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e-mail: msramka@ousa.sk

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editorial

Dear Readers,

The journal "Zdravotníctvo a sociálna práca" (Health and Social Work) was renamed in 2021 to International Journal of Health, New Technologies and Social Work.

Our long-term effort is to gradually acquire for the journal European significance and be included in international databases. Starting with issue No. 4 in 2016, the journal accepted the Harvard style of referencing, and changed guidelines for the authors. The aim of the changes was to move closer to the standard in international journals published in English in the area of health and helping professions. The editors are aspiring for registration in other relevant international databases. Since last 2020 the journal has published all articles in English only.

The journal "Zdravotníctvo a sociálna práca" *(Health and Social Work)* was established in 2006 at Faculty of Health and Social Work blessed to P. P. Gojdič in Prešov and St. Elizabeth University College of Health and Social Work in Bratislava. In 2023, the journal celebrated its 18th year of publication.

Previously professional journal, within 5 years developed into an international, peer-reviewed scholarly journal, published quarterly (4 issues per year). The journal were published by the St. Elizabeth University of Health and Social Work in Bratislava. The journal became international in 2009. The journal was published and distributed in the Slovak Republic and also in the Czech Republic.

Since 2011, the journal is published both in print and as electronic issues, available from: www.zdravotnictvoasocialnapraca.sk. Starting by issue No. 3 in 2014, the scope of the journal has broaden and the journal is covering health sciences, such as Public Health, Nursing, Laboratory Medicine, but also helping professions such as Social Work or Pedagogy.

The journal is indexed in the following databases: Central and Eastern European Online Library — CEEOL (since 2018), Bibliographia Medica Slovaca (BMS), and Slovak reference database CiBaMed.

The part of journal is Supplementum, to publish abstracts from international conferences organized by the St. Elizabeth University of Health and Social Work in Bratislava. In 2024, the conference will take place in October in Czudec, in the Poland.

prof. Miron Šrámka, MD, DSc.
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Breastfeeding as an initiative of a baby friendly hospital
Dojčenie ako inciatíva nemocnice priateľskej deťom

Ľubomíra Karoľová [1], Mária Kilíková [2]

[1] Nemocnica Agel Košice-Šaca, novorodenecké oddelenie
[2] Vysoká škola zdravotníctva a sociálnej práce sv. Alžbety Bratislava, Detašované pracovisko bl. Salkaházi Rožňava

Contact adress: Ľubomíra Karoľová, PhDr. a doctoral student, Nemocnica Agel Košice-Šaca, Lúčna 57, 040 15 Košice-Šaca
e-mail: lubomirakarolova@gmail.com
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ABSTRACT

Backround: There is no doubt about the many benefits of breastfeeding in general. That is why the World Health Organization, in collaboration with the International Children's Emergency Fund (UNICEF), developed the "Ten Steps to Successful Breastfeeding", which became the basis of the Baby Friendly Hospital Initiative (BFHI). Following these developments, many hospitals have stepped up activities towards breastfeeding-oriented practice changes. Breastfeeding offers society economic, environmental and a number of other benefits in the form of reduced costs for the prevention and treatment of disease later in life.

Objectives of the study: To undertake a systematic collection and analysis of data on newborn breastfeeding and to confirm a statistically significant relationship between early breastfeeding and breastfeeding at discharge to home care.

Material and methods: We used the quantitative content analysis method of document analysis. We detected the dichotomy by analyzing the contingency of two analytical categories. The first category was early breastfeeding-eatching the newborn to the mother's breast within 1 hour after birth-and the second category was breastfeeding at discharge to home care. Percentages for the frequencies of the analytic categories were used to describe the data. The chi-square test of independence was used for statistical analysis of the data. We tested the expected result at the 5 % significance level. A total of 3827 documents were analyzed for the period 2021 (n =2016) and 2022 (n =1811). The base population was newborns born in Agel Košice-Šaca Hospital.

Results: The results of the analysis showed a higher average number of early breastfed infants ($\bar{x}$ = 38,6) in 2022 compared to 2021 ($\bar{x}$ = 36,1). We confirmed statistical significance between early breastfeeding and breastfeeding at discharge to home care (df =3,841). The results of the statistical analysis showed that early breastfeeding has a positive effect on maintaining the need for breastfeeding at discharge to home care.

Conclusion: Early breastfeeding is a factor that affects the development of lactation in the mother and affects the long-term breastfeeding of the newborn. The results of the survey suggest the need for maternal education throughout the hospitalization period to reinforce the function of the need to breastfeed for as long as possible.

Key words: Newborn, breastfeeding, nutrition.

ABSTRAKT

Východiská: O mnohých výhodách dojčenia vo všeobecnosti niet pochýb. Preto Svetová zdravotnícka organizácia v spolupráci s Medzinárodným fondom pre núdzové situácie detí (UNICEF) vyvinula „Desať krokov k úspešnému dojčeniu", ktoré sa stali základom iniciatívy Baby Friendly Hospital Initiative (BFHI). Po tomto vývoji mnohé nemocnice zintenzívnili aktivity smerom k zmenám praxe orientovanej na dojčenie. Dojčenie ponúka spoločnosti ekonomické, environmentálne a mnohé iné východy v podobe zníženia nákladov na prevenciu a liečbu ochorení v neskoršom veku. Ciele: Uskutočniť systematický zber a analýzu dát o dojčení novorodencov a potvrdiť štatisticky významný vzťah medzi včasným dojčením a dojčením pri prepustení do domácej starostlivosti.

Materiál a metódy: Použili sme metódu kvantitatívnej obsahovej analýzy dokumentov. Dichotómiu sme zisťovali analýzou kontingencie dvoch analytických kategórii. Prvou kategóriou bolo včasné dojčenie — priloženie novorodenca do 1 hodiny po narodení k prsníku matky a druhou kategóriou bolo dojčenie pri prepustení do domácej starostlivosti. Na popis údajov boli použité percentá pre frekvencie analytických kategórií. Na štatistickú analýzu dát sme použili chí-kvadrát test nezávislosti. Očakávaný výsledok sme testovali na hladine významnosti 5 %. Celkovo bolo analyzovaných 3827 dokumentov za obdobie roka 2021 (n = 2016) a 2022 (n = 1811). Základnou populáciou boli novorodenci narodení v Nemocnici Agel Košice-Šaca.

Výsledky: Výsledky analýzy preukázali vyšší priemerný počet včasne dojčených novorodencov v roku 2022 ($\bar{x}$ = 38,6) v porovnaní s rokom 2021 ($\bar{x}$ = 36,1). Potvrdili sme štatistickú významnosť medzi včasným dojčením a dojčením pri prepustení domácej starostlivosti (df =3,841). Výsledky štatistickej analýzy preukázali, že včasné dojčenie má pozitívny vplyv na udržanie potreby dojčenia pri prepustení do domácej starostlivosti.

Záver: Včasné dojčenie je faktor, ktorý má vplyv na rozvoj laktácie u matky a ovplyvňuje dlhodobé dojčenie novorodenca. Z výsledkov prieskumu vyplýva potreba edukácie matiek počas celej doby hospitalizácie s cieľom upevniť funkciu potreby dojčenia čo najdlhšie.

Klúčové slová: Novorodenec, dojčenie, výživa.

BACKROUND

Remarkable is the unanimity of opinion that breastfeeding is important for physiological growth and immunological protection of the newborn. Sedlak (2016, p. 12) states that "the health of future generations is closely related to how we care for children during the first months of their life." Breastfeeding as a form of nutrition has short-term and long-term benefits. This is pointed out by Podracka (2016, p. 15). She states that the practiced concept of nutritional programming in early childhood, can be a source of chronic diseases in adulthood. Bellu, Condo (2017) points out the health benefits of breastfeeding in children and mothers. They draw attention to the recommendations of the World Health Organization, which suggests exclusive breastfeeding up to 6 months of age and continuation of breastfeeding up to 2 years of age. It also notes that overall breastfeeding rates remain low. The authors note that only 41 % of infants aged 0 — 6 months are currently breastfed globally and exclusively. The need for breastfeeding is determined by external and internal environmental factors. External factors include bonding. The aim of bonding is the creation of an emotional bond between mother and child through uninterrupted contact of the naked infant with the mother's skin, culminating in the infant's first breastfeeding (Mazúchová, Kelčíková, Vasilková, 2017, p. 252). The results of the study from 11 European countries (Belgium, Croatia, Denmark, Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden and Switzerland) showed differences between countries in the orientation of breastfeeding practices. Countries have committed to increase the breastfeeding orientation practice by 2025. Slovak data in the form of sentinel indicators (eatching the newborn to the breast within 1 hour after birth = early breastfeeding) show a positive impact on the number of fully breastfed infants. In 2021, 56,3 % of newborns in Slovakia were breastfed and in 2022 it was 55 % (nczi.sk). The Slovak Republic has also taken a position on the issue of sentinel indicators. This is evidenced by the publication of the second revision of the standard of the Ministry of Health of the Slovak Republic under the title Standard Procedure for the Practice of Prevention: Maternal and Newborn Care according to the Baby-friendly Hospital Initiative (BFHI) Principles — Promoting Relational Bonding and Lactation, The aim of the standardised procedure is to ensure clinical care of the mother and the newborn in a way that improves the promotion of breastfeeding. Coordinate discharge from the health facility so that parents and their babies have timely access to ongoing breastfeeding support.

OBJECTIVES OF THE STUDY

The aim of the study was to quantify the number of early breastfed newborns and the number of newborns breastfed at discharge to home care from Agel Hospital Košice-Šaca for the period 2021 and 2022. To identify the statistical significance of these key indicators for the protection, promotion and support of breastfeeding in a given health care facility.

MATERIAL AND METHODS

A total of 3 827 newborn medical records were included. We used a quantitative content analysis method to identify the contingency of two analytic categories. We analyzed 2016 documents for the year 2021 and 1811 documents for the year 2022. The sentinel indicator category — breastfeeding within 1 hour after delivery was coded in the documentation as: "BFHI-Early initiation of breastfeeding-Yes or No." We detected the category: breastfeeding at discharge as a statement recorded in the discharge report. We recorded the results of the content analysis of the documents in Microsoft Office Excel. To confirm the relationship of early initiation of breastfeeding and breastfeeding at discharge, we used a method of applied statistics, chi-square test of independence. We tested the expected result at the 5 % significance level.

RESULTS

In 2021 (Table 1), out of the total number of newborns (n =2016) early breastfed were 1383 ($\bar{x}$= 36,1). The overall mean number of early breastfed newborns in 2022 (n = 1811) was higher ($\bar{x}$= 38,6). We identified a year-on-year increase in the mean number of early breastfed newborns. In the category of breastfeeding at discharge to home care in 2022 (n =1184), we found a slight decrease in the average number of newborns breastfed in 2022 ($\bar{x}$= 30,93) compared to 2021 ($\bar{x}$= 36,37). The sentinel indicator is higher in 2021 ($\bar{x}$= 72,51) than in 2022 ($\bar{x}$= 69,55).

DISCUSION

Mothers' awareness of breastfeeding in the first hours and days of a child's birth is low, they do not have enough support in the neonatal unit in case of problems, they suffer from an increased level of frustration with breastfeeding, they suffer from psychological instability (Racene et al., 2022). Mothers from a marginalized Roma background have different attitudes towards care, for whom a correlation between readiness for motherhood, mental health and later susceptibility to failure in parental responsibilities has been demonstrated. Mental health can affect mothers' ability to manage stress, bond with their children, and effectively fulfill parenting responsibilities (Ludvigh Cintulova, Budayová, Juhásová, 2023).

The results of a contingency analysis of the two categories in 2021 (n = 2016) and 2022 (n = 1811), demonstrated the importance of breastfeeding support in a sample of 3 827 newborns ($\bar{x}$= 70,3). Early breastfeeding made a particular contribution to this outcome ($\bar{x}$= 74,7). The results are comparable to those of the study by Theurich, et al. (2019) which shows, based on reports from the countries studied, that early breastfeeding was implemented in 56 — 98 % of newborns. Dudukcu et al. (2019) who reported that out of 368 mothers (n =368), 50,8 % eatched the newborn to the breast within 1 hour after birth and 51,6 % of mothers exclusively breastfed in the first six months. The results of the study by Mazúchová, Kelčíková, Vasilková (2017) showed that 55,87 % (n =2001) of women did not implement early breastfeeding. A community-based prospective cohort study by Khanal (2023) in a cohort of 735 newborns showed that mothers who initiated breastfeeding within 1 hour of delivery had a higher likelihood of breastfeeding continuity up to 6 months of infant's age. In that set of mothers, as many as 9,4 % started breastfeeding their infant within 1 hour after birth. The results of the study by Khanal, Scott, Lee, Karkee, and Binns (2015) point to factors that reduce the success of sentinel indicators. Zarshenas, Zhao, Scott, and Binns (2020) monitored a set of 700 mothers. At hospital discharge, 74,3 % of the mothers were breastfeeding. In our cohort, 2 576 (67,3 %) mothers

Table 1: Results of frequency analysis of categories of variables

Early breastfed *(n)*		$\bar{x}$		Breastfed at discharge *(n)*		$\bar{x}$	
2021	2022	2021	2022	2021	2022	2021	2022
1 383	1 478	36,1	38,6	1 392	1 184	36,37	30,93
∑ 2 861		74,7		∑ 2 576		67,3	

Legend: n = absolute frequency, $\bar{x}$= arithmetic mean

Table 2: The dependence of the number of breastfed at discharge on the number of early breastfed newborns

Early breastfed *(n)*	Breastfed at discharge *(n)*	*df*
2 861	2 576	3,841

Legend: n = absolute frequency, *df* = critical change value

The analyzed data showed that there is a statistically significant relationship (*df* = 3,841) between early breastfeeding and breastfeeding at discharge.

were breastfeeding at discharge to home care (n =3 827). The results of the authors' studies as well as our results demonstrated the importance and impact of the Baby Friendly Hospital Initiative. The principles of the BFHI are the basis for future breastfeeding support programs in Slovakia. Engaging with local communities is crucial for the success of maternity projects. This involves collaborating with community leaders, involving local women in project planning, and addressing cultural considerations to ensure that interventions are culturally sensitive and accepted. Sustainability is a key consideration in maternity projects. Efforts should be directed towards establishing sustainable healthcare systems and educational programs that can continue to benefit mothers and children in the long term (Pedro Allegria, Kuniaková et al, 2021). As part of the historical development of social services, the authors point out that there is no support system within community social services that would provide care for mothers, first-time mothers or postpartum care, as is the case abroad. Providing complex care to mothers could also be linked to the support of their independence and mental health (Ludvigh Cintulová L, Budayová Z, Buzalová, 2022). The authors Ludvigh Cintulová L, Beňo P, Pavlovičová T, (2023) add that impaired mental health during morning care can lead to post-traumatic stress disorder. The presence of PTSD in mothers can have long-term consequences for their own mental health and ability to fully care for their children. These consequences can affect not only mothers' emotional well-being, but also their ability to build healthy relationships and fulfill family responsibilities.

Tomanek et al. (2021) in his study points out the necessity of psychological support for women who do not have experience in caring for infants, in order to be able to take responsibility for parental duties, consultation with several experts is necessary.

CONCLUSION

The duration of breastfeeding is influenced by a complex mixture of multiple factors, including sociodemographic, biomedical and psychosocial factors. Regardless of the nature of the factors compromising breastfeeding, we believe it is important to provide care according to the standard practice for prevention: maternal and newborn care according to the principles of the Baby-friendly Hospital Initiative-promoting relational bonding and lactation. Every health care facility providing maternal and newborn care services should follow the Ten Steps of the Standard Practice. Doing so helps to improve breastfeeding support. We share the view that mothers who initiate early breastfeeding within 1 hour after birth achieve an increase in exclusive breastfeeding rates during hospitalization compared with those who did not practice early breastfeeding.

Conflict of interest

I declare that I have no conflict of interest.

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Possibilities of solving hip joint microinstability in professional dancers

Možnosti riešenia mikroinstability bedrových kĺbov u profesionálnych tanečníkov

Andrea Strečanská [1), 2)]

[1)] Univerzita sv. Cyrila a Metoda v Trnave, Fakulta zdravotníckych vied, Rázusová 14, Piešťany, Slovenská republika
[2)] Slovenské národné divadlo — Balet. Bratislava, Slovenská republika

Contact adress: Mgr. Andrea Strečanská, Žarnovická 1, 821 06 Bratislava, Slovak Republic
Phone: +421 902 617 292
e-mail: andreastrecanska@gmail.com
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ABSTRACT

Introduction: Injuries in the area of the hip joint and groin are considered very common in dancers, they represent up to 17.7 %. Among the specifics of the biomechanics of movement in ballet are primarily extraphysiological ranges, while the emphasis is mainly on extrarotation and abduction of the hip joint.

Core of Work: Instability is one of the three most common etiologies of pain in the hip joint area in dancers. Its initial treatment consists primarily of precisely and specifically targeted kinesiotherapy, which focuses mainly on strengthening the core of the dancers' body and the periarticular muscles in the hip joint area. Its primary goal is to ensure the optimal function of the dancer's locomotor apparatus, minimizing the risk of injuries, and also contributes to the long-term sustainability of their career. The goal of the research is to verify whether and to what extent it is possible to influence the stabilizing function of the hip joints in professional classical ballet dancers using targeted kinesiotherapy.

Conclusion: Microinstability of the hip joints is evaluated through the use of three new, currently sufficiently scientifically based, clinical tests (AB-HEER test, HEER test, Prone instability test) Research should be a source of relevant data that will have a significant impact on a better understanding of this issues.

Keywords: professional dancers, classical ballet, hip microinstability, physiotherapy, kinesiotherapy

ABSTRAKT

Úvod: Poranenia v oblasti bedrového kĺbu a slabín považujeme u tanečníkov za veľmi časté, predstavujú až 17,7 %. Medzi špecifiká biomechaniky pohybu v balete patria predovšetkým extrafyziologické rozsahy, pričom dôraz je kladený najmä na extrarotáciu a abdukciu bedrového kĺbu.

Jadro práce: Práve instabilita patrí medzi tri najčastejšie etiológie pôvodu bolesti v oblasti bedrového kĺbu u tanečníkov. Jej prvotná liečba pozostáva predovšetkým z presne a špecificky cielenej kinezioterapie, ktorá sa zameriava najmä na posilnenie jadra tela tanečníkov a periartikulárneho svalstva v oblasti bedrového kĺbu. Jej primárnym cieľom je zabezpečiť optimálnu funkciu pohybového aparátu tanečníka, minimalizovanie rizika zranení, taktiež prispieva k dlhodobej udržateľnosti ich kariéry. Cieľom výskumu je overiť, či a do akej miery je možné, pomocou cielenej kinezioterapie ovplyvniť stabilizačnú funkciu bedrových kĺbov u profesionálnych tanečníkov klasického baletu.

Záver: Mikroinstabilita bedrových kĺbov je vyhodnotená prostredníctvom využitia troch nových, v súčastnosti dostatočne vedecky podložených, klinických testov (AB-HEER test, HEER test, Prone instability test) Výskum by mal byť zdrojom relevantných dát, ktoré budú mať výrazný vplyv na lepšie pochopenie tejto problematiky.

Klúčové slová: profesionalny tanečníci, klasický balet, mikroinstabilita bedrového kĺbu, fyzioterapie, kinezioterapia

INTRODUCTION

The world of professional dancers places high demands on the physical condition, as well as on the movement apparatus of the dancers. Professional classical ballet dancers achieve a high standard of physical performance, at the same time they must pay attention to perfect aesthetics and graceful movement. This demanding profession often brings with it a high risk of injury. According to a study published in the Journal of Dance Medicine & Science, professional dancers have a 30 % higher risk of injury than the general population. They are most often caused by injuries to the legs, especially ankles, knees and ankles. Other frequent injuries are injuries to the back, shoulders and hands. We consider injuries in the area of the hip joint and groin to be very common among ballet dancers.

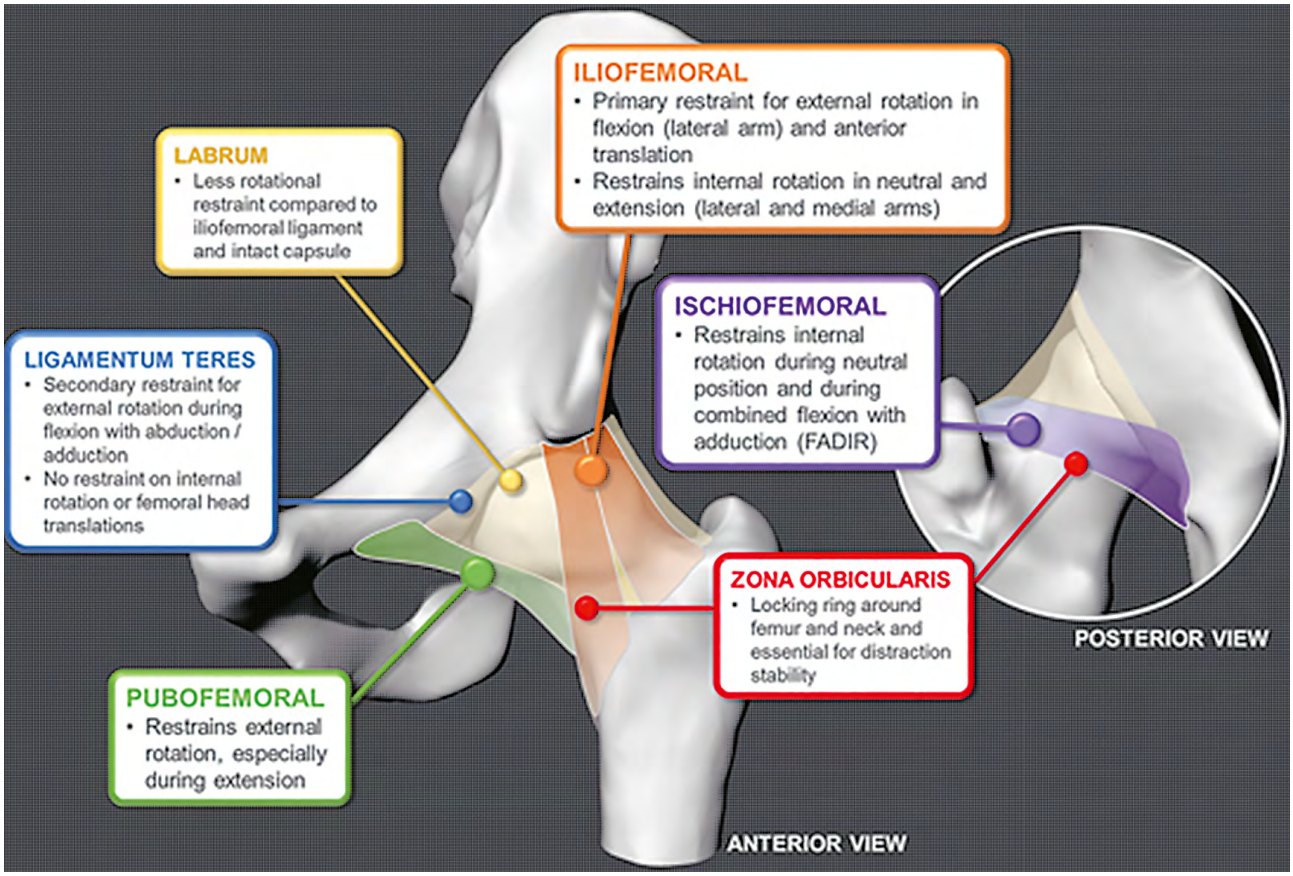
FOCUS

The specifics of the biomechanics of movement in ballet are primarily extraphysiological ranges of movement, while the emphasis is mainly on extrarotation and abduction of the hip joint. The three most common etiologies of hip pain in ballet dancers include hip instability, femoroacetabular impingement syndrome (FAIS) and extra-articular snapping hip syndrome. Initial treatment of hip instability consists primarily of precisely and specifically targeted kinesiotherapy, which focuses mainly on strengthening the dancers' core and periarticular muscles in the hip joint area (Curley, et al., 2022). Physiotherapy plays an important role in the prevention and management of these injuries.

THE CORE OF A JOB

Performing specific dance movements is no exception, high demands are placed on the movement apparatus of ballet dancers, especially for excessive ranges during the execution of individual dance positions. Frequent jumps and specific positions lead to a heavy load on the joints of the lower limbs, the pelvis and the lumbar region of the back. As a result of excessive load, there is also a high incidence of injuries, which are predominantly of a minor nature, but often recur (Smith, et al., 2016; Yau, et al., 2017). Repeated injuries later result in a transition to a chronic stage, or they can contribute to the development of a serious acute injury, which can ultimately lead to disability and, in extreme cases, to the end of the career of a professional ballet dancer. Atraumatic instability of the hip joint, or microinstability, is a relatively new clinical

Figure 1. The findings of in vitro cadaveric studies on individual capsular ligament contributions to joint stability, outlining iliofemoral, ischiofemoral, and pubofemoral ligaments, the zona orbicularis, ligamentum teres, and labrum



entity that is increasingly considered to be the cause of pain and performance impairment in young patients and athletes (Kalisvaart, Safran 2015), or by rotational loading of the hip joint in conditions of subtle anatomical abnormalities of the structures that they usually provide joint stability, leading to damage to the labrum and articular cartilage (Boykin, et al., 2011; Shu, Safran, 2011). Possibilities of malfunction in the area of the hip joint, see fig. 1.(Geoffrey 2019) Contributing factors include ligamentous or capsular laxity, muscle weakness of the hip joint and pelvic girdle, and repeated loading of the hip joint during sports activities (Boykin, et al., 2011; Shu, Safran, 2011).

CONCLUSION

Education of the dancer, training and artistic staff is one of the important components of a successful physiotherapy program. Therapy should include exercises to increase joint stability with strengthening of periarticular muscles. Exercises should target hip flexors, hip abductors, short external and internal rotators, core and lumbar spine (Kalisvaart, Safran, 2015). Prevention of injuries and possible damage to the hip joint through adequate physiotherapeutic intervention is currently insufficient or absent. Although the active career of a ballet dancer is relatively short, the impact of this occupation on health remains lifelong. Therefore, we consider it necessary to increase the quantity and quality of research and studies on the given issue. The goal of the research will be to verify whether and to what extent it is possible to influence the stabilization function of the hip joints in professional classical ballet dancers using targeted kinesiotherapy. Microinstability of the hip joints is evaluated through the use of three new, currently sufficiently scientifically based, clinical tests (AB-HEER test, HEER test, Prone instability test). Evaluation of the development of muscle strength of the periarticular muscles of the hip joint and evaluation of the range of mobility of the hips can be measured using a hand-held dynamometer — HHD. This research should be a source of relevant data that will have a significant impact on a better understanding of this issue and will contribute to improving the stability of the hip joint and reducing injuries in dancers.

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Neurological complications postcovid and postanticovid vaccination; prevention, treatment, virtual reality, rehabilitation and artificial intelligence, a review and casereports

Miron Šrámka [1), 4)], Jan Mašan [1), 2)], Eugen Ružicky [3)], Marcel Metes [5), 6)]

[1)] St. Elizabeth University of Health Care and Social Work in Bratislava, Slovak Republic
[2)] Faculty of Health Sciences, University of Saints Cyril and Methodius in Trnava, Slovak Republic
[3)] Pan-European University in Bratislava, Faculty of Informatics, Slovak Republic
[4)] St. Elizabeth Cancer Institute, Bratislava, Slovak Republic
[5)] Stará Vajnorská 39, 831 04 Bratislava, AELOS, Slovak Republic
[6)] Solea, Stará Vajnorská 39, 831 04 Bratislava, Slovak Republic

Contact adress: prof. MUDr. Miron Šrámka, DrSc.,
St. Elizabeth University of Health Care and Social Work in Bratislava, Slovak Republic
e-mail: miron.sramka@ousa.sk
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ABSTRACT

Backround: The COVID-19 pandemic continues to cause depression, anxiety, sleep disturbances and aggression years later. Similar symptoms on the nervous system appear after vaccination, postanticovid vaccination syndrome. They have diverse neurological, sensory, psychiatric, post-traumatic, neurodegenerative, autoimmune disorders and cognitive reduction.

Material and methods: Our experience with patients who were post-COVID-19 pandemic and also with patients who were post-antiviral vaccine syndrome was the basis of the research methods examined. We used publications detailing patients who experienced depression, anxiety, sleep disturbances, and aggressiveness after surviving the COVID pandemic or after vaccination against COVID.

Results: This review highlights the importance of a multidisciplinary approach to the proper management of post-covid and post-vaccination syndrome in general and neuropsychiatric and musculoskeletal symptoms in particular. They highlight the challenge of risk management and specialist involvement that can potentially support a reduction in the number of people with these symptoms. There must be a multidisciplinary approach during the clinical follow-up of patients after COVID-19, including the simultaneous use of artificial intelligence to ensure coherent, interactive and comprehensive care.

Conclusion: Prevention strategies must take into account the severity of the course of COVID-19, age, comorbidities and also gender, as women are more at risk of developing fatigue after COVID-19 and disorders such as anxiety, depression are also known to occur. The number of symptoms in the acute phase is also an important risk factor for the development of the syndrome after COVID-19. In addition, systematic screening for neuropsychiatric symptoms in the acute phase of COVID-19 and targeting circadian dysfunction and promoting physical activity in at-risk individuals could be effective ways to reduce neuropsychiatric symptoms after COVID-19.

Key words: COVID-19 pandemic, post-vaccination syndrome, artificial intelligence, virtual reality, comprehensive post-pandemic patient care

ABSTRAKT

Východiská: Pandémia COVID-19 spôsobuje depresie, úzkosti, poruchy spánku a agresivitu aj po rokoch. Podobné príznaky na nervovom systéme sa objavujú aj po očkovaní, postanticovidový vakcinačný syndróm. Majú rôznorodé neurologické, senzorické, psychiatrické, posttraumatické, neurodegeneratívne, autoimunitné poruchy a zníženie kognitívnych funkcií.

Materiál a metódy: Základom skúmaných výskumných metód boli naše skúsenosti s pacientmi, ktorí boli po pandémii COVID-19, a tiež s pacientmi, ktorí boli po syndróme antivírusovej vakcíny. Použili sme publikácie s podrobnými informáciami o pacientoch, u ktorých sa vyskytla depresia, úzkosť, poruchy spánku a agresivita po prekonaní pandémie COVID alebo po očkovaní proti COVID.

Výsledky: Tento prehľad poukazuje na dôležitosť multidisciplinárneho prístupu k správnemu manažmentu postcovidového a postvakcinačného syndrómu vo všeobecnosti a najmä neuropsychiatrických a muskuloskeletálnych symptómov. Zdôrazňujú výzvu riadenia rizík a zapojenia špecialistov, ktoré môžu potenciálne podporiť zníženie počtu ľudí s týmito príznakmi. Počas klinického sledovania pacientov po COVID-19 musí existovať multidisciplinárny prístup vrátane súčasného využívania umelej inteligencie na zabezpečenie koherentnej, interaktívnej a komplexnej starostlivosti.

Záver: Pri stratégiách prevencie sa musí brať do úvahy závažnosť priebehu COVID-19, vek, komorbidity a tiež pohlavie, keďže ženy sú viac ohrozené únavou po COVID-19 a sú známe aj poruchy ako úzkosť, depresia. Počet príznakov v akútnej fáze je tiež dôležitým rizikovým faktorom pre rozvoj syndrómu po COVID-19. Okrem toho by systematický skríning neuropsychiatrických symptómov v akútnej fáze COVID-19 a zameranie sa na cirkadiánnu dysfunkciu a podpora fyzickej aktivity u rizikových osôb mohli byť účinnými spôsobmi na zníženie neuropsychiatrických symptómov po COVID-19.

Klúčové slová: pandémia COVID-19, postvakcinačný syndróm, umelá inteligencia, virtuálna realita, komplexná postpandemická starostlivosť o pacienta

Introduction

After two years of the pandemic, due to COVID-19, depression, anxiety, sleep disorders, and aggressiveness, patients with a history of stress and associated diseases are arising. Similar symptoms on the nervous and sensory systems after overcoming postcovid syndrome appear after vaccination, postanticovid vaccination syndrom. They have diverse neurological, sensory, psychiatric, post-traumatic, neurodegenerative, autoimmune disorders, and cognitive reduction functions. (Šramka et al., 2022). PCNS signs and symptoms that occur during or after infection in accordance with the SARS-CoV2 disease and persist longer than 12 weeks are not explained by an alternative diagnosis. (Okrzeja et al., 2023). In studying the effect on the nervous and sensory systems postcovid and postanticovid vaccination syndrom, it is necessary to distinguish between complications like hypoxic encephalopathy, acute neuropathy, including infectious, parainfectious and postinfectious encephalitis. Complications, hypercoagulable states, nervous, and cardiovascular system diseases, metabolic, immune, and endocrine system disorders. If primary COVID-19 is accompanied by alterations of smell and taste (Moein et al., 2020), patients may have serious neurological, sensory, psychological and musculoskeletal disorders (Sramka et al., 2020).

Nervous System Response to SARS-CoV-2 Infection.

Patients after infection with SARS-CoV-1 and middle east respiratory syndrome coronavirus (MERS-CoV) do not return to normal quality of life and experience neurological complications for years after an acute infection. (Fotuhi et al., 2020). They may have neurological, sensory, musculoskeletal and neuropsychiatric disorders (Duran et al. 2021). Disorders of the frontal lobe of the brain are prevalent in individuals with encephalopathy (Rass et al., 2021), 36.4 % of cases with COVID-19 have CNS disorders, 8.9 % PNS disorders, 10.7 % skeletal muscle symptoms (Collantes et al., 2021), 28.8 % NCPM with COVID-19 higher risk of severe disability or death. (Immovilli et al., 2022). Guillain-Barré syndrome was the most common neurological disorder (21.8 %), NCPM (16.4 %), optic neuritis. They remain latent in the nervous system after SARS-CoV-2 and are able to reactivate. (Jaafar et al., 2022). The rapidly developing coronavirus disease pandemic was caused by severe acute respiratory SARS-CoV-2 syndrome (Zhu et al. 2019). associated with lung infection, leads to pneumonia, affected are cardiovascular, immune, gastrointestinal and nervous systems (Kakamed et al., 2021).

Affinity for the human angiotensin-converting enzyme 2 receptor allows SARS-CoV-2 to infect the nervous system. Receptor present in neural, glial cells, explains neurological symptoms, anosmia, peripheral neuropathy, brain disorders. In postmortem studies, SARS-CoV-2 particles were identified

in cerebrospinal fluid, cytoplasm, hypothalamus, and neocortex, causing neuronal degeneration, edema, cellular infiltration, hyperplasia, and glial cell death. Research on an animal model confirmed that SARS-CoV-2 enters the central nervous system through the olfactory bulb, a region of the brain, causing a perivascular inflammatory reaction, meningitis (Monroy-Gómez et al., 2020). Postcovid syndrome is defined by the World Health Organization (WHO) as "a condition that occurs in patients with probable or confirmed SARS CoV-2 infection, usually 3 months after the onset of the COVID-19 disease symptoms, and which lasts for at least 2 months, and cannot be explained by an alternative diagnosis" (World Health Organization, 2021).

The coronavirus is latent in the CNS for a long time, is capable of reactivation, and causes neurological problems (Monroy-Gómez et al., 2020), includes symptoms associated with residual inflammatory reaction, organ failure, impact on existing diseases (Moreno-Pérez et al., 2021). Secondary hypoxia, cytokine-related dysfunction and retrograde transit through the olfactory nerve bulbus, can reactivate SARS-CoV-2 (Kumar et al., 2021). Careful, continuous monitoring of COVID-19 patients, asymptomatic, in the acute stage of the disease, with neurological symptoms, and through routine screening, requires contact between primary care physicians and neurologists so that they can be documented and analyzed (Wijeratne et al., 2021). The ability of SARS-CoV-2 to infect and replicate in the human brain was demonstrated by detection of genomic RNA and subgenomic RNA by polymerase chain reaction imaging methods of SARS-CoV-2, RNA and protein in CNS cells, and sequencing in CNS (Stein et al., 2022). There is significant heterogeneity between brain regions, low concentrations of viral RNA indicate that SARS-CoV-2 has a weak CNS tropism (Thakur et al., 2021). SARS-CoV-2 can occur in most areas of the nervous system, both hemispheres of the brain, brainstem, thalamus, sciatic nerves, except for the dura mater (Thakur et al. 2021; Stein et al., 2022).

The link between the infection and diseases of the nervous system is not clear. In clinical studies), 36.4 % of patients with COVID-19 had CNS symptoms, 8.9 % had peripheral nervous system symptoms (Collantes et al., 2021). Neurological symptoms may not be related to CNS, PNS infection, they may be the result of a strong systemic reaction to COVID-19. Cases of meningitis and encephalitis associated with coronavirus disease suggests that SARS-CoV-2 can directly attack the nervous system (Chen et al., 2020). Acute symptoms of COVID-19, such as muscle pain, vertigo, headache, and concentration disorders may have a neurological cause and persist after the acute period (Gupta et al., 2020; Singh et al., 2020). Small emboli to the brain (Dixon et al., 2020; Sawlani et al., 2020), failure of the blood-brain barrier (Buzhdygan et al., 2020; Crook et al., 2020), inflammatory reactions in the CNS (Lee et al., 2021) lead to coagulopathy, initiators of hospitalization, mechanical ventilation, sedatives and in long-term neurological problems (Lee et al., 2021; Taquet et al., 2021).

Syndrome includes psychiatric problems caused by social isolation, panic, and loss of family members (Taquet et al., 2021). Stay in hospital, intensive care unit, duration of critical illness affects the occurrence of neuropsychiatric disorders after infection (Crook et al., 2020). Chronic symptoms caused by a combination of physiological factors, coronavirus RNA can persist in brain tissue, exacerbating neurodegeneration (Singh et al., 2020; Najjar et al., 2020; Wu et al. 2020; Generoso et al., 2021). Infiltration of innate immune cells associated with brain barrier failure can prolong neuroinflammatory processes (Generoso et al. 2021). Injuries during acute illness, chronic exhaustion are associated with the development of neuropsychiatric disorders after infection, especially sleep difficulties (Morin et al., 2021). Symptoms of the neurological and neuropsychiatric syndrome PCNS are exhaustion, cognitive disorders, brain fog, memory, concentration, and sleep disorders. Twelve weeks after the onset of the acute illness of COVID-19, they persist for a period of 3 — 6 months, more often half a year after infection (Taquet et al., 2021; Estiri et al., 2021).

Atrophy of the hippocampus and cerebral cortex (Generoso et al., 2021; Poloni et al., 2021; Solomon et al., 2021), ischemic changes (Radnis et al., 2020), small vessel disease (SVD) (Lowenstein et al.,2020) develop as a result of inflammatory reactions and oxidative stress during COVID-19 (Generoso et al., 2021; Huth et al., 2021). The long-term effects of these processes can manifest as memory, concentration and cognitive impairments disorders, brain fog. Anosmia, loss of smell, dysgeusia, taste disturbances, headaches are symptoms of an acute illness of COVID-19, they often disappear. In patients during acute coronavirus disease with, anosmia and taste disorder, 68 % recovered their sense of smell, 70 % their taste after 2 months from the onset of symptoms (Nguyen et al., 2021). Disorders polyneuropathy, myopathy, encephalopathy, post-infectious transverse myelitis, seizures, Parkinsonism, orthostatic hypotension associated with vasovagal syncope, strokes, neuro-ophthalmological problems, and were detected in patients at 12-week tracking (Rass et al., 2021).

GBS has been occurring more frequently since the beginning of the epidemic, there is a link between SARS-CoV-2 infection and GBS (Gupta et al., 2021). Most GBS patients with COVID-19 were parainfectious, while GBS after infection is rare (Maramattom et al., 2021). After recovery from COVID-19, twelve cases of GBS were shown to link between COVID-19 and GBS progression during acute infection (Abolmaali et al., 2021). The mechanism is the production of antibodies against the surface glycoproteins of SARS-CoV-2, which cause damage to peripheral nerves due to similar native protein forms (Gupta et al. 2021), SARS-CoV-2 can

cause stroke by invading vascular walls, coagulopathy due to endothelial inflammatory reactions, and damage to the heart by the formation of clots, destabilization of atheroma plates (Fraiman et al., 202

Differential diagnoses

Stroke, thrombosis of cerebral veins, neurodegenerative diseases, encephalitis, encephalopathy, seizures, insomnia, anxiety, depression, post-traumatic stress disorder and other mental disorders in which MRI, CT, PET/CT can help in the differential diagnosis (Verger et al., 2022; Baig et al. 2022; StatPearls et al., 2022). According to analyzes of SARS-CoV1 and MERS, patients who returned to full health may have neurological sequelae years later (Fotuhi et al., 2020). PCNS and PVCNS is one of the most significant long-term global public health problems that affects both hospitalized and non-hospitalized people. Age over 65 years, chronic lung disease, heart disease, high blood pressure, adiposity and diabetes are important risk factors for PCNS (Nuzzo et al., 2021). Despite recovery from the acute illness, we emphasize the necessity of monitoring all patients. (Sramka et al. 2020 a; Sramka et al. 2020 b; Sramka et al. 2021).

At the beginning of the COVID-19 pandemic, there was information about loss of smell and taste, headaches, confusion, hallucinations, delirium, depression, anxiety, and sleep disorders. The SARS-CoV-2 virus enters the brain along the olfactory nerve, it is neurotropic, and the symptoms are related to brain inflammation. Post-mortem MRI of the brain of patients with COVID-19 confirmed microvascular damage and leakage of fibrinogen into the brain. Blood clots, inflamed epithelium, disorders of the blood-brain barrier can contribute to brain damage with COVID-19. Inflammation changes the neurotransmitters in the brain — serotonin, norepinephrine, dopamine — that allow nerve cells to communicate. Patients with depression have high levels of inflammation. Acute cerebrovascular disease is a complication of COVID-19. Clinical symptoms of nervous system disease associated with COVID-19, Parkinson's disease, encephalopathy, encephalitis, neuropsychiatric, neurocognitive disorders, psychosis, and types of dementia, affective disorders (Varatharaj et al. 2020), irritability, and confusion, disorders of consciousness, it is associated with seizures, psychotic symptoms, and renomination. (Ellul et al. 2020; Wong et al. 2020).

Neurological symptoms after respiratory symptoms, cough, fever, are irritability, confusion, disturbances of consciousness, associated with seizures (Bernard-Valnet et al. 2020; Sohal et al. 2020), psychotic symptoms (Vollono et al. 2020) and renomination (Wong et al. 2020). Risks in patients due to severe acute respiratory syndrome SARS-CoV-2 differ according to age and comorbidity. Encephalitis caused by infection or immune disorder has been described in connection with COVID-19 infection, encephalopathy, and changes in personality, behavior, cognition, disorders of consciousness, delirium coma (Slooter et al. 2020). Acute disseminated encephalomyelitis, multifocal demyelination syndrome (Dugue et al. 2020; Helms et al. 2020; Mao et al. 2020; Paniz-Mondol et al. 2020; Zhou et al. 2020), acute hemorrhagic necrotizing encephalopathy and myelitis (Zhao et al. 2020). Diseases of the PNS in connection with COVID-19 are GBS, acute polyradiculopathy with progressive symmetric limb weakness, sensory disorders, and loss of facial nerve sensitivity, dysphagia, respiratory failure (Zhao et al. 2020), ophthalmoplegia, ataxia and areflexia, acute vestibular syndrome, rhabdomyolysis, Miller Fisher syndrome.

In patients with encephalopathy and COVID-19 who do not have encephalitis, the cause may be hypoxia, medications, drugs, toxins, metabolic disorders. Patients with severe respiratory diseases experienced dizziness, headaches and impaired consciousness. Neurological symptoms with structural brain MRI changes were eight months after infection (Nuzzo et al. 2021; Chen et al. 2020; Carfì et al. 2020). Neurological, neuropsychiatric disorders, anosmia, ageusia, dysgeusia, headache, muscle and joint pain, fatigue and brain fog persist for months (Rudroff et al. 2020), leading to delirium, psychosis, inflammatory syndromes. NCPM (Rudroff et al. 2020; Morgul et al. 2020; Satici et al. 2020; Iadecola et al. 2020), headaches, cognitive disorders, mental confusion, delirium, dementia (Liotta et al. 2020). Encephalopathy occurs in older people with existing chronic diseases (Nuzzo et al. 2021). Cognitive decline and dementia in persons older than 60 years with a predisposition to cerebrovascular diseases, arterial hypertension, diabetes, dyslipidemia have a higher risk of ischemic stroke during the disease of COVID-19 (Qureshi et al. 2020), acute neuropathy and polyneuropathy, GBS, damage nerves with gradual loss of muscle strength, and affected respiratory muscles (Webb et al. 2020). When walking, weakness of the lower limbs, lack of muscle strength of the pelvic girdle, skin hyperalgesia, drowsiness, malaise. Absence of movement in bed, immobilization, decrease in muscle mass, muscle strength, chronic fatigue, headaches, finger paresthesia, anxiety, depression.

The impact of post-COVID-19 on sensory disorders shows that inflammatory eye disease can be the first sign of COVID-19. Red eyes are also a symptom of emerging tumors of the eyes, orbit and auxiliary organs (Furdová et al. 2020). Musculoskeletal disorders during the use of mobile devices during COVID19 are a consequence of failure to maintain proper posture, as well as inappropriate working conditions when working at home (Mašán et al. 2021, Golská et al. 2021; Kerestéšová et al. 2021). Patients with a severe form of COVID-19 have permanent feelings of physical and mental fatigue, muscle weakness, drowsiness, and lack of concentration and reduced cognitive functions. They perceive physical exhaustion and experience feelings of fatigue and lack

of energy, which affect their daily life (Carfi et al. 2020; Goertz et al. 2020, Masan 2020). GABAergic dysfunction explains apathy, fatigue and performance deficits (Orteli et al. 2020), dysexecutive syndrome (Orteli et al. 2020; Helms et al. 2020). COVID-19 has a negative impact on motivational aspects and a direct correlation between apathy and depression has been found. In the acute phase of COVID-19, a hyper inflammatory state with a disorder of oxidative cellular stress developed, associated with complications of the central and peripheral nervous system (Masan et al. 2021).

Altered mental status, psychosis, affective disorders, neurocognitive disorders (similar to dementia), headache, encephalitis, myelitis, myopathy, myositis, GBS, mononeuritis, multineuritis (Filosto et al. 2020; Koralnik et al. 2020; Romero-Sanchez et al. 2020; Zhao et al. 2020). Six months after symptom onset, patients developed fatigue, muscle weakness, sleep problems, anxiety and depression. In severe course of the disease, reduced lung diffusion capacity (Huang et al. 2021). Hyper inflammation and endothelitis disrupt the blood-brain barrier of the brain (Najjar et al. 2020). The virus increases hypercoagulability through mechanisms and interactions between thrombosis and inflammation (Wang et al. 2020). Neurological syndrome after COVID-19 (PCNS) causes symptoms with prolonged muscle weakness and forms of myopathy (Wijeratnea et al. 2020c). A study of SARS reported active central nervous system involvement and chronic fatigue four years after infection (Chan et al. 2003; Lam et al. 2009). In patients with encephalopathy and COVID-19, hypoxia, medications, drugs, toxins, and metabolic disorders may be the cause of worsening of the disorder. Patients with severe respiratory diseases, claimed dizziness, headaches and disturbances of consciousness. (Sramka et al. 2020). For doctors, COVID-19 is associated with sleep disorders, depression, anxiety, signs of severe post-traumatic stress disorder (Bo et al. 2020). Even asymptomatic or mildly symptomatic patients experience long-term muscle pain, dizziness, headache, fatigue, anosmia for several months (Goërtz et al. 2020).

The neurotropism of SARS-CoV-2 is unclear (Harapan et al. 2021). Patients with a severe disease of COVID-19 need the care of a multidisciplinary team. Risks in SARS-CoV-2 patients vary according to age and comorbidity. Infectious encephalitis, an immune disorder, has been described in association with COVID-19 infection. Diseases of the PNS in connection with COVID-19 are GBS with progressive symmetrical weakness of the limbs, sensory disorders, loss of sensitivity of the facial nerve, dysphagia, ophthalmoplegia, acute vestibular syndrome. Neurological symptoms with structural changes in brain MRI were present eight months after infection, neuropsychiatric disorders, anosmia, ageusia, dysgeusia, headache, muscle and joint pain, fatigue, brain fog can persist for months, lead to delirium, psychosis, inflammatory syndromes, NCPM, cognitive disorders, including mental confusion, delirium, dementia. Encephalopathy, changes in personality, behavior, cognition, disturbances of consciousness, delirium and coma occur in elderly people with existing chronic diseases. Cognitive decline and dementia, especially in people over 60 years of age with a predisposition to cerebrovascular diseases, arterial hypertension, diabetes, and dyslipidemia have a higher risk of ischemic stroke during the disease of COVID-19, GBS. They cause nerve damage with gradual loss of muscle strength, respiratory muscles are also affected. When walking, weakness of the lower limbs, lack of muscle strength of the pelvic girdle, skin hyperalgesia, drowsiness, malaise are present.

Absence of movement in bed and immobilization cause a decrease in muscle mass, muscle strength, chronic fatigue, headaches, finger paresthesia, anxiety and depression. On the MRI of the brain, there are hyperintense areas in the periventricular, subcortical white matter, in the center of the semioval. After five months, neurological disorders appeared along with depression and seizures (Nuzzo et al. 2021). According to cardiologist SARS-CoV-2 infection can cause heart problems in some people, including inflammation of the heart muscle (Abu-Rumeileh et al. 2021). One recent study found that 60 % of people who recovered from COVID-19 still had symptoms of recurrent heart inflammation, which could lead to common symptoms such as palpitations, shortness of breath, and rapid heart rate. This inflammatory response was even observed in patients who had no previous comorbidities or were healthy individuals.

Case studies:

MRI CNS disturbances — coma, epileptic seizure. Fig. 1 — 3.

We observed changes on MRI in a 56-year-old female patient. Two days after contact with COVID-19, she fell into a coma, had an epileptic seizure, and was put on pulmonary ventilation. MRI after one month: Infratentorially in the middle cerebellar peduncles and supratentorially, predominantly in the paraventricular white matter, hyperintense areas with microvascular etiology are present on both sides on both sequences. GABAergic dysfunction explains apathy, fatigue, performance deficits, and dysexecutive syndrome. This study documents reduced GABAergic inhibition in patients who have recovered from COVID-19 with neurological complications and manifested fatigue and dysexecutive syndrome. Significance: TMS can serve as a diagnostic tool for cognitive disorders and fatigue in patients after COVID-19. (Versace et al. 2023). COVID-19 has a negative impact on motivational aspects, a correlation was found between apathy and depression, psychosis, affective disorders, neurocognitive disorders, headache, encephalitis, Guillain-Barré syndrome. Six months after symptom onset, patients developed fatigue, muscle weakness, sleep problems, anxiety and depression.

Previous SARS epidemics report involvement of the central nervous system and chronic fatigue even four years after infection. Asymptomatic or mildly symptomatic patients experience muscle pain, dizziness, headache.

(Fig. 1). Repeated MRI after 3 months. (Fig. 2). After intensive rehabilitation, sleep disturbance, general weakness, and fatigue persist. MRI image after 6 months (Fig. 3).

Figure 1: at the level of the basal ganglia

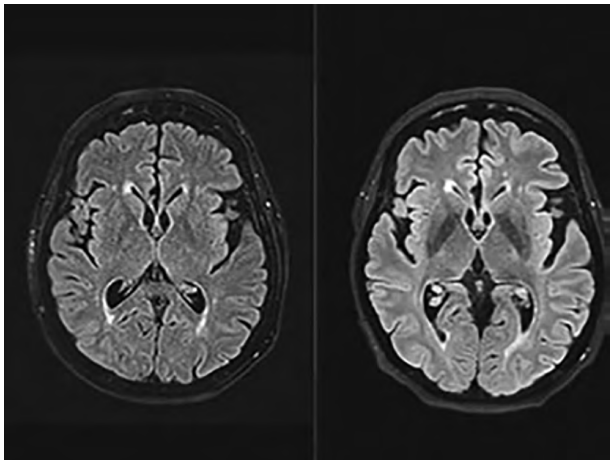


Figure 2: FLAIR sequence (T2 TIRM) at the level of the brainstem

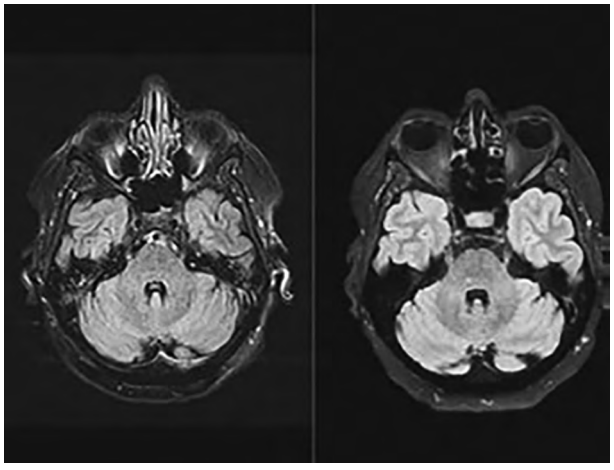


Figure 3: at the level of the basal ganglia

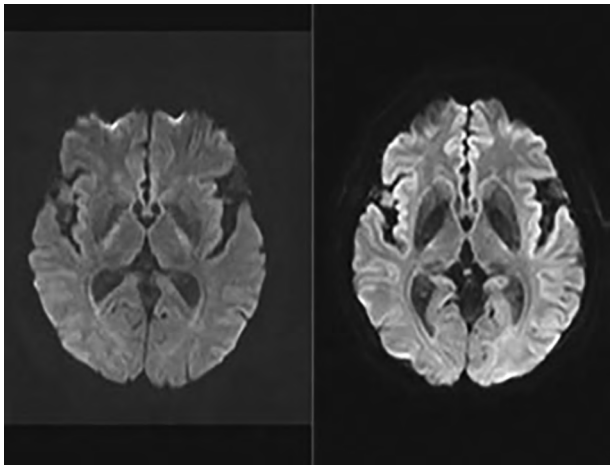
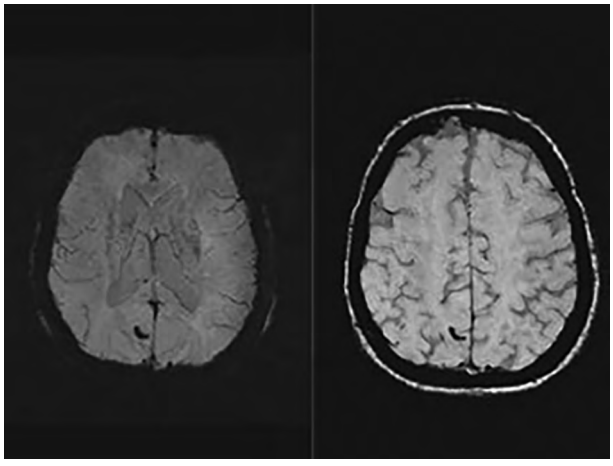


Figure 4: above the ceiling of the lateral ventricles.



MRI disorders dizziness, disorders of balance, orientation in space Fig. 5 — 6.

A 72-year-old patient with disorders of the vestibular apparatus, dizziness, disorders of balance, orientation in space, distinguished between peripheral and central disorders on MRI.

Figure 5: MRI examination

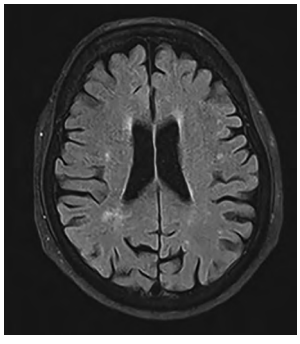
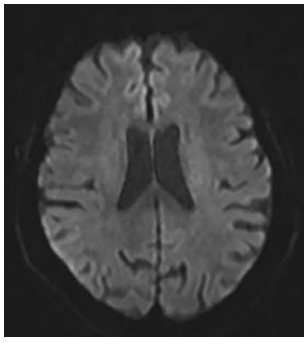


Figure 6: after 3 months of follow-up



A 83-year old patient with disorders of balance, disorders of sleep, anxiosity, after two vaccinacion and two atacs covid on repeated MRI examination distinguised on MRI.

Virtual reality

An important role is played by rehabilitation using virtual reality (Šramka et al, 2022; Masan 2020; Ružický et al. 2020; Ružický et al. 2022). Virtual reality, as one of the possible rehabilitation methods, creates emotional changes that motivate the patient to rehabilitate. The virtual environment has a direct impact on the quality of individual rehabilitation movements and exercises. (Ružický et al. 2021; Estiri et al. 2021; Filosto M. et al. 2020). Patients prefer a realistically processed 3D scene in which they can move comfortably and concentrate directly on the activity being performed (Varela-Aldá 2021). At the time of the pandemic crisis, telerehabilitation became an extremely useful tool for providing health care to patients.

The use of artificial intelligence in post-COVID-19 syndrome

Artificial intelligence can be used to predict the duration and consequences of the disease; machine learning algorithms were used to predict the consequences of COVID-19. Using artificial intelligence, they predicted the development of the pandemic based on records of infected patients and territories close to the development of the pandemic. In the treatment of the post-COVID-19 syndrome, parameters have been identified that can be measured to objectively assess the improvement of the patient‘s condition and to continue the personalization of individual rehabilitation scenarios. In patients who completed the combined rehabilitation method with virtual reality, progress was observed in the ability to improve breathing, motor skills of the limbs and also cognitive functions of the patients (Ružický et al. 2022, Lacko et al. 2023). In electronic healthcare, there is use of artificial intelligence. (Ruzicky et.al 2020; Šramka et al. 2021). Cohort studies are able to provide evidence within a broad patient population. The COVID-19 pandemic emphasized the need for fast methods, with a focus on public health, informatics. On the basis of several studies, a theoretical model was proposed on how to increase the engagement of people in the period of COVID-19 and after it (De-la-Calle-Durán et al. 2021). At the same time, methods do not sufficiently use the abilities of human thinking to solve problems that computers could not solve, just as the human brain is capable of making correct predictions. It is important to increase interest in new strategies and their combinations, to minimize the consequences of postcovid and postvaccination syndrome.

Compilation peer reviewed medical papers of covid vaccine injuries.

More than 1,000 peer reviewed medical articles on covid vaccine injuries to various medical journals evidencing a multitude of adverse events in covid −19 vaccine recipients. February 20, 2022.

Myocarditis. Includes terms: Inflammatory Heart Reactions & Myocardial. Inflammation of the heart muscle (myocardium). The inflammation can reduce the heart‘s ability to pump and cause rapid or irregular heart rhythms (arrhythmias). Signs and symptoms of myocarditis include chest pain, fatigue. shortness of breath, and rapid or irregular heartbeats. In a small percentage of cases persons with myocarditis can be at risk of sudden death following strenuous activity. Some sufferers of myocarditis may require heart surgery or a heart transplant later in life (**228** peer reviewed articles on covid vaccine injuries).

Thrombosis. Includes terms: Thrombotic & Thromboembolic & Thromboembolism. There are three categories of causes of thrombosis: damage to the blood vessel (catheter or surgery), slowed blood flow (immobility), and/or thrombophilia (if the blood itself is more likely to clot). (**150** peer reviewed articles on covid vaccine injuries).

Thrombocytopenia. A condition in which there is a lower-than-normal number of platelets in the blood. It may result in easy bruising and excessive bleeding from wounds or bleeding in mucous membranes and other tissues. (**116** peer reviewed articles on covid vaccine injuries).

Cerebral Venous Thrombosis. A type of stroke in which the venous channels of the brain become thrombosed. resulting in cerebral infarction in the areas corresponding to the thrombosis. (**61** peer reviewed articles on covid vaccine injuries). ***Vasculitis.*** Includes term: Microscopic polyangiitis. Inflammation of the blood vessels that causes changes in the blood vessel walls. When your blood vessel becomes weak, it might stretch and bulge (called an aneurysm). It might also burst open, causing bleeding. This can be life. threatening. **(43** peer reviewed articles on covid vaccine injuries).

Guillain-Barré Syndrome. A neurological disorder in which the body‘s immune system mistakenly attacks part of its peripheral nervous system-the network of nerves located outside of the brain and spinal cord. GBS can range from a very mild case with brief weakness to nearly devastating paralysis, leaving the person unable to breathe independently. Fortunately, most people eventually recover from even the most severe cases of GBS. After recovery, some people will continue to have some degree of weakness. (**43** peer reviewed articles on covid vaccine injuries).

Lymphadenopathy. Includes terms: Unilateral, Supraclavicular And Cervical. A disease affecting the lymph nodes where the sizes of the lymph can be affected. **(35** peer reviewed articles on covid vaccine injuries).

Anaphylaxis. *Includes term*: Anaphylactoid. A severe. potentially life-threatening allergic reaction. (**30** peer reviewed articles on covid vaccine injuries).

Myopericarditis. A complication of acute pericarditis, is characterized by extension of pericardia! inflammation to the myocardium, which manifests as an elevated troponin level. It is generally evaluated and treated as acute pericarditis. (**21** peer revewed articles on covid vaccine injuries).

Allergic Reactions. *Includes T*erm: Allergy. A condition in which the immune system reacts abnormally to a foreign substance. (**20** peer reviewed articles on covid vaccine injuries).

Bell's Palsy. *Includes Terms:* Facial Paralysis & Facial Palsy. An unexplained episode of facial muscle weakness or paralysis. It begins suddenly and worsens over 48 hours. This condition results from damage to the facial nerve (the 7th cranial nerve). Pain and discomfort usually occur on one side of the face or head. (**18** peer reviewed articles on covid vaccine injuries).

Axillary Adenopathy. Includes term: Adenopathy. Also called armpit lump. axillary lymphadenopathy occurs when your underarm (axilla) lymph nodes grow larger in size. While this condition may be concerning, it's usually attributed to a benign cause. It may also be temporary. (**18** peer reviewed articles on covid vaccine injuries).

Pericarditis. swelling and irritation of the thin, saclike tissue surrounding your heart (pericardium). Pericarditis often causes sharp chest pain and sometimes other symptoms. The chest pain occurs when the irritated layers of the pericardium rub against each other. (**15** peer reviewed articles on covid vaccine injuries).

Acute Myelitis. Includes Term Transverse Myelitis. An inflammation of the spinal cord which can disrupt the normal responses from the brain to the rest of the body, and from the rest of the body to the brain. Inflammation in the spinal cord, can cause the myelin and axon to be damaged resulting in symptoms such as paralysis and sensory loss. Myelitis is classified to several categories depending on the area or the cause of the lesion; however, any inflammatory attack on the spinal cord is often referred to as transverse myelitis. (**15** peer reviewed articles on covid vaccine injuries).

Perimyocarditis. An acute inflammation of the pericardium and the underlying myocardium resulting in myocellular damage. It is usually asymptomatic with complete resolution in most cases. It can however lead to fulminant cardiac failure resulting in death or requiring cardiac transplantation. (**10** peer reviewed articles on covid vaccine injuries).

Intracerebral Haemorrhage. Includes Term: Stroke. lntracerebral haemorrhage (bleeding into the brain tissue) is the second most common cause of stroke (15 — 30 % of strokes) and the most deadly. Blood vessels carry blood to and from the brain. Arteries or veins can rupture, either from abnormal pressure or abnormal development or trauma. (**8** peer reviewed articles on covid vaccine injuries).

Immune-Mediated Hepatitis. Defined as an elevation in the patient's liver function tests that requires corticosteroids and that has no alternate etiology. (**8** peer reviewed articles on covid vaccine injuries).

Facial Nerve Palsy. Patients cannot move the upper and lower part of their face on one side. (**6** peer reviewed articles on covid vaccine injuries).

Neurological Symptoms. Includes Terms: Neurological Side Effects & Neurological Complications. Medically defined as disorders that affect the brain as well as the nerves found throughout the human body and the spinal cord. (**6** peer reviewed articles on covid vaccine injuries).

Haemorrhage. Includes terms: cerebral. lobar. acral and retinal. The release of blood from a broken bloody vessel. either inside or outside the body. (**6** peer reviewed articles on covid vaccine injuries).

Immune-Mediated Disease Outbreaks. Autoimmune diseases occur when the immune system produces antibodies that attack the body's own cells. There are many types, including Coeliac disease, lupus and Graves' disease. Although they can't be cured, there are various treatment options to manage the symptoms and reduce further damage co your body. (**6** peer reviewed articles on covid vaccine injuries).

Takotsubo cardiomyopathy. A temporary heart condition chat develops in response to an intense emotional or physical experience. It's also known as stress cardiomyopathy or broken heart syndrome. In this condition, the heart's main pumping chamber changes shape, affecting the heart's ability to pump blood effectively. Death is rare, but heart failure occurs in about 20 % of patients. Rarely reported complications include arrhythmias (abnormal heart rhythms), obstruction of blood flow from the left ventricle, and rupture of the ventricle wall. (**5** peer reviewed articles on covid vaccine injuries).

Cardiac. Cardiac complications include myocardial injury, heart failure (HF), cardiogenic shock, multisystem inflammatory syndrome in adults, and cardiac arrhythmias including sudden cardiac arrest. (**10** peer reviewed articles on covid vaccine injuries).

Rhabdomyolysis. A serious syndrome due to a direct or indirect muscle injury. It results from the death of muscle fibers and release of their contents into the bloodstream. This can lead to serious complications such as renal (kidney) failure. This means the kidneys cannot remove waste and concentrated urine. In rare cases, rhabdomyolysis can even cause death. (**5** peer reviewed articles on covid vaccine injuries).

Thrombotic Thrombocytopenic Purpura. A disorder that causes blood clots (thrombi) to form In small blood vessels throughout the body. These clots can cause serious medical problems if they block vessels and restrict blood flow to organs such as the brain, kidneys, and heart. (**4** peer reviewed articles on covid vaccine injuries).

Cardiovascular events. Refer to any incidents that may cause damage to the heart muscle. (**4** peer reviewed article s on covid vaccine injuries).

Acute Hyperactive Encephalopathy. Includes Terms: Acute Encephalopathy & Encephalitis. A general brain dysfunction due to significantly high blood pressure. Symptoms may Include headache. vomiting, trouble with balance, and confusion. Onset Is generally sudden. Complications can Include seizures. Posterior reversible encephalopathy syndrome, and bleeding, the back of the eye. (**4** peer reviewed articles on covid vaccine injuries).

Acute Kidney Injury. A sudden episode of kidney failure or kidney damage that occurs within a few hours or a few days. (**3** peer reviewed articles on covid vaccine injuries) peer reviewed articles on covid vaccine injuries).

Multiple Sclerosis. A potentially disabling disease of the b rain and spinal cord (central nervous system). (**4** peer reviewed articles on covid vaccine injuries).

Henoch-Schonlein Purpura. Affects the small blood vessels of the skin, joints, intestines and kidneys. It‘s most common before the age of seven but can affect anyone. A disorder causing inflammation and bleeding in the small blood vessels. (**3** peer reviewed articles on covid vaccine injuries).

Bleeding Episodes. Major episodes include most joint bleeds. bleeding into large muscles. muscle bleeds with signs of compartment syndrome, life-threatening bleeds, and surgery. These usually require a 70 — 100 % correction and more than one infusion. The exact dose will depend on the individual and on HTC policy. (**3** peer reviewed articles on covid vaccine injuries).

Cutaneous Adverse Effects. Also known as toxidermia, are skin manifest at ions resulting from systemic drug administration. These reactions range from mild erythematous skin lesions to much more severe reactions such as Lyell's syndrome. (**3** peer reviewed articles on covid vaccine injuries).

Skin Reactions. An allergic reaction can cause rash. itching, burning, redness, bumps, hives, and swelling. (**9** peer reviewed articles on covid vaccine injuries).

Vogt-Koyanagi-Harada syndrome. A rare disorder of unknown origin that affects many body systems. including as the eyes, ears, skin, and the covering of the brain and spinal cord (the meninges). The most noticeable symptom is a rapid loss of vision. (**2** peer reviewed articles on covid vaccine injuries).

Capillary Leak Syndrome. Includes Term: Systemic Capillary Extravasation Syndrome. A rare disorder by acute and severe recurrent attacks associated with a rapid fall in blood pressure as a result of fluid leaks from smaller vessels called capillaries. Attacks often last several days and require emergency care. They are sometimes life threatening. SCLS occurs most often in adults and the disease is very rare in children. (**2** peer reviewed articles on covid vaccine injuries).

Systemic Lupus Erythematosus. An autoimmune disease in which the immune system attacks its own tissues, causing widespread inflammation and t issue damage in the affected organs. It can affect the joints, skin, brain, lungs. kidneys. and blood vessels. Treatment can help, but this condition can‘t be cured. (**2** peer reviewed articles on covid vaccine injuries).

Petechiae. Includes: Petechial rash. Tiny purple, red. or brown spots on the skin. They usually appear on your arms. legs, stomach, and buttocks. You might also find them inside your mouth or on your eyelids. These pinpoint spots can be a sign of many different conditions — some minor, others serious. They can also appear as a reaction to certain medications. Though petechiae look like a rash, they‘re actually caused by bleeding under the skin. (**2** peer reviewed articles on covid vaccine injuries).

Purpura Annularis Telangiectodes. An uncommon pigmented purpuric eruption, which is characterized by symmetrical, purpuric. telangiectatic. and atrophic patc2 hes with a predilection for the lower extremities and buttocks. (**2** peer reviewed articles on covid vaccine injuries).

Pulmonary Embolism. Pulmonary embolism is a blockage in one of the pulmonary arteries in your lungs. In most cases, pulmonary embolism is caused by blood clots that travel to the lungs from deep veins in the ~ or, rarely, from veins in other parts of the body (deep vein thrombosis). Because the clots block blood flow to the lungs, pulmonary embolism can be life-threatening. (**2** peer reviewed articles on covid vaccine injuries).

Psoriasis. A chronic autoimmune condition that causes the rapid buildup of skin cells. This buildup of cells causes scaling on the skin‘s surface. Inflammation and redness around the scales is fairly common. Typical psoriatic scales are

whitish-silver and develop 1n thick, red patches. Sometimes, these patches will crack and bleed. (**4** peer reviewed articles on covid vaccine injuries).

Nephrotic Syndrome. Kidney disorder that causes your body to pass too much protein in your urine. Nephrotic syndrome is usually caused by damage to the clusters of small blood vessels In your kidneys that filter waste and excess water from your blood. (**4** peer reviewed articles on covid vaccine injuries).

Bullous Drug Eruption. Refers to adverse drug reactions that result in fluid-filled blisters or bullae. Blistering may be localised and mild, or widespread and severe, even life-threatening. (**2** peer reviewed articles on covid vaccine injuries).

Hemophagocytic Lymphohistiocytosis. An aggressive and life-threatening syndrome of excessive immune activation. It most frequently affects infants from birth to 18 months of age, but the disease is also observed in children and adults of all ages. (**2** peer reviewed articles on covid vaccine injuries).

Pulmonary Embolism. Pulmonary embolism is a blockage in one of the pulmonary arteries in your lungs. In most cases, pulmonary embolism is caused by blood clots that travel to the lungs from deep veins in the legs or, rarely, from veins in other parts of the body (deep vein thrombosis). Because the clots block blood flow to the lungs. pulmonary embolism can be life-threatening. (**6** peer reviewed articles on covid vaccine injuries).

Blood Clots. A gelatinous mass oʿ fibrin and blood cells formed by the coagulation of blood. (**1** peer reviewed articles on covid vaccine injuries).

Thrombophilia. A blood disorder that makes the blood in your veins and arteries more likely to clot. This is also known as a hypercoagulable condition because your blood coagulates or clots more easily. (**1** peer reviewed articles on covid vaccine injuries).

iTTP episode. A rare, life-threatening thrombotic microangiopathy caused by severe ADAMTS13 (a disintegrin and metalloproteinase with thrombospondin, motifs 13) deficiency, recurring in 30 — 50 % of patients. (**1** peer reviewed articles on covid vaccine injuries).

Refractory Status Epilepticus. Can be defined as status epilepticus (seizures) that continues despite treatment with benzodiazepines and one antiepileptic drug. RSE should be treated promptly to prevent morbidity and mortality; however scarce evidence is available to support the choice of specific treatments. (**1** peer reviewed articles on covid vaccine injuries).

Central Serous Retinopathy. A medical condition where fluid builds up behind the retina in the eye. It can cause sudden or gradual vision loss as the central retina detaches. This central area is called the macula. (**1** peer reviewed articles on covid vaccine injuries).

Cutaneous Reactions. A group of potentially lethal adverse drug reactions that involve the skin and mucous membranes of various body openings such as the eyes. ears, and inside the nose, mouth, and lips. (1 peer reviewed articles on covid vaccine injuries).

Prion Disease. Prion diseases comprise several conditions. A prion is a type of protein that can trigger normal proteins in the brain to fold abnormally. Prion diseases or transmissible spongiform encephalopathles (TSEs) are a family of rare progressive neurodegenerative disorders that affect both humans and animals. They are distmguished by long incubation periods. Characteristic spongiform changes associated with neuronal loss, and a failure to induce inflammatory. (**1** peer reviewed articles on covid vaccine injuries).

Pregnant Woman. Characteristic spongiform changes associated with neuronal loss, and a failure to induce inflammatory. (**1** peer reviewed articles on covid vaccine injuries).

Process-Related Impurities. Characteristic spongiform changes associated with neuronal loss, and a failure to induce inflammatory. (**1** peer reviewed articles on covid vaccine injuries).

CNS Inflammation. A disease that causes inflammation of the small arteries and veins in the brain and/or spinal cord. The brain and spinal cord make up the CNS. Intense Interest in Inflammation In the CNS has arisen from Its potential role In diseases including acute brain Injury. stroke, epilepsy, multiple sclerosis. motor neurone disease, movement disorders and Alzheimer's disease, and more recently some psychiatric disorders. (**1** peer reviewed articles on covid vaccine injuries).

CNS Demyelination. A demyelinating disease is any condition that results in damage to the protective covering (myelin sheath) that surrounds nerve fibers in your brain. optic nerves and spinal cord. When the myel1n sheath is damaged. nerve impulses slow or even stop, causing neurological problems. (**1** peer reviewed articles on covid vaccine injuries).

Orofacial. An orofacial myofunctional disorder (OMO) is when there is an abnormal lip, jaw, or tongue position during rest, swallowing or speech. (**1** peer reviewed articles on covid vaccine injuries).

Brain Haemorrhage. Includes Term: Lobar Hemorrhage. An emergency condition in which a ruptured blood vessel causes bleeding inside the brain. (**1** peer reviewed articles on covid vaccine injuries).

Varicella Zoster Virus. The varicella-zoster virus 01N) is so named because it causes two distinct illnesses: varicella (chickenpox), following primary infection. and herpes zoster (shingles), following reactivation of latent virus. Varicella is a highly contagious infection with an incubation period of 10 — 21 days, most commonly 14 — 16 days, after which a characteristic rash appears. Acute varicella may be complicated by secondary bacterial skin infections, haemorrhagic complications, cerebellar is, encephalitis, and viral and bacterial pneumonia. (**1** peer reviewed articles on covid vaccine injuries).

Nerve and Muscle Adverse Events. Many different possible neurologic adverse events including encephalitis, myelopathy, aseptic meningitis, meningoradiculit is, Guillain-Barré like syndrome. peripheral neuropathy (including mononeuropathy, mononeuritis multiplex. and polyneuropathy) as well as myasthenic syndrome. (**1** peer reviewed articles on covid vaccine injuries).

Oculomotor Paralysis. Defines the decreased strength of a muscle, which produces a reduced rotational movement of the eyeball in the direction corresponding to the paralysed muscle. Partial deficit Is called paresis. while full deficit is called paralysis. (**1** peer reviewed articles on covid vaccine injuries).

Parsonage-Turner Syndrome. An neurological disorder characterized by rapid onset of severe pain in the shoulder and arm. This acute phase may last for a few hours to a few weeks and is followed by wasting and weakness of the muscles (amyotrophy) in the affected areas. (**1** peer reviewed articles on covid vaccine injuries).

Acute Macular Neuroretinopathy. A rare, acquired retinal disorder characterised by transient or permanent visual impairment accompanied by the presence of reddish brown, wedge-shaped lesions in the macula. the apices of which tend to point towards the fovea. (**1** peer reviewed articles on covid vaccine injuries).

Lipschutz ulcers (Vaginal ulcers). Acute genital ulceration, also known as "Lipschutz ulcers" or "ulcus vulvae acutum," is an uncommon, self-limited, non sexually transmitted condition characterized by the rapid onset of painful, necrotic ulcerations of the vulva or lower vagina. (**1** peer reviewed articles on covid vaccine injuries).

Amyotrophic Neuralgia. A disorder characterized by episodes of severe pain and muscle wasting (amyotrophy) in one or both shoulders and arms. Neuralgic pain is felt along the path of one or more nerves and often has no obvious physical cause. (**1** peer reviewed articles on covid vaccine injuries).

Polyarthralgia. Pain in multiple joints. Symptoms may include pain, tenderness. or tingling in the joints and reduced range of motion. Polyarthralgia is similar to polyarthritis, but it doesn't cause inflammation. Lifestyle changes, home remedies and medication can help manage the symptoms. (**1** peer reviewed articles on covid vaccine injuries).

Thyroiditis. The swelling, or inflammation, of the thyroid gland and can lead to over-or under-production of thyrod hormone. A thyroid storm-or thyroid crisis — can be a life-threatening condition. It often includes a rapid heartbeat, fever, and even fainting, Symptoms may include pain in the throat. feeling generally unwell swelling of the thyroid gland and, sometimes, symptoms of an overactive thyroid gland or symptoms of an under active thyroid gland. (**1** peer reviewed articles on covid vaccine injuries).

Keratolysis (Corneal Melting). A common prelude to the development of corneal perforation. This process occurs from conditions such as infections, sterile inflammation, or surgical/chemical injury to the cornea. Collectively, these conditions are a significant cause for blindness world-wide. (**1** peer reviewed articles on covid vaccine injuries).

Arthritis. The swelling and tenderness of one or more joints. The main symptoms of arthritis are Joint pain and stiffness. which typically worsen with age. The most common types of arthritis are osteoarthritis and rheumatoid arthritis. (**1** peer reviewed articles on covid vaccine injuries).

Thymic hyperplasia. A condition in which the thymus gland is inflamed. It is often accompanied by autoimmune diseases such as systemic lupus erythematosus, myasthenia gravis and rheumatoid arthritis. (**1** peer reviewed articles on covid vaccine injuries).

Tolosa-Hunt Syndrome. A rare disorder characterized by severe periorbita, headaches, along with decreased and painful eye movements (ophthalmoplegia). Symptoms usually affect only one eye (unilateral). In most cases. affected individuals experience intense sharp pain and decreased eye movements. (**1** peer reviewed articles on covid vaccine injuries).

Hailey-Hailey Disease. Also known as benign chronic pemphigus, is a rare skin condition that usually appears in early adulthood. The disorder is characterized by red, raw, and blistered areas of skin that occur most often in skin folds, such as the groin, armpits, neck. and under the breasts. (**1** peer reviewed articles on covid vaccine injuries).

Acute Lympholysis. The destruction of lymph cells. (**1** peer reviewed articles on covid vaccine injuries).

Interstitial Lung Disease. Describes a large group of disorders, most of which cause progressive scarring of lung tissue. The scarring associated with interstitial lung disease eventually affects your ability to breathe and get enough oxygen into your bloodstream. (**1** peer reviewed articles on covid vaccine injuries).

Vesiculobullous Cutaneous Reactions. A vesiculobullous lesion of the skin encompasses a group of dermatological disorders with protean clinicopathological features. They usually occur as a part of the spectrum of various infectious. inflammatory, drug-induced, genetic, and autoimmune disorders. (**1** peer reviewed articles on covid vaccine injuries).

Hematologic Conditions. Disorders of the blood and blood-forming organs. (**1** peer reviewed articles on covid vaccine injuries).

Hemolysis. The destruction of red blood cells. (**1** peer reviewed articles on covid vaccine injuries).

Headache. The destruction of red blood cells. (**1** peer reviewed articles on covid vaccine injuries).

Acute Coronary Syndrome. Any condition brought on by a sudden reduction or blockage of blood flow to the heart. (**1** peer reviewed articles on covid vaccine injuries). ***ANCA***

Glomerulonephritis. The term we use when ANCA vasculitis has affected or involved the kidneys, and when this happens there is inflammation and swelling in the kidney filters. meaning that the body‘s own immune system injures its cells and tissues. (**1** peer reviewed articles on covid vaccine injuries).

Neurologic Phantosmia. An olfactory hallucination perceived when no odorants are present. Both the olfactory distortions are typically described as unpleasant. (**1** peer reviewed articles on covid vaccine injuries).

Uveitis. Includes terms: bilateral. A form of eye, inflammation. It affects the middle layer of tissue in the eye waif (uvea). uveitis warning signs often come on suddenly and get worse quickly. They include eye redness. pain and blurred vision. (**1** peer reviewed articles on covid vaccine injuries).

Pathophysiologic Alterations. Deranged function in an individual or an organ due to a disease. For example, a pathophysiologic alteration is a change in function as distinguished from a structural defect. (**1** peer reviewed articles on covid vaccine injuries).

Inflammatory Myositis. Inflammatory myopathies are a group of diseases that involve chronic (long-standing) muscle inflammation, muscle weakness, and, in some cases. muscle pain. Myopathy is a general medical term used to describe a number of conditions affecting the muscles. All myopathies cause muscle weakness. (**1** peer reviewed articles on covid vaccine injuries).

Still‘s Disease. A rare type of inflammatory arthritis that features fevers, rash and joint pain. Some people have just one episode of adult Still‘s disease. In other people, the condition persists or recurs. This inflammation can destroy affected joints, particularly the wrists. (**1** peer reviewed articles on covid vaccine injuries).

Pityriasis Rosea. A skin rash that sometimes begins as a large spot on the chest abdomen or back. followed by a pattern of smaller lesions. (**1** peer reviewed articles on covid vaccine injuries).

Acute Eosinophilic Pneumonia. Is the acute-onset form of eosinophilic pneumonia. a lung disease caused by the buildup of eosinophils, a type of white blood cell, in the lungs. It is characterized by a rapid onset of shortness of breath. cough, fatigue, night sweats. and weight loss. (**1** peer reviewed articles on covid vaccine injuries).

Sweet‘s Syndrome. An uncommon skin condition marked by a distinctive eruption of tiny bumps that enlarge and are often, tender to the touch. They can appear on the back. neck. arms or face. Sweet‘s syndrome. also called acute febrile neutrophilic dermatosis, is an uncommon skin condition. (**1** peer reviewed articles on covid vaccine injuries).

Sensorineural Hearing Loss. Hearing loss caused by damage to the inner ear or the nerve from the ear to the brain. Sensorineural hearing loss is permanent. (**1** peer reviewed articles on covid vaccine injuries).

Serious Adverse Events Among Health Care Professionals. Hearing loss caused by damage to the inner ear or the nerve from the ear to the brain. Sensorineural hearing loss is permanent (**1** peer reviewed articles on covid vaccine injuries).

Toxic Epidermal Necrolysis. A life-threatening skin disorder characterized by a blistering and peeling of the skin. This disorder can be caused by a drug reaction-often antibiotics or anticonvulsives. (**1** peer reviewed articles on covid vaccine injuries).

Ocular Adverse Events. The majority of ocular immune-related adverse events (irAEs) are mild, low-grade, non-sight threatening. such as blurred vision, conjunctivitis, and ocular surface disease. (**1** peer reviewed articles on covid vaccine injuries).

Depression. A common and serious medical illness that negatively affects how you feel. the way you think and how

you act. Depression causes feelings of sadness and/or a loss of interest in activities you once enjoyed. (**1** peer reviewed articles on covid vaccine injuries).

Pancreas Allograft Rejection. When the body's blood cells identify the pancreas as foreign and begin mounting an army of cells to attack the transplanted organ. Although acute rejection can happen at any time. about 15 to 25 % of pancreas acute rejection occurs within the first three months after transplant. (**1** peer reviewed articles on covid vaccine injuries).

Acute Hemichorea-Hemiballismus. Hemiballismus is characterized by high amplitude. violent. fl1ng1ng and flailing movements confined to one side of body and hemichorea is characterized by involuntary random-appearing irregular movements that are rapid and non-patterned confined to one side of body. (**1** peer reviewed articles on covid vaccine injuries).

Alopecia Areata. Sudden hair loss that starts with one or more circular bald patches that may overlap. Alopecia areata occurs when the immune system attacks hair follicles and may be brought on by severe stress. (**1** peer reviewed articles on covid vaccine injuries).

Graves' Disease. An autoimmune disorder that causes hyperthyroidism. or overactive thyroid. With this disease, your immune system attacks the thyroid and causes it to make more thyroid hormone than your body needs. The thyroid is a small, butterfly-shaped gland in the front of your neck. Thyroid hormones control how your body uses energy. so they affect nearly every organ in your body-Even the way your heart beats. If left untreated, hyperthyroidism can cause serious problems with the heart bones, muscles, menstrual cycle, and fertility. During pregnancy, untreated hyperthyroidism can lead to health problems for the mother and baby. Graves' disease also can affect your eyes and skin. (**1** peer reviewed articles on covid vaccine injuries).

Cardiovascular Events. Incidents that may cause damage to the heart muscle. (**1** peer reviewed articles on covid vaccine injuries).

Metabolic Syndrome. A cluster of conditions that increase the risk of heart disease, stroke and diabetes. (**1** peer reviewed articles on covid vaccine injuries).

Eosinophilic Dermatosis. Eosinophilic skin diseases, commonly termed as eosinophilic dermatoses, refer to a broad spectrum of skin diseases characterized by eosinophil infiltratKln and/or degranulation in skin lesions, with or without blood eosinophilia. The majority of eosinophilic dermatoses he in the allergy-related group, including allergic drug eruption, urticaria. allergic contact dermatitis. atopic dermatitis, and eczema. (**1** peer reviewed articles on covid vaccine injuries).

Hypercoagulability. The tendency to have thrombosis as a result of certain inherited and/or acquired molecular defects. clinical manifestations of hypercoagulability can be devastating and even lethal. (**1** peer reviewed articles on covid vaccine injuries).

Neuroimaging Findings in Post COVID-19 Vaccination. The tendency to have thrombosis as a result of certain inherited and/or acquired molecular defects. clinical manifestations of hypercoagulability can be devastating and even lethal (**1** peer reviewed articles on covid vaccine injuries).

Urticaria. Allergic reaction. (**1** peer reviewed articles on covid vaccine injuries).

Central Vein Occlusion. A blockage of this vein that causes the vein to leak blood and excess fluid into the retina. This fluid often collects in the area of the retina responsible for central vision called the macula. When the macula is affected. central vision may become blurry. The second eye will develop vein occlusion in 6 — 17 % of cases. There's no cure for retinal vein occlusion. Your doctor can't unblock the retinal veins. What they can do is treat any complications and protect your vision. (**1** peer reviewed articles on covid vaccine injuries).

Thrombophlebitis. A condition in which a blood clot in a vein causes inflammation and pain. (**1** peer reviewed articles on covid vaccine injuries).

Squamous Cell Carcinoma. A slow-growing type of lung cancer. (**1** peer reviewed articles on covid vaccine injuries).

Chest Pain. A slow-growing type of lung cancer. (**1** peer reviewed articles on covid vaccine injuries).

Acute Inflammatory Neuropathies. Encompass groups of heterogeneous disorders characterized by pathogenic immune-mediated hematogenous leukocyte infiltration of peripheral nerves. nerve roots or both, with resultant demyelination or axonal degeneration or both. and the pathogenesis of these disorders remains elusive. (**1** peer reviewed articles on covid vaccine injuries).

Brain Death. Irreversible cessation of all functions of the entire brain, including the b rain stem. A person who is brain dead is dead. (**1** peer reviewed articles on covid vaccine injuries).

Kounis Syndrome. The concurrence of acute coronary syndromes with conditions associated with mast cell activation, such as allergies or hypersensitivity and anaphylactic or anaphylactoid insults that can involve other

interrelated and interacting inflammatory cells behaving as a ‚ball of thread'. (**1** peer reviewed articles on covid vaccine injuries).

Angioimmunoblastic T-cell Lymphoma. A type of peripheral T-cell lymphoma. It is a high grade (aggressive) lymphoma that affects blood cells called T cells. High grade lymphomas tend to grow more quickly than low grade lymphomas. NTL usually affects older people, typically around the age of 70, is typically aggressive with a median survival of fewer than 3 years. even with intensive treatment. (**1** peer reviewed articles on covid vaccine injuries).

Gastroparesis. A condition that affects the stomach muscles and prevents proper stomach emptying. (**1** peer reviewed articles on covid vaccine injuries).

Asthma. A condition in which a person's airways become inflamed, narrow and swell and produce extra mucus, which makes it difficult to breathe. Asthma can be minor or it can interfere with daily act JVit1es. In some cases, it may lead to a life-threatening attack. (**3** peer reviewed articles on covid vaccine injuries).

Safety Monitoring of the Janssen Vaccine. A slow-growing type of lung cancer. (**1** peer reviewed articles on covid vaccine injuries).

Myocardial Injury. Refers to the cell death of cardiomyocytes and is defined by an elevation of cardiac troponin values. It is not only considered a prerequisite for the diagnosis of myocardial infarction but also an entity in itself and can arise from non-ischaemic or non-cardiac conditions. (**2** peer reviewed articles on covid vaccine injuries).

Autoimmune Inflammatory Rheumatic Diseases. Rheumatic diseases are autoimmune and inflammatory diseases that cause your immune system to attack your joints, muscles, bones and organs. Rheumatic diseases are often grouped under the term "arthritis" — which is used to describe over 100 diseases and conditions. (**1** peer reviewed articles on covid vaccine injuries).

Neurological Autoimmune Diseases. If you have a neurological autoimmune disease, your immune system may be overly active and mistakenly attack healthy cells. These include central nervous system demyelinating disorders such as multiple sclerosis and neuromyelitis is optica, paraneoplastic, and other autoimmune encephalomyelitis and autoimmune inflammatory myositis and demyelinating neuropathies. (**1** peer reviewed articles on covid vaccine injuries).

Herpes Simplex Virus. A virus causing contagious sores, most often around the mouth or on the genitals. (**1** peer reviewed articles on covid vaccine injuries).

Conclusion

This review emphasizes the importance of a multidisciplinary approach to the proper treatment of postcovid and postvaccination syndrome in general and neuropsychiatric and musculoskeletal symptoms in particular. They show a call for risk management and specialist involvement that can potentially support the reduction of those presenting with postcoid and postvaccination symptoms. During the clinical follow-up of patients after COVID-19, there must be a multidisciplinary approach, also with the simultaneous use of artificial intelligence, to guarantee coherent, integrative and holistic care.

Prevention strategies must take into account the severity of the course of COVID-19, age, comorbidities and also gender, as women are more at risk of developing fatigue after COVID-19 and are also known for disorders such as anxiety, depression. The number of symptoms in the acute phase is also an important risk factor for the development of the syndrome after COVID-19, perhaps because this parameter could reflect the importance of the systemic response. In addition, systematic screening of neuropsychiatric symptoms in the acute phase of COVID-19 and targeting circadian dysfunction and encouraging physical activity in at-risk people could be effective ways to reduce neuropsychiatric symptoms after COVID-19.

All of these very promising strategies should be studied further. With reference to the high prevalence of post-covid and postvaccinations syndrome, their high disease burden and economic impact on the labor market and social security systems, a positive evaluation of the intervention, the detection of possible adverse consequences and subsequent implementation could be of great importance for mental and public health as well as economic importance. This review has highlighted several potential therapeutic strategies for post-covid and postvaccination symptoms that have emerged as a result of hypothesized mechanisms.

Most of them are far from routine clinical practice. Without any clinical trial and validation, however, these therapeutics remain hypothetical and should be investigated in further clinical trials. The hope that a multidisciplinary complex approach is effective in reversing some of the long-term consequences of not only the acute infection of COVID-19 but also the postcovid and postvaccination syndrome will bring useful results. We expect that the COVID-19 pandemic will further facilitate holistic and integrated systems of care for physical and mental health and provide a blueprint not only for the treatment of the post-covid and postvaccination syndrome, but also for the development and transformation of healthcare across all chronic, ongoing and long-term health conditions.

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Nervus terminalis – still an enigmatic cranial nerve

Nervus terminalis – stále záhadný hlavový nerv

Zora Haviarová [1)], Roman Kuruc [2)], Viktor Matejčík [3)]

[1)] Institute of Anatomy, Faculty of Medicine, Comenius University, Sasinkova 2, 81 372 Bratislava, Slovak Republic, zora.haviarova@fmed.uniba.sk, ORCID: 0000-0003-1583-6938
[2)] Institute of Forensic Medicine, Health Care of Surveillance Authority, Žellova 2, 82 924 Bratislava 25, Slovak Republic, ORCID: 0000-0002-5058-5356
[3)] Department of Neurosurgery, Faculty of Medicine and University Hospital, Comenius University, Limbová 5, 83 305 Bratislava, Slovak Republic, ORCID: 0000-0001-9051-4803

Contact adress: prof. Viktor Matejčík Ph. D.
Neurochirurgická klinika LFUK a UNB, Limbová 5, 833 05 Bratislava
e-mail: matejcik@pobox.sk

ABSTRACT

Introduction: Nervus terminalis is called "cranial nerve 0" or "thirteenth cranial nerve". Although it was also discovered in humans more than 100 years ago as a plexiform structure medial to the olfactory nerve, the exact place of its entry into the brain differs according to several authors.

Embryology: Evidence proved its presence along with the vomeronasal organ in parasagittal sections of 7-week-old (19-mm) human embryos.

Gross anatomy: Postnatally it presents as a nerve plexus medial to the olfactory bulbs with ganglia found on the dura of the crista galli.

Function and clinical significance: Likewise, its function is still unclear today: it is assumed that it modulates the activity of the olfactory epithelium.

Discussion and conclusion: Its course can complicate the outcome of endonasal endoscopic surgical procedures and access to the frontal sinuses. Some authors assume that it could be responsible for the spread of the SARS-Cov-2 virus to the brain.

Key words: terminal nerve, cranial nerve 0, course, clinical significance

ABSTRAKT

Úvod: Nervus terminalis sa nazýva „hlavový nerv 0" alebo „trinásty hlavový nerv". Hoci bol pred viac ako 100 rokmi objavený aj u ľudí ako plexiformná štruktúra mediálne od čuchového nervu, presné miesto jeho vstupu do mozgu sa podľa viacerých autorov líši.

Embryológia: Dôkazy preukázali jeho prítomnosť spolu s vomeronazálnym orgánom v parasagitálnych rezoch 7-týždňových (19 mm) ľudských embryí.

Makroskopická anatómia: Postnatálne sa javí ako nervová spleť mediálne od čuchového nervu s gangliami nachádzajúcimi sa na dura mater crista galli.

Funkcia klinický význam: Aj jeho funkcia je dodnes nejasná: predpokladá sa, že moduluje činnosť čuchového epitelu.

Diskusia a záver: Jeho priebeh môže skomplikovať výsledok endonazálnych endoskopických operačných výkonov a prístup do frontálnych dutín. Niektorí autori predpokladajú, že by mohol byť zodpovedný za šírenie vírusu SARS-Cov-2 do mozgu.

Klúčové slová: nervus terminalis, hlavový nerv 0, priebeh, klinický význam

Introduction

The nervus terminalis is also known as the "zero nerve" or the "N nerve" (nerve N), but sometimes as the cranial nerve thirteenth (CN XIII), to add it to formerly known 12 pairs of cranial nerves (López-Ojeda, 2022). It was first discovered in 1870 in sharks and other fish species. In 1905, it came to be classified as a terminal nerve (nervus terminalis) because in other species it was observed to extend into the lamina terminalis. More recent textbooks, published after 1987, classify this cranial nerve as the zero nerve, given that it is more rostral than the other cranial nerves. Even the most recent update of neuroanatomic terminology lists it as "cranial nerve 0", an English term: terminal nerve (FIPAT, 2017). Historically also other names were used for this newly discovered nerve: nerve of Pinkus, tractus olfactocommissuralis, new nerve, nerve nulla or cranial nerve 13 (Lopez-Ojeda, 2022). Although it was first officially mentioned in a work on human anatomy in 1945, it has rarely been mentioned in the medical literature since then. A probable reason for this may be that during anatomical dissection this nerve is severed when the dura is removed and cannot be found on subsequent examination. If, however, the pia mater remains intact, the nerve can be located between the olfactory peduncle and the rostral part of the optic chiasm. The nerve is attached to the pia mater by connective tissue (Bordoni, 2013).

Embryology

Like other cranial nerves (CNs), the embryological origin of nervus terminalis is a result of synergistic developmental interactions between the neural crest and sensory placodes. The formation of the terminal nerve (nervus terminalis, CN 0) occurs at the most ventral boundary of the migrating neural crest cells, the termination of the neural tube, and at the adenohypophyseal and olfactory placodes. So the embryological origin of the terminal nerve is similar to that of the rest of the human olfactory nerve structures (the olfactory nerves CN I, the olfactory bulbs, and the vomeronasal organ (VNO). It consists of one to two nerve bundles passing through the anterior end of the cribriform plate. Evidence suggests that these nerve fibres enter the brain along with the olfactory nerves and those of the vomeronasal processes at embryological stages 17 and 18 (i.e., Carnegie stages 17 and 18 of human embryonic development). A recent embryological study employing classical histological techniques reported the identification of the VNO and fibres of nervus terminalis in parasagittal sections of 7-week-old (19-mm) human embryos. An interesting feature of this nerve is its structural organization. In most species (including humans), the nerve is composed of axons expressing immunoreactivity to the decapeptide gonadotropin-releasing hormone (GnRH). The GnRH neuroendocrine cells and the nervus terminalis fibers mainly arise from the olfactory placode with neural crest contributions. However, the literature suggests that GnRH neurons may also arise from other embryological origins. GnRH neurons of the hypothalamus differentiate and develop from outside the diencephalon into the forebrain, following a migratory route out of the placodal epithelium that carries the central fibres of nervus terminalis (CN 0), combined with CN I and the VNO. Inappropriate embryological processes (i.e., inadequate migration and genetic mutations) may result in reproductive issues and other physiological disturbances, including anosmia in some cases. Currently, some of the factors modulating GnRH neuronal migration are known, but the exact mechanisms regulating the migratory processes remain inconclusive (López-Ojeda, 2022).

Gross anatomy

The nervus terminalis exists as a plexus medial to the olfactory bulbs with ganglia found on the dura of the crista galli (Figure 1). Branches then perforate the cribriform plate distinctly, but alongside branches of CN I, making it difficult to distinguish the two (Mohammad, 2023).

Figure 1. Axial schematic illustration of cranial nerve 0 at the level of the cranial base (Mohammad, 2023).

The nervus terminalis is one of the 5 systems innervating the nasal cavity, i.e., the terminal system, the vomeronasal system, the olfactory system, the septal organ, and the trigeminal system. The terminal nerve (nervus terminalis) is made up of plexiform fibres and several ganglia. In the nasal cavity (near the lamina cribriformis), its fibres are located near the vomeronasal nerve, medial to the olfactory nerve, and are distributed in the upper and anterior part of the nasal cavity (Peña-Melián, 2019). The nerve then

passes through the medial region of the stria olfactoria (i.e., medial to the substantia perforata anterior) and reaches the crista galli laterally via the gyrus rectus of the orbital surface of the lobus frontalis telencephali. It passes through the lamina cribriformis of the ethmoid bone more medially and deeper than the pathways of the olfactory nerve. The nervus terminalis is very thin in adults but is easily identifiable in the fetal stage. It has small ganglia with other as yet unidentified afferents, suggesting that it might have some residual function that would merit attention in diagnosis and treatment. The exact site of entry into the brain varies according to several authors: pedunculus olfactorius, trigonum olfactorium, septal nuclei and precommissural region, nucleus hypothalamicus supraopticus or in the hippocampal region (Bordoni, 2013).

In a single cadaver dissection (performed by Mohammad, 2023), the nerve was identified over the posterior planum entering the nasal cavity at the approximate location of the planum above the posterior septum in the region of the sphenoid rostrum (Figure 2 and 3). This area places the nerve at risk of injury during sphenoidotomy with the removal of the rostrum, as occurs with some pituitary and skull base surgery (Mohammad, 2023).

Figure 2. Sagittal illustration of cranial nerve 0 in the sinonasal cavity (Mohammad, 2023).

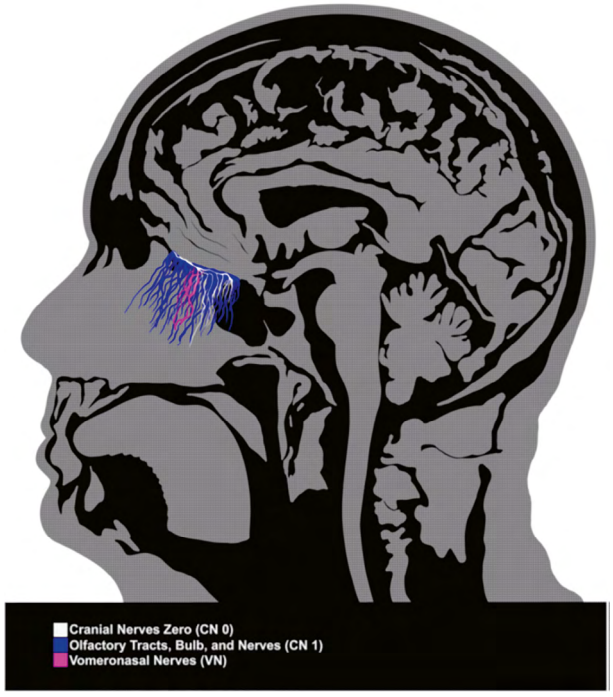
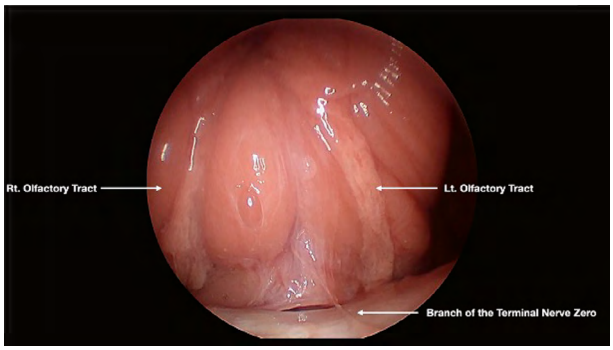


Figure 3. Intracranial endoscopic photograph of cranial nerve 0 seen arising off the brain at the level of the planum sphenoidale (Mohammad, 2023).



In the anterior region of the lamina cribrosa of the ossis ethmoidalis, the nervus terminalis usually passes through its own opening, the so-called "ethmoidal slit". In addition to the ganglionic unmyelinated fibres of the nervus terminalis, this opening contains the thick dura mater encephali and the tissues of the arachnoidea mater telencephali (Figure 4 and 5). Structures passing through this opening can complicate the outcome of endonasal endoscopic surgical procedures (complication rates vary from 0.5 % to 4.0 %) and can be as high as 11 % in frontal sinus endoscopic procedures because of damage to the lamina cribriformis. Bone thinness and poor knowledge of the anatomy of the lamina cribrosa region are usually the main causes of such injuries (Roussel, 2019).

Function, clinical significance

More than 100 years after its discovery, the function of the terminal nerve is far from completely clear (Singh, 2020).

While it is closely associated with CN I, it is distinct anatomically, and functionally it has been confirmed distinct in other mammals. As an example, the nerve has been well-described in whales, however, whales have no CN I and no sense of smell. In humans, nervus terminalis appears to be tied into the hypothalamic kisspeptin (KP) neuronal network. The KP neural network is involved in sexual development and human reproduction by inducing gonadotropin-releasing hormone (GnRH) from the hypothalamus. This suggests a possible pheromone function for the terminal nerve, which has not been confirmed. However, in other animals, the evidence is strong as cutting the nerve in male hamsters has been shown to result in sexual dysfunction with decreased mating (Mohammad, 2023).

The current view is that the nervus terminalis should modulate the activity of the olfactory epithelium, making pheromones more detectable. Researchers hypothesize that the nervus terminalis may trigger hormonal responses, independently or together with other neuroanatomical circuits such as the

Figure 4. Lamina cribrosa. Endocranial (left) and endonasal (right) view of frontal part of lamina cribrosa (os ethmoidale) and its openings (Roussel, 2019).

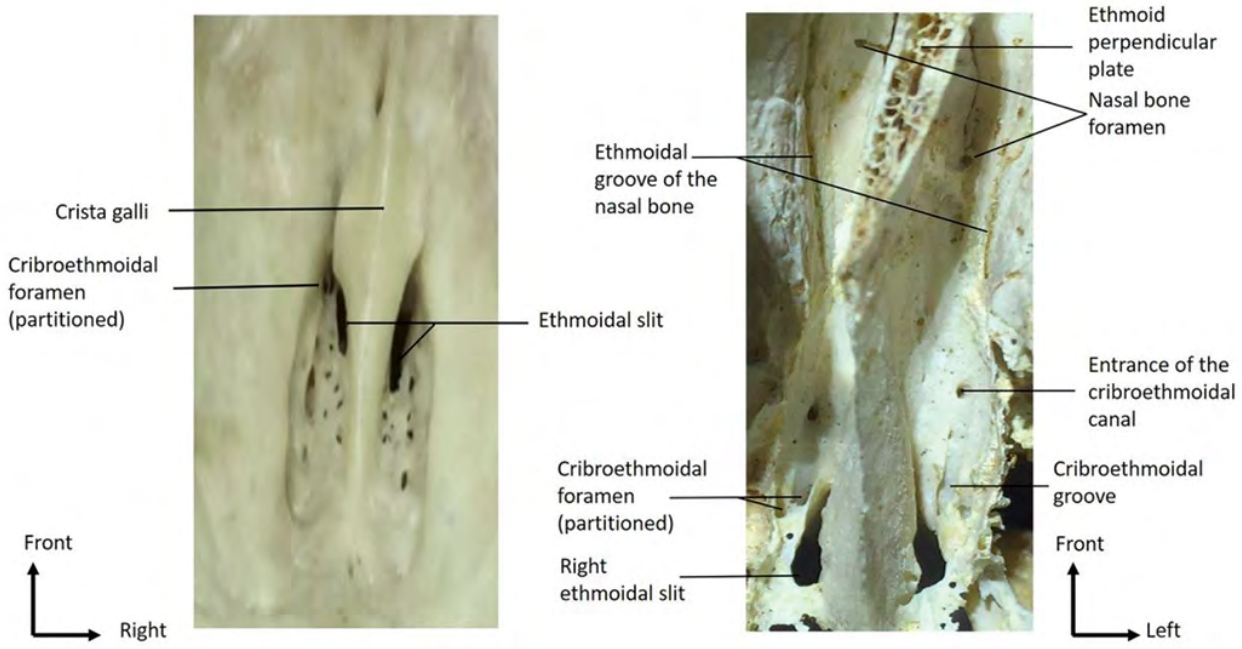
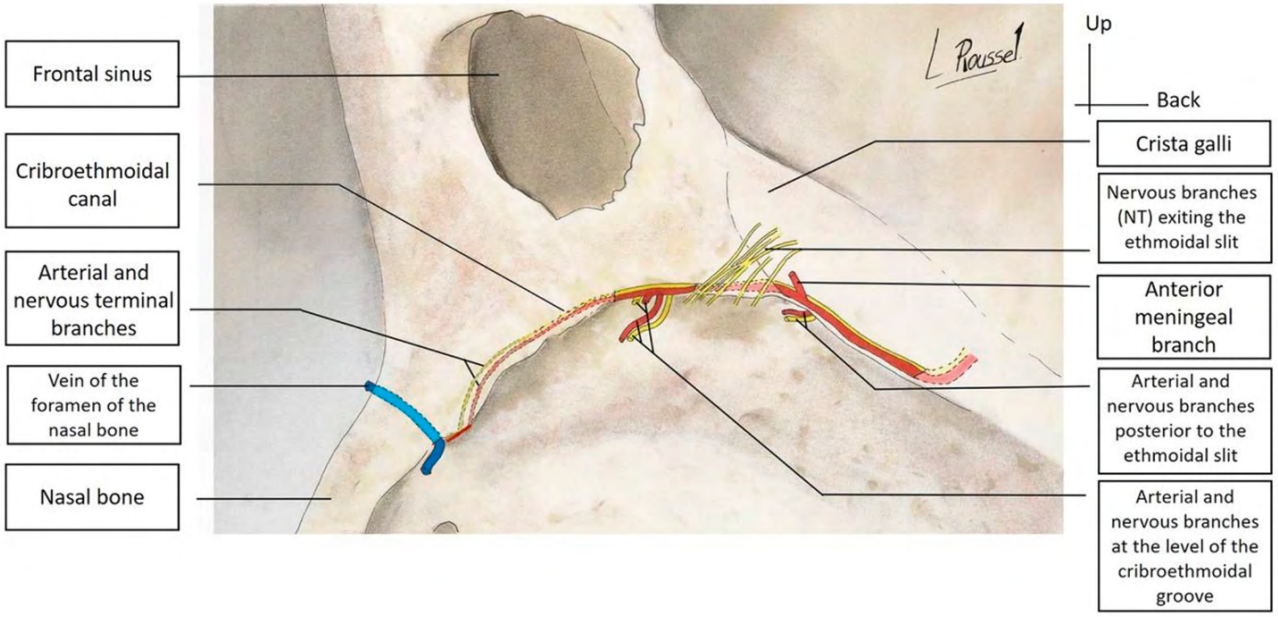


Figure 5. Sagittal view showing the branches of nervus et arteria ethmoidalis anterior in their relation to sinus frontalis and "ethmoidal slit". NT = nervus terminalis (Roussel, 2019).



abovementioned kisspeptin nerve network. In females, these cells are mainly localized in the preoptic area and in the infundibular regions of the hypothalamus, which represents an important sexually dimorphic trait with considerable clinical significance (Peña-Melián, 2019). In addition (as mentioned above), the nervus terminalis is involved in the release of GnRH from the hypothalamus, which plays an important role in gonadal development and possibly in the odour-mediated sexual behaviour of the individual (Singh, 2020).

Discussion and conclusion

The terminal nerve has also gained importance in the context of the recent COVID-19 (SARS-Cov-2) pandemic. Some authors believe that it might be the nervus terminalis rather than the olfactory nerve, whose neurons could be the most direct route of viral spread from the nasal epithelium (presumably via innervation of Bowman's glands = the olfactory glands under the epithelium of the nasal mucosa regio olfactoria) to targets in the brain (involving both the telencephalon and diencephalon) However, this possibility (documented in mice) should also be confirmed in a more appropriate animal model or human tissue (Bilinska, 2021).

Although direct evidence is still missing, the described facts suggest possible abnormalities in sexual development following possible CN 0 damage during sinus or skull base surgery in humans. With the evidence that the nerve is functionally tied into neural networks involved with sexual development and GnRH release from the hypothalamus, the chance of sexual dysfunction with injury appears possible. The neurosurgeons and rhinologists should be aware of this possibility (Mohammad, 2023). We hope that this mysterious cranial nerve will still receive enough scientific attention to help unravel the confusion surrounding it.

Conflict of Interests
All the authors declare, that they do not have any conflict of interest.

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Book Review: Peculiarities of the Autonomic Nervous System by Matejčík V., Haviarová Z. and Kuruc R.

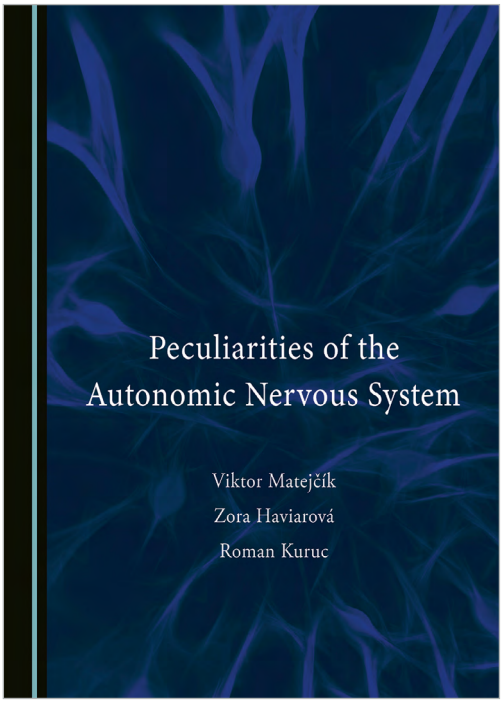
Recenzia knihy: Peculiarities of the Autonomic Nervous System autorov Matejčík V., Haviarová Z. a Kuruc R.

Miron Šrámka [1)], **Štefan Durdík** [2)]

[1)] Clinic of the Stereotactic Radiosurgery, St. Elisabeth's Oncological Institute, Bratislava, Slovak Republic
[2)] Department of Oncological Surgery, St. Elisabeth's Oncological Institute, Bratislava, Slovak Republic

Contact adress: prof. MUDr. M. Šrámka, DrSc.
Clinic of the Stereotactic Radiosurgery, St. Elisabeth's Oncological Institute, Heydukova 10, 812 50 Bratislava, Slovak Republic
e-mail: msramka@ousa.sk

At the beginning of February 2023 Cambridge Scholars Publishing (a British academic publishing house) issued an interesting book (monograph): **"Peculiarities of the Autonomic Nervous System",** written by three Slovak authors: Prof. Matejčík Viktor, doc. Haviarová Zora and Dr. Kuruc Roman.



This book was written with the aim of making it easier for students and physicians to understand the complexity of the peripheral nervous system, including the autonomic system, in relation to diagnosis and treatment. It can be an illustrative addition to undergraduate education for students and postgraduate education for physicians.

It is based on the specific professional experience of the authors and is a supplement to previous monographs on the variability of the peripheral nervous system. The structure of the autonomic nervous system, due to its unpredictability, can sometimes be perceived as very complex, sometimes as unsolvable. Writing solutions in the form of some mathematical expression or formula is impossible. We have to reconcile with a serious fact: sometimes we know the laws that govern the observed system, laws are also very simple; nevertheless, it is impossible to determine what the next development of the system will be. Even behind the seemingly complex beauty of nature, it is necessary to look for the repetition of simple rules. It turns out that natural creations, including body structure, in many cases resemble a fractal approach.

The book includes five main chapters, along with the introduction, conclusion, lists of abbreviations, figure legends, and references, and is equipped with more than 190 figures and schemes. The first chapter is a general part. The standard anatomical description, course, and deviations of ANS formation are contained in the second and third chapters of this book.

The second chapter deals mainly with the construction and structure of the peripheral autonomic nervous system and its variations, providing details on:

- vertebral part of the autonomic nervous system, describing
  - differences in the construction of the cervical section of the sympathetic trunk (right side)

  - differences in the construction of the cervical section of the sympathetic trunk (left side)
  - differences in the construction of stellate ganglia
  - differences in the construction of the thoracic section of the sympathetic trunk (from right)
  - differences in the structure of the thoracic section of the sympathetic trunk (from left)
  - differences in the structure of the lumbar section of the sympathetic trunk (from right)
  - differences in the structure of the lumbar section of the sympathetic trunk (from left)
  - differences in the construction of the sacral section of the sympathetic trunk.

and then focusing on

- anastomoses of the sympathetic trunk with spinal nerves, with details about
  - anastomoses of the sympathetic trunk with spinal nerves in the cervical region
  - anastomoses of the sympathetic trunk with spinal nerves in the thoracic region
  - construction details of rami communicantes in the thoracic region
  - anastomoses of the sympathetic trunk with spinal nerves in the lumbar region
  - construction details of communicating branches (rr. communicantes) in the lumbar region
  - anastomoses of the sympathetic trunk with spinal nerves in the sacral region
  - construction details of communicating branches (rr. communicantes) in the sacral region

The third chapter describes the peculiarities of the prevertebral segment of the autonomic nervous system through detailed descriptions of

- anastomoses of vagus nerve and sympathetic trunk in the neck
- details of anastomoses of vagus nerve and sympathetic nerves in the neck
- details of the construction of visceral branches of the nerves of the sympathetic trunk
- nerves of the thyroid gland
- participation of vagus nerve in lung innervation
- anastomoses between vagus nerve and nerves of the sympathetic trunk in the lung region
- sources of upper cardiac branch formation
- sources of autonomic innervation of the heart
- variations in the structure of the coeliac plexus
- formation of the coeliac plexus
- forming level of splanchnic nerves;
- participation of the vagus nerve in innervation of the stomach
- innervation of the liver, its vessels and bile ducts
- anastomoses of nerves of the stomach with nerves of neighbouring organs
- anastomoses of the phrenic nerve with the nerves of the abdominal organs
- differences in the structure of the splenic plexus
- details of the structure of the splenic plexus and its participation in the innervation of other organs of the abdominal cavity.
- differences in the structure of the superior mesenteric plexus
- differences in the nerve supply of the vermiform appendix
- differences in the structure of the inferior mesenteric plexus
- innervation of the distal section of the colon
- differences in the structure of the renal plexus
- differences in the structure of the aortic plexus
- innervation of lesser pelvic organs in men
- innervation of lesser pelvis organs in women
- differences in the structure of the spermatic plexus

The fourth chapter deals with the influence of autonomic nervous system variations on the clinical picture by providing some thoughts on the importance of data in extreme types of the autonomic nervous system. And the fifth chapter mentions some physiological notes.

The unique feature of our book is the descriptions of various nervous connections and variabilities of the autonomic nervous system in almost all regions of the human body. We believe that this book will substantially deepen our understanding of the structure and functions of the vegetative nervous system in many regions of the human body. Knowledge of this is important and interesting to many medical specialists such as neurologists, neurosurgeons, spinal surgeons, thoracic and abdominal surgeons, anatomists/clinical anatomists, and medical students, but it should also be interesting for specialists in biomedicine, biology, natural sciences or others.

Prof. Šrámka Miron, MD, DSc. (Head of the Clinic of the Stereotactic Radiosurgery, St. Elisabeth's Oncological Institute, Bratislava, Slovakia):

A monograph of Prof. Matejéik is an attractive work in which the author provides in a practical and simple way the information necessary to deal with the morphological peculiarities of the peripheral autonomic nervous system.

It follows his earlier work on variations of the peripheral nervous system. It's written in detail, it is richly documented by drawings and diagrams. The extent is not large, but it represents a solid piece of science, not only in its subject matter but also in its conception and detailed processing. It is an essential benefit in understanding the full breadth of anatomical variations of the peripheral nervous system, which is unprecedented in literature. The author managed to produce an original publication suitable for both pre-and post-graduate education. It will doubtless serve as a source

of information for the fields of Anatomy, Neurosurgery, Neurology, but also Neurophysiology, Algesiology, Rehabilitation, Physiotherapy and other specialisations.

My opinion of the publication is positive. I am very pleased that our medical community is also, or above all, presenting itself with publishing activities. This increases the impact of medical science, but also of all our health care and, ultimately, of our country. I would very much like to have as many books like this as possible. It's an excellent editorial piece. I believe that this book will please many readers in both form and content.

Prof. Durdík Štefan, MD, PhD, MHA (Head of the Department of Oncological Surgery, St. Elisabeth's Oncological Institute, Bratislava, Slovakia):

The evaluated manuscript reaches a very good level, I propose to include it in the category of scientific monographs after its editorial processing. The manuscript is considered to be at a high professional and methodical level. The text is easy to understand, it represents a suitable interpretation of the study literature for students of medical faculties and also in the postgraduate education of doctors. It follows on from the author's previous monographs, which were highly praised by the professional community. The language level of the document meets the required criteria. The illustration material is well chosen. The professional terminology used is in accordance with valid standards. At the scientific, professional and didactic levels, it is comparable to similar works of domestic and foreign literature.

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Ergonomics and Safety of the Work Environment of ICU Nurses

Ergonomie a bezpečnost pracovního prostředí sester pro intenzivní péči

Dagmar Kalatova [1)], **Ansell lammert** [1)]

[1)] St. Elizabeth University of Health and Social Sciences, Bratislava, Slovak Republic; St. John Nepomucene Neumann Institute, Pribram, Czech Republic

Correspondence to: prof. PhDr. Dagmar Kalatova, PhD.
St. Elizabeth University of Health and Social Sciences, Bratislava, Slovak Republic; St. John Nepomucene Neumann Institute, Jiraskovy sady 240, 261 01 Pribram I, Czech Republic
e-mail: kalatovad@seznam.cz
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ABSTRACT

Introduction: in the current state of knowledge, there is a gap in research specifically focused on the ergonomics and safety of the work environment of nurses who work in anesthesia facilities, although ergonomic risks are well documented in other areas of health care. The aim of this study is both to identify the main ergonomic and safety risks in the working environment of nurses who provide anesthesia care, and to propose ways to solve them.

Methods: empirical research methods were used, including a non-standardized questionnaire and structured short-term observation. Data were collected from nurses working in anesthesiology departments, with an emphasis on their experiences with ergonomic and safety risks. The research also included an analysis of working conditions and the effect of the work environment on nurses. Compliance with the ethical principles of the research was ensured by the anonymity of the questionnaires. Statistical data was processed in MS Excel.

Results and discussion: the high prevalence of musculoskeletal symptoms among nurses is related to non-ergonomic working conditions, such as repetitive movements, and difficult-to-access work spaces. The existing work environment in anesthesia workplaces is often insufficiently ergonomically adapted, leading to an increased risk of health problems for nurses.

Conclusion: confirms the necessity of an increased focus on ergonomics in anesthesiology workplaces. It is important to modify the work environment to meet the ergonomic needs of nurses, which will reduce the risks to their health and increase the safety of the work environment. The research contributes to a better understanding of the specific needs of nurses working in anesthesiology workplaces and offers a basis for further research and development of intervention strategies in this area.

Key words: Anesthesia Care, Ergonomics, Working environment.

ABSTRAKT

Úvod: v současném stavu poznání existuje mezera ve výzkumu specificky zaměřeném na ergonomii a bezpečností pracovního prostředí sester, pracujících na anesteziologických pracovištích, ačkoli ergonomická rizika jsou dobře dokumentována v jiných oblastech zdravotní péče. Cílem práce je identifikovat hlavní ergonomická a bezpečnostní rizika v pracovním prostředí sester, poskytujících anesteziologickou péči, a navrhnout způsoby jejich řešení.

Metody: byly použity empirické metody zkoumání, zahrnující nestandardizovaný dotazník a strukturované krátkodobé pozorování. Data byla sbírána od sester, pracujících na anesteziologických pracovištích, s důrazem na jejich zkušenosti s ergonomickými a bezpečnostními riziky. Výzkum také zahrnoval analýzu pracovních podmínek a vliv pracovního prostředí na sestry. Dodržování etických principů výzkumu bylo zajištěno anonymitou dotazníků. Statistická data byla zpracovaná v MS Excel.

Výsledky a diskuse: vysoký výskyt muskuloskeletálních symptomů mezi sestrami souvisí s neergonomickými pracovními podmínkami, jako jsou opakované pohyby, a obtížně přístupné pracovní prostory. Stávající pracovní prostředí na anesteziologických pracovištích je často nedostatečně ergonomicky přizpůsobeno, což vede ke zvýšenému riziku zdravotních problémů u sester.

Závěr: potvrzuje nutnost zvýšeného zaměření na ergonomii na anesteziologických pracovištích. Důležité je upravit pracovní prostředí tak, aby odpovídalo ergonomickým potřebám sester, což povede ke snížení rizik pro jejich zdraví a zvýší bezpečnost pracovního prostředí. Výzkum přispívá k lepšímu pochopení specifických potřeb sester pracujících na anesteziologických pracovištích a nabízí základ pro další výzkum a vývoj intervenčních strategií v této oblasti.

Klíčová slova: anesteziologická péče, ergonomie, pracovní prostředí.

INTRODUCTION

Although surgical techniques are constantly evolving and improving thanks to the most modern technologies, the ergonomics of operating rooms and safety measures for medical personnel remain in an outdated state. Research indicates that standard "best practices" for ergonomics, set by industry regulations, are being seriously breached in many remote areas, posing a significant safety risk to workers. At the center of this issue are anesthesia providers, who often work in a very confined space that is adapted more to the surgeon's needs than those of the own. This environment is characterized by overcrowding with equipment, monitoring systems, electrical cables and other obstacles that complicate their movement and work. Although intensive care nurses' duties do not allow the prioritization of ergonomics and personal safety, poor ergonomic practices and repetitive movements lead to an increased risk of musculoskeletal disorders.

Given the challenges faced by the anesthesia team when working in a demanding and intensive environment, it is necessary to focus research on more ergonomic approaches. Such approaches are key to minimizing the symptoms of musculoskeletal disorders, increasing the overall safety of the work environment, and ultimately prolonging professional activity in the field of anesthesiology (Zacharova et al., 2021).

CURRENT STATUS OF THE PROBLEM INVESTIGATED

In a field study conducted by Szeto et al. (2002), an analysis of neck and shoulder posture in administrative workers was performed, combining data obtained using the Nordic Musculoskeletal Questionnaire (NSQ) and video recordings used to capture posture data. The study revealed that most subjects placed their visual displays at or slightly below eye level. The results indicated that subjects reporting neck pain showed increased neck tilt and flexion. Although the sample was limited to 16 participants, the detailed data collected for each individual strengthened the informative value of the study. A significant difference was found between symptomatic and asymptomatic groups in terms of acromion protraction deviation and evaluated data. Participants with current or past complaints of neck and shoulder discomfort showed greater acromion protraction compared to those without complaints ($p = 0.015$). The findings of this study led to the inclusion of neck motion in a data collection tool for future observations.

Bartnicka et al. (2015) observed that surgeons maintained a flexed neck position during open operations and an extended neck position during laparoscopic procedures. A study with 42 participants, of whom 90.48 % reported symptoms of musculoskeletal disorders, used surveys to assess symptoms of musculoskeletal disorders. The most common were symptoms of musculoskeletal disorders of the lumbosacral spine (71.43 %), followed by symptoms of musculoskeletal disorders of the cervical spine or neck (64.29 %). Video recordings and photos from various open surgeries were used to evaluate the ergonomic working conditions in the operating room. The combination of different data collection methods added weight to the study and allowed for the comparison of different musculoskeletal disorders. The goal of Bartnicka's study was to create a computerized system to support hospital

processes to improve ergonomics, so comparing results from multiple data points was useful for the purposes of this literature review.

In Iran, operating room nurses participated in an ergonomics survey conducted by Choobineh et al. (2010) using the Nordic Musculoskeletal Questionnaire (NMQ). The aim of this study was to determine the prevalence of musculoskeletal disorders and to propose intervention programs for their prevention or mitigation. In this cross-sectional study of 375 OR nurses, symptoms related to the lower back were the most commonly reported form of musculoskeletal disorders, with 60.6 % of respondents reporting them. The results of the study showed that there is a relationship between high perceived psychological demands and the prevalence of symptoms of musculoskeletal disorders. The researchers pointed out that the repetitive and physically demanding nature of the job contributes to the increased incidence of musculoskeletal disorders among nurses working in the operating room.

Davis and Hignett (2016) conducted a study focusing on the design of anesthesia rooms in the United Kingdom. The research included an ergonomic assessment of the sequence of events in 24 observations in three different anesthesia rooms, primarily used for regional block administration before transition to the operating room. The study highlighted the need for a variety of movements during induction of anesthesia and pointed out the impact of the size and setup of the workspace on these movements. Although the study examined a work environment other than a hospital, it contributed to the discussion about physical ergonomics in the anesthesia work environment.
In the initial stages of surgery, the operating theater is configured to facilitate patient transport into the room and placement on the operating table (Eichhosn, 2010). This role often falls to nurses, who take care of moving equipment and setting monitors according to the needs of the patient, the anesthetists, and the specific requirements of the given surgical procedure (Gaszynski, 2016). Research by Selvaggi and his team (2010) that focused on time and movement during ten breast augmentation surgeries showed that increased surgical time was often associated with delayed initiation of operating room activities and the equipment setup process. The main factors influencing this delay were the specific requirements for the layout of the operating theater and anesthesia protocols.

A study by Manser et al. (2007) aimed to improve realism in simulations by analyzing the activity patterns of the anesthesia team in operating theaters during two real operating cases and three simulation scenarios, using a structured system to observe and analyze their tasks. Data visualization revealed the distribution of activities over time. Multivariate analysis of variance was used to identify statistical significance, especially in the context of multiple activity tasks such as monitoring and manual handling.

A study by Manser et al. (2007) provided important insights into the activities of the anesthesia team, which are key for planning further observational studies. It emphasizes that while patient safety is a priority in the critical environment of the operating room, ensuring optimal safety conditions for care providers can significantly improve their ability to attend to patient care.

METHODOLOGY

The aim is to identify the main ergonomic and safety risks in the working environment of nurses at anesthesiology workplaces and to propose solutions for them.

To achieve the goal, empirical research methods (non-standardized questionnaire; structured short-term observation) were used to study in detail the ergonomic movements of nurses in their work environment, as well as to identify the safety risks associated with them.

A sample of anesthesia care providers (both general nurses without specialization and general nurses with specialization for intensive care) who provide anesthesia care was included in this study. The study lasted 9 days from 06. 09. 2023 to 01. 11. 2023 (6. 09. 2023; 13. 09. 2023; 20. 09. 2023; 27. 09. 2023; 4. 10. 2023; 11. 10. 2023; 18. 10. 2023; 25. 10. 2023; 01. 11. 2023). Data collection started at 7:15 a.m. and ended around 3:45 p.m.

Two tools were used for data collection: 1.) "Recording sheet for structured short-term observation"; 2.) "Questionnaire for research participants".

The "recording sheet for structured short-term observation" related to the anesthesia center and the type of general anesthesia used. This section was completed by the researcher prior to the start of the surgical case in the operating room, when the anesthesia work area was measured and the type of seating furniture for the nurses was recorded.

The questionnaire consisted of 17 questions. These questions sought both demographic information and personal experiences of participants in the field of ergonomics and workplace risks. The questions focused on the personal safety and health protection of the participants. Special emphasis was placed on the last two questions, which were open-ended and provided space for comments and other details from the respondents.

Statistical data was processed in MS Excel.

The study emphasizes the ethical treatment of human subjects, particularly measures to ensure their protection, and compliance with ethical principles.

The researcher refrained from influencing, interfering with, commenting on, or documenting patient care, medical history, demographic information, or other identifiers. All observations and conversations that did not form part of the observation instrument were considered confidential and private and were therefore not recorded or discussed. This study did not collect any personal identifiers or personal information.

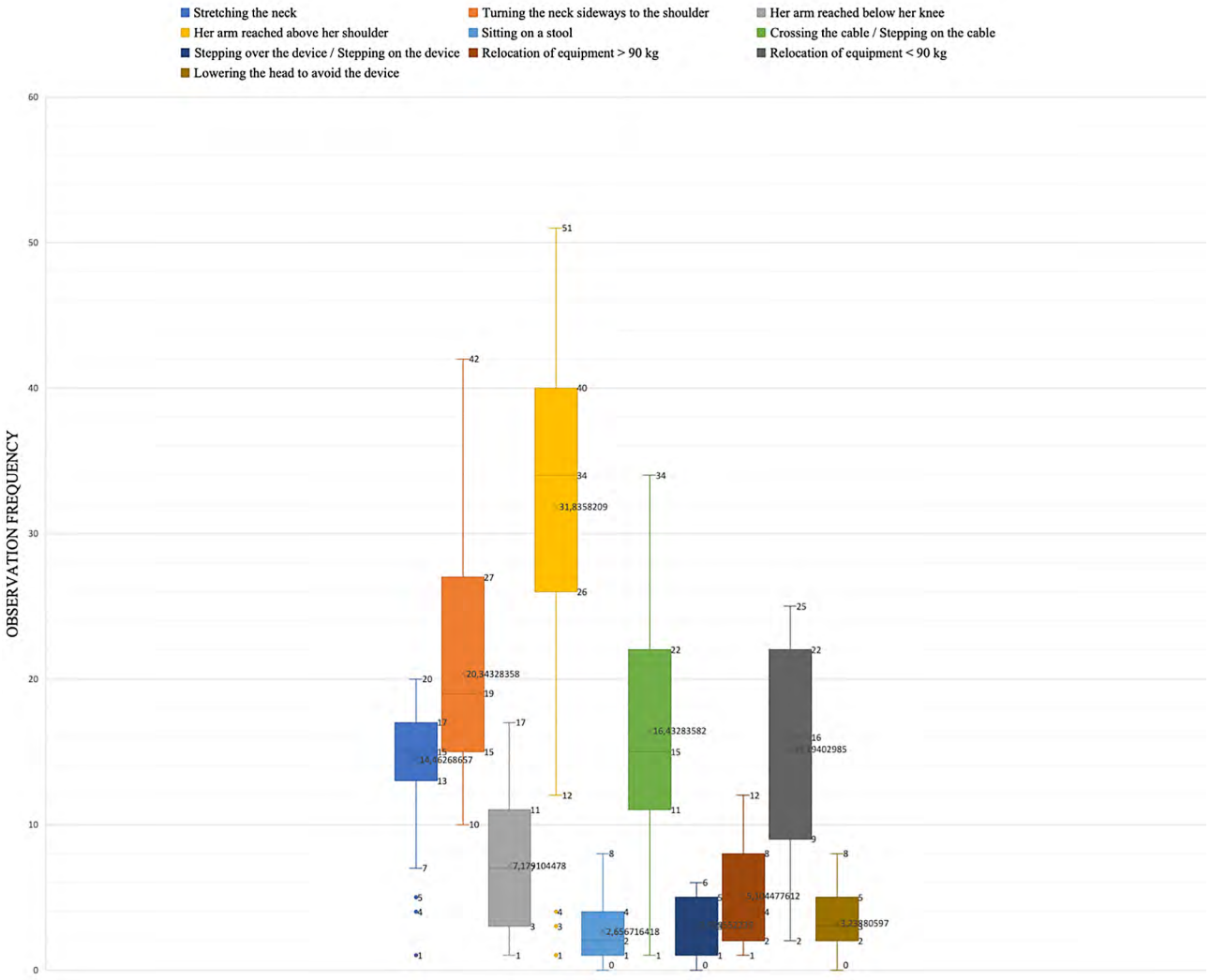
RESULTS

Data were collected over 9 days (6. 09. 2023; 13. 09. 2023; 20. 09. 2023; 27. 09. 2023; 4. 10. 2023; 11. 10. 2023; 18. 10. 2023; 25. 10. 2023; 01. 11. 2023). An information email was sent to all intensive care nurses exactly one week before the first day of data collection. Data obtained from both observation and questionnaire were included in the analysis. The results of both data collection methods are presented in this chapter.

A total of 68 anesthesia care providers (both general nurses without specialization and general nurses with specialization for intensive care) were selected to participate in both parts of the study — observation and filling out the questionnaire. The overall participation rate in both parts of the study — observation and completing the questionnaire — was 100 % [n =68].

The demographic profile of the participants showed that 93 % of them were female and 7 % were male. No participant withdrew from the research prior to completion of data collection. The average height of the participants was 1 m 70 cm ± 7.62 cm. The participant group included 89 % [n =61] general nurses with intensive care specialization and 11 % [n =7] general nurses without specialization. All participants reported providing anesthesia care for more than 40 hours per week, with 14 % [n =9] of nurses providing anesthesia care 20 — 40 hours per week and 86 % [n =59] of nurses providing more than 40 hours per week (by agreement on adjustment of

Chart 1 Observation of non-ergonomic repetitive movements and non-ergonomic obstacles.



working hours in accordance with § 83a and related provisions of Act No. 262/2006 Coll., Labor Code, as amended).

During the observation, the participants performed various repetitive movements. On average, they craned their necks 14.46 times to look at monitors or other devices placed above eye level. In addition, on average, they raised their arms above shoulder height 31.83 times, reached their arms below knee level 15.19 times, sat on a stool 3.23 times, and turned their necks to the side 20.34 times.

Chart 1 highlights the considerable variability in lateral neck rotation and arm reach above shoulder height. Correlation between participant height and frequency of arm reaching above the shoulders and below the knees was also examined using Pearson's correlation coefficient. The analysis revealed a slight negative correlation ($r = -0.477$, $p = 0.029$) between height and high arm reach, indicating that as the height of the participant increases, the number of observed incidents of high arm reach decreases.

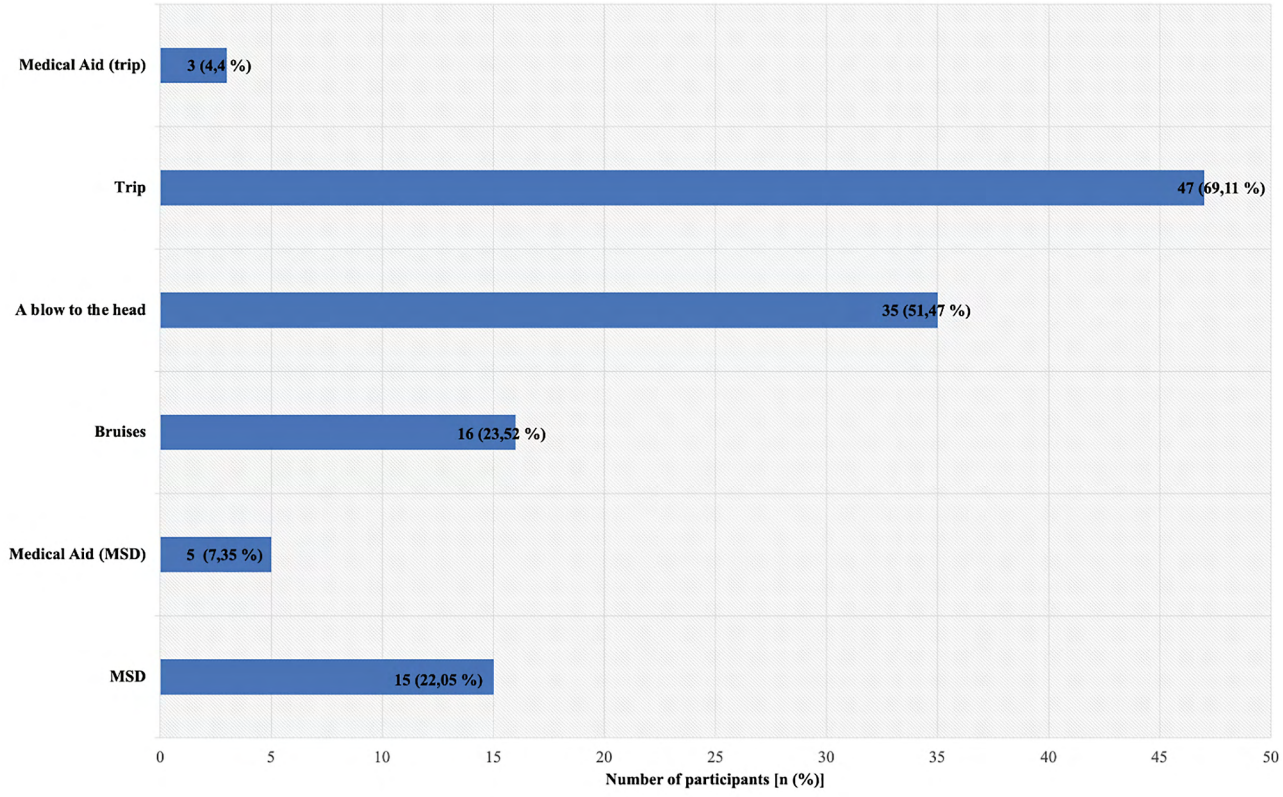
It was found that the hazard "Treading over/stepping on the cable" showed the highest mean and median frequency compared to the other observed non-ergonomic obstruction hazards. In contrast, the mean frequencies of the hazards "Stepping over/stepping on equipment", "Moving heavy equipment (more than 90 kg)" and "Bending head to avoid equipment" ranged from 3.08 to 6.0 times. This points to a marked difference in the frequencies of the various obstruction hazards, with "overstepping/stepping on the cable" occurring at a higher frequency than the other hazards observed.

Observations revealed that participants stepped or stepped on the cable an average of 16.43 times, which is marked by an "X" in Chart 1. The interquartile range of 11 to 22 times indicates that half of the participants performed this activity within this frequency range. Notably, the two significant outliers in the category "Exceeding/Treading the Cable" had a unique feature in common: both were recorded in cases using an operating theater MR scanning machine. In one case, 34 occurrences of "Trespassing/stepping on the cable" were recorded per individual case. The lowest frequency of this action in all observed cases was once per case.

The data also showed that, on average, participants were more likely to move devices weighing less than 90 kg. The average frequency of moving the lighter devices was ten times per case, with half of the participants performing this activity between 9 and 22 times per case. In contrast, the mean frequency of movement of heavier devices exceeding 90 kg was 19.19 per case, indicating a higher incidence of movement of heavier devices during the observation.

Participants were asked about their work experience, mainly musculoskeletal disorders, injuries leading to bruising,

Chart 2 Reported security concerns.



accidents involving blows to the head or tripping over obstacles.

The questionnaire focused on the safety issues of anesthesia care providers in the operating room, as highlighted in the last research question. Graph 2 presents the findings from the questionnaire. Participants were asked about work experiences, especially musculoskeletal disorders, bruises, accidents involving blows to the head and tripping over obstacles.

Participants had the option to choose from several options related to musculoskeletal disorders such as back pain, neck pain, wrist pain, muscle spasms in the arms or legs, or to indicate another condition. Chart 2 also shows the cases where participants sought medical help after a work-related injury. These questionnaire data provide an overview of the safety issues that nurses encounter in the work environment and highlight the prevalence of various issues and the need for medical intervention following workplace injuries.

In the questionnaire, all participants reported incidents of tripping in the operating room (69.11 %), with 51.47 % reporting incidents of hitting the head. Bruising was reported by 23.53 % of participants. Musculoskeletal disorders were reported by 22.05 % of participants.

Participants who reported any of the safety concerns were subsequently asked if they had sought medical attention. Of the 15 participants reporting musculoskeletal disorders, 7.35 % sought medical attention.

Although all participants acknowledged tripping incidents, only 4.4 % reported an injury and sought medical attention.

A comparison of mean heights was made between those who reported musculoskeletal disorders/injuries and those who did not. The mean height of subjects reporting head injury was 1.71 m, while those without head injury had a mean height of 1.63 m. Independent samples t-tests revealed no statistically significant difference in heights.

In the questionnaire, participants were asked to share their views on hazards and ergonomics in the operating room. These questions were open-ended and included: 1.) "What motion or ergonomic hazards do you think pose the greatest threat to your safety in the operating room?" and 2.) "How would you change your workspace to improve ergonomics and safety?" Responses to these questions were qualitatively analyzed and coded based on frequency. Despite their similarities, the two questions were analyzed independently.

For the first question regarding the biggest security threats, responses mentioning lanyards were grouped together. Examples include "stray cords" or "power cords". Responses such as "trip" or "tripping hazard" were not included because they did not specify the nature of the hazard. Among those surveyed, 57 % cited cables and wires as a major safety concern. Responses related to room space, size, or layout were also grouped together, e.g. "confined spaces" or "small operating room size." Approximately 43 % of participants cited workspace size as a problem.

In the following question, participants were asked to suggest changes to improve ergonomics and safety in the workplace. Answers mentioning cables or wireless solutions were categorized together, including suggestions such as "wireless monitoring", "cable reduction" or "cable management". A total of 67 % of participants suggested changes to cables and wires to improve ergonomics and safety. Responses related to room space, size, or layout, such as "more spacious" or "expanding the anesthesia work area," were also grouped. Approximately 74 % of participants believed that increasing the workspace would improve ergonomics and safety.

DISCUSSION

The analysis revealed the initial lack of system, lack of concept in the organization of anesthesiology workplaces. In addition to the main task of ensuring the safety of the patient, checking the important functions of the patient's body during the operation, the nurse has to solve many problems with the adaptation of the most modern equipment to poorly prepared spaces. For the effective operation of the purchased equipment, it is necessary to solve the issues of assembly, placement in the available space, connection to outdated energy sources, and the creation of reliable grounding systems.

The reluctance of nurses to perform technical functions and creatively organize their workplace is not the main reason. Unsatisfactory organizational decisions are primarily caused by the fact that, in the absence of adequate financial resources, the purchase and delivery of medical equipment is carried out unsystematically. Tenders, competitions and auctions, which are organized as a competitive form of selection of proposals for supplies, are mostly formal in nature. As long-term experience shows, the prices of medical equipment are often inflated and tenders are won by companies that have a strong lobby at many levels. Administration representatives, who are direct participants in the selection process, base their decisions only on the price of the lot, without taking into account the most important parameters, such as the quality of the purchased equipment, interchangeability, comparability with existing equipment, the price of consumables, the cost of service, repairs, the necessity of connection to specific spaces, electricity sources, water supply, medical gases, vacuum systems. The spaces planned for the operation of the equipment usually have insufficient areas, the necessary power systems are often missing, or they have insufficient capacity.

The area around the operating table and anesthesia station is literally tangled with electrical cables, ground wires and gas hoses. Next to a modern expert-class device, there may be a device whose production was discontinued half a century ago. Unthought-out, irrational placement of medical equipment creates considerable inconvenience for nurses, who are forced to constantly move complex medical equipment from one workplace to another, due to the lack of a sufficient number of necessary devices. At the same time, there is plenty of other, often outdated, equipment in the operating rooms. In such conditions, the operation of a modern, most desirable medical facility is inevitably complicated by frequent mechanical breakdowns, emergency situations during the transfer of the patient to the operating room, during surgery and the transfer of the patient from the operating room to the intensive care unit.

This study aimed to understand the ergonomics of the work environment of intensive care nurses in the operating room. To our knowledge, this topic has not been extensively explored in recent research. Although there are some studies focusing specifically on anesthesiologists and ergonomics, they did not address the same questions as this study.

The results showed that lateral rotation of the neck and extension of the arm(s) above shoulder level were the most frequently observed repetitive movements. During the short observation period, an average frequency of 20.34 occurrences of lateral neck rotation and 31.83 occurrences of extension of the arm(s) above shoulder level was recorded. These frequencies can escalate over the extended period of time of a surgical case in the operating room, potentially leading to muscle strain and musculoskeletal disorders over years of practice.

Anesthesia providers often have to rotate their heads between the operating field, the patient, the monitors, and the anesthesia machine. The placement of patient monitors and other displays often does not meet the recommended parameters of the field of view (0 — 30°). A study by McIntyre (1982) found that 30 of 32 anesthesia care providers preferred a more comfortable position for viewing information on the monitor than was actually possible. Awkward placement of monitors and displays that require close observation by anesthesiologists likely contributes to frequent and repeated lateral rotation of the neck. Studies confirm that workers performing repetitive tasks face an increased risk of work-related musculoskeletal disorders.

In a study by Szeto et al. (2002) found that the most commonly perceived factor associated with neck pain symptoms among practicing surgeons was uncomfortable posture. This study, which focused on general surgeons, serves as a valuable point of comparison for current research focusing on a different group of healthcare professionals in the operating room. A parallel study by Kumar, Mor, and Narayan examined x-ray techniques and identified significant upper extremity problems related to shoulder and arm movements. These technicians often perform tasks similar to those performed by anesthesia providers, including reaching above shoulder level, reaching in front of the body, and twisting the arms.

Contrary to the results of a recent study by Kumar and colleagues (2004), our findings show that low back pain is the most commonly reported musculoskeletal condition, with neck pain coming in second. This discrepancy may be due to slight differences in normal work practices when handling the equipment. X-ray technicians often move heavy equipment between patients, while anesthesiologists usually make subtle adjustments in preparing a patient for the operating room.

Our study noted a significant prevalence of neck pain (65 %) and back pain (71 %) among respondents. This high incidence of self-reported neck pain correlates with the observation of frequent lateral rotation of the neck, a common movement in critical care nurses. These findings are consistent with existing literature documenting a high prevalence of neck and back pain among healthcare workers.

While the observed frequency of handling devices weighing more than 90 kg in nurses was relatively low (less than 3.23 times), it is critical to recognize the potential consequences of this repetitive action. Although this movement is rarer compared to other frequent movements, moving heavy equipment can have significant implications for musculoskeletal health.

Scientists generally agree that tasks requiring frequent movements of the upper limbs can lead to unnatural neck and shoulder alignment, which contributes to the development of musculoskeletal disorders. As a result, repetitive movements performed by nurses, especially lateral rotation of the neck and reaching of the arms above shoulder level, are considered non-ergonomic and potentially risky. Future studies should pay special attention to these potential risk areas to improve the ergonomic aspects of the work environment for anesthesia care providers.

Another research survey focused on identifying non-ergonomic and obstructive hazards. Stepping on an electrical cable was found to be the most common incident (Szeto et al., 2009). This finding correlates with the results of the third research question, where tripping was the main safety concern among respondents. The average frequency of stepping on the cable during the observation was 16.43 times, and all participants in the questionnaire reported their own experience of tripping in the operating room. Although no tripping occurred during the observation, the current research highlights the potential dangers posed by electrical cables. Various studies point out that cables and hoses are

a significant contributor to tripping hazards in operating theatres, with 83 % of operating theater surgeons and nurses acknowledging their potential risk.

Notably, the two significant outliers in the non-ergonomic obstruction risk analysis shared a common element. Both cases involved surgical procedures in operating rooms where an MRI scanner was used, a relatively new addition to standard operating room equipment. The introduction of the MR scanner required nurses to disconnect and reconnect patients‘ ventilators, monitoring cables, and IV lines several times while moving patients from gurneys to the operating table. This process has been associated with an increased frequency of tripping or stepping on electrical cords.

Although statistical significance was not demonstrated, the data suggest a potential trend where the introduction of new equipment such as an MRI scan is associated with an increased frequency of tripping or stepping on cords. Further data collection is needed to investigate and confirm this hypothesized association.

The responses from the open-ended questionnaire provided important themes. The responses regarding the electrical cables resonated with the findings from the self-observation tool used in the study, even though the tool was not introduced to the participants beforehand. Results showed that 57 % of respondents identified cords as the primary threat to their safety in the operating room. In addition, two responses that did not use the terms “cord“ or “power cord“ but that could fall into the trip hazard category were excluded from the analysis. Even with this inclusion, a significant number of respondents expressed concern about electrical cables, highlighting the perception of this particular ergonomic risk among critical care nurses.

Although this was a major safety concern among survey participants, workspace size did not correlate with an increased frequency of non-ergonomic repetitive motions or obstruction risks in the study results. A small workspace can create feelings of claustrophobia, limit space for equipment storage and lead to frustration, especially in the context of the anesthesia team model. The study may not have examined the right variables affected by the small workspace, such as team collaboration problems (eg, general nurse with a specialty in critical care, a doctor with a specialist qualification in anesthesiology and intensive care medicine, a doctor without a specialist qualification under expert supervision). In emergency scenarios not captured by this observational project, the limited space for nurses (approximately 60x60 cm) could present a significant challenge. A study by Bartnicka et al. (2015), looking at ergonomics and working conditions in operating theaters, identified “confined workspace“ as a major environmental problem for workers in these environments. This finding is consistent with the current study, although the specific reasons for this concern remain unclear.

This study encountered a number of limitations that need to be addressed for the further development of this research area.

A limitation was the high level of activity during anesthesia procedures, which may have led to some actions of anesthesia providers being overlooked when documenting observed items.

The relatively small sample size may have limited data analysis and missed potentially significant findings. Nevertheless, the study gained reliability and consistency due to all observations being made by the same researcher. The researcher conducting the observations was experienced in anaesthesia, which may have led to some bias. Sampling bias may also have occurred because the participants were not randomly selected. The wording of some questions in the questionnaire may have led participants to report symptoms of musculoskeletal disorders.

The reduced observation time of each anesthesia care provider allowed more cases to be observed per day, but did not necessarily cover the entire duration of each case in the operating room. This limitation may have led to an underrepresentation of the maintenance phase of anesthesia in the data.

The lack of uniformity among surgical cases in the operating rooms was another limitation. Variability in induction and settings for different surgeries meant different patient positions, operating theater table configurations, and equipment settings could significantly influence the observed behavior. In addition, the mobile nature of the operating table and anesthesia machine contributed to this variability. In one case, the size of the anesthetic workspace changed after measurement by the researcher, highlighting a potential consideration for future studies to account for such changes during methodology planning.

The findings of this study shed light on potential ergonomic risks within the anesthesia workspace in the main operating theaters. While the study focused on specific hospitals, the concerns identified could likely be extrapolated to other anesthesia providers who face similar ergonomic and safety issues.. Shared repetitive motions, obstructive risks, and safety issues underline the importance of addressing ergonomics in anesthesia, an aspect that has historically been overlooked.

As highlighted earlier, the study revealed that most anesthesia providers experience ergonomic hazards and engage in non-ergonomic practices that can be corrected. Simple measures could be implemented, such as adjusting the position of the anesthesia provider to ensure a clear line of sight for

monitors, patients, or adjusting the height of equipment and monitors to reduce frequent reaching above shoulder level. In addition, electrical cables on the floor are covered with mats to reduce the risk of tripping. Education about ergonomics and the prevention of musculoskeletal disorders should be disseminated across health care disciplines, including anesthesia providers.

Despite the lack of statistical significance, clinical significance is evident in the increased incidence of non-ergonomic risks observed in operating room surgical cases involving an MRI scanner. This suggests potentially increased ergonomic risks whenever new equipment is introduced into the OR, particularly large and cumbersome devices such as MRI. Anesthesia care providers and all operating room staff should maintain a heightened awareness of ergonomic risks during changes in their routine patient care practices and be aware of the associated risks not only to provider safety but also to patient well-being.

In addition, the analysis identified a variety of musculoskeletal disorders reported among anesthesia providers, including back pain, neck pain, skin trauma, and injuries resulting in extremity bruising. Addressing this issue requires further research to determine effective solution approaches.

Several suggestions are offered regarding data collection methods that should be considered if this study were to be replicated. To facilitate comparison, it is recommended to align data collection tools for both observation and questionnaires. Rather than asking broad questions about trips or head injuries during the participant‘s career, questions can be narrowed down to elicit information about the most common non-ergonomic hazards encountered. Specificity in data collection tools, focusing on individual non-ergonomic repetitive motions or obstructive hazards, would allow for more accurate data and analysis. It is also recommended to adjust the language of the questions to minimize bias.

Expanding the population sample would increase the generalizability of the findings to a broader population of anesthesia care providers. Inclusion of other hospitals could reveal nuances related to ergonomics, such as problems associated with non-ergonomic chairs or stools. A larger sample size would also facilitate more robust statistical analyzes of both observational and questionnaire results.

Narrowing the selection of surgical cases to a specific specialty (eg, cardiac, orthopedic) would streamline data comparisons by reducing confounding differences in anesthesia care. Incorporating time measurements during observation would improve the ability to compare the frequency of repetitive movements and obstacles.

The study suggests that lateral rotation of the neck represents the dominant repetitive motion among nurses. In this context, future research should specifically investigate whether there is a correlation between this movement and symptoms of musculoskeletal disorders. It should be recognized that other activities performed by anesthesia providers, such as intubation and application of breathing masks, may contribute to neck pain.

Additionally, addressing the common ergonomic hazards identified in this study, such as inappropriately positioned cords and tripping hazards, should be the subject of implementation studies aimed at mitigating these issues. Implementation studies should also investigate non-ergonomic repetitive motions to reduce the need for lateral neck rotation or over-the-shoulder reaching. Post-implementation follow-up questionnaires should assess any reduction in the frequency of reported musculoskeletal disorder symptoms. Furthermore, research efforts should be directed at identifying specific barriers to effective ergonomics and increasing workplace safety in anesthesiology.

CONCLUSION

This study represents an initial survey aimed at increasing awareness of ergonomic risks in the anesthesia work environment. The results showed significant variability, which underlines the necessity of further research activities leading to the formulation of complex conclusions. The limited scope of existing research on safety and ergonomics for anesthesia providers should not be misinterpreted as an indication of its equally limited importance. On the contrary, it is evidence of the need for further research in this area.

The optimal organization of workplaces for specialists working in operating theaters would make it possible to increase the efficiency of work. In conditions of time shortages, it directly affects the timely, correct adoption of clinical decisions in emergency situations, typical for the functioning of any operating theater (critical in cases of emergency tracheal intubation, defibrillation during cardiac arrest, and timely blood compensation losses). In this situation, the loss of precious time searching for the absent devices, sockets, and connectors, and the readiness level of the team for work, can result in serious complications and, potentially, the death of the patient.

Although this work focused on the effects of poor ergonomics on anesthesia providers, it is clear that negative consequences for providers can also have negative effects on patient care. Given the serious findings of the work, quick intervention is recommended. Incorporating ergonomic education into anesthesiologist training programs could promote safe work practices and prevent the development of harmful work habits.

This study highlights a significant lack of understanding of ergonomics among anesthesia providers. It emphasizes the importance of raising awareness of ergonomics to increase workplace safety and reduce risks for healthcare workers. The main goal of the thesis is to improve the quality of anesthesiology as a profession by identifying and solving ergonomic problems found in the work of nurses. The conclusions point to significant problems in the ergonomics and safety of the work spaces of anesthesiology teams. Most nurses find their workplace uncomfortable and unsafe, resulting in difficult access to equipment, poor organization of the work space and lighting problems. Most of the interviewed experts emphasize the importance of improving these working conditions. The conclusions of the thesis emphasize the need to take measures to solve the identified problems, including improving equipment, adapting new technologies and ensuring staff training. Such changes could significantly improve the safety and efficiency of anesthetic procedures, as well as improve the overall working conditions of critical care nurses.

Improving conditions could lead to greater efficiency, safety and overall staff satisfaction, which would positively impact patient care. It is important to emphasize the need for continuous education and adaptation to new technologies to ensure optimal care and safety.

Conflict of interests:
The authors have no conflict of interests to declare.

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SPOLUPRÁCA POMÁHAJÚCICH PROFESIÍ
POĽSKO – ČESKO – SLOVENSKÉ ŠTÚDIE

Slovenská komora
sociálnych pracovníkov
a asistentov sociálnej práce

Vysoká škola zdravotníctva a sociálnej práce sv. Alžbety, n. o., v Bratislave
v spolupráci
so Slovenskou Komorou sestier a pôrodných asistentiek
a Slovenskou Komorou sociálnych pracovníkov
a asistentov sociálnej práce
a v spolupráci
s Sliezskou lekárskou univerzitou, Fakultou zdravotníckych vied
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