kuri pieder pie ļoti augsta KV riska grupas un smēķētājiem.

Introduction

Cardiovascular diseases are the leading cause of death worldwide (Yusuf et al., 2004). Low-density lipoprotein cholesterol is a major causal factor in cardiovascular diseases. The higher the low-density lipoprotein cholesterol level, the higher the risk for a cardiovascular event (Goldstein et al., 2015). Low-density lipoprotein cholesterol remains the primary target of cholesterol lowering

therapy. Lowering LDL-C reduces the risk of atherosclerotic cardiovascular disease proportionally to the absolute achieved reduction in LDL-C (Baigent et al., 2005, Ference et al., 2017). Also, the LDL-C level has been used as an indicator of response to therapy.

The cardiovascular risk level of individuals determines low-density lipoprotein cholesterol treatment goals. Consequently, it is important to optimize lipid-lowering therapy to reach these goals for each cardiovascular risk group.

Material and Methods. Study population consisted of 104 patients receiving lipid-lowering therapy for at least two months with the low-density lipoprotein cholesterol level measured while on stable lipid-lowering dose.

For all of the patients, cardiovascular risk was assessed. The SCORE risk chart was used for people without overt cardiovascular disease, diabetes, chronic kidney disease, familial hypercholesterolemia, or very high levels of individual risk factors. We estimated a 10-year risk of fatal cardiovascular disease using the SCORE chart for high risk regions, as Latvia belongs to a high risk region.

Patients with known cardiovascular disease, type 2 diabetes or type 1 diabetes with microalbuminuria, chronic kidney disease were automatically at very high or high total cardiovascular risk. Patients whose risks exceed 5-10% according to the SCORE were also attributed to these categories. Patients whose risks were 1-4% according to the SCORE were classified as the moderate-risk patients. The low-risk category included patients whose risk level was less than 1% on the SCORE.

To evaluate the results of lipid-lowering therapy low-density lipoprotein cholesterol measurements were used and compared to the low-density lipoprotein goal levels for each cardiovascular risk group defined by the European dyslipidemia guidelines 2016 and 2019 year (ESC/EAS 2016 and 2019). The criteria for LDL-C goals became more aggressive in the ESC/EAS 2019 guidelines. According to them, for the very-high risk group in primary or secondary prevention at least 50% LDL-C reduction from baseline and the LDL-C goal of <1,4 mmol/L is recommended, while in the previous 2016 ESC/EAS guidelines the LDL-C goal for the very-high risk group was LDL-C < 1,8 mmol/L or a reduction of at least 50% if baseline is between 1,8 and 3,5 mmol/L. As for the high-risk group the new ESC/EAS guidelines recommend a therapeutic regimen that achieves ≥50% LDL-C reduction from baseline and an LDL-C goal of <1,8 mmol/L instead of the 2016 guidelines' recommended goal of LDL-C < 2,6 mmol/L or a reduction of at least 50% if baseline is between 2,6 and 5,2 mmol/L. In addition, the new guidelines have established different LDL targets for moderate and low risk patients, unlike the previous guidelines that recommended the same LDL targets for both risk levels (LDL-C < 3,0 mmol/L). The new

guidelines established the LDL-C target of <2,6 mmol/L for the moderate risk group and LDL-C <3,0 mmol/L for the low-risk group.

The statistical analysis was done using IBM SPSS applying the Chi-square and T-tests to determine whether factors such as gender, age, smoking, diabetes, body mass index, cardiovascular risk category, lipid-lowering therapy dose or combined lipid-lowering therapy, were associated with achieving the LDL-C target level. Quantitative data was described using mean and standard deviation, as well as numbers and percentage.

Results

The study included 104 patients, 41 women and 63 men. Mean age was 67,7 years +/- SD 8,1 years. All participants had arterial hypertension. 29% had type 2 diabetes. Significant number of participants had previous cardiovascular disease: 24% of participants (n=25) had acute coronary syndrome, 13.5% (n=14) had previous percutaneous coronary intervention due to significant coronary atherosclerosis, one patient had previous coronary bypass graft due to three-vessel disease. There were four patients who had significant carotid artery stenosis, two of them underwent surgical treatment - carotid endarterectomy. Three patients had peripheral artery disease in the lower extremities and underwent surgical procedures (bypass grafting or balloon angioplasty with stenting). Only 7% (n=7) of participants had normal body mass index, while 46% (n=48) were overweight and 47% (n=49) were obese. As for the smoking status, in this study we found that 20% (n=21) of participants were smokers. Majority of the patients (63%) belong to the very high total cardiovascular risk group, 20% (n=21) of the patients belong to the high risk group, 17% (n=18) of the patients belong to the moderate risk group and only 2% (n=2) of the patients belong to the low risk group. 81% (n=84) of the patients received statin monotherapy, 19% (n=20) were on combination therapy. Combination therapy included statin plus cholesterol absorption inhibitor (ezetimibe). 51% (n=53) of the patients received high-intensity statins that include atorvastatin at a dosage of 40-80 mg or rosuvastatin at a dosage of 20-40 mg. 49% (n=51) of the patients received moderate intensity statin monotherapy. 97,1% of all the participants have achieved the treatment goals defined by the European guidelines 2016 but only 60,6% participants have achieved the goals defined by the European guidelines 2019. 96,8% (n=61) of the very high CV group participants have achieved the 2016 guidelines' goals, whereas 52,4% (n=33) of participants have achieved the 2019 guidelines' goals. All of the patients of the high CV group have achieved the old guidelines' goals but only 57,1% (n=12) have achieved the new guidelines' goals. 88,9% (n=16) of participants of the moderate CV group have achieved the new goals, 94,4% (n=17) of participants of the moderate CV group have achieved the old ones. All patients in the low cardiovascular risk group have achieved both the 2016 and 2019 guidelines goals. In our study we determined whether factors such as gender, age, smoking, diabetes, body mass index, cardiovascular risk category, lipid-

lowering therapy dose or combined lipid-lowering therapy, were associated with failure to achieve the LDL-C target level. According to our study, smoking *(p = 0.04)* and being in the very high CV risk group *(p = 0.02)* are associated with non-attainment of the LDL-C target levels. Body mass index, gender, age, diabetes, lipid-lowering therapy intensity or using combined lipid-lowering therapy were found not to be statistically significant factors associated with failure to achieve the LDL-C goals.

Discussion. This study found that approximately one half of patients of the very high and high CV risk group have achieved their risk-based goals, whereas over two-thirds of the moderate CV risk group patients have achieved their risk-based goals according to the new EAS/ESC dyslipidemia guidelines. In comparison with the results of cross-sectional observational study called "The International ChoLesterol management Practice Study (ICLPS) conducted in Eastern Europe, Asia, Africa, the Middle East and Latin America only 32.1% of the very high risk group patients versus 51.9% of the high risk and 55.7% of the moderate risk group patients achieved their LDL-C goals (Danchin et al., 2018). Other study, "The Lipid Treatment Assessment Project (L-TAP)" was conducted exactly in primary care settings in the USA (1996−1997) and found out that the LDL-C goal attainment overall was 38%, decreasing to 18% among patients with established heart disease (Pearson et al., 2000). The L-TAP 2 was conducted about one decade after the L-TAP and showed an improvement in the achievement of the national guideline levels with overall attainment of 73% (Waters et al., 2009). In our study overall goal achievement was 60.6% and 97.1% according to the EAS/ESC 2019 and 2016 year, respectively. Success rate for the LDL-C goal achievement in the L-TAP 2 was largely dependent on the risk level, with a lower success rate for the highest risk group, for example, 30% achievement rate in the very high risk group, 67% in the high risk group and 74% in the moderate risk group (Waters et al., 2009). This trend is also observed in our study - the lowest LDL-C target achievement rate was seen in the very high CV risk category. If we compare the results with other studies, The centralized pan-European survey on the under-treatment of hypercholesterolaemia (CEPHEUS) found that 55.3% of patients achieved their LDL-C target (Hermans et al., 2010). The "Pan-Middle East CEPHEUS" survey found that the LDL-C goal was attained in 91.1% of the low risk, 52.7% of the high risk and 32.0% of the very high risk category patients (Arafah et al., 2013). All the studies indicate that there is suboptimal achievement of the target LDL-C level.

As to factors that are associated with failure to achieve the LDL-C goals, our study indicated that smokers (p=0.04) and the very high CV group patients (p=0.02) were less likely to achieve the LDL-C goals. Pan-European CEPHEUS survey found that such factors as normal body mass index, not smoking, not having metabolic syndrome, being on statin therapy and good treatment adherence were independently associated with the LDL-C goal achievement (Hermans et al., 2010). On the

contrary, the Pan-Middle East CEPHEUS study showed that the LDL-C goal attainment was improved by the presence of diabetes, hypertension, obesity, and family history of CVD. (Arafah et al., 2013).

Limitations of the study is limited amount of participants and the fact that the study was conducted in one family practice so that it is not fully representative of all the patients treated with lipid-lowering therapy in our country. In addition, the study cannot show causal associations.

Conclusions. Total number of patients who achieved the LDL-C target levels dropped after applying the new target levels defined by the 2019 ESC/EAS guidelines in comparison to the ESC/EAS 2016 guidelines. The lowest LDL-C target achievement rate was in the very high CV risk category. Lipid-lowering therapy should be optimized in all of the groups with particular emphasis on the patients of the very high cardiovascular risk category and smokers.

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OBESITY OF PRESCHOOL CHILDREN IN RELATION TO NUTRITIONAL QUALITY AND PHYSICAL ACTIVITY

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Abstract

Obesity of preschool children in relation to nutritional quality and physical activity
Key Words: *children, overweight, malnutrition, physical activities*

Nowadays, childhood obesity has become a more apparent problem. According to the World Health Organization (WHO), the number of overweight children has doubled from 1980 to 2010. It is crucially important to timely detect and assess obesity in children to prevent further weight gain and minimize the risk of related health problems. Therefore, it is essential to identify potential risk factors associated with malnutrition and lack of physical activity. The study includes 20 children aged 6 to 7 years whose parents completed a specially designed questionnaire. 8 out of 20 participants were overweight. One of the main risk factors for weight gain is an unbalanced diet. Children should eat 4 to 5 times a day, and food has to contain carbohydrates, protein, fat, vitamins, and minerals (VM 2003). Mealtime should not be rushed and advisably together with the family. In the study, ten children ate three or fewer times a day, nine children age 4 to 5 times a day, and one child eats six times a day. 3 of 8 children with higher body mass index than suggested had eating culture as a risk factor for being overweight. Another popular risk factor for being overweight is a lack of physical activities. Children shouldn't spend more than two hours a day watching television or using a computer. Two boys who were overweight spent three or more hours per day using a computer. Three boys who were overweight spent three or more hours watching television. Children should spend on average 60 minutes a day engaging in physical activities. It is recommended to engage in high-intensity physical activity at least three times a week and three times a week for activities strengthening muscles and bones (SPKC 2021). 4 out of 6 overweight boys don't engage in physical activities more than once a week.

Kopsavilkums

Pirmskolas vecuma bērnu aptaukošanās saistība ar uztura kvalitāti un fiziskām aktivitātēm
Atslēgvārdi: *bērni, aptaukošanās, uzturs, fiziskās aktivitātes*

Mūsdienās bērnu vidū aizvien aktuālākā kļūst aptaukošanās problēma. Pēc Pasaules Veselības organizācijas (PVO) datiem bērnu skaits ar lieko svaru pēdējo 30 gadu laikā (1980-2010) divkāršojies. Svarīgi ir savlaicīgi pamanīt un novērtēt lieko svaru bērniem, lai nepieļautu turpmāku svara pieaugumu un ar to saistīto veselības problēmu rašanos. Būtiski ir izzināt iespējamos riska faktorus, kas saistīti ar nepareizu uzturu un fizisko aktivitāšu trūkumu. Pētījumā tika iekļauti 20 bērni vecumā no 6 līdz 7 gadiem. No 20 bērniem 8 bērniem ir liekais svars. Viens no riska faktoriem palielinātam svaram ir nesabalansēts uzturs. Šajā vecumā bērnam ir jāēd regulāri, 4 – 5 reizes dienā, uzņemot gan ogļhidrātus, gan olbaltumvielas, gan taukus, kā arī vitamīnus un minerālvielas (VM 2003). Tāpat jānodrošina bērnam iespēja ēst nesteidzoties, kopā ar ģimeni. Pētījumā deviņi bērni dienā ēd 4-5 reizes, viens bērns ēd 6 reizes dienā. Pārējiem bērniem ir 3 un mazāk ēdienreizes dienā. Trīs bērniem no 8 ēšanas kultūras neievērošana ir riska faktors palielinātam svaram. Otrs riska faktors palielinātam svaram ir fizisko aktivitāšu trūkums. Šī vecuma bērniem nav ieteicams pavadīt laiku pie televizora, datora ilgāk par divām stundām dienā. Divi zēni ar palielinātu svaru pavada pie datora 3h un vairāk. Trīs zēni ar palielinātu svaru pavada pie TV 3h un vairāk. Fiziskās aktivitātes šajā vecumā bērniem ieteicamas vidēji 60 minūtes dienā. Ar augstas intensitātes fiziskām aktivitātēm vēlams nodarboties vismaz 3 dienas nedēļā, tāpat 3 reizes nedēļā vēlamas aktivitātes, kas stiprina muskuļus un kaulus (SPKC 2021). Četri zēni no sešiem ar lieko svaru ar fiziskām aktivitātēm nenodarbojas vispār, vai tikai vienu reizi nedēļā.

Introduction

Obesity has reached epidemic levels not only among adult population, but also among children and adolescents (WHO 2020). During last decades the number of cases of child obesity worldwide has increased rapidly, and therefore has caused serious health and social problems. These problems subsequently contribute to decline in quality of life. According to data presented by World Health Organization (WHO) number of overweight children during last 30 years (1980-2010) has doubled, while number of overweight adolescents – tripled (WHO 2020). This paper presents findings related to prevalence of obesity in Latvia and the possible contributing risk factors. In order to evaluate the obesity among children the following activities shall be performed.

Firstly, anthropometric measurements should be taken (BKUS 2015). Secondly, gathered data should be evaluated using criteria which is based on results from research on population. This data is necessary for identification of the causes of obesity and determination of the preventive measures against complication development (BKUS 2015). It should be noted that there is not a singular cause which contributes to development of obesity, but rather a set of conditions which further the problem. It is important to notice and evaluate obesity in children in a timely manner, as it can prevent advancement of further weight gain and related issues. Possible contributing risk factors related to malnutrition and lack of physical activities should be identified in order to timely perform preventive measures. In tackling the epidemic of obesity, government policies and promotion of healthy lifestyle is as important as the role of family, educational institutions, primary care physician and other health care professionals (BKUS 2015). Children and adolescents should be taught to be responsible for their own health (BKUS 2015).

Aim: To study the obesity of preschool children in relation to diet and physical activity.

Materials and methods: Prospective, cross-sectional study was performed from August 2020 to February 2021. The participants were 20 children from which 10 (50%) were boys and 10 (50%) were girls. Average age among participants - 6.65 years, average height - 1.31m, average weight – 30.1kg, average BMI (*body mass index*) (BKUS 2015) – 17.8. Before gathering anthropometric data from participants, signed agreement allowing children to participate in the study was obtained from respective parents or legal guardians. Following the agreement, the parents and legal guardians filled a survey regarding nutrition, lifestyle of the child and habits of the family. The participants of research group were weighted and their height was measured. Children were weighted without shoes and in their underwear. Boys and girls were measured separately (CDC 2021). Obtained data was evaluated using international and Latvian body mass index scale (BKUS 2015).

Results

It was found that eight participants from twenty had weight that is considered to be exceeding the norm. Respectively six boys had increased BMI. 30% of boys (n=3) were overweight (BMI in the range of 85 to 94 percentiles) and 30% (n=3) were obese (BMI over 95 percentiles). From group of 10 girls, two had increased BMI. 10% (n=1) of girls were overweight and 10% (n=1) were obese. Two contributing risk factors were considered in this study – healthy nutrition and physical activities. One of the risk factors contributing to increased weight is malnutrition. In order to support optimal mental and physical development, child's nutrition should be complete. To obtain the nutrients and energy, a child should eat regularly (4-5 times a day) meals which contain all the necessary nutrients (VM 2003). Sweets and other snacks shouldn't be included in the diet as this kind of food cannot substitute a wholesome meal. Sweets shouldn't serve as a prize for achievements or as a comfort for distress (VM 2003). It was found that nine participants had meals

4-5 times a day, one participant - 6 times a day while others had 3 or less meals a day. To decrease the development of obesity, children should be provided with opportunity to eat with pleasure, without the need to rush, with family or friends. For three children from the group of eight children who had weight exceeding the norm, the culture of eating is a risk factor, meaning these children had their meals by the TV or computer and without their families. These children consumed their meals wherever, whenever and however they wanted. A child should be provided with easily accessible drinking water at every given time (VM 2003). All twenty participants of this study consumed water every day, twelve of them also consumed sweetened, carbonated drinks once a week. One child of the twelve that consumed sweetened, carbonated drinks had weight that exceeded the norm. Children and adolescents receive up to 15% of their daily calories from sweetened drinks or of 100% fruit juice, which can be a cause further weight gain (Kupča 2014). All twenty participants had breakfast which is an important meal. After a night's sleep, stored energy that was absorbed from nutrition in the previous days is depleted (VM 2003). It is important that a child eats breakfast as it will help to concentrate in school as well as participate in activities at kindergarten or home. Having breakfast also helps to follow other meals and wait for lunch without having unnecessary snacks. Breakfast shouldn't consist or be replaced with sweets, confectionery or snacks, and shouldn't be consumed while commuting to school or during breaks between classes (VM 2003). For children's nutrition to be complete, the diet must include carbohydrates, protein, fat and minerals (VM 2003). Carbohydrates are divided into simple carbohydrates (monosaccharides and disaccharides) and complex carbohydrates (polysaccharides) (VM 2003). Simple carbohydrates are found in honey, sugar and other sweets, and are rapidly converted from digestive organs into the blood (VM 2003). Subsequently excess intake gets turned into fat, so these carbohydrates should be used in moderation. Complex carbohydrates are found in foods such as bread, whole grains, pasta, vegetables (including potatoes), fruits (VM 2003). Complex carbohydrates are processed by the body longer than the simple carbohydrates and create feeling of satiety and are a sufficient source of energy (VM 2003). Simple carbohydrates (which are found in sweets, pastries, potato chips) once a week are consumed by fifteen participants and seven of them consume this kind of food twice a week. Two participants of the seven consuming simple carbohydrates twice a week are overweight. Complex carbohydrates are consumed daily by 13 or participants. Previously mentioned protein, which should be included in diet, form, regenerate and protect the tissues in body. Protein is crucial in growth and development processes. Children's diet should include eggs, milk and other dairy products, lean meat, meat and fish as these are sources of protein (VM 2003). 17 participants consumed dairy products daily. Only 3 participants consumed fish and fish products once a week. Seven of the participants had daily intake of meat products while 13 participants consumed meat products three times a week. Fruits and vegetables are rich in vitamins, minerals, fiber and other

biologically active substances. To provide the necessary amounts of vitamins and minerals, a child's diet requires a variety of fruits and vegetables, including root and leafy vegetables, greens, fruits and berries. Vegetables and fruits can serve as a healthy snack between meals if needed (BKUS 2015). 13 of participants consumed fruits and vegetables daily. Another essential part of diet is fat. Fat helps to provide the physically active, growing child with the necessary energy. The fat that is needed for the body is absorbed with previously mentioned food groups as well as from fat that is used to prepare food (Kupča 2014). 35% of total daily energy intake should be from fat of which 90% must be vegetable fat (VM 2003).

Other contributing risk factor to increased body weight is lack of physical activities. Physical activities for this age group are an important part of everyday life (E-veselība 2021). Physical activities help to improve health, develop physical and social skills, make friends, promotes development and growth processes (BKUS 2015). Encouraging children to participate in physical activities significantly diminishes the risk of various diseases in the future. Combined medium and high intensity aerobic physical activity for an average of 60 minutes per day is recommended for this age group, but in case of physical activities – more is better, so activities can last several hours (SPKC 2021). Engaging in activities which are considered high intensity and activities which strengthen muscles and bones is recommended at least 3 times a week (SPKC 2021). Physical activities which last at least 60 minutes a day contribute to healthy growth and development processes, builds strong bones and muscles, improve balance and develop skills, improves flexibility, aids in gain and maintenance of health body weight, helps to relax, improves posture, confidence and can help to make new friends. It was found that only 4 of the 10 boys participating in this study engaged in physical activities in the recommended capacity. Four of six boys, who had weight that exceeded the norm, didn't participate in any physical activities or participated only once a week. Children in this age group shouldn't use devices (watch TV, DVD, use computer, play video games etc.) for longer than 2 hours a day especially during daylight hours (SPKC 2021). The research suggests that children use devices (TV, computer, etc.) for more than 1-2 hours a day. Two of the overweight boys spent 3 or more hours at the computer daily. Three of the overweight boys spend 3 or more hours watching TV daily. Four of the six overweight boys participate in physical activities once a week or don't participate in these kinds of activities at all.

Discussion

The main goal of this research was to determine the incidence of obesity among preschool children and to study possible contributing risk factors (nutrition, physical activities) in overweight children. In 2014 Sarmīte Kupča presented research "Aptaukošanās bērniem Latvijā un ar to saistītie riska faktori" which overlooks obesity in children in Latvia and corresponding risk factors (Kupča 2014). Considering the results of S. Kupča's research and the research data presented in this paper, it can be concluded that the average weight and BMI has increased over the years. In S.

Kupča's research the average age of participating children was 7.5 years and average height 1.31m (Kupča 2014). In research that is presented in this paper, the participants were of similar age group (6.65 years) and the same average height -1.31 m. In S.Kupča's research the average body weight was 28.65 kg and BMI was 16.68 (Kupča 2014). As presented in this paper, average body weight among participants was 30.1 kg and BMI – 17.8.

Conclusions: Obesity is more common among boys. From 10 participating boys 6 had increased BMI while from 10 participating girls only 2 had increased BMI. Nine children had meals 4-5 times a day (4 boys and 5 girls), one child had 6 meals daily while other participants had meals 3 or less times a day. It can be concluded that 3 of 8 children who were overweight had disregard for food culture as contributing risk factor to their increased BMI. Disregard for food culture could be summarized as eating wherever, whenever and however the children want. Gathered data suggests that for achieving more balanced diet more complex carbohydrates, protein and minerals should be included. Analysis of the submitted data suggests that the diet of participants is not wholesome and that can impact the development and growth of these children. Sweets, sweetened, carbonated drinks shouldn't be included in diet. As for the physical activities, it can be concluded that children spend more than 1-2 hours daily using devices. Two of the overweight boys spent more than 3 hours at the computer daily while other two overweight boys spent 3 or more hours daily watching TV. Data suggests that boys were less active than girls, meaning they engaged in physical activities less frequently. Four of the six overweight boys participated in physical activities only once a week or didn't participate at all. Therefore, one can conclude than obesity is more common among boys.

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DERMATOSCOPY AND HISTOPATHOLOGY OF LICHEN PLANUS, NON-SPECIFIC AND ZOON'S BALANITIS

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Abstract
Dermatoscopy and histopathology of lichen planus, non-specific and Zoon's balanitis
Key Words: *balanitis, dermatoscopy, lichen planus, Zoon's balanitis, non-specific balanitis*
Introduction. Balanitis commonly runs a chronic course with non-specific symptoms including erythema, papules, burning sensation and sometimes erosions. In some cases, malignant transformation has been documented, therefore prompt diagnosis is essential. Dermatoscopy is a non-invasive optical tool that has been widely used in diagnosing inflammatory conditions of the skin and scalp. However, studies on utility of dermatoscopy in differentiating inflammatory balanitis are rare. The study aims to identify characteristic dermatoscopic features of common non-infectious balanitis.
Materials and Methods. The study was approved by Riga Stradins University Ethics Committee. Dermatoscopic images (magnification 20x) of histopathologically confirmed Lichen planus (LP, N=5), non-specific (NB, N=5) and Zoon's balanitis (ZB, N=3) were analyzed by a board-certified dermatologist. Sexually transmitted infections (STIs) were ruled out in all patients.
Results. Regularly distributed linear branched vessels were observed in 4/5 NB cases. Wickham's striae (WS) (5/5) surrounded by dotted (3/5) and linear vessels (5/5) were characteristic dermatoscopic findings in LP. Erosion was observed in one LP case, while in case of ZB erosions were present in all cases (3/3). Other dermatoscopic findings in ZB included red and orange structureless areas and regularly distributed curved and branched linear vessels.
Conclusions. Dermatoscopy could be a useful tool to differentiate common non-infectious balanitis.

Kopsavilkums
Lichen planus, Zoona un nespecifiskā balanīta dermatoskopija un histopatoloģija
Atslēgvārdi: *balanīts, dermatoskopija, lichen planus, Zoona balanīts, nespecifisks balanīts*
Ievads. Balanītiem bieži ir raksturīga hroniska gaita un nespecifiska simptomātika, kas ietver eritēmu, papulas, dedzināšanu un dažkārt erozijas. Atsevišķos gadījumos ir paaugstināts malignizācijas risks, tādēļ saslimšanu ir būtiski laicīgi diagnosticēt. Dermatoskopija ir neinvazīva, optiska diagnostikas metode, kas tiek plaši pielietota gan ādas veidojumu, gan iekaisīgu ādas un skalpa saslimšanu izmeklēšanā. Tajā pašā laikā tikai nelielā publikāciju skaitā tiek pētīts dermatoskopijas pielietojums iekaisīgu balanītu diferencēšanā. Šī pētījuma mērķis ir identificēt neinfekcioziem balanītiem raksturīgas dermatoskapiskas pazīmes.
Materiāli un metodes. Pētījumu apstiprināja Rīgas Stradiņa universitātes Ētikas komiteja. Histopatoloģiski apstiprinātu lichen planus (LP, N=5), nespecfiska balanīta (NB, N=5) un Zoona balanīta (ZB, N=3) dermatoskopiskus attēlus (20x palielinājumā) novērtēja sertificēts dermatologs. Visiem pacientiem tika izslēgtas seksuāli transmisīvas saslimšanas.
Rezultāti. Regulāri izvietoti, lineāri, zaroti asinsvadi novēroti 4/5 NB pacientiem. Vikhema strijas (WS) (5/5), kuras aptver punktveida (3/5) un lineāri (5/5) asinsvadi bija raksturīgas dermatoskopiskas LP pazīmes. Erozijas novērotas vienam LP pacientam un visiem ZB pacientiem. Tāpat ZB pacientiem konstatēti sarkani un oranži bezstruktūru apvidi un regulāri izvietoti izlocīti un zaroti lineāri asinsvadi.
Secinājumi. Dermatoskopija varētu tikt pielietota, lai diferencētu neinfekciozus balanītus.

Introduction

Balanitis is an inflammation of the glans penis that encompasses a broad variety of conditions. The prevalence of patients with balanitis attending specialized genitourinary clinics ranges from 10.7 – 11% and approximately half of these cases are non-infectious (Lisboa 2009: 445). In this case the condition commonly runs a chronic course with non-specific symptoms including erythema, papules, burning sensation and sometimes erosions. In some cases, malignant transformation has been documented, therefore prompt diagnosis is essential (Kristiansen 2019: 315). Dermatoscopy is a non-invasive optical tool that has been widely used not only to diagnose skin cancer, but also to evaluate inflammatory conditions of the skin and scalp (Wolner 2017: 417).

However, studies on utility of dermatoscopy in differentiating inflammatory balanitis are rare. The study aims to identify characteristic dermatoscopic features of common non-infectious balanitis.

Material and Methods

The study was approved by Riga Stradins University Ethics Committee. Patients (N=13) with non-infectious, chronic, or recurrent balanitis were enrolled in the study. Sexually transmitted infections (STIs) were ruled out in all patients. Dermatoscopic images (magnification 20x) of the condition were acquired with and without ultrasound gel. The immersion technique with ultrasound gel makes scaling transparent and limits compression of vasculature, thus improving visualization of vascular structures. The lesion was infiltrated with a lidocaine 2% solution for anesthesia purposes, then a 3 mm penile punch biopsy was performed. A board-certified pathologist provided a histopathological description and diagnosis. were analyzed by a board-certified dermatologist. were histopathological findings sought out to diagnose ZB, while.

Results

Cases of lichen planus (LP, N=5), non-specific (NB, N=5) and Zoon's balanitis (ZB, N=3) were diagnosed histopathologically. Regularly distributed linear branched vessels were observed in 4/5 NB cases. Wickham's striae (WS) (5/5) surrounded by dotted (3/5) and linear vessels (5/5) were characteristic dermatoscopic findings in LP. Erosion was observed in one LP case, while in case of ZB erosions were present in all cases (3/3). Other dermatoscopic findings in ZB included red and orange structureless areas and regularly distributed curved and branched linear vessels. The findings are summarized in Table 1.

Table 1. **Dermatoscopic features of LP, ZB and NB**

Dermatoscopic features		Lichen planus	Zoon's balanitis	Non-specific balanitis
Vascular structures	Dotted vessels	3/5	–	–
	Linear vessels	5/5	3/3	4/5
	Regular distribution	–	3/3	4/5
	Peripheral distribution	5/5	–	–
Structureless areas	Red and orange	–	3/3	–
Other features	Erosions	1/5	3/3	–
	Wickham's striae	5/5	–	–

Discussion

LP, ZB and NB seem to have characteristic dermatoscopic features that could correlate with a specific histopathological process observed in each entity.

ZB is benign, inflammatory condition that involves the glans penis or the prepuce of middle-aged and elderly men. Nevertheless, a similar condition known as plasma cell vulvitis, has been described in female patients. Although the exact etiopathogenesis is not clear, triggers such as

irritation, maceration and mild trauma have been described. Circumcision is sometimes curative (Kyriakou 2014: 18). The usual clinical presentation of ZB is characterized by circumscribed, erythematous, shiny lesions on the glans and prepuce. The condition has been previously described dermatoscopically in a limited number of publications. Patchy or diffuse structureless areas of varying color from yellow to brown and curved vessels are considered the most characteristic dermatoscopic feature in ZB. Therefore, our findings correspond to the previously published ones. Erosions were observed in all our cases. Histopathologically, the structureless areas of varying color correlate with dermal hemosiderin depositions. This could explain why residual pigmentation changes can be seen months after successful treatment of ZB with topical anti-inflammatory medication. Plasma cell infiltrate and dilated vertically oriented blood vessels in the papillary dermis are other histopathological manifestations of ZB (Borghi 2018: 451; Corazza 2016: 182).

LP is a chronic inflammatory condition that could involve cutaneous and mucosal surfaces. Although oral and genital lesions frequently occur concomitantly, isolated genital disease has also been described. Genital mucosal LP is less prone to remission than the cutaneous disease. Various triggers such as viral agents, particularly hepatitis C, metal ions and medication have been linked to LP. The disease is mediated by cytotoxic T lymphocytes that attack basal keratinocytes (Khurana 2019: 105). Cutaneous LP is clinically characterized by planar, purple, pruritic papules. Genital lesions are sometimes erosive and painful, especially in women. In male patients, annular lesions on the glans and prepuce have been described. Lichenoid lymphocytic infiltrate, degeneration of basal keratinocytes and pigment incontinence are histopathological features of LP. Hypergranulosis is also common, and it corresponds to WS on dermatoscopy. WS are white lines commonly arranged in a lacy pattern. Dotted and linear vessels at the periphery of the lesion have also been described previously and are consistent with our findings. Erosive LP balanitis has also been seen in one instance (Borghi 2018: 451).

NB is thought to account for 23-60% of chronic, recurrent balanitis cases. This is a diagnosis of exclusion, meaning that other conditions such as genital psoriasis, LP, ZB and allergic contact dermatitis should be ruled out (Fornasa 1994: 345). Histopathologically chronic perivascular infiltrate and spongiosis are features found in NB. Clinical features as the name implies are non-specific, such as mild patchy erythema, burning sensation. To our knowledge the previously reported dermatoscopic description of NB is limited to the personal observations of one author's group, these findings are consistent with our dermatoscopic evaluation (Errichetti 2016: e209; Errichetti & Stinco 2016: 471).

One of the limitations of this study is its small sample size, mainly because male patients are sometimes reluctant to undergo a penile biopsy. We speculate that this could also explain the scant previous publications in this field.

Conclusions

Inflammatory balanitis tends to have characteristic dermatoscopic features that could help in differentiating these conditions. Dermatoscopic features correspond to particular findings seen on histopathology. Further studies to evaluate the diagnostic accuracy of dermatoscopy during the examination of balanitis are necessary.

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HAND HYGIENE AND MASK WEARING HABITS OF ADOLESCENTS DURING THE COVID-19 PANDEMIC IN LATVIA

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Abstract
Hand hygiene and mask wearing habits of adolescents during the Covid-19 pandemic in Latvia
Key Words: *COVID-19, adolescents, teenagers, children, hygiene, hand washing, disinfection, masks*
Background and objectives: With the COVID-19 pandemic it is more important than ever to have proper hand hygiene and correct mask use, especially among socially active adolescents. Looking into their habits of use of these safety measures will let us analyze the situation and propose ways to improve it.
Materials and methods: data was gathered using a survey that was distributed to Latvian schools (grades 8-12) in November-December of 2020. IBM SPSS Statistics 26 (descriptive statistics, chi-square test) was used to analyze the surveys (total N=161).
Results: Participants pay more attention to hand washing (61.5%; N=99) and hand disinfection (77.6%; N=125) now than they did before the COVID-19 pandemic.
All participants have seen the "6-step hand washing technique", but only a fifth part (21.7%; N=35) follow all the steps. The majority (68.3%; N=110) only follow some.
37.3% and 40.3% of participants wash their hands 4-6 and 7-10 times a day respectively. However, 16.1% (N=26) do not use hand disinfection at all. Older respondents wash their hands more often. It was also found that female attitude toward hand washing, and disinfection is more positive than male.
34.8% of adolescents (N=56) change masks once a week, 14.9% (N=24) – when the mask is not usable anymore. Only 9.3% of all children change or wash their masks before every use.
When wearing masks, participants cover both mouth and nose at almost all times: in public transport (95%; N=153), in shops (94.4%; N=152), in restaurants (80.7%; N=130), during public events (84.5%; N=136).
Conclusions: Despite being informed of proper hand washing technique, most do not use it fully. Overall, most participants wash their hands in decent amounts every day. A considerable number of participants do not use hand disinfection at all. As anticipated, older adolescents use hand hygiene more often than younger children. Habits of mask wearing are proper in the majority of participants, but the frequency of mask changing is concerning.

Kopsavilkums
Pusaudžu roku higiēna un masku valkāšanas paradumi Covid-19 pandēmijas laikā Latvijā
Atslēgvārdi: *COVID-19, pusaudži, bērni, higiēna, roku mazgāšana, dezinfekcija, maskas*
Pamatojums un mērķi: COVID-19 pandēmijas laikā ir būtiski ievērot roku higiēnu un pareizi lietot maskas. Tas īpaši attiecas uz pusaudžiem, jo šī vecuma grupa ir ļoti sociāli aktīva. Pusaudžu ieradumu izpēte saistībā ar higiēnas noteikumu ievērošanu un masku lietošanu, ļauj mums analizēt pašreizējo situāciju un izstrādāt priekšlikumus, tās uzlabošanai.
Materiāli un metodes: dati tika iegūti ar aptaujas palīdzību 2020. gada novembrī un decembrī. Aptauja tika izsūtīta uz vairākām Latvijas skolām. Aptaujā piedalījās 8.-12. klašu skolēni. Aptauju datu analīzei (N=161) tika izmantota IBM SPSS Statistics 26 programma (aprakstošās statistikas, Hī kvadrāta testi).
Rezultāti: Aptaujas dalībnieki pievērš vairāk uzmanības roku mazgāšanai (61,5%; N=99) un roku dezinfekcijai (77,6%; N=125) tagad, nekā pirms COVID-19 pandēmijas.
Visi aptaujas dalībnieki ir redzējuši "6-soļu roku mazgāšanas tehniku", bet tikai piektā daļa (21,7%; N=35) pielieto visus soļus ikdienā mazgājot rokas. Lielākā daļa (68,3%; N=110) seko tikai dažiem soļiem.
37,3% dalībnieku mazgā rokas 4-6 reizes dienā, 40,3% to dara 7-10 reizes. 16,1% (N=26) ikdienā vispār nedezinficē rokas. Tika atklāts, ka vecāki aptaujas dalībnieki mazgā rokas biežāk, nekā jaunāki, kā arī meitenēm attieksme pret roku mazgāšanu un dezinfekciju ir pozitīvāka, nekā zēniem.
34,8% pusaudžu (N=56) maina maskas reizi nedēļ, 14,9% (N=24) – tad, kad maska vairs nav lietojama. Tikai 9,3% dalībnieku maina vai mazgā maskas pirms katras lietošanas reizes.
Valkājot maskas, pusaudži gandrīz vienmēr nosedz gan muti, gan degumu: 95,0% (N=153) to vienmēr dara sabiedriskajā transportā, 94,4% (N=152) veikalos, 80,7% (N=130) ēdināšanas iestādēs, 84.5% (N=136) sabiedriskos pasākumos.
Secinājumi: Neskatoties uz to, ka visi dalībnieki ir informēti par pareizu roku mazgāšanas tehniku, lielākā daļa to neizmanto pilnībā. Kopumā, pusaudži mazgā rokas ļoti bieži. Tomēr, liela daļa aptaujas dalībnieku ikdienā nedezinficē rokas. Vecāki pusaudži mazgā rokas biežāk nekā jaunāki. Lielākā daļa dalībnieku pareizi izmanto maskas, bet biežums ar kādu tās tiek mainītas/mazgātas rada bažas.

Introduction

On the 12th of March of 2020, it was announced that Europe is now the center of the COVID-19 pandemic with more than 20 000 confirmed cases and almost 1000 deaths from this virus in the region. European countries were called to full preparedness to start actions for prevention and fight the virus. People were officially advised to properly use hand hygiene and masks, avoid touching face, maintain a social distance of 2 meters and stay at home if possible and avoid travelling [15]. Latvia, as well as many other European countries, enacted a law about the obligatory use of personal protective measures in public places and started active information spreading how to protect self and others from COVID-19 infection. Social events, work of many institutions including schools were limited as well.

Coronavirus group viruses are known as respiratory infection pathogens from 1965. SARS-COV-2 which came from Wuhan at the end of 2019 attracted attention from all over the world by its extremely fast spread rate with severe impact on healthcare and economics of many countries. COVID-19 virus is transmitted with droplets or aerosols from an infected person while they talk, cough or sneeze and can infect other people by getting into their airways. Touching the surface after the infected person and then touching the face is also a possible way of transmission [11].

The first and the most important goal of the protective measures is to limit transmission as much as possible. Hand washing and disinfection helps to avoid infection spread via contaminated surfaces (as it could be in public transport), and masks and social distance limits the possibility of inhalation of virus containing droplets. The effectiveness of these protective measures depends on how qualitatively they are used and on how responsible are the users.

Adolescents are known as an age group with still developing critical thinking skills which leads to them being easy to influence by different information sources adolescents come in contact with [6]. They are very socially active, energetic and independent. Adolescents and young adults more than other age groups have asymptomatic or mild disease with a long incubation period but still can spread the infection to other people they are in contact with [7]. Therefore, adolescents are an important group to consider when thinking about the limitation of virus spread. Effective use of protective measures in adolescents could improve the situation with new COVID-19 cases or at least make it more stable.

2. Materials and methods

Data for this study was gathered a using 45-question survey that was created in Google Forms. The questionnaire had several question blocks on hand washing and disinfection technique, habits of hand hygiene use in daily life, as well as frequency of use, also face masks – mask wearing habits and techniques, as well as types of masks participants use. The results also compared habits of hand washing and mask use in different age groups and genders.

The survey was distributed online to several Latvian schools throughout November-December of 2020. Children of grades 8-12 were asked to fill it in. A total of 161 surveys were completed and valid to use in this study.

IBM SPSS Statistics 26 (descriptive statistics, chi-square test) and Microsoft Excel were used to analyze the data.

3. Results

3.1. Overall hand hygiene

65.8% (N=106) of survey participants were females, and 34.2% (N=55) males. Ages of participants: 13-19 (mean age – 15.8 years).

The overall trend for hand washing and disinfection was, that - most participants pay more attention to hand washing 61.5% (N=99) and hand disinfection 77.6% (N=125) now than they did before COVID-19.

3.2. Hand washing technique and habits

All of the participants (N=161) say that they have seen the WHO recommended "6-step hand washing technique" before, without specifying the source.

The majority of participants (68.3%; N=110) follow only some of the hand washing steps, 21.7% (N=35) follow all of them, and 9.9% (N=16) do not follow them at all and wash hands with their technique. This leads to incomplete hand hygiene and reduces handwashing effectiveness against respiratory and diarrheal infections, including COVID-19 [1]. The Center for Disease Control and Prevention (CDC) recommends washing hands in 3 steps, with no specific directions to how exactly the hands should be scrubbed [1]. The World Health Organization (WHO) recommends the Six-Step Hand Hygiene Technique, and it was found superior to that recommended by CDC. Research that compared the 6-step vs 3-step washing technique in a randomized controlled trial found that the 6-step washing technique is more effective in reducing bacteria on healthcare worker's hands [10]. Latvian Disease Prevention and Control Center (DPCC) also recommends the 6-step hand washing technique [3]. The same technique of 3 or 6-steps applies to the hand disinfection technique. CDC and WHO, as well as Latvian DPCC recommend scrubbing hands for at least 20 seconds, which is considered enough for a proper hand cleaning.

The questionnaire for this study did not contain any questions about how long the participants wash their hands, as it may be hard for participants to think of, or recall specific timing, and answers would likely be subjective.

WHO, CDC and DPCC all emphasize on when to wash or disinfect hands: when visibly dirty, after using the toilet, before/during/after preparing food, before and after eating, after using the toilet, after entering/leaving a public place, etc. Hand sanitizer that contains at least 60% alcohol should be used when soap and water are not available [1],[14],[3]. **Figure 1** and **Figure 2** display the participant's hand washing and hand disinfection habits in daily life.

The majority of participants wash their hands after coming home from the street (94.4%; N=152), after using the toilet (90%; N=145) and when their hands are visibly dirty (90%; N=145), before eating (75.7%; N=122). Only 47.1% (N=76) wash their hands after contact with other people. Only 1.2% (N=2) admit to not washing their hands on a daily basis.
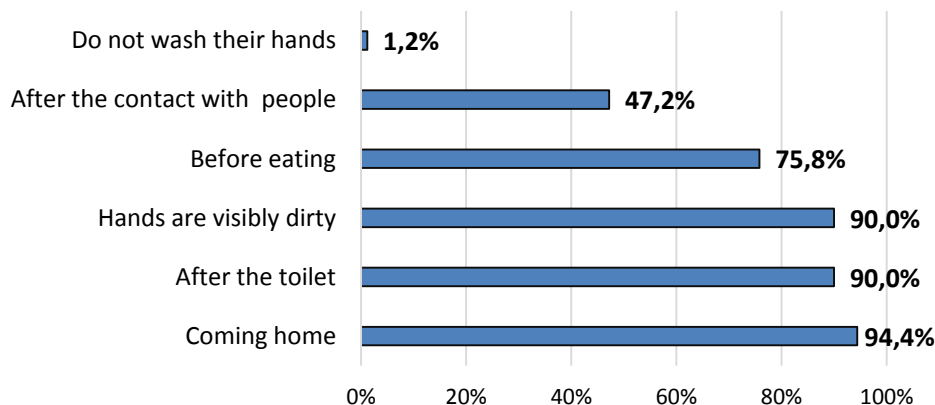

Figure 4. **Situations when adolescents wash their hands in daily life**

Analyzing the data about hand disinfection in daily life, it was found that 68.9% (N=111) disinfect their hands after entering a public place, 63.3% (N=102) – after leaving. A slightly bigger number (compared to washing) rather disinfect their hands after contact with other people (52.7%; N=85). 37.2% (N=60) disinfect their hands after coming home from the street. Despite 89.4% of participants agreeing that hand disinfection is important for COVID-19 prevention, nevertheless 18.6% do not disinfect their hands daily. Such a big number of participants who do not disinfect their hands could be attributed to the fact that in Latvia at the time of the survey it was a law for children starting from Grade 4 to study remotely, which lead to adolescents spending more time at home where soap and water are available.
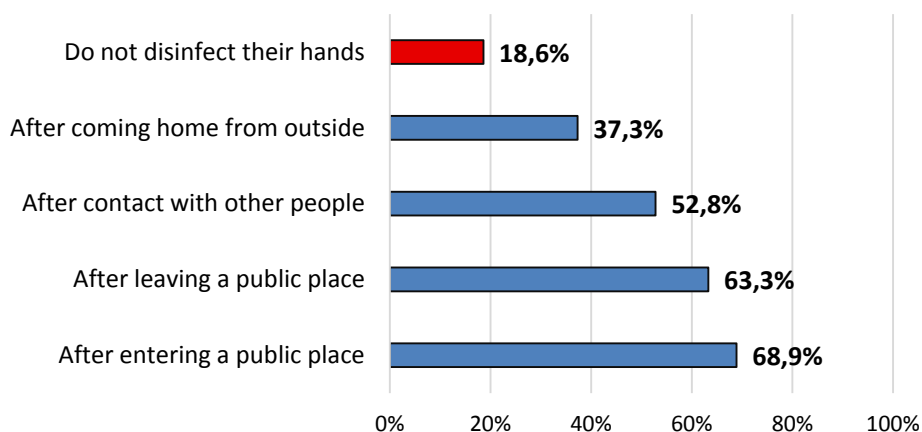

Figure 5. **Situations when adolescents disinfect their hands in daily life**

3.3. Frequency of hand washing and disinfection

The major health organizations (WHO and CDC), as well as DPCC do not have recommendations for how many times a day a person should wash or disinfect their hands. They emphasize that the amount of hand washing is not the most important thing. What matters the most is the correct hand washing technique and specific situations in which hands should be washed or disinfected, which were mentioned earlier in this article [1],[14],[3]. However, the survey for this study had several questions about hand washing and disinfection frequency. The idea behind this is - the more times children wash and disinfect their hands daily, the more of the 'key situations' [1] when health organizations recommend to wash/disinfect hands they cover.

A study on the effectiveness of hand hygiene education among a random sample of women in a community showed, that participants who reported to washing their hands more frequently (>6 times/day) had higher hygiene awareness, scarcer bacterial growth and coliform bacteria were not detected on their hands [13].

Participants wash their hands much more often than compared to disinfecting, as can be seen in **Figure 3** and **Figure 4**.

The majority of children – 37.3% and 40.3% wash their hands 4-6 or 7-10 times a day respectively. 8.1% wash their hands more than 11 times a day. Only 14.3% wash their hands 1-3 times a day.
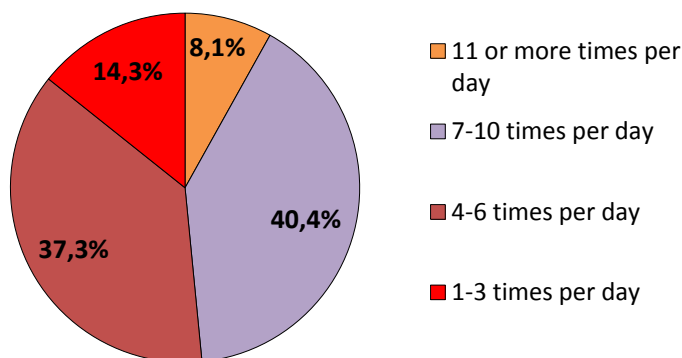

Figure 6. **Hand washing frequency among adolescents**

Figure 4 shows the results for hand disinfection – almost half of the participants (49.1%; N=79) disinfect their hands 1-2 times a day. 20.5% do it 3-4 times a day, 9.3% do it 5-6 times a day, and 5% - more than 7 times a day.

16.1% (N=26) of participants answered that they do not disinfect their hands at all.
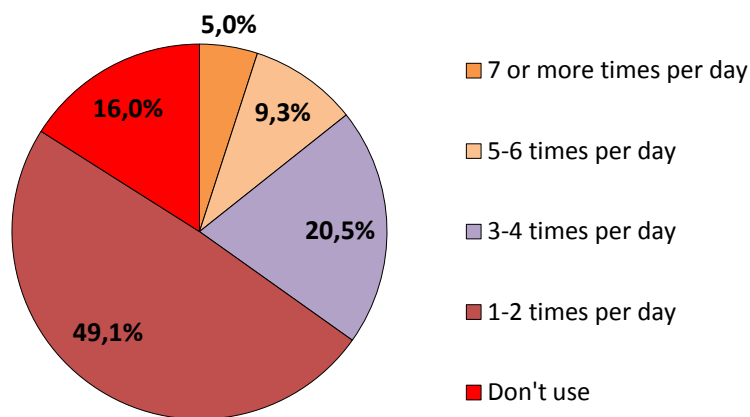
Figure 7. **Hand disinfection frequency among adolescents**

As mentioned earlier in the article, such a high number of participants who do not use hand disinfection could be attributed to the fact that, at the time of the survey, grades 8-12 were studying remotely starting from March 13th, 2020 [5], and starting from June 9th, 2020 many restrictions and rules were enforced specifically for visiting public places, like limited amounts of people that were allowed to gather per square meter, distancing rules, and others [8], which lead to a significant reduction of public gatherings and Latvians were staying home much more often. These restrictions could have possibly led to the reduction of hand disinfection frequency. However, to determine whether this is factual or not, an additional survey should be done.

3.4. Hand hygiene use in different age groups

To understand how age affects hand washing frequency, the sample was divided into 3 age groups and the numbers of hand washing per day were analyzed accordingly.

It was found that older responders wash their hands more often. Most of the 13-14 year old group (54.5%) wash their hands 4-6 times a day, while 60% of 18-19 year old group wash their hands 7-10 times a day.

3.5. Mask wearing technique

The WHO has recommendations for mask wearing that are constantly getting updated. Current recommendations are as follows [16], [17]:

- mask wearers should clean their hands (washing/disinfection) before putting the mask on, before and after taking it off, as well as after touching the mask at any time. Both outer and inner surface of the mask will contain aerosols, viruses, microbes and saliva, both from the mask wearer and from the environment, including other people [4], [17].

- masks should cover nose, mouth and chin

- when mask is taken off, it should be stored in a clean plastic bag and washed every day it's a fabric mask, or disposed of in a trash bin if it is a medical mask

The Latvian Disease Prevention and Control Center (SPKC) uses the gives recommendations as the WHO [11], [12].

According to the survey results, only 24.2% (N=39) of participants disinfect their hands before putting on a mask, and an even smaller number − 17.3% (N=28) disinfect hands before taking off the mask.

Figure 5 portrays the proper mask use (covering both mouth, nose and chin) according to law in various public places:

- Public transport: 89.4% (N=144) always use the masks properly and according to law, 9.3% (N=27) sometimes use masks according to law when in public transport, and only 1.2% (N=2) do not use masks.

- Stores: 93.2% (N=150) always use face masks and 6.8% (N=11) sometimes use masks in stores. Nobody answered "No" to this question.

- Shopping centers: 86.3% (N=139) always use masks, 13% (N=21) sometimes use them, and only 1 participant (0.6%) answered that they do not use masks at all while in shopping centers.

- Out on the street: there are currently no laws that require citizens to use face masks on the street, but nevertheless, 9.9% (N=16) always use masks while on the street, and 28% (N=45) use them sometimes. 62.1% (N=100) do not use masks while out on the street at all.
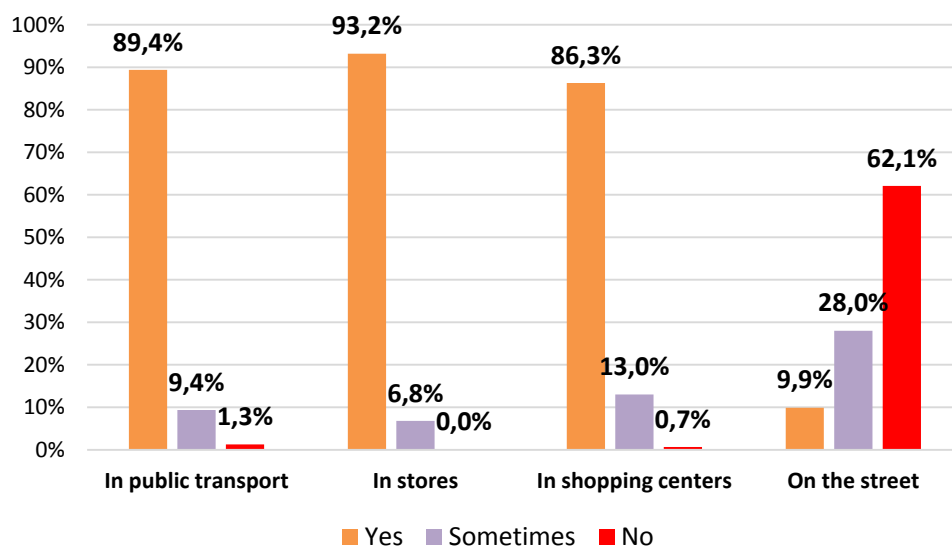

Figure 8. **Mask wearing in different public places**

After the mask is taken off, the majority of participants (72.6%; N=117) put it in their pockets, half of the participants (50.3%; N=81) also put it in their bags. Only 16.1% (N=26) of participants put the mask in a plastic bag before storing it.

3.6. Types of masks used

The World Health Organization have some recommendations on how to choose masks: it is recommended to use masks that have two or more layers of washable, breathable fabric, masks should have a nose wire to prevent air from leaking out of the top of the masks. Mask should also fit snugly and not have any gaps. It is generally not recommended to use face shields, as the effectiveness of them is not known at this time. Masks with exhalation valves or vents are also not recommended, as they allow virus particles to escape. Gaiters with two layers are mentioned as a special consideration, however, there is no mention of uses of scarves [2].

The majority of survey participants (72.6%; N=117) use fabric masks, 67% (N=108) use surgical masks, 37.9% use both kinds, without specifying whether it is at the same time or interchangeably. 1.8% (N=3) of participants use face shields, and 6.8% (N=11) use scarves or rims of their clothing instead of masks.

3.7 Frequency of mask changing

As for the frequency of mask changing, the WHO and other sources like the DPCC and UK's National Health Service (NHS) do not have a set time for how often masks should be changed. There is no recommended number of masks to use per day or hour. Mask should be changed when it gets wet, dirty or damaged, as well as if the inside of it is touched with dirty hands [17],[9],[12]. If the mask is worn, the condensation from breath wets the inside of the mask, which causes the fibers of the mask material to swell. This weakens the ability of mask to filter out microbes and particles [4]. Masks that are torn or damaged for other reasons are also less effective.

Figure 6 displays the frequency of mask changing/washing among adolescents. The majority of survey participants (34.8%; N=56) change masks only once per week. Quite a big number of participants (19.9%; N=32) change masks several times per week and a considerable number (14.9%; N=24) - when mask is not usable anymore.

Only 8.1% (N=13) of participants change masks every day, and 9.3% (N=15) of all children change or wash their mask before every use.
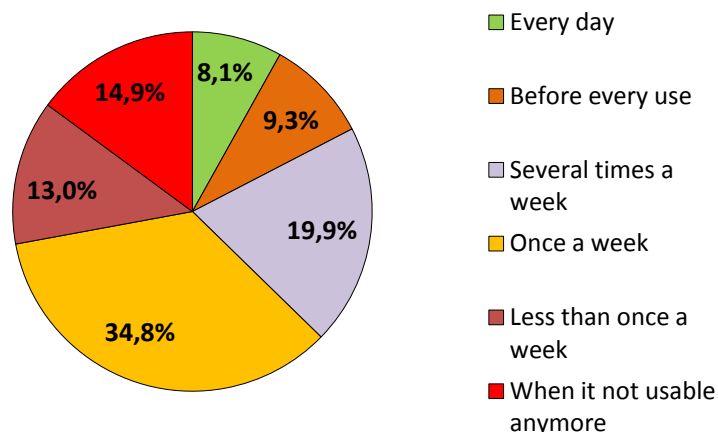
Figure 9. **Mask changing/washing frequency among adolescents**

The frequency of mask changing among adolescents is quite concerning. A very small percentage change masks every day or before every use, the way it is recommended in the health organization guidelines.

Discussion

As the pandemic has been ongoing for more than a year now, and continuation of COVID-19 spread is inevitable, all age groups need to have proper hygiene habits and stick to the necessary preventative measures to at least slow down the spread of the COVID-19 virus.

This study provided an insight into the, as it was discovered, overall positive situation in protective measure usage among adolescents. Although this work has some limitations, including: non-determined answer trust level due to the possibility of untrue answers given due to different reasons, lack of motivation to finish the survey with as strong focus as participants had in the beginning (due to a large number of questions), big the difference between the number of boys and girls that took this survey, age groups, a limited number of schools that participated.

This work could be improved with correction of the aforementioned limitations by the participation of more schools and adolescents of different ages and genders as well as using lie-detecting questions in survey to calculate the level of trust. Skills of handwashing and disinfection should also be accessed practically – by visiting schools, explaining the correct scrubbing procedure, and assessing the results with the help of a liquid, gel or powder microbe simulant that tests the effectiveness of hand washing, such as Glo Germ gel.

As seen from the results, adolescent's habits of mask washing and changing are poor. More investigation and in-depth look should be done to determine why – is it the unavailability of masks, their price, or something else? What is the reason for keeping the same mask for so long without washing/changing it? What would motivate adolescents to change their masks more often?

Quickly changing situation with the pandemic also creates a limitation, because some data collected could become outdated as COVID-19 laws and change, so, if continuation and expansion of the study are planned, the survey should be repeated to gain newer data.

The work shows the significance of the organization of hand hygiene promotion – bigger attention should be given to younger age groups and males because of less motivation and performance in these groups. This is important to make hygiene promotion more effective and directed at less engaged groups because of their relatively active socialization which increases the risk of transmission. Children should be informed about the "silent" infection they could have and the practical need of using protective measures to protect both themselves and the people around them.

Conclusions

Despite being informed of proper hand washing technique, most adolescents do not use all the recommended steps fully, which can lead to incomplete hand hygiene and an additional risk of spreading the COVID-19 infection. Hand hygiene education should include more practical knowledge about the handwashing technique specifically, as well as children should be informed about the 'key situations' when hand washing is the most important.

Overall, most participants wash their hands in decent amounts every day While there are no specific recommendations for hand washing times per day, a higher number of washes could provide better hygiene overall.

A considerable number of participants do not use hand disinfection at all. However, such rare disinfection use could be due to children being at home most of the time.

As anticipated, older adolescents use hand hygiene more often than younger children. Therefore, additional education aimed at smaller children is necessary.

Habits of mask wearing are proper in the majority of participants, but the frequency at which they change their masks is very concerning – less than one tenth of participants change their masks according to the worldwide and Latvian health organization recommendations.

Acknowledgements

We would like to thank Latvian school students for participation in our research and for their kind words of support. This is very important for us to know that people find our work useful and interesting.

Also, we would like to acknowledge school principals and teachers who helped us to organize our survey by spreading among students. We really value the support, especially in such difficult situation of pandemic.

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TOXIC BRAIN LESIONS AND THEIR RADIOLOGICAL FINDINGS

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Abstract

Toxic brain lesions and their radiological findings

Key Words: *Neuroimaging, CT, MRI, toxic brain lesions, alcohol, drugs, psycholeptic substances*

Introduction. Central nervous system is the site of primary exposure to alcohol, drugs and psycholeptics. Brain is a target organ for these toxic substances. Toxic substances can cause structural and functional changes in the brain. Structural changes caused by toxic substances can be assessed using CT (Computed Tomography) and MRI (Magnetic Resonance Imaging).

Aim. Purpose of study was to access and analyze radiological signs of acute and subacute toxic brain lesions in patients exposed to toxic substances using CT and MRI.

Materials and methods. Retrospectively medical records, head CT and MRI of 687 patients with acute toxic injury (ICD-10 T40, T51- T52, T58) admitted and treated in Intensive care unit (ICU) of Riga East Clinical University Hospital during the period between Jan 1, 2018 and Dec 31, were analyzed. Clinical parameters were analyzed statistically in correlation to imaging data. Significance: $p < 0.05$. Microsoft Excel 2016 was used to gather data. Statistical analysis was performed with SPSS software. The study was approved by Rīga Stradiņš University (RSU) Research Ethics Committee.

Results. Of 687 patients 516 (75,11%) men, 171 (24,89%) women, mean age 45. Among 687 patients most common etiological cause of intoxication was alcohol 61.73% (n = 542), opioids were the most prevalent drug, detected in 38.36% (n = 28), psycholeptics - 7.40% (n = 65). 60.12 % (n = 413) patients had head CT; 1.16 % (n = 8) had both head CT and MRI, 0.87% (n = 6) patients had only brain MRI. Positive CT findings were found 42.61 % (n = 176), positive MRI 100% (n = 14). Following acute brain injury signs were established on head CT: cortical-subcortical encephalomalacia - 25, lacunar infarctions - 14, basal ganglia lesions - 7, cerebral edema (loss of white-gray matter interface and/or cortical edema) - 6, brain stem stroke - 1. Chronic brain lesions signs on CT were cerebral atrophic changes - 95, cerebellar atrophy - 5. Brain lesions found on MRI: basal ganglia, insular, hippocampus, frontal and parietal cortex acute and global brain hypoxic lesions - 6, global brain atrophy – 2, cerebellar atrophy – 2. Affected basal ganglia were nucleus caudatus, nucleus lentiformis un thalamus, globus pallidus, hypothalamus, putamen - 4, cerebral microhemorrhages - 3, PRES - 1.

Conclusion. MRI is the most sensitive and informative method for the detection and characterization of acute and subacute toxic brain damage.

Kopsavilkums

Galvas smadzeņu toksiski bojājumi un to radioloģiskā atrade

Atslēgvārdi: *neiroradioloģija, CT, MR, toksiski galvas smadzeņu bojājumi, alkohols, narkotikas, psiholeptiskas vielas*

Ievads. Centrālā nervu sistēma ir alkohola un narkotisko vielu primārās iedarbības vieta, galvas smadzenes ir šo toksisko vielu mērķa orgāns. Toksiskās vielas var izraisīt galvas smadzeņu strukturālas un funkcionālas izmaiņas. Toksisko vielu radītās strukturālās izmaiņas ir iespējams izvērtēt ar CT (Datortomogrāfijas) un MR (Magnētiskās rezonanses) attēldiagnostikas metodēm.

Pētījuma mērķis. Pētījumā mērķis ir analizēt akūtu un subakūtu galvas smadzeņu toksisku bojājumu radioloģiskās pazīmes pacientiem, kuri pakļauti akūtai toksisko vielu iedarbībai, izmantojot CT un MR izmeklēšanas metodes.

Materiāli un metodes. Retrospektīvā pētījumā apkopoti CT un MR izmeklējumu dati 687 pacientiem ar akūtu toksisku ietekmi (SSK-10 T40, T51-T52, T58), kuri stacionēti RAKUS Toksikoloģijas un sepses klīnikā laika posmā 2018. g. 1. janvāra līdz 2018. g. 31. decembrim. Statistiski analizēti klīniskie parametri korelācijā ar attēldiagnostikas izmeklējumos iegūtiem datiem. Statistiski nozīmīga korelācija $p < 0.05$. Dati apkopoti Microsoft Excel 2016. Statistiskā analīze veikta ar SPSS programmu. Pētījumam saņemta Rīgas Stradiņa universitātes Pētījumu ētikas komitejas atļauja.

Rezultāti. No 687 pacientiem 75,11% (n = 516) bija vīrieši, 24,89% (n = 171) sievietes, vecumā no 16 līdz 96 gadi, vidējais pacientu vecums 45 gadi. Visbiežākais intoksikācijas etioloģiskais faktors bija alkohols 61.73% (n = 542). Saindēšanās ar narkotiskām un psihodisleptiskām vielām konstatēta 7.40% (n = 65), visbiežāk konstatētā narkotiskā viela bija opioīdi 38.36% (n=28). CT izmeklējums veikts 60.12% (n = 413), gan CT, gan MR izmeklējums veikts 1.16 % (n = 8) un 0.87% (n=6) veikts tikai MR izmeklējums. Pozitīva CT atrade konstatēta 42.61 % (n = 176), pozitīva MR atrade konstatēta 100% (n = 14). CT atrasti sekojoši galvas smadzeņu bojājumi: galvas smadzeņu tūska, t.sk., neprecizēta galvas smadzeņu tūska, baltās-pelēkās vielas starpības zudums, kortikāla galvas smadzeņu tūska, kopā – 6; kortikāla - subkortikāla encefalomalācija – 25; lakunāri infarkti – 14; bazālo kodolu bojājumi –7; smadzeņu stumbra ķīlēšanās – 1. Hroniski smadzeņu bojājumi CT: galvas smadzeņu lielo pusložu atrofija – 95; smadzenīšu atrofija – 5.

MR atrasti sekojoši smadzeņu bojājumi: hipoksiski galvas smadzeņu bojājumi zemgarozas kodolos, insulārā garozā, hippocampus, pieres, paura daivās, kā arī difūzi lielās smadzeņu puslodēs – 4; galvas smadzeņu globāla atrofija – 2; smadzenīšu atrofija – 2; smadzeņu lielo pusložu tūska – 2; nespecifiski pelēkās vielas bojājumi kodolos: nucleus caudatus, nucleus lentiformis un thalamus, globus pallidus, hypothalamus, putmaen – 4; mikrohemorāģijas – 3; PRES – 1.

Secinājumi. MR metode ir visjūtīgākā galvas smadzeņu bojājumu izplatības un to veida precīzā atspoguļojumā gan CNS intoksikācijas akūtā, gan subakūtā stadijā.

Introduction

People tend to be quite concerned about the impact of toxic substances on human health. The potential effects after being exposed to different kind of toxic substances are quite varied.

Exposure to toxic substances can cause various neurological disorders, it can be short-term and reversible, without causing changes in central nervous system or permanent and irreversible, even progressive. Some of these changes in central nervous system can be life threatening. Diagnostic imaging plays an important role in determining diagnosing and providing prognostic information. (de Oliveira et al., 2019) (Geibprasert et al., 2010)

Toxic disorders of the nervous system follow overexposure to abused substances. Most abused substances are ethanol or alcohol, narcotics, medicinal drugs.

According to the World Health Organization (WHO), drug use and alcohol consumption are very topical and significant issue worldwide (WHO, 2018) (WHO, 2019)

The latest data from WHO Global status report on alcohol and health (2018) shows that European countries has highest levels of alcohol consumption worldwide. In Latvia alcohol consumption per capita is increasing every year and drinking is more prevalent among men; lifetime abstention form alcohol is more prevalent among women. (WHO, 2018)

According to the report of the European Monitoring Center for Drugs and Drug Addiction (EMCDDA) Latvia has one of the highest rates of injecting drug use in Europe among the population aged 15-64. Drug use is mainly concentrated among young adults aged 15-34 years. Males generally report illicit drug use more often than females. Cannabis is the most common illicit drug used in Latvia. High-risk drug use in Latvia is mainly linked to the use of opioids and amphetamines. (EMCDDA, 2018)

Central nervous system is the site of primary exposure to alcohol, drugs, psycholeptics and other toxic substances. (Tamrazi et al., 2012)

Toxic substances can cause adverse structural and functional changes in the brain. (Geibprasert et al., 2010). Structural changes caused by toxic substances can be assessed using CT (Computed Tomography) and MRI (Magnetic Resonance Imaging). MRI is most sensitive method for evaluating acute toxic brain damage. (Geibprasert et al., 2010) (Sharma et al., 2009)

The aim of study was to access and analyze radiological signs of acute and subacute toxic brain lesions in patients exposed to toxic substances using CT and MRI.

Materials and methods

Retrospectively medical records, head CT and MRI of 687 patients with acute toxic injury (ICD-10 T40, T51- T52, T58) admitted and treated in Intensive care unit (ICU) of Riga East Clinical University Hospital during the period between Jan 1, 2018 and Dec 31, were analyzed.

Data describing brain lesions was obtained from radiology reports using "Ārsta birojs" database. Clinical parameters were analyzed statistically in correlation to imaging data. Significance: $p < 0.05$. Microsoft Excel 2016 was used to gather data. Statistical analysis was performed with SPSS software.

The study has been approved by the Ethics Committee of Riga Stradins University.

Results

Of 687 patients 516 (75,11%) were men, 171 (24,89%) women. Patient age ranged from 16 to 96 with average age of 45 years. Most patients 204 (29.69%) were in age group from 31 to 40 years of age.
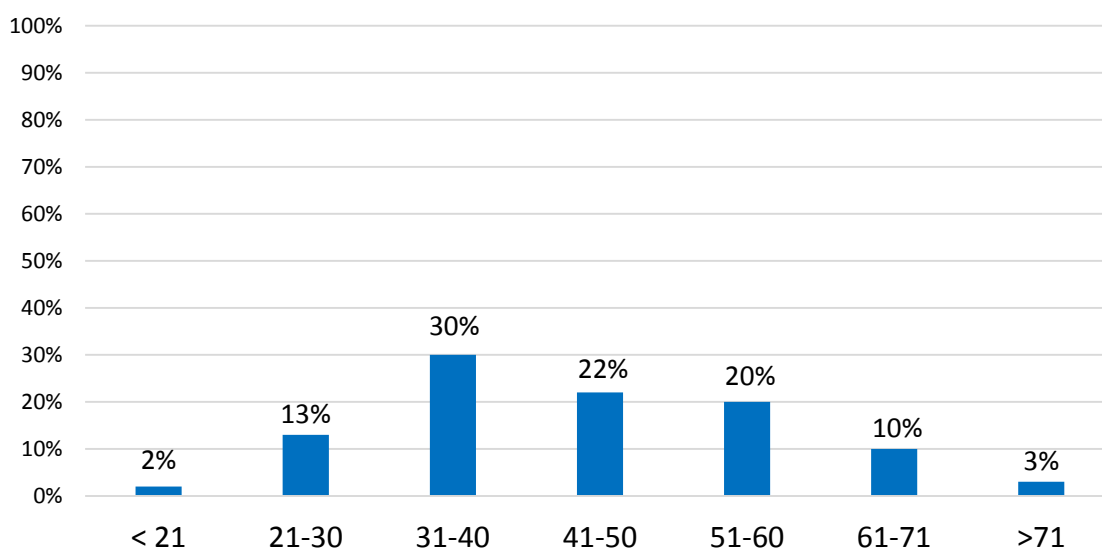

Figure 1. **Age distribution**

Among 687 patients most common etiological cause of intoxication was alcohol 61.73% (n = 542). Therapeutic drug abuse comes in as second most common cause for intoxication 18.0% (n = 155), most cases in combination with alcohol. Narcotics and psycholeptic substances 7.40% (n = 65) and alcohol withdrawal syndrome (AWS) 7.63% (n = 67) comes in as third most common causes for intoxication.
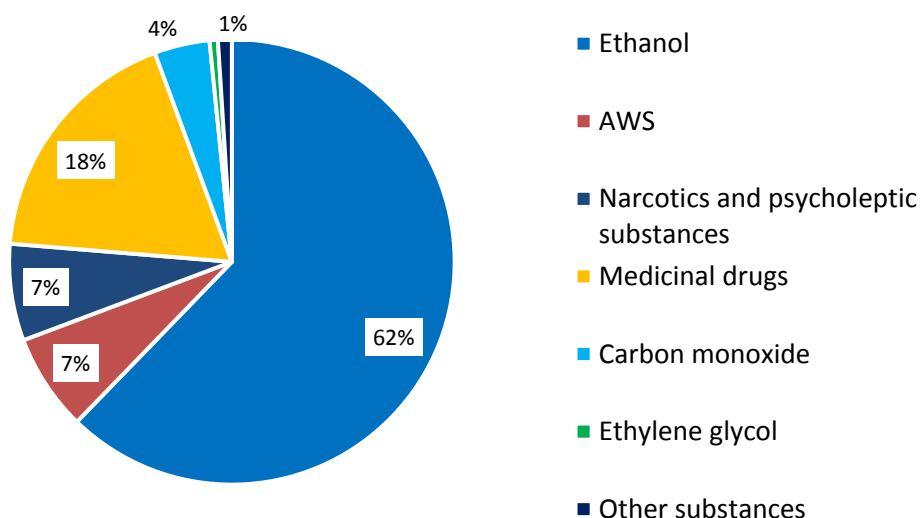
Figure 2. **Intoxication causes**

Opioids were most identified drug 38.36% (n = 28), cannabis was detected in 23.29% (n = 17) cases. 13.70% (n = 10) patients were intoxicated with drugs from phenethylamine and amphetamine drug group.
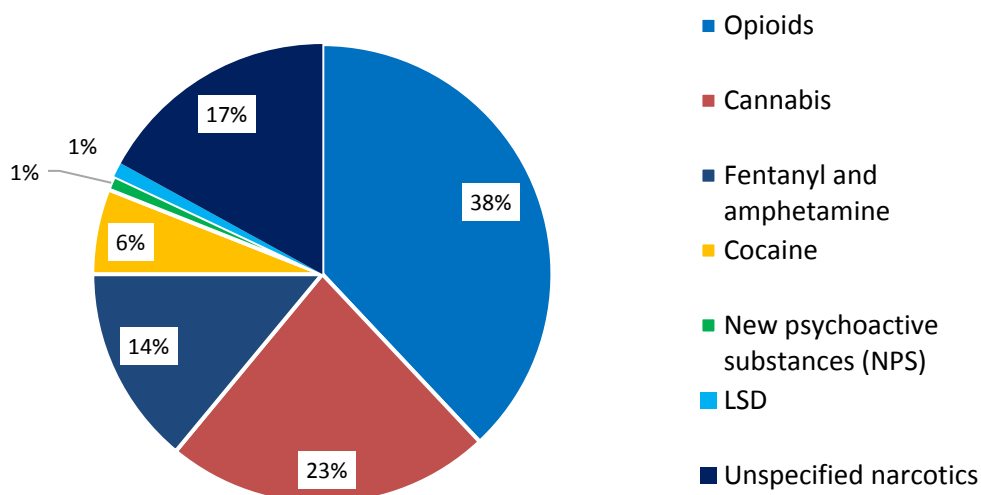

Figure 3. **Narcotics and psychotropic substances**

Of 687 patients 60.12 % (n = 413) had CT; 1 % (n = 8) had both CT and MRI, 1 % (n = 6) patients had only MRI. To 38 % (n = 260) patients CT and MRI scans were not performed.
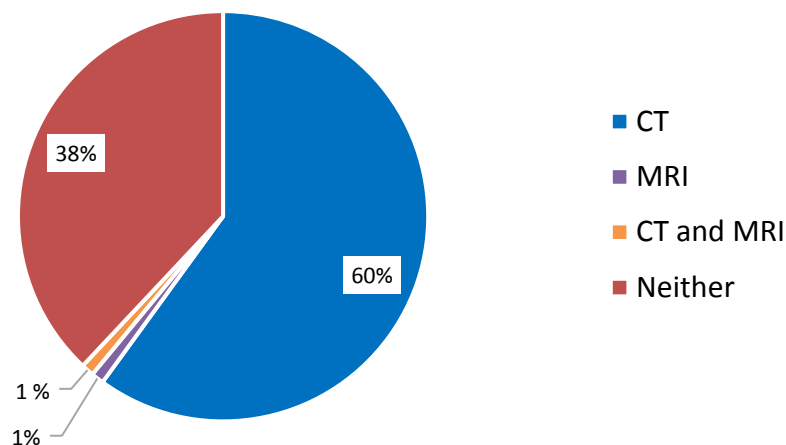
Figure 4. **Radiological examinations**

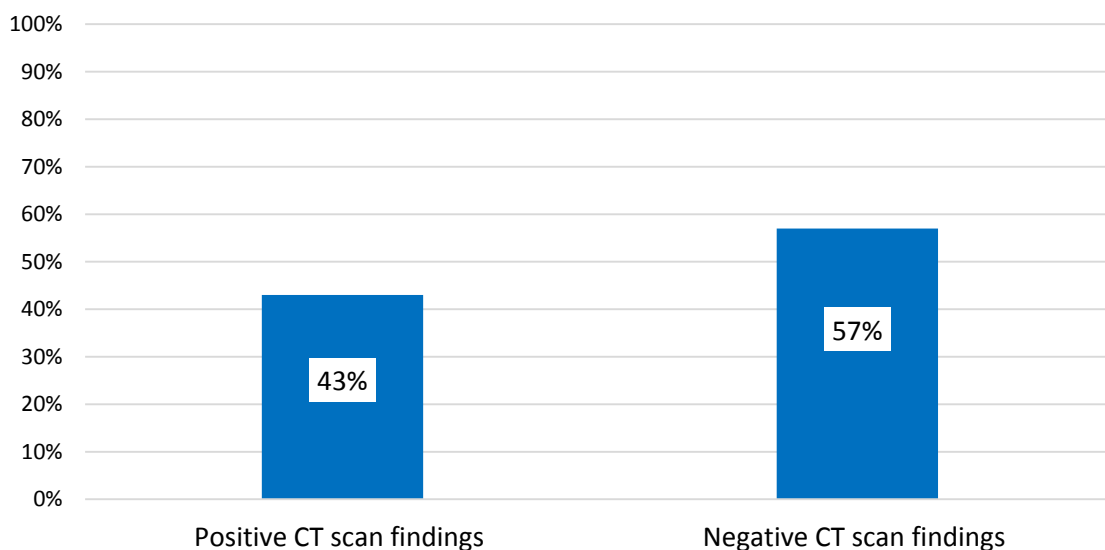Positive CT findings were found in 43 % (n = 176). Positive MRI findings 100% (n = 14).

Figure 5. **CT findings**

Following acute brain injury signs were established on head CT: cortical-subcortical encephalomalacia - 25, lacunar infarctions - 14, basal ganglia lesions - 7, cerebral edema (loss of white-gray matter interface and/or cortical edema) - 6, brain stem stroke - 1. Chronic brain lesions signs on CT were cerebral atrophic changes - 95, cerebellar atrophy - 5.

Brain lesions found on MRI: basal ganglia, insular, hippocampus, frontal and parietal cortex acute and global brain hypoxic lesions - 6, global brain atrophy – 2, cerebellar atrophy – 2. Affected basal ganglia were nucleus caudatus, nucleus lentiformis un thalamus, globus pallidus, hypothalamus, putamen - 4, cerebral microhemorrhages - 3, PRES - 1.

Discussion

According to World Health Organization and the European Monitoring Center for Drugs and Drug Addiction alcohol consumption and illicit drug use is more prevalent among men. (WHO, 2018) (EMCDDA, 2018). In this study of all 687 patients with acute toxic injury admitted and treated in Intensive care unit (ICU) of Riga East Clinical University Hospital 75% were men and were 25% women.

According to scientific literature toxic disorders of the nervous system follow overexposure to abused substances and the most abused substances are alcohol, narcotics, medicinal drugs. Data of this study shows that most common intoxication was alcohol poisoning 62%, followed by medicinal drugs 18% (most cases combined with alcohol) and then narcotic and psycholeptics substance abuse 7%.

European Monitoring Center for Drugs and Drug Addiction report shows that cannabis is the most common illicit drug used in Latvia and high-risk drug use in Latvia is mainly linked to the use of opioids and amphetamines. (EMCDDA, 2018) In study from all identified narcotics and psychotropic substances opioids was detected most common 38%, cannabis 23%, phenethylamine and amphetamine drugs 14%, cocaine 6%. Cannabis is not commonly associated with overdoses but consuming too much of the drug can lead to hospitalization. Opioids are the drug most frequently associated with overdosing and acute drug toxicity presentations at emergency departments. (EMCDDA, 2017)

Positive CT findings were found in 43 %. Positive MRI findings were found in 100%. MRI is much more sensitive than CT for evaluating alterations related to toxic brain damage. (Geibprasert et al., 2010)

Signs of acute and subacute toxic brain lesions are mainly neurodegenerative lesions, cortical atrophic changes, neurovascular complications. (Obad et al., 2018) (Tamrazi et al., 2012) CT head reports described following acute brain injury signs: cortical-subcortical encephalomalacia - 25, lacunar infarctions - 14, basal ganglia lesions - 7, cerebral edema (loss of white-gray matter interface and/or cortical edema) - 6, brain stem stroke - 1. Brain lesions found on MRI: basal ganglia, insular, hippocampus, frontal and parietal cortex acute and global brain hypoxic lesions - 6, global brain atrophy – 2, cerebellar atrophy – 2. Affected basal ganglia were nucleus caudatus, nucleus lentiformis un thalamus, globus pallidus, hypothalamus, putamen - 4, cerebral microhemorrhages - 3, PRES - 1.

Conclusion

MRI is the most sensitive and informative method for the detection and characterization of acute and subacute toxic brain damage.

References

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