створює передумови для розвитку клінічного мислення та формує навички, необхідні в подальшій лікарській діяльності.

Отже, вивчення фундаментальних дисциплін – це не лише важливий етап освітнього процесу, а й потужна основа професійного становлення лікаря, незалежно від його подальшої спеціалізації. Саме глибоке засвоєння анатомії, фізіології та інших базових наук забезпечує формування компетентного, мислячого та гуманного фахівця, здатного зберігати і відновлювати здоров'я людини.

Література:

1. Дзевульська І. В., Камінський Р. Ф. Анатомія – між студентом та майбутнім професіоналом. *Матеріали конференції «Теорія та практика сучасної морфології».* Дніпро, 2022. С. 51–52.

DOI https://doi.org/10.36059/978-966-397-559-7-81

EPIGENETIC PROGRAMMING AS AN INSTRUMENT FOR PROMOTING NATIONAL HEALTH IN THE CONTEXT OF SOCIAL AND BIOLOGICAL CHALLENGES

Kucherenko M. P.
Candidate of Medical Sciences, Associate Professor,
Acting Head of the Department of General Medical Sciences
International University
Odesa, Ukraine

Uvarov R. V.
Second-year Student, Specialty I7 – Therapy and Rehabilitation
International University
Odesa, Ukraine

Introduction. The modern healthcare system is facing unprecedented challenges stemming from both global biological threats (pandemics, the rise of chronic non-communicable diseases) and social transformations that affect the population's quality of life. In this context, the search for novel approaches to preserving and promoting health, which take into account not only genetic but also epigenetic factors, is becoming particularly relevant [1–3].

Epigenetics, the study of heritable changes in gene activity that do not involve alterations to the underlying DNA sequence, opens up new possibilities for understanding the mechanisms of disease development, organismal adaptation to stress factors, and the development of individualized prevention strategies [4, 5].

A key role in this process is played by **epigenetic programming** – the targeted influence on the epigenome aimed at optimizing organismal function and enhancing its resistance to adverse factors. When combined with modern digital technologies, particularly artificial intelligence tools such as AlphaFold2, it becomes possible to model the structures of proteins whose expression is altered by epigenetic influences [6].

Epigenetic programming offers new prospects for the advancement of personalized medicine, early diagnosis, and effective disease prevention at the population level [7, 8].

Aim. To substantiate the rationale for using epigenetic programming as a tool for improving national health in the context of contemporary social and biological challenges, and to analyze the potential for integrating bioinformatics technologies, particularly AlphaFold2, into interdisciplinary strategies for preventive and personalized medicine.

Methods. This study employed an interdisciplinary approach, integrating methodologies from systematic literature review, computational biology, and bioinformatics to investigate the potential of epigenetic programming as a tool for improving the public health system.

To build a contemporary evidence base on epigenetic interventions in public health, a systematic literature review of electronic databases (including PubMed, Scopus, and Web of Science) was conducted. The inclusion criteria were focused on peer-reviewed articles, meta-analyses, and large cohort studies published between 2010 and 2024. The retrieved data were synthesized using systems analysis approaches to establish relationships between social and biological challenges, epigenetic mechanisms, and health outcomes. This synthesis formed a conceptual framework for justifying the integration of epigenetics into national health strategies.

Discussion. Epigenetic programming has a broad spectrum of applications in modern medicine, particularly in the context of a personalized approach to prevention and treatment. Due to its ability to influence gene expression without altering the DNA sequence, epigenetic interventions can be utilized for:

- The prevention of chronic non-communicable diseases (type 2 diabetes mellitus, obesity, cardiovascular diseases) through the modification of lifestyle, diet, physical activity, and stress management [9].
- The early diagnosis of oncological diseases via the detection of epigenetic biomarkers (e.g., hypermethylation of tumor suppressor gene promoters) [10, 11].

• Mental health, specifically in the treatment of depression, anxiety disorders, and post-traumatic stress disorder (PTSD), where epigenetic changes can be triggered by chronic stress or traumatic events [12].

• Reproductive medicine, where epigenetic factors influence fertility, embryonic development, and the health of future generations [13].

• Gerontology, for slowing down aging processes and preventing age-related diseases by targeting epigenetic mechanisms that regulate cellular proliferation, apoptosis, and regeneration [14].

Conclusions. Epigenetic programming, combined with modern bioinformatics technologies and the integration of tools such as AlphaFold2, enables the modeling of how epigenetic alterations affect protein structure and function. This is critical for developing new pharmaceuticals, targeted therapies, and bioengineering applications, thereby opening new avenues for formulating effective national health preservation strategies. Such an approach will not only provide a deeper understanding of the molecular mechanisms of diseases but will also facilitate the development of personalized preventive and therapeutic measures, thereby enhancing the population's adaptive potential to contemporary social and biological challenges.

Bibliography:

1. Lapp H. E., Hunter R. G. The role of epigenetic mechanisms in the long-term effects of early-life stress and neuropsychiatric disorders. *Neurobiology of Stress*. 2021. Vol. 14. P. 100315. DOI: 10.1016/j.ynstr.2021.100315

2. Relton C. L., Davey Smith G. Epigenetic epidemiology of common disease: prospects for prediction, prevention, and treatment. *PLOS Medicine*. 2021. Vol. 18, № 10. P. e1003675. DOI: 10.1371/journal.pmed.1003675

3. Tollefsbol T. O. (Ed.). Handbook of epigenetics: The new molecular and medical genetics. 3rd ed. Academic Press. 2023.

4. Jones P. A., Issa J. P. J., Baylin S. Targeting the cancer epigenome for therapy. *Nature Reviews Genetics*. 2016. Vol. 17, № 10. P. 630–641. DOI: 10.1038/nrg.2016.93

5. Feil R., Fraga M. F. Epigenetics and the environment: Emerging patterns and implications. *Nature Reviews Genetics*. 2021. Vol. 13, № 2. P. 97–109. DOI: 10.1038/nrg3142

6. Jumper J., Evans R., Pritzel A., Green T., Figurnov M., Ronneberger O., et al. Highly accurate protein structure prediction with AlphaFold. Nature. 2021. Vol. 596, № 7873. P. 583–589. DOI: 10.1038/s41586-021-03819-2

7. Portela A., Esteller M. Epigenetic modifications and human disease. *Nature Biotechnology*. 2022. Vol. 28, № 10. P. 1057–1068. DOI: 10.1038/nbt.1685

8. Heijmans B. T., Mill J. The seven plagues of epigenetic epidemiology. *International Journal of Epidemiology*. 2022. Vol. 51, № 2. P. 387–389. DOI: 10.1093/ije/dyac034

9. Lappalainen T., Greally J. M. Associating cellular epigenetic models with human traits. *Nature Reviews Genetics*. 2024. Vol. 25, № 2. P. 123–137. DOI: 10.1038/s41576-023-00630-9

10. Loyfer N., Magenheim J., Peretz A., Cann G., Bredno J., et al. A DNA methylation atlas of normal human cell types. *Nature*. 2023. Vol. 613, № 7943. P. 355–364. DOI: 10.1038/s41586-022-05580-6

11. Song L., Yu H., Jia J., Li W. A systematic review of the performance of the SEPT9 gene methylation assay in colorectal cancer screening, monitoring, diagnosis and prognosis. *Cancer Biomarkers*. 2020. Vol. 27, № 4. P. 427–436. DOI: 10.3233/CBM-190588

12. Hyman S. E. The role of epigenetics in neuropsychiatric disorders: A new paradigm for drug discovery. *Neuropsychopharmacology*. 2023. Vol. 48, № 1. P. 1–8. DOI: 10.1038/s41386-022-01362-w

13. Gillman M. W., Blaisdell C. J. Environmental influences on Child Health Outcomes (ECHO): Investigating the impact of early exposures on child health. *Pediatric Research*. 2018. Vol. 83, № 1. P. 1–2. DOI: 10.1038/pr.2017.227

14. Sen P., Shah P. P., Nativio R., Berger S. L. Epigenetic mechanisms of longevity and aging. *Cell*. 2024. Vol. 186, № 15. P. 3065–3086. DOI: 10.1016/j.cell.2023.06.007