ТЕРАПІЯ ТА РЕАБІЛІТАЦІЯ

PHYSICAL THERAPY IN THE REHABILITATION OF PATIENTS FOLLOWING BREAST CANCER TREATMENT (LITERATURE REVIEW)

ФІЗИЧНА ТЕРАПІЯ ЯК СКЛАДНИК РЕАБІЛІТАЦІЇ ПАЦІЄНТОК ПІСЛЯ ЛІКУВАННЯ З ПРИВОДУ РАКУ ГРУДНОЇ ЗАЛОЗИ (ОГЛЯД ЛІТЕРАТУРИ)

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Abstracts

This article summarizes the current challenges, issues, and selected modern approaches to physical therapy in the rehabilitation of patients who have undergone specialized treatment for breast cancer (BC). BC is the most common malignant neoplasm (MN) among the female population worldwide, with approximately 2.296.840 new cases recorded in 2022. However, the implementation of breast cancer screening and improvements in diagnostic and therapeutic interventions have led to significantly high survival rates, with a five-year survival rate of approximately 81% in Europe. Despite these advancements, many breast cancer survivors experience a range of neuromuscular, musculoskeletal, pain-related, and functional disorders resulting from both the disease and its treatment. These challenges underscore the growing importance of rehabilitation measures to enhance quality of life and, to some extent, improve overall prognosis. The **aim** of this study was to examine, analyze, and summarize the current challenges and contemporary approaches to physical therapy in the rehabilitation of patients who have received specialized treatment for breast cancer. **Methods.** A search for relevant sources was conducted in the following databases: PubMed, Medline, Cochrane Library, Embase, BMJ Group, and Google Scholar. **Results.** Several barriers hinder the effective implementation of rehabilitation measures, including a lack of knowledge, limited access to care, and poor adherence to treatment regimens. A substantial body of evidence supports the benefits of incorporating range-of-motion exercises, aerobic activities, resistance training, and stretching, which have been shown to improve shoulder mobility and reduce pain without increasing the risk of lymphedema development or progression. Additionally, combined physical therapy interventions have demonstrated effectiveness in reducing upper limb swelling. **Conclusion.** The integration of physical rehabilitation programs into the clinical management of breast cancer patients is a crucial step toward ensuring optimal conditions for achieving maximum independence and the best possible quality of life. A multidisciplinary approach is essential to address the oncological, functional, and psychosocial needs of this patient cohort.

Key words: breast cancer, rehabilitation, physical therapy, quality of life.

У статті узагальнено актуальні проблеми, виклики та вибрані сучасні підходи до фізичної терапії у реабілітації пацієнток, що отримали спеціальне лікування з приводу раку грудної залози (РГЗ). РГЗ – найпоширеніше злоякісне новоутворення (ЗН) жіночого населення у світі: у 2022 році зареєстровано близько 2,296,840 нових випадків РГЗ. Водночас із упровадженням скринінгу патології грудної залози, підвищенням ефективності діагностично-лікувальних заходів вдалось досягнути доволі високих рівнів виживаності (п'ятирічна виживаність пацієнток із РГЗ становить близько 81% в Європі). У цієї когорти пацієнток нерідко спостерігається низка нервово-м'язових, кістково-м'язових, больових та функціональних розладів внаслідок як наявності РГЗ, так і його лікування,

що веде до підвищення уваги до заходів реабілітації з метою покращення якості життя, а також певною мірою і прогнозу у цих жінок. **Мета** цієї роботи – вивчити, проаналізувати та підсумувати актуальні виклики та сучасні підходи до фізичної терапії у реабілітації пацієнток, що отримали спеціальне лікування з приводу РГЗ. **Матеріал.** Пошук релевантних джерел здійснювався у таких базах даних: PubMed, Medline, Cochrane Library, Embase, BMJ Group та Google Scholar. **Результати.** Є низка бар'єрів на шляху до ефективного застосування реабілітаційних заходів: дефіцит знань, доступу та дотримання режиму лікування. Накопичено вагому доказову базу на користь того, що застосування вправ на діапазон рухів, аеробних вправ, вправ на опір і розтяжку демонструє позитивні ефекти, зокрема збільшення рухливості плеча та зменшення больового синдрому, водночас не підвищуючи ризику виникнення і/або прогресування лімфостазу. Натомість комбінована фізична терапія сприяє зменшенню набряку верхньої кінцівки. **Висновки.** Інтеграція програм фізичної реабілітації у клінічний шлях пацієнток із РГЗ є важливим кроком до створення належних умов для досягнення максимально можливої незалежності та найкращої якості життя. Для відповіді на онкологічні, функціональні та психосоціальні потреби цієї когорти пацієнток вкрай важливим є мультидисциплінарний підхід.

Ключові слова: рак грудної залози, реабілітація, фізична терапія, якість життя.

Introduction. Cancer rehabilitation is a process that helps patients achieve and maintain the highest possible level of physical, social, psychological, and professional functionality despite the challenges posed by malignant neoplasms (MNs) and their treatment [7]. While MNs inherently have the potential to impair function through tissue invasion and destruction, in some cases, functional limitations are more commonly caused by the treatment itself.

Therefore, cancer rehabilitation requires a multidisciplinary approach, incorporating pharmacological, psychological, and physiotherapeutic interventions, as well as occupational and functional therapy, tailored to the specific needs of each patient [12].

Breast cancer (BC) is the most common malignant neoplasm (MN) among the female population worldwide. According to the latest data from the International Agency for Research on Cancer (IARC) – an intergovernmental organization within the World Health Organization (WHO) – as part of the Globocan project, 2.296.840 new cases of BC were registered globally among women in 2022. This makes BC the leading type of newly diagnosed malignancies in this population cohort [15].

In Ukraine, according to data from the National Cancer Registry, 14.036 new cases of BC were recorded in women in 2021. This figure does not include data from Donetsk, Luhansk regions, the Autonomous Republic of Crimea, and the city of Sevastopol. In the structure of MN incidence among the female population of Ukraine, BC is ranked first, accounting for 22.2% of all cases [1].

Despite the persistently high global incidence of this malignancy, the widespread implementation of screening programs, along with advancements in diagnostic and treatment methods, has led to an increase in survival rates among BC patients, particularly in economically developed countries. For instance, the five-year survival rate for BC patients is 84% in the United States, 89.5% in Australia, 81% in Europe [4], 69.55% in Iran [2], 74% in Vietnam [18], 51.07% in Indonesia [20], 49.45% in Malaysia [3], and 66.1% in India [20].

However, BC survivors often experience a range of physical and psychological challenges that significantly impact their daily lives, work, and social interactions [10; 26]. These include various neuromuscular, musculoskeletal, pain-related, and functional disorders, which can arise both from the disease itself and as a result of its treatment [23].

Notably, almost 90% of BC patients can expect to develop one or more treatment-related side effects within six months post-treatment, while 62% of them continue to experience these effects even six years after treatment [7].

This undoubtedly increases the focus on rehabilitation interventions [25], aiming to improve the quality of life and, to some extent, the prognosis for this patient cohort.

Given the aforementioned factors, BC survivors have diverse rehabilitation needs driven by the variability of clinical scenarios. This under-

scores the necessity for individualized and personalized approaches to their recovery.

Thus, the aim of this study was to examine, analyze, and summarize the current challenges and selected modern approaches to the physical rehabilitation of patients who have undergone specialized treatment for breast cancer.

Materials and methods. This study utilized bibliosemantic and analytical methods. A search for relevant sources was conducted in the following databases: PubMed, Medline, Cochrane Library, Embase, BMJ Group, and Google Scholar. The search was performed using the following keywords: "breast cancer rehabilitation", "breast cancer physical rehabilitation", "breast cancer survivors", "cancer rehabilitation", "cancer-related impairments", "rehabilitation after breast cancer treatment".

Results. BC treatment options can include surgical interventions of varying scope, chemotherapy, radiation therapy, systemic therapy, biological therapy, and hormonal therapy, either individually or in combination.

Patients who undergo axillary lymph node dissection are at the highest risk of developing functional impairments in the arm and shoulder, including reduced range of motion, loss of strength, pain, lymphedema, and limitations in daily activities. Lumpectomy is also associated with functional limitations affecting everyday life. Additionally, radiation therapy and hormonal therapy are major risk factors for the development of chronic pain syndrome [17].

Beyond restricted mobility, pain, and impaired daily function, other common treatment-related symptoms include paresthesia, muscle spasms, and arthralgia. Pain syndrome has been reported in 12–51% of women 6 months to 3 years after BC treatment. The incidence of lymphedema varies widely (0–94%) due to differences in diagnostic methods and evaluation duration [9].

However, high-risk factors for lymphedema include: axillary lymph node dissection, radiation therapy targeting regional lymph nodes, taxane-based chemotherapy, higher body mass index (BMI), and cellulitis [12].

Conversely, patients with unaffected sentinel lymph nodes have a low risk of developing lymphedema [5].

Moreover, patients with metastatic BC experience more severe functional impairments, leading to greater rehabilitation challenges.

The causes of pain syndrome and functional disorders in BC patients can be classified into three main categories: neuromuscular, musculoskeletal, and lymphovascular.

Specific causes include postoperative pain, rotator cuff syndrome, adhesive capsulitis (frozen shoulder), arthralgia, cervical radiculopathy, brachial plexopathy, mononeuropathy, post-mastectomy pain syndrome, aromatase inhibitor-induced arthralgia, lymphedema, axillary web syndrome (cording), deep vein thrombosis (DVT), cellulitis, and others [8].

In a study by A.L. Cheville et al. (2008), which included a cohort of outpatient patients with metastatic BC undergoing chemotherapy, 92% of participants demonstrated some form of physical impairment. Even though 92% of these patients required physical rehabilitation, and 88% would have benefited from physical therapy and/or occupational therapy, only 30% of those needing rehabilitation services and 21% of those requiring physical therapy and/or occupational therapy actually received the necessary treatment [8].

The main barriers to the effective implementation of rehabilitation interventions include lack of knowledge, limited access to rehabilitation services, and poor adherence to treatment regimens.

The lack of knowledge is associated with insufficient education, awareness, and information – both among clinicians working with cancer patients and among the patients themselves [23].

Access barriers extend beyond time, financial constraints, and logistical challenges (such as transportation issues and the geographical distance of specialized facilities from patients' residences). They also include the lack of specialized rehabilitation programs and trained oncology rehabilitation clinicians, including physicians and therapists with the necessary knowledge, skills, and experience to provide safe and effective treatment for cancer-related impairments. Additional barriers to access may include:

– Lack of appropriate facilities and resources, such as therapeutic centers, gyms, parks, sidewalks, and swimming pools, that meet patient needs.

– Time constraints among medical professionals (including oncologists, surgeons, radiation therapists, and nursing staff) that limit their ability to fully assess rehabilitation needs and refer patients for appropriate therapy [21].

Adherence-related barriers are among the most extensively studied and can include convenience and accessibility, self-motivation and engagement, lack of satisfaction with rehabilitation programs, the perception that physical exercise is boring or burdensome, low self-confidence, and reluctance to engage in physical activity, lack of self-monitoring skills, absence of encouragement and social support, limited awareness of common barriers and strategies to overcome them.

Additionally, fear of injury and fatigue can discourage some patients from participating in rehabilitation. Moreover, oncological and other comorbid conditions often serve as significant obstacles to rehabilitation engagement [23].

Despite some clinicians' skepticism regarding the strength of the evidence supporting the benefits of rehabilitation interventions for cancer patients, there is no doubt that rehabilitation measures, particularly physical therapy, provide clear benefits in addressing specific impairments resulting from BC treatment [22; 24].

Moreover, the impact of rehabilitation interventions on various clinical biomarkers, which were previously understudied in this context, is now being actively researched. This growing body of evidence may contribute to the integration of a multidisciplinary approach to the rehabilitation of BC patients [28; 29].

Several studies highlight the positive effects of physical exercise and rehabilitation in increasing the concentration of anti-inflammatory cytokines and promoting the release of anti-inflammatory regulatory T-lymphocytes [30; 31].

This hypothesis has been validated by both preclinical and clinical studies, which emphasize the key role of physical exercise in regulating chemokine expression, enhancing the cytotoxic activity of immune cells, and reducing the regulation of immune-suppressor cells [32; 33].

Regarding specific physical therapy interventions, M.L. McNeely et al. (2010), in a Cochrane review, concluded that upper limb exercises, including those targeting a range of motion (ROM) and stretching, significantly contribute to the restoration of upper limb mobility following surgical procedures for BC [19].

In a systematic review and meta-analysis, B.S. Cheema et al. (2014) reported that early initiation of exercises (between Day 1 and Day 3 post-surgery) can improve short-term shoulder mobility outcomes, although it may lead to increased wound drainage volume and duration.

The authors also found that structured exercise programs, particularly those incorporated into physical therapy, contribute to improved upper limb mobility and functional use, such as reaching overhead.

Furthermore, a meta-analysis of 15 randomized controlled trials (RCTs) evaluating the safety and effectiveness of progressive resistance training (PRT) for BC survivors concluded that this method enhances physical function and reduces lymphedema associated with BC [7].

According to a systematic review conducted by A. De Groef et al. (2015), multimodal physical therapy, including methods such as stretching and active exercises, has been found to be effective in managing postoperative pain and improving range of motion impairments following BC treatment [14].

Several studies have also demonstrated that physical rehabilitation interventions improve the quality of life in BC patients.

In a study by Y. Cho et al. (2016), physical therapy combined with manual lymphatic drainage was shown to reduce shoulder pain, restore shoulder function, and improve quality of life in BC patients with axillary web syndrome (AWS) [9].

Another randomized controlled trial (RCT) found that supervised physical therapy enhances cardiovascular and respiratory function, including VO_2max (maximum oxygen consumption), overall physical function, and quality of life in early-stage BC patients who had undergone chemotherapy and radiation therapy [6].

Early postoperative rehabilitation should be considered at least two weeks after surgery and before the start of adjuvant therapy (radiotherapy and/or chemotherapy). This allows for assessing functional impairments, such as reduced range of motion, axillary web syndrome, weakness, pain, or other dysfunctions that may require rehabilitation interventions. Additionally, this consultation period allows patients to ask questions and clarify concerns regarding postoperative care, recommendations, and potential risks. Rehabilitation can begin on the first day after surgery with gentle mobility exercises to maintain movement and prevent stiffness. Early exercise (rather than delayed initiation) has been shown to promote wound healing and improve drainage of postoperative wounds [19]. Active stretching exercises can be initiated one-week post-surgery and should be continued until the full range of motion is restored. Progressive resistance exercises should begin with light loads (450–900 g) on the affected shoulder. The need for continuous rehabilitation supervision should be adapted to the patient's individual needs and adherence, considering ongoing treatment plans (chemotherapy or radiotherapy), clinical status, and personal risk factors. Since prevention, early detection, and treatment of physical impairments, particularly lymphedema, depend on self-monitoring, regular follow-up assessments should be conducted for at least one-year post-surgery. Hand hygiene and proper skincare counseling are crucial for lymphedema prevention, while timely treatment of wound infections or seromas plays a key role in reducing complications [16].

After achieving clinical and functional stability, BC survivors can engage in adapted physical exercises or functional training exercises aimed at restoring limb function on the surgical side, as well as enhancing self-perception and self-esteem. Adapted physical exercises include gymnastic routines, such as adapted gymnastics three times per week or Pilates. Adapted training exercises involve physical activity within a sports framework, such as fencing and Dragon boating, both of which have been shown to aid functional recovery and psychosocial well-being.

Since fencing is an asymmetrical sport, patients are encouraged to alternate their weapon grip multiple times during training to ensure both limbs are equally engaged, including the operated side.

Additionally, the extensive use of parrying movements forces fencers to perform broader motions, which increase shoulder joint engagement and mobility, contributing to functional recovery [27].

Conclusions.

1. Women diagnosed with BC and treated for this malignancy often experience various physical impairments that negatively impact their well-being and quality of life.

2. The most common physical impairments observed in this patient group include upper limb dysfunction, lymphedema, and pain syndrome.

3. A substantial body of evidence supports the early implementation of range-of-motion exercises, aerobic training, resistance exercises, and stretching, demonstrating positive effects, such as improved shoulder mobility and reduced pain syndrome, without increasing the risk of developing or worsening lymphedema. Moreover, combined physical therapy approaches have been shown to effectively reduce upper limb swelling.

4. After achieving clinical and functional stability, adapted physical exercises (such as adapted gymnastics or Pilates) and adapted training exercises (fencing and rowing) promote further functional recovery of the limb on the surgical side while also enhancing self-perception and self-esteem.

5. Thus, integrating rehabilitation programs into the clinical pathway of BC patients is a crucial step toward creating the optimal conditions for achieving maximum independence and the highest possible quality of life. These programs should focus on managing physical impairments, reducing treatment-related consequences and symptoms, and facilitating social reintegration. A multidisciplinary approach is essential to effectively address the oncological, functional, and psychosocial needs of this patient cohort.

Bibliography

1. Бюлетень національного канцер-реєстру України № 24 «Рак в Україні», 2021–2022. /

З.П. Федоренко, О.В. Сумкіна, В.О. Зуб та ін. Національний інститут раку. Київ, 2023. 148 с.

2. Abedi G., Janbabai G., Moosazadeh M., Farshidi F., Amiri M., Khosravi A. Survival Rate of Breast Cancer in Iran: A Meta-Analysis. *Asian Pac J Cancer Prev.* 2016;17(10):4615–4621. doi: 10.22034/apjcp.2016.17.10.4615.

3. Abdullah N.A., Wan Mahiyuddin W.R., Muhammad N.A., et al. Survival rate of breast cancer patients in Malaysia: a population-based study. *Asian Pac J Cancer Prev*. 2013;14(8):4591–4594. doi: 10.7314/apjcp.2013.14.8.4591.

4. Allemani C., Sant M., Weir H.K., et al. Breast cancer survival in the US and Europe: a CONCORD high-resolution study. *Int J Cancer*. 2013;132(5):1170–1181. doi: 10.1002/ijc.27725.

5. Brouwers M.C., Kho M.E., Browman G.P., et al. AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ*. 2010;182(18):E839–E842. doi: 10.1503/cmaj.090449.

6. Casla S., López-Tarruella S., Jerez Y., et al. Supervised physical exercise improves VO_2max, quality of life, and health in early stage breast cancer patients: a randomized controlled trial. *Breast Cancer Res Treat*. 2015;153(2):371–382. doi: 10.1007/s10549-015-3541-x.

7. Cheema B.S., Kilbreath S.L., Fahey P.P., Delaney G.P., Atlantis E. Safety and efficacy of progressive resistance training in breast cancer: a systematic review and meta-analysis. *Breast Cancer Res Treat*. 2014;148(2):249–268. doi: 10.1007/s10549-014-3162-9.

8. Cheville A.L., Troxel A.B., Basford J.R., Kornblith A.B. Prevalence and treatment patterns of physical impairments in patients with metastatic breast cancer. *J Clin Oncol*. 2008;26(16):2621–2629. doi: 10.1200/JCO.2007.12.3075.

9. Cho Y., Do J., Jung S., Kwon O., Jeon J.Y. Effects of a physical therapy program combined with manual lymphatic drainage on shoulder function, quality of life, lymphedema incidence, and pain in breast cancer patients with axillary web syndrome following axillary dissection. *Support Care Cancer.* 2016;24(5):2047–2057. doi: 10.1007/s00520-015-3005-1.

10. Buonomo O.C., Grasso A., Pistolese C.A., Anemona L., Portarena I., Meucci R., Morando L., Deiana C., Materazzo M., Vanni G. Evaluation of Concordance Between Histopathological, Radiological and Biomolecular Variables in Breast Cancer Neoadjuvant Treatment. *Anticancer Res.* 2020; 40: 281–286.

11. Falcicchio C., Di Lallo D., Fabi A., et al. Use of rehabilitation pathways in women with breast cancer in the first 12 months of the disease: a retrospective study. *BMC Cancer*. 2021;21(1):311. doi: 10.1186/s12885-021-07927-0.

12. Földi E., Földi M., Clodius L. The lymphedema chaos: a lancet. *Ann Plast Surg*. 1989;22(6):505–515. doi: 10.1097/00000637-198906000-00007.

13. Ganz P.A. Current issues in cancer rehabilitation. *Cancer.* 1990;65(3 Suppl):742–751. doi: 10.1002/1097-0142(19900201)65:3+<742::aid-cncr2820651319>3.0.co;2-p.

14. De Groef A., Van Kampen M., Dieltjens E., et al. Effectiveness of postoperative physical therapy for upper-limb impairments after breast cancer treatment: a systematic review. *Arch Phys Med Rehabil*. 2015;96(6):1140–1153. doi: 10.1016/j.apmr.2015.01.006.

15. Globocan 2022. URL: http://gco.iarc.fr/.

16. Harris S.R., Schmitz K.H., Campbell K.L., McNeely M.L. Clinical practice guidelines for breast cancer rehabilitation: syntheses of guideline recommendations and qualitative appraisals. *Cancer*. 2012;118(8 Suppl):2312–2324. doi: 10.1002/cncr.27461.

17. Hidding J.T., Beurskens C.H., van der Wees P.J., van Laarhoven H.W., Nijhuis-van der Sanden M.W. Treatment related impairments in arm and shoulder in patients with breast cancer: a systematic review. *PLoS One*. 2014;9(5):e96748. doi: 10.1371/journal.pone.0096748.

18. Lan N.H., Laohasiriwong W., Stewart J.F. Survival probability and prognostic factors for breast cancer patients in Vietnam. *Glob Health Action*. 2013;6:1–9. Published 2013 Jan 17. doi: 10.3402/gha.v6i0.18860.

19. McNeely M.L., Campbell K., Ospina M., et al. Exercise interventions for upper-limb dysfunction due to breast cancer treatment. *Cochrane Database Syst Rev*. 2010;(6):CD005211. doi: 10.1002/14651858.CD005211.pub2.

20. Sinaga E.S., Ahmad R.A., Shivalli S., Hutajulu S.H. Age at diagnosis predicted survival outcome of female patients with breast cancer at a tertiary hospital in Yogyakarta, Indonesia. *Pan Afr Med J*. 2018;31:163. doi: 10.11604/pamj.2018.31.163.17284.

21. Smith-Turchyn J., Richardson J., Tozer R., McNeely M., Thabane L. Physical Activity and Breast Cancer: A Qualitative Study on the Barriers to and Facilitators of Exercise Promotion from the Perspective of Health Care Professionals. *Physiother Can*. 2016;68(4):383–390. doi: 10.3138/ptc.2015-84.

22. Spence R.R., Heesch K.C., Brown W.J. Exercise and cancer rehabilitation: a systematic review. *Cancer Treat Rev*. 2010;36(2):185–194. doi: 10.1016/j.ctrv.2009.11.003.

23. Stubblefield M.D. The Underutilization of Rehabilitation to Treat Physical Impairments in Breast Cancer Survivors. *PM R*. 2017;9(9S2):S317–S323. doi: 10.1016/j.pmrj.2017.05.010.

24. Stubblefield M.D., Keole N. Upper body pain and functional disorders in patients with breast cancer. *PM R*. 2014;6(2):170–183. doi: 10.1016/j.pmrj.2013.08.605.

25. Dimitrov G., Atanasova M., Popova Y., Vasileva K., Milusheva Y., Troianova P. Molecular and genetic subtyping of breast cancer: the era of precision oncology. *WCRJ* .2022; 9: e2367.

26. Vella F., Senza P., Vitale E., Marconi A., Rapisarda L., Matera S., Cannizzaro E., Rapisarda V. Work ability in healthcare workers (HCWs) after breast cancer: preliminary data of a pilot study. *WCRJ*. 2021; 8: e1840.

27. Berretta M., Facchini B.A., Garozzo D., Necci V., Taibi R., Torrisi C., Ficarra G. and Bitto A. Adapted physical activity for breast cancer patients: shared considerations with two Olympic and world Italian sports champions. *Eur Rev Med Pharmacol Sci*. 2022; 26: 5393–5398.

28. Esteva F.J., Hubbard-Lucey V.M., Tang J., and Pusztai L. Immunotherapy and targeted therapy combinations in metastatic breast cancer. *Lancet. Oncol.* 2019. 20 (3), e175–e186. doi: 10.1016/s1470-2045(19)30026-9.

29. Invernizzi M., Lopez G., Michelotti A., Venetis K., Sajjadi E., De Mattos-Arruda L., et al. Integrating biological advances into the clinical management of breast cancer related lymphedema. *Front. Oncol.* 2020. 10, 422. doi: 10.3389/fonc.2020.00422.

30. Pierce B.L., Ballard-Barbash R., Bernstein L., Baumgartner R.N., Neuhouser M.L., Wener M.H., et al. Elevated biomarkers of inflammation are associated with reduced survival among breast cancer patients. *J. Clin. Oncol.* 2009. 27 (21), 3437–3444. doi: 10.1200/jco.2008.18.9068.

31. Mancuso P. The role of adipokines in chronic inflammation. *Immunotargets Ther*. 2016. 5, 47–56. doi:10.2147/itt.s73223.

32. Upadhyay S., Sharma N., Gupta K.B., and Dhiman M. Role of immune system in tumor progression and carcinogenesis. *J. Cell. Biochem*. 2018. 119 (7), 5028–5042. doi: 10.1002/jcb.26663.

33. Liu H., Yang Z., Lu W., Chen Z., Chen L., Han S., et al. Chemokines and chemokine receptors: A new strategy for breast cancer therapy. *Cancer Med.* 2020. 9 (11), 3786–3799. doi:1 0.1002/cam4.3014.

34. Bartlett D.B., Hanson E.D., Lee J.T., Wagoner C.W., Harrell E.P., Sullivan S.A., et al. The effects of 16 Weeks of exercise training on Neutrophil functions in breast cancer survivors. *Front. Immunol.* 2021. 12, 733101. doi: 10.3389/fimmu.2021.733101.

References

1. Biuleten natsionalnoho kantser-reiestru Ukrainy № 24 «Rak v Ukraini», 2021–2022 [Bulletin of the National Cancer Registry of Ukraine No. 24 "Cancer in Ukraine", 2021–2022]./ Z.P. Fedorenko, O.V. Sumkina, V.O. Zub et al. National Cancer Institute. Kyiv, 2023. 148 p. [in Ukrainian].

2. Abedi, G., Janbabai, G., Moosazadeh, M., Farshidi, F., Amiri, M., Khosravi, A. (2016). Survival Rate of Breast Cancer in Iran: A Meta-Analysis. *Asian Pac J Cancer Prev*. 17(10):4615–4621. doi: 10.22034/apjcp.2016.17.10.4615.

3. Abdullah, N.A., Wan Mahiyuddin, W.R., Muhammad, N.A., et al. (2013). Survival rate of breast cancer patients in Malaysia: a population-based study. *Asian Pac J Cancer Prev*. 14(8):4591–4594. doi: 10.7314/apjcp.2013.14.8.4591.

4. Allemani, C., Sant, M., Weir, H.K., et al. (2013). Breast cancer survival in the US and Europe: a CONCORD high-resolution study. *Int J Cancer*. 132(5):1170–1181. doi: 10.1002/ijc.27725.

5. Brouwers, M.C., Kho, M.E., Browman, G.P., et al. (2010). AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ*. 182(18):E839–E842. doi: 10.1503/cmaj.090449.

6. Casla, S., López-Tarruella, S., Jerez, Y., et al. (2015). Supervised physical exercise improves VO_2max, quality of life, and health in early stage breast cancer patients: a randomized controlled

trial. *Breast Cancer Res Treat*. 153(2):371–382. doi: 10.1007/s10549-015-3541-x.

7. Cheema, B.S., Kilbreath, S.L., Fahey, P.P., Delaney, G.P., Atlantis, E. (2014). Safety and efficacy of progressive resistance training in breast cancer: a systematic review and meta-analysis. *Breast Cancer Res Treat*. 148(2):249–268. doi: 10.1007/s10549-014-3162-9.

8. Cheville, A.L., Troxel, A.B., Basford, J.R., Kornblith, A.B. (2008). Prevalence and treatment patterns of physical impairments in patients with metastatic breast cancer. *J Clin Oncol*. 26(16):2621–2629. doi: 10.1200/JCO.2007.12.3075.

9. Cho, Y., Do, J., Jung, S., Kwon, O., Jeon, J.Y. (2016). Effects of a physical therapy program combined with manual lymphatic drainage on shoulder function, quality of life, lymphedema incidence, and pain in breast cancer patients with axillary web syndrome following axillary dissection. *Support Care Cancer*. 24(5):2047–2057. doi: 10.1007/s00520-015-3005-1.

10. Buonomo, O.C., Grasso, A., Pistolese, C.A., Anemona, L., Portarena, I., Meucci, R., Morando, L., Deiana, C., Materazzo, M., Vanni, G. (2020). Evaluation of Concordance Between Histopathological, Radiological and Biomolecular Variables in Breast Cancer Neoadjuvant Treatment. *Anticancer Res*. 40: 281–286.

11. Falcicchio, C., Di Lallo, D., Fabi, A., et al. (2021). Use of rehabilitation pathways in women with breast cancer in the first 12 months of the disease: a retrospective study. *BMC Cancer*. 21(1):311. doi: 10.1186/s12885-021-07927-0.

12. Földi, E., Földi, M., Clodius, L. (1989). The lymphedema chaos: a lancet. *Ann Plast Surg*. 22(6):505–515. doi: 10.1097/00000637-198906000-00007.

13. Ganz, P.A. (1990). Current issues in cancer rehabilitation. *Cancer*. 65(3 Suppl):742–751. doi: 10.1002/1097-0142(19900201)65:3+<742::aid-cncr2820651319>3.0.co;2-p.

14. De Groef, A., Van Kampen, M., Dieltjens, E., et al. (2015). Effectiveness of postoperative physical therapy for upper-limb impairments after breast cancer treatment: a systematic review. *Arch Phys Med Rehabil*. 96(6):1140–1153. doi:10.1016/j.apmr.2015.01.006.

15. Globocan 2022. Retrieved from: http://gco.iarc.fr/.

16. Harris, S.R., Schmitz, K.H., Campbell, K.L., McNeely, M.L. (2012). Clinical practice guidelines for breast cancer rehabilitation: syntheses of guideline recommendations and qualitative appraisals. *Cancer*. 118(8 Suppl):2312–2324. doi: 10.1002/cncr.27461.

17. Hidding, J.T., Beurskens, C.H., van der Wees, P.J., van Laarhoven, H.W., Nijhuis-van der Sanden, M.W. (2014). Treatment related impairments in arm and shoulder in patients with breast cancer: a systematic review. *PLoS One*. 9(5):e96748. doi: 10.1371/journal.pone.0096748.

18. Lan, N.H., Laohasiriwong, W., Stewart, J.F. (2013). Survival probability and prognostic factors for breast cancer patients in Vietnam. *Glob Health Action*. 6:1–9. doi: 10.3402/gha.v6i0.18860.

19. McNeely, M.L., Campbell, K., Ospina, M., et al. (2010). Exercise interventions for upper-limb dysfunction due to breast cancer treatment. *Cochrane Database Syst Rev*. (6):CD005211. doi: 10.1002/14651858.CD005211.pub2.

20. Sinaga, E.S., Ahmad, R.A., Shivalli, S., Hutajulu, S.H. (2018). Age at diagnosis predicted survival outcome of female patients with breast cancer at a tertiary hospital in Yogyakarta, Indonesia. *Pan Afr Med J.* 31:163. doi: 10.11604/pamj.2018.31.163.17284.

21. Smith-Turchyn, J., Richardson, J., Tozer, R., McNeely, M., Thabane, L. (2016). Physical Activity and Breast Cancer: A Qualitative Study on the Barriers to and Facilitators of Exercise Promotion from the Perspective of Health Care Professionals. *Physiother Can*. 68(4):383–390. doi: 10.3138/ptc.2015-84.

22. Spence, R.R., Heesch, K.C., Brown, W.J. (2010). Exercise and cancer rehabilitation: a systematic review. *Cancer Treat Rev*. 36(2):185–194. doi: 10.1016/j.ctrv.2009.11.003.

23. Stubblefield, M.D. (2017). The Underutilization of Rehabilitation to Treat Physical Impairments in Breast Cancer Survivors. *PM R*. 9(9S2):S317–S323. doi: 10.1016/j.pmrj.2017.05.010.

24. Stubblefield, M.D., Keole, N. (2014). Upper body pain and functional disorders in patients with breast cancer. *PM R*. 6(2):170–183. doi: 10.1016/j.pmrj.2013.08.605.

25. Dimitrov, G., Atanasova, M., Popova, Y., Vasileva, K., Milusheva, Y., Troianova, P. (2022). Molecular and genetic subtyping of breast

cancer: the era of precision oncology. *WCRJ*. 9: e2367.

26. Vella, F., Senza, P., Vitale, E., Marconi, A., Rapisarda, L., Matera, S., Cannizzaro, E., Rapisarda, V. (2021). Work ability in healthcare workers (HCWs) after breast cancer: preliminary data of a pilot study. *WCRJ*. 8: e1840.

27. Berretta, M., Facchini, B.A., Garozzo, D., Necci, V., Taibi, R., Torrisi, C., Ficarra, G. and Bitto, A. (2022). Adapted physical activity for breast cancer patients: shared considerations with two Olympic and world Italian sports champions. *Eur Rev Med Pharmacol Sci*. 26:5393–5398.

28. Esteva, F.J., Hubbard-Lucey, V.M., Tang, J., and Pusztai, L. (2019). Immunotherapy and targeted therapy combinations in metastatic breast cancer. *Lancet. Oncol*. 20 (3), e175–e186. doi: 10.1016/s1470-2045(19)30026-9.

29. Invernizzi, M., Lopez, G., Michelotti, A., Venetis, K., Sajjadi, E., De Mattos-Arruda, L., et al. (2020). Integrating biological advances into the clinical management of breast cancer related lymphedema. *Front. Oncol*. 10, 422. doi: 10.3389/fonc.2020.00422.

30. Pierce, B.L., Ballard-Barbash, R., Bernstein, L., Baumgartner, R.N., Neuhouser, M.L., Wener, M.H., et al. (2009). Elevated biomarkers of inflammation are associated with reduced survival among breast cancer patients. *J. Clin. Oncol*. 27 (21), 3437–3444. doi: 10.1200/jco.2008.18.9068.

31. Mancuso, P. (2016). The role of adipokines in chronic inflammation. *Immunotargets Ther*. 5, 47–56. doi: 10.2147/itt.s73223.

32. Upadhyay, S., Sharma, N., Gupta, K. B., and Dhiman, M. (2018). Role of immune system in tumor progression and carcinogenesis. *J. Cell. Biochem*. 119 (7), 5028–5042. doi: 10.1002/jcb.26663.

33. Liu, H., Yang, Z., Lu, W., Chen, Z., Chen, L., Han, S., et al. (2020). Chemokines and chemokine receptors: A new strategy for breast cancer therapy. *Cancer Med*. 9 (11), 3786–3799. doi: 10.1002/cam4.3014.

34. Bartlett, D.B., Hanson, E.D., Lee, J.T., Wagoner, C.W., Harrell, E.P., Sullivan, S.A., et al. (2021). The effects of 16 Weeks of exercise training on Neutrophil functions in breast cancer survivors. *Front. Immunol*. 12, 733101. doi: 10.3389/fimmu.2021.733101.

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