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ОСНОВНІ ПЛЯМИСТОСТІ ГРИБНОЇ ЕТІОЛОГІЇ НА ЯЧМЕНІ ОЗИМОМУ

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MAIN SPOTS OF FUNGAL ETIOLOGY ON WINTER BARLEY

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Анотація

Зернові колосові культури, відіграють важливу роль у світовому сільському господарстві та продовольчій безпеці. Ячмінь озимий – одна з кращих кормових культур. Вивчення особливостей прояву, зберігання та поширення хвороб грибної етіології на ячмені дозволяє розробляти та оптимізувати систему захисту ячменю озимого від основних хвороб. Встановлено, що в Україні основними плямистостями грибної етіології на ячмені озимому є гельмінтоспоріози, ринхоспоріоз та септоріоз.

Abstract

Cereal crops play an important role in world agriculture and food security. Winter barley is one of the best fodder crops. Studying the features of the manifestation, storage and spread of diseases of fungal etiology on barley allows developing and optimizing a system for protecting winter barley from major diseases. It has been established that in Ukraine the main spots of fungal etiology on winter barley are helminthiasis, rhynchosporiasis and septoria.

Ключові слова: зернові культури, ячмінь озимий, хвороби, патогени, заходи захисту, плямистості, гельмінтоспоріоз. ринхоспоріоз, септоріоз.

Keywords: grain crops, winter barley, diseases, pathogens, protection measures, spotting, helminthiasis. rhynchosporiasis, septoria.

Вступ. Зернові колосові культури, відіграють важливу роль у світовому сільському господарстві та продовольчій безпеці. Ці культури щороку висівають на мільйонах гектарів землі по всьому світі, де це дозволяють погодно-кліматичні умови та придатність ґрунтів. Зернові культури є джерелом енергії, вітамінів, білків та мінералів, вони використовуються для виробництва хліба, макаронних виробів, круп та інших продуктів, у пивоварінні та становлять основу харчування людства. Також вони входять до кормового раціону в тваринних господарствах. Урожаї зернових культур можуть відносно довго зберігатися, що робить ці культури стратегічно важливими для забезпечення продовольчої безпеки в умовах непередбачуваних обставин, таких як економічні кризи або природні катастрофи.

Ячмінь озимий – одна з кращих кормових культур. Зерно містить у середньому до 65 % БЕР і порівняно мало білка (біля 12 %), тому він є цінною сировиною для пивоваріння. Солома та полова – цінний грубий корм. Їх згодовують худобі. Вирощують ячмінь також у зеленому конвеєрі. У сприятливі для перезимівлі роки врожайність зерна досягає 5,0–5,8 т/га, а на сортодільницях – 8,0–8,5 т/га. Середня врожайність – 2,8–3,0 т/га. Ячмінь озимий має важливе агротехнічне значення. У сівозмінах, насичених озимими хлібами, після ячменю можна висівати інші озимі, оскільки до їхньої сівби залишається достатньо часу для напівпарового обробітку ґрунту. Посівна площа ячменю озимого у світі становить 8,0–8,5 млн га. Більшість посівних площ зосереджено в країнах Євросоюзу. Найбільше його висівають у Франції (1,4–1,5 млн га), Німеччині (1,2–1,3 млн га), Румунії (близько 0,9–1,0 млн га) та інших країнах. Україна входить до п’ятірки світових лідерів за посівними площами під цією культурою. Стрімке зростання посівних площ ячменю озимого в Україні спостерігалося в період з 1995 по 2010 рр. (з 370 тис. га в 1995 р. до 1470 тис. га – у 2009 р.). Протягом останніх років ці площі стабілізувалися на рівні 1,1–1,2 млн га (у 2013 р. – 1,09 млн га, у 2014 – 1,18 млн га). Ячмінь озимий рекомендований для вирощування в 14 областях. Понад 70 % його посівних площ зосереджено в південному регіоні – Криму, Одеській, Миколаївській та Херсонській областях.

Постановка проблеми. Щороку внаслідок життєдіяльності шкідливих організмів людство недоотримує 30–40 % потенційного врожаю зернових колосових культур, у тому числі ячменю озимого. Левову частку втрат врожаю ячменю спричиняють хвороби різної етіології. Серед яких чільне місце займають плямистості грибної етіології: гельмінтоспоріози, ринхоспоріоз та септоріоз.

Викладення основного матеріалу.

Темно-бура плямистість. Хвороба розповсюджена скрізь. Проявляється на сходах й дорослих рослинах довгастими темними плямами у вигляді штрихів і смуг. Іноді утворюється один корінь замість трьох, а паростки викривлюються і гинуть. На листках дорослих рослин виникають спочатку темні, а пізніше темно-сірі або світло-бурі плями, трохи подовжені уздовж листків, у центрі вони світліші, з темною облямівкою. У місцях плям з'являється оливково-бурий або чорно-сірий наліт. Іноді нижні вузли стебла загнивають, внаслідок чого воно пом'якшується і вилягає. Уражене стебло вкривається чорно-сірим нальотом.

Колоскові лусочки ураженого колоса буріють, зародковий кінець насіння чорніє або стає коричневим. Особливо інтенсивний розвиток хвороби на дорослих рослинах спостерігається при випаданні дощів і високій вологості повітря.

Збудником темно-бурої плямистості є незавершений гриб *Bipolaris sorokiniana* Shoem. (*Helminthosporium sorokinianum* Sacc.). Його грибниця розміщується у міжклітинниках тканин рослини, а на поверхні уражених органів утворюється конідіальне спороношення, що виходить через подих або між клітинами епідермісу. Конідієносці багатоклітинні, темні, колінчасті, довжиною до 130 і завтовшки 6–7 мкм (рідко до 10 мкм). Конідії темно-оливкові, довгастояйцеподібні, з 12–13 поперечними перетинками, 60–134 × 17–30 мкм.

Під час вегетації гриб поширюється конідіями, які проростають полярними клітинами. Грибниця дифузно не поширюється, тому кожне ураження органів рослин є місцем, де відбувається самостійне зараження.

Зимує патоген у формі грибниці і конідіального спороношення на стерні й зерні. Отже, джерелом інфекції може бути уражене зерно і поживні рештки уражених рослин.

Уражені рослини зменшують загальну і продуктивну кущистість, на них утворюється менше первинних і вторинних коренів. Недобір урожаю зерна при сильному розвитку хвороби може досягати 20–40 %.

Рис. 1. Темно-бура плямистість ячменю

Смугаста плямистість листків. В Україні дуже поширена у Лісостепу і Поліссі. Спостерігається на ячмені від початку сходів до стиглості. На листках сходів утворюються блідо-жовті плями, які пізніше видовжуються, робляться світло-коричневими з вузькою пурпуровою облямівкою. На плямах утворюється оливково-бурий наліт. Плямистість особливо сильно проявляється під час цвітіння і наливання зерна. Смуги розтріскуються, листки розщеплюються уздовж на 2–3 частини, після чого всихають і відпадають. Смугаста плямистість проявляється і на насінні, зовні (у стійких сортів) й у межах зародка (у сприйнятливих сортів), коли зерно буріє.

Збудником смугастої плямистості є незавершений гриб *Drechslera graminea* Shoem. порядку Hyphomycetales. Він розвиває конідіальне спороношення у вигляді чорно-сірого нальоту на утворених плямах. Конідієносці темні, багатоклітинні, неправильної форми, зубчасті, завдовжки до 120 і завтовшки 10–12 мкм. Конідії майже циліндричні, буруваті, з 2–6 перетинками, розміром 80–110 × 12–20 мкм.

У сприйнятливих сортів ячменю, які мають пухку паренхіму і неміцну склеренхімну тканину, гриб поширюється дифузно, грибниця легко проникає у судинно–провідні пучки і досягає меристема-

тичних тканин. Уражене насіння завжди несе інфекцію біля основи зародка у вигляді грибниці, тому при проростанні зерна майже повністю руйнуються зародкові корені. У ранньому віці рослини грибниця проникає у судинно-провідні пучки через підсім'ядольне, кол іно, пригнічує загальний стан рослини, а інколи зумовлює її загибель. Цим і пояснюється, що протруювання насіння нестійких сортів ячменю, уражених *D. graminea*, не забезпечує повного його знезараження.

Стійкі сорти, навпаки, не допускають проникнення у судиннопровідні пучки гриба, які в них оточені товстостінними склеренхімними клітинами, а їхні ядра проявляють активну реакцію проти укорінення паразита і перешкоджають розвитку грибниці. Тому зараження рослин стійких сортів відбувається повітряною інфекцією і ураження тканин має місцевий характер. Грибниця патогена на зерні стійких сортів ячменю розміщується у верхній частині насіннєвої шкірки і не виявляється у зародку. Він затримується на етіольованому колеоптилі і тільки інколи може «загрожувати» першому зародковому листку. Паросток у рослин стійких сортів завжди має здорову кореневу систему, тому протруювання насіння дає позитивні результати. На поверхні зерна також виявляються конідії, від яких можуть навесні заражатися рослини. На рештках рослин після збирання патоген може зберігатися у вигляді грибниці, а інколи і конідій.

Доведено, що на пожнивних рештках гриб може після перезимовування утворювати псевдотеції з сумками і сумкоспорами. Останні також є додатковим джерелом інфекції. Особливо велика кількість утворень сумчастої стадії гриба спостерігається на посівах багаторічних трав, де ячмінь висівають як покривну культуру.

У сумчастій стадії збудник смугастої плямистості ячменю називається *Pyrenophora graminea* Ito. et Kuribay. Він належить до порядку Sphaeriales.

Менші прояви смугастої плямистості спостерігаються на посівах ячменю при посиленому удобренні грунту фосфорно-калійними добривами у суміші з мікроелементами (марганцем і міддю). Однобічне внесення тільки азотистих добрив зумовлює посилення хвороби.

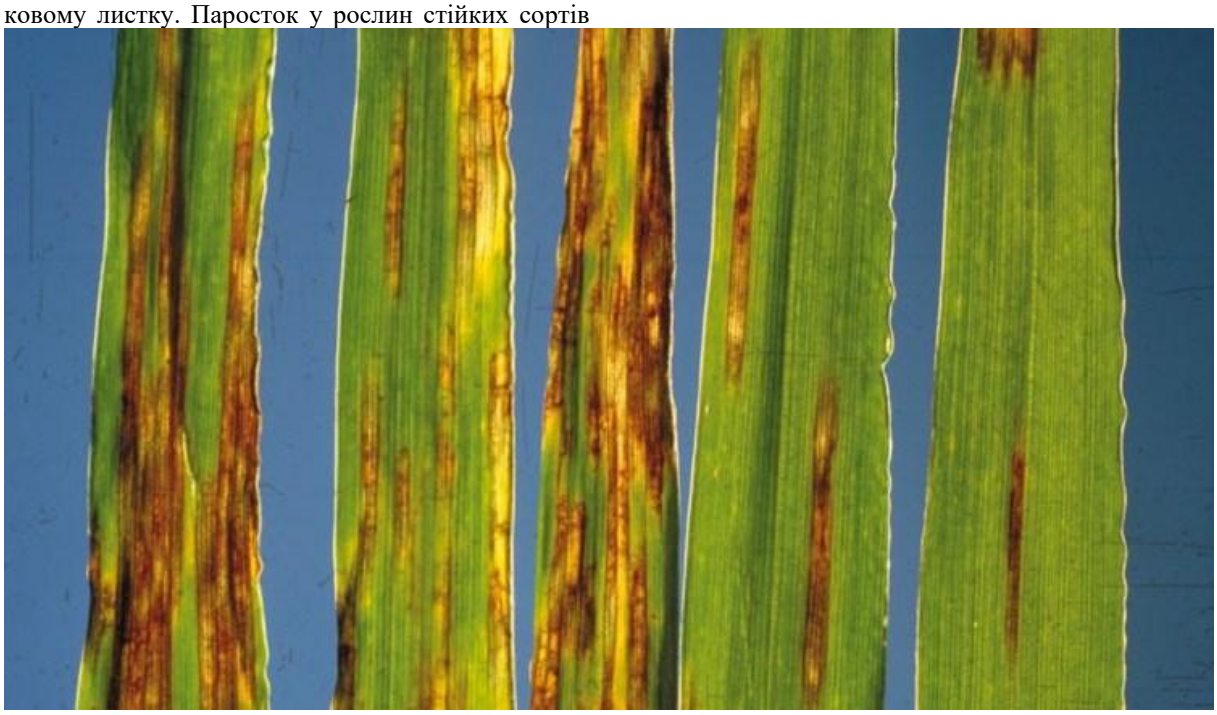

Рис. 2. Смугаста плямистість листків ячменю

Сітчаста плямистість. Виявляється у всіх зонах вирощування ячменю, особливо з підвищеною кількістю опадів. Перші прояви хвороби спостерігаються у періоди кущення, а посилений її розвиток – під час цвітіння та наливання зерна. Характерна ознака – поява на листках овальних бурих плям з блідо-жовтим обідком. Плями мають поздовжні і поперечні смуги, які утворюють сітчастий малюнок. Плями не зливаються, а листя не розщеплюється, чим зовні сітчаста плямистість відрізняється від смугастої. У місцях плям утворюється темно–сірий наліт, на колоскових лусочках і зернах уражених рослин можуть з'явитись малопомітні світло-бурі плями.

Збудником сітчастої плямистості є незавершений гриб *Drechslera teres* Shoem. Його грибниця не поширюється дифузно і розміщується у міжклітинниках ураженої тканини. Наліт на плямах – конідіальне спороношення гриба. Конідієносці темні, розміщуються пучками, циліндричні, довгасті, до 130 мкм завдовжки і 12 мкм завтовшки. Конідії світло-оливкові, циліндричні, з 3–8 поперечними перетинками, 80–175 × 15–22 мкм.

Рис. 3. Сітчаста плямистість ячменю

D. teres може зимувати у формі конідій на пожнивних рештках і зерні. На уражених рештках рослин, що перезимували, він може утворювати псевдотеції із сумками і сумкоспорами й тоді носить назву *Pyrenophora teres* Drechs. Сумкоспори навесні також можуть бути додатковим джерелом інфекції.

Ринхоспоріоз, або облямівкова плямистість. Хвороба розповсюджена в Поліссі України та інших районах з підвищеною вологістю. Уражується ячмінь, жито і багато злакових трав. На листках і піхвах спостерігається поява овальних або неправильної форми водянистих сіро-зелених плям з темно-бурою облямівкою з обох боків листка. З нижнього боку листя утворюються слабопомітні білуваті подушечки із спороношення збудника.

Рис. 4. Ринхоспоріоз ячменю

Хворобу викликає незавершений гриб *Rhynchosporium secalis* (Oudem.) J. J. Davis. В місцях плям він утворює конідіальне спороношення. Конідії безбарвні, двоклітинні, верхня клітина яких зігнута у вигляді садового ножа або дзьоба. Розмір конідій – 12–20 × 2,3–5,4 мкм. Розповсюджується гриб конідіями, а взимку – на посівах озимого жита і рештках уражених рослин – грибницею. Може

зберігатись на зерні, у яке проникає грибниця у фазі молочної стиглості зерна. На міцелії, що перезимував утворюються конідії, що масово заражають посіви. Проростають конідії за умов наявності крапельної води при температурі від 2 до 30 °С (оптимум 16 … 20 °С).

При сильному розвитку плямистості на листі утворюються некрозні п'ятна. При їх зливанні листя передчасно відмирає, рослини не отримують необхідної кількості поживних речовин. Через інфікування посівів недобір врожаю в роки епіфітотії може досягати 45 % і більше, кількість колосків на стеблі зменшується на 15 %, число зерен в колосі — на 20 %, збір соломи — більше ніж на 32 %. При ураженні ячменю суттєво погіршується якість зерна для пивоваріння.

Септоріоз. Зустрічається скрізь, але найбільше шкідливий у районах з підвищеною вологістю. Хвороба звичайно проявляється у другій половині вегетації рослин, але інколи її можна спостерігати і на сходах. Уражуються листя, стебла і навіть колоскові лусочки. На них з'являються залежно від збудника світлуваті, жовтуваті і ясно–бурі плями. На них з обох боків листків у великій кількості утворюються чорні пікніди. У випадках масового ураження рослин листя і стебла передчасно усихають.

Збудниками септоріозу ячменю є незавершені гриби роду *Septoria* Fr., родини Sphaeropsidaceae, порядку Sphaeropsidales: *S. hordei* Gacz., *S. graminum* Desm. і *S. nodorum* Berk.

При ураженні *S. hordei* і *S .nodorum* спочатку з'являються світлі й жовті, неясні, а пізніше розпливчасті плями. *S. graminum* проявляє себе ясно-бурими плямами, які пізніше стають білуватими, з темною облямівкою. У *S. hordei* пікніди діаметром 125–200 мкм, а пікноспори безбарвні, прямі, мають 3–5 поперечних перетинок, 25–35 × 3–3,5 мкм. *S. nodorum* має пікніди діаметром 140–210 мкм, а пікноспори безбарвні, вузькоциліндричні, прямі або трохи зігнуті, з перетинками, 15–25 × 2–3 мкм. У *S. graminum* пікніди до 150 мкм у діаметрі, а пікноспори безбарвні, ниткоподібні або зігнуті, з невиразними перетинками, 50–75 × 1–1,5 мкм.

Рис. 5. Септоріоз ячменю

Під час вегетації ячменю патогени поширюються пікноспорами за допомогою вітру і крапельок дощу на відстань до 100 м. Проростають у крапельках вологи при температурі 9–28 °С (оптимум 20–22°С). Інкубаційний період хвороби триває 6–9 днів. За час вегетації рослин патогени дають кілька поколінь. Зимують вони пікнідами на уражених рештках рослин і нерідко на зимуючих злаках, а навесні зараження вегетуючих рослин відбувається від пікноспор. Недобір урожаю зерна ячменю від септоріозу при сильному його розвитку може становити 20–30 %.

Система заходів проти основних хвороб ячменю

Вирощування в господарстві як мінімум двох районованих сортів з комплексною стійкістю до основних хвороб. Такими показниками характеризуються сорти ячменю озимого: Абориген, Барвистий, Герлах, Дев'ятий вал, Добриня 3, Достойний, Калі-

псо, ярого – Взірець, Воєвода, Геліос, Інклюзив, Звершення, Квенч, Командор, Октавіа, Піонер, Псьол, Паула, Аграрій, Святогор, Модерн.

Використання здорового насіннєвого матеріалу з високими посівними якостями. Проведення заходів, які запобігають заспоренню або зараженню збудниками сажок, септоріозу, фузаріозу, кореневих гнилей, бактеріозів. Цього можна досягнути якісним післязбиральним очищенням, сушінням, сортуванням насіння та доведенням його до посівних кондицій.

Дотримання науково обґрунтованих сівозмін, розроблених для кожної еколого-географічної зони залежно від ґрунтово-кліматичних умов і структури посівних площ. Це ефективний фітосанітарний захід, який запобігає виникненню епіфітотій хвороб.

Дотримання просторової ізоляції між насіннєвими ділянками і товарними посівами ячменю з метою стримування поширення аерогенної інфекції хвороб і отримання здорового посівного матеріалу.

Якісний передпосівний обробіток ґрунту, який забезпечує сприятливий водний режим для одержання дружних сходів, а також нормального росту і розвитку рослин та підвищення стійкості рослин до основних хвороб.

Обов'язкове протруювання насіння одним із препаратів: Максим Форте 050 Р8, т.к.с. з н.в. 1,5–2,0 л/т, Дивіденд Стар 036 Р8, тн 1,5–2,0 л/т, Вітавакс 200 ФФ, в.с.к. 2,5–3,0 л/т, Ламардор Про 180 Р8, тн 0,5–0,6 л/т, Систіва, тн 0,5–1,5 л/т, Вінцит 050 CS, к.с. 1,5л/т. Також можна застосовувати біопрепарати: Агат 25-К, па 0,03 кг/т, Планриз БТ, в.с. 1,0–2,0 л/т; Фітоцид, р. 0,5-1,5 л/т; Мікосан Н, 3,0 % в.р.к . 7,0 л/т, Сабрекс, п. 125 г/100 кг.

Дотримання оптимальних строків сівби і норм висіву насіння з метою забезпечення оптимальних умов для росту і розвитку рослин, а також підвищення стійкості до основних хвороб і покращання зимостійкості озимої форми.

Унесення збалансованих доз мінеральних і органічних добрив під основний і передпосівний обробітки ґрунту, а також вчасне підживлення рослин макро- і мікроелементами, що суттєво підвищує стійкість рослин до основних хвороб.

Починаючи з фази виходу в трубку (ВВСН 31-39), обприскування рослин проти комплексу хвороб одним із фунгіцидів: Рекс Дуо, к.с. 0,5 л/га; Амістар Екстра 280 SC, к.с. 0,5–0,75 л/га; Абакус, мк.е. 1,25–1,75 л/га; Фолікур 250 EW, ев. 1,0 л/га; Альто Супер 330 ЕС, к.е. 0,4-0,5 л/га.

Обприскування посівів проти хвороб одним із біопрепаратів: Агат 25-К, па (0,03 кг/га); Триходерма Бленд Bio-Green Microzyme TR, к.с. (0,3–1,0 л/га); Фітоцид, р. (0,5–0,6 л/га).

Збирання урожаю в стислі строки за вологості зерна 14–17 %. Проведення післязбирального очищення, просушування, повітряно-теплового обігріву зерна, що дозволить не допустити перезараження зібраного зерна фузаріозом, пліснявінням і бактеріальними хворобами.

Ретельне загортання післяжнивних рослинних решток та знищення падалиці зернових культур, які можуть бути джерелами інфекції багатьох хвороб грибної та бактеріальної етіології, а також резерваторами – вірусної.

Висновок.

Встановлено, що в Україні основними плямистостями грибної етіології на ячмені озимому є гельмінтоспоріози: темно-бура плямистість, смугаста плямистість листків, сітчаста плямистість, ринхоспоріоз, або облямівкова плямистість, ринхоспоріоз та септоріоз.

Список літератури

1. Біловус Г. Я., Ващишин О. А., Пристацька О. Н., Добровецька М. Р. Вплив біологічних і хімічних препаратів на обмеження розвитку ринхоспоріозу на ячмені озимому. Вісник аграрної науки. 2024. № 3 (852). С. 28-33.

2. Голосна Л. Хвороби насіння ячменю. Пропозиція. 2021. № 6-7. URL: https://propozitsiya.com/ua/hvoroby-nasinnya-yachmenyu (дата звернення: 05.02.2025).

3. Горяінова В.В., Станкевич С.В., Батова О.М., Жукова Л.В. Загальна фітопатологія: навч. посіб. Житомир: ПП «Рута», 2023. 378 с.

4. Жукова Л.В., Станкевич С.В., Туренко В.П., Горяінова В.В., Батова О.М. Патологія насіння сільськогосподарських культур: навч. посіб. Житомир: Видавництво «Рута», 2023. 292 с.

5. Лавренко О. Основні шкодочинні хвороби озимого ячменю, які зпричиняють потенційно найвищі втрати урожаю. URL: https://www.agronom.com.ua/osnovni-shkodochynni-hvoroby-ozymogo-yachmenyu-yaki-zprychynyayut-potentsijno-najvyshhi-vtraty-urozhayu/ (дата звернення: 05.02.2025).

6. Мостіпан Т., Гайденко О. Плямистості листя ячменю: шкодочинні хвороби. Агробізнес Сьогодні. URL: https://agro-business.com.ua/agro/ahronomiia-sohodni/item/20411-pliamystosti-lystia-iachmeniu-shkodochynni-khvoroby.html

7. Піковський М., Кирик М. Початок вегетації ячменю озимого: небезпечні мікози. Пропозиція. 2018. № 10. URL: https://propozitsiya.com/ua/pochatok-vegetaciyi-yachmenyu-ozymogo-nebezpechni-mikozy (дата звернення: 29.05.2024).

8. Станкевич С.В., Положенець В.М., Немерицька Л.В., Журавська І.А. Моніторинг хвороб сільськогосподарських культур: навч. посіб. Житомир: Видавництво «Рута», 2022. 304 с.

9.Тітов І.О. Контамінація зерна ячменю озимого грибними патогенами в Степу України. Аграрні інновації. 2024. № 25. С.67–71. https://doi.org/10.32848/agrar.innov.2024.25.11

10. Тітов І.О., Жукова Л.В., Станкевич С.В. Основні хвороби в посівах ячменю озимого на півдні України. Таврійський науковий вісник. 2024. №138. С. 182–192. https://doi.org/10.32782/2226-0099.2024.138.23

11. Titov, I., Zhukova, L., Batova, O. Pathology of winter barley seeds. Modern trends in the development of agricultural production: problems and perspectives: monograph. Edited by S. Stankevych, O. Mandych. Tallinn: Teadmus OÜ, 2022. P. 156–164.

BIOLOGICAL SCIENCES

ОСОБЕННОСТИ ФУНКЦИОНАЛЬНОГО СОСТОЯНИЯ ГОЛОВНОГО МОЗГА ЖЕНЩИН ЗРЕЛОГО ВОЗРАСТА В УМСТВЕННОМ НАПРЯЖЕНИИ В ГЕОМАГНИТНО-СПОКОЙНЫЕ ДНИ

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FEATURES OF THE FUNCTIONAL STATE OF THE BRAIN OF MATURE WOMEN UNDER MENTAL STRESS ON GEOMAGNETICALLY QUIET DAYS

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Аннотация

В настоящем исследовании, проведен персонализированный анализ биоэлектрической активности головного мозга (ЭЭГ) женщин зрелого возраста 30-35 лет, в дни со спокойной геомагнитной обстановкой. Компьютерными программами «Нейрон-Спектр NET, определялись частотно-амплитудные и индексные характеристики основных ритмов ЭЭГ, в состоянии покоя и при умственном напряжении -решение арифметической задачи (глаза закрыты). Выявлено, что у молодых женщин переход от состояния покоя к умственной деятельности, регулируется адекватным усилением деятельности активирующей неспецифической системы при ослаблении ее тормозных влияний на кору головного мозга.

Abstract

In the present study, a personalized analysis of the bioelectrical activity of the brain (EEG) was carried out in women of mature age 30-35 years old, on days with a calm geomagnetic environment. Computer programs “Neuron-Spectrum NET” determined the frequency-amplitude and index characteristics of the main EEG rhythms, at rest and under mental stress - solving an arithmetic problem (eyes closed). It has been revealed that young women experience a transition from a state of rest to mental activity is regulated by an adequate increase in the activity of the activating nonspecific system while weakening its inhibitory effects on the cerebral cortex.

Ключевые слова: электроэнцефалография, частотно-амплитудный, индексный анализы, счет в уме, женщины, спокойные дни.

Keywords: electroencephalography, frequency-amplitude, index analyses, mental arithmetic, women, quiet days.

Введение. Изучение вопросов, связанных с функционированием головного мозга человека, несомненно ценно в клинике в диагностических вопросах, но и представляет большой интерес в медики-биологических исследованиях, касающихся мозговой деятельности на разных этапах развития в норме и при воздействии внутренних и внешних факторов. Суммарная электрическая активность головного мозга (ЭЭГ), подвергается изменениям в процессе развития, характеризуя особенности этапов онтогенеза. Картина ЭЭГ стабилизируется в зрелом возрасте и имеет особенности, зависящие от функционального состояния организма. При этом не исключены половые, популяционные и различия, связанные с особенностями окружающей среды. Особый интерес представляют исследования, касающиеся переходов в мозговой деятельности от состояния покоя к активной физической и умственной деятельности, что позволяет определить адаптивные возможности мозга. При этом важен анализ персонифицированных исследований,

что позволяет избежать ошибок общегрупповых измерений.

На протяжении последних лет нами проводятся исследования по изучению влияния различной геомагнитной ситуации на функциональное состояние головного мозга женщин. В представленном исследовании, как составная часть этой большой работы, освещены результаты ЭЭГ здоровых женщин зрелого возраста в состоянии покоя и как напряженное психическое состояние при решении арифметической задачи, в дни со спокойной геомагнитной обстановкой.

Методика. К исследованиям привлекались здоровые женщины зрелого возраста (30-35). Влияние устранения вариабельности индивидуальных параметров на результаты достигалось проведением персонализированных исследований. Осуществлялся анализ динамики показателей одной и той же личности. (ЭЭГ) регистрировалась на многоканальном компьютерном электроэнцефалографе –Нейрон-Спектр-5. Регистрировалась активность от: лобных полюсов - Fp2 и Fp1, лобных – F4 и F3центральных – C4 и C3, теменных – P4 и P3, затылочных – O2 и O1, передне-височных – F8 и F7, центрально-височных – T4 и T3, задне-височных – T6 и T5 – отделов коры мозга по международной схеме 10-20%, в условиях геомагнитно спокойной обстановки. (Кр=1). С привлечением программ «Нейрон-Спектр NET» (Россия), анализировались индексные, амплитудные и частотные характеристики всех ритмов 15 секундных отрезков безартефактных отрезков ЭЭГ в состоянии покоя и при умственном напряжении -решение арифметической задачи (глаза закрыты). С помощью программы «Microsoft Excel» проводился сравнительный анализ соответствующих характеристик ЭЭГ зарегистрированных в состоянии покоя и при умственном напряжении.

Результаты исследований и обсуждение. В результате периодометрического анализа были получены характеристики частот, амплитуд и процентной представленности основных ритмов ЭЭГ от обеих гемисфер головного мозга позволяющие раскрыть особенности функционального состояния мозга женщин 30-35 лет в состоянии покоя и при решении арифметической задачи в геомагнито-спокойные периоды. В предыдущие годы нами были представлены работы посвященные изучению функциональной активности головного мозга молодых женщин в спокойном состоянии в спокойные дни и в периоды гелиогеомагнитных флуктуаций [1, с. 47-51][2, с. 56-57][3, с. 7-13][4, с. 75-82]. С целью определения особенностей динамики показателей электроэнцефалограмм в процессе перехода из спокойного состояния к напряженному, в данной статье мы представили результаты сравнительного анализа полученных данных и постарались наглядно продемонстрировать выявленные изменения построенными гистограммами. Проведенный сравнительный анализ процентной представленности ритмов ЭЭГ раскрыл следующие закономерности. На (рис. 1) и (рис. 2) отмечены изменения индексов дельта- и тета-ритмов по основным областям обеих гемисфер при переходе из покоя в состояние умственного напряжения в геомагнитно-спокойные дни.

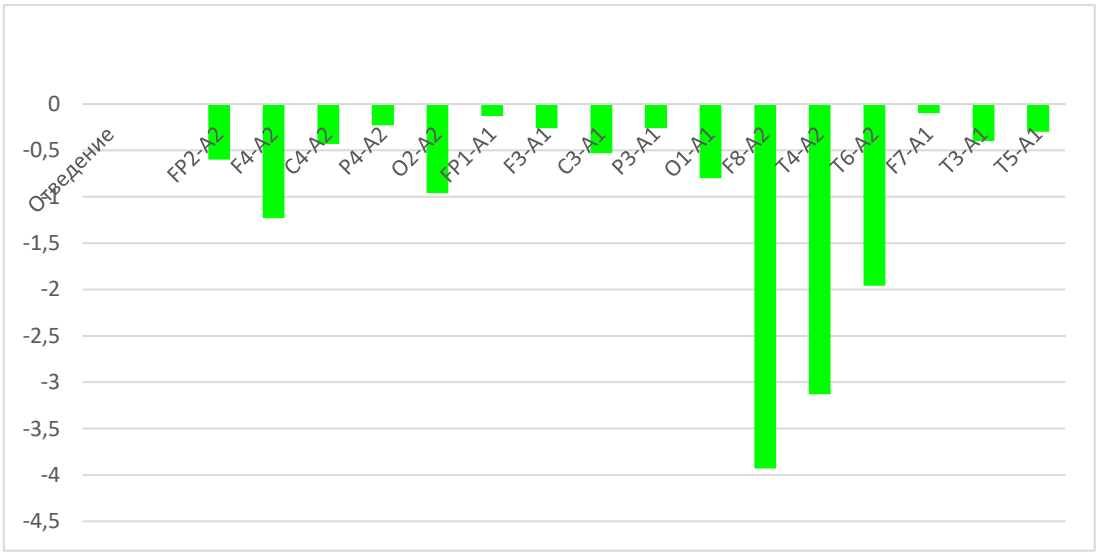

Рис. 1 Гистограмма разницы индекса дельта ритма при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Ось абсцисс – области коры (отведения) обеих гемисфер, по оси ординат – динамика выраженная разницей величин индекса дельта-ритма в состоянии умственного напряжения и в покое.

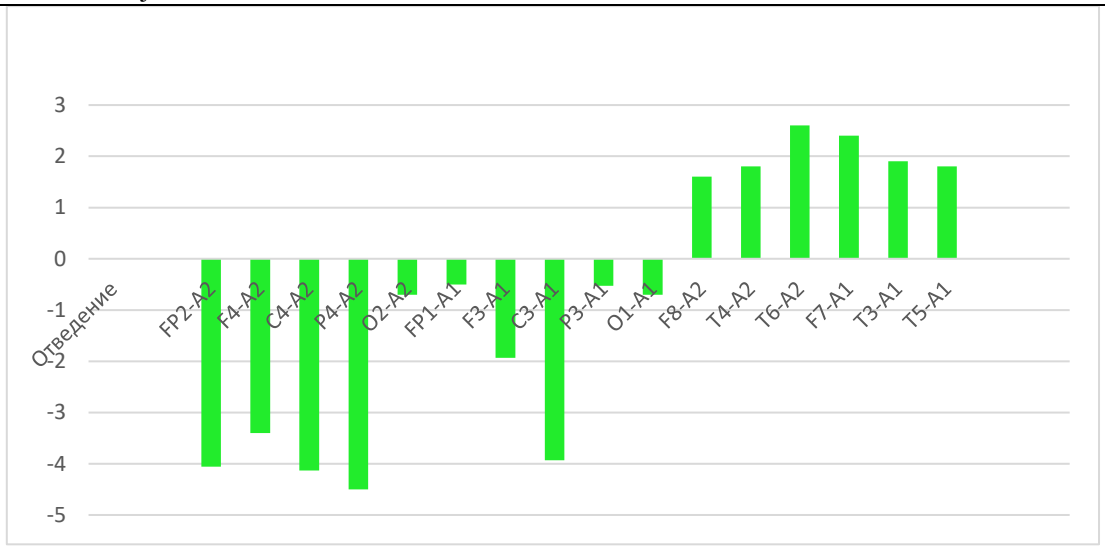

Рис. 2 Гистограмма разницы индекса тета ритма при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Остальные обозначения те же, что и на рис. 1

Из представленных выше данных видно, что при смене покоя, состоянием решения арифметической задачи (рис. 1) регистрируется уменьшение индекса дельта-ритма по всем областям. Процентная представленность тета-ритма при переходе в состояние напряжения, увеличивалась в височных отделах обоих гемисфер, на фоне снижения в других областях. Известно, что мыслительная деятельность сопровождается перестройкой структуры ЭЭГ, в том числе и изменениями медленно-частотного спектра активности [6, с. 93-102][7, с. 25][8, с. 50-53][9, с. 17-22][11, с. 91-108]. При этом усиление процентной представленности медленных волн коррелирует со степенью интеллектуального напряжения [10, с183]. Учитывая сведения о том, что степень процентной представленности тета-ритма положительно коррелирует с успешностью решения задачи [5, с. 142-146], выявленное нами увеличение тета-индекса в височных областях при переходе в состояние умственного напряжения, по-видимому отражает особую роль височных отделов в умственной деятельности, механизм сложившихся в корковых отделах связях, направленных для достижения поставленных задач.

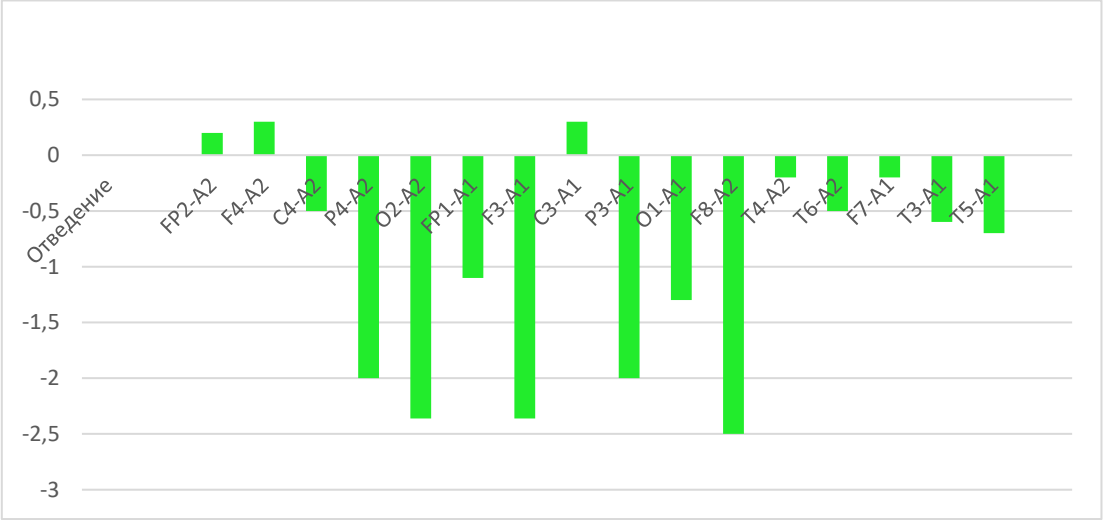

Рис. 3 Гистограмма разницы индекса альфа-ритма при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Остальные обозначения те же, что и на рис. 1

Альфа-ритм является индикатором степени зрелости и созревания коры головного мозга, высокие его показатели в каудальных отделах мозга, отражают нормальный, соответствующий возрастной динамике процесс развития. Переход в состояние умственного напряжения сопровождался снижением индекса альфа-ритма во всех областях. (рис. 3)

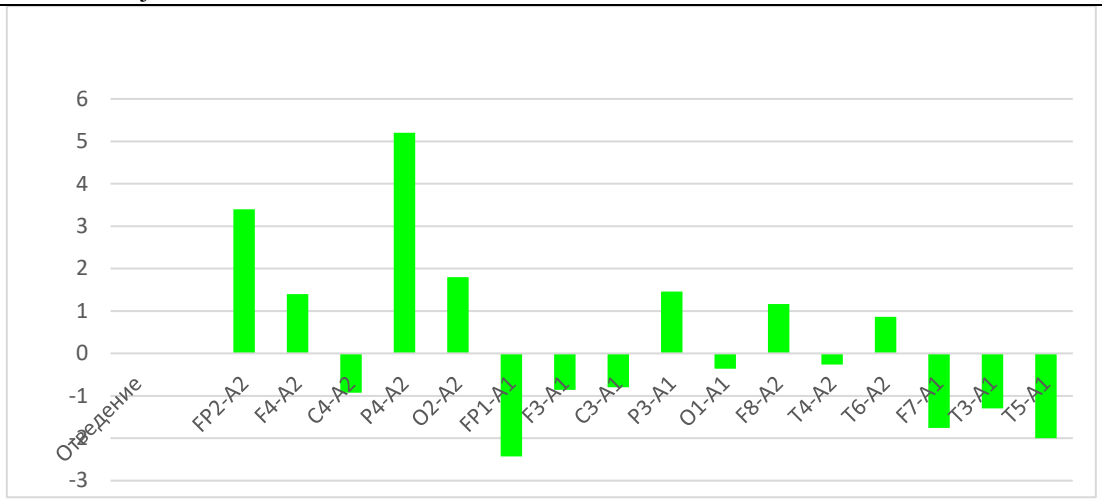

Рис. 4 Гистограмма разницы индекса бета-1-ритма при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Обозначения те же, что на рис. 1

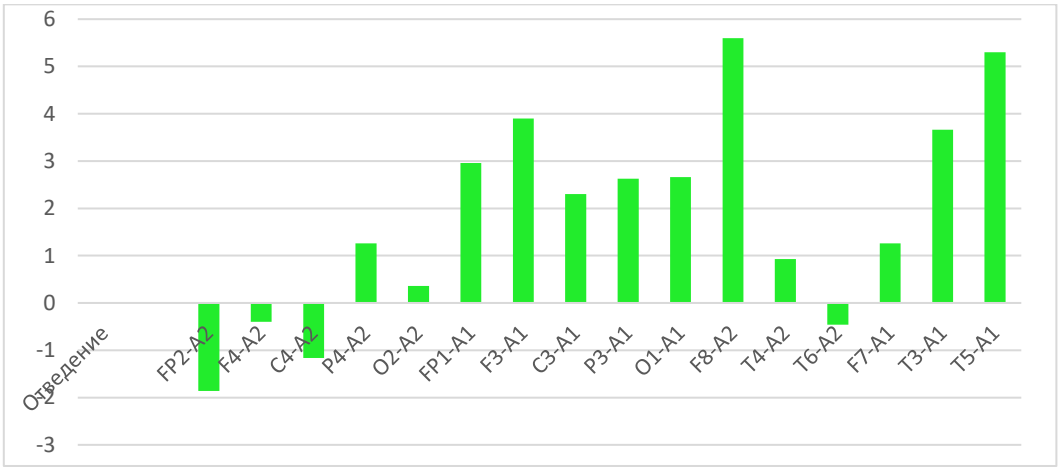

Рис. 5 Гистограмма разницы индекса бета-2-ритма при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Обозначения те же, что на рис. 1

Рис. 4 и (рис. 5) свидетельствуют о том, что при смене покоя счетом в уме, в геомагнитно-спокойные дни повышается индекс бета-ритма, отчетливо выраженный в спектре высокочастотного диапазона. Динамика индексов бета-ритма при смене состояний, свидетельствует об усилении восходящих влияний активирующих механизмов неспецифических систем, формирующим оптимальное функциональное состояние корковых областей, нужное для успешного выполнения намеченных заданий.

При смене состояния покоя счетом в уме, наблюдается увеличение амплитуд альфа- и бета-ритмов ЭЭГ, за исключением существенного диффузного снижения амплитуды дельта-ритма и незначительного снижения амплитуды тета-ритма.

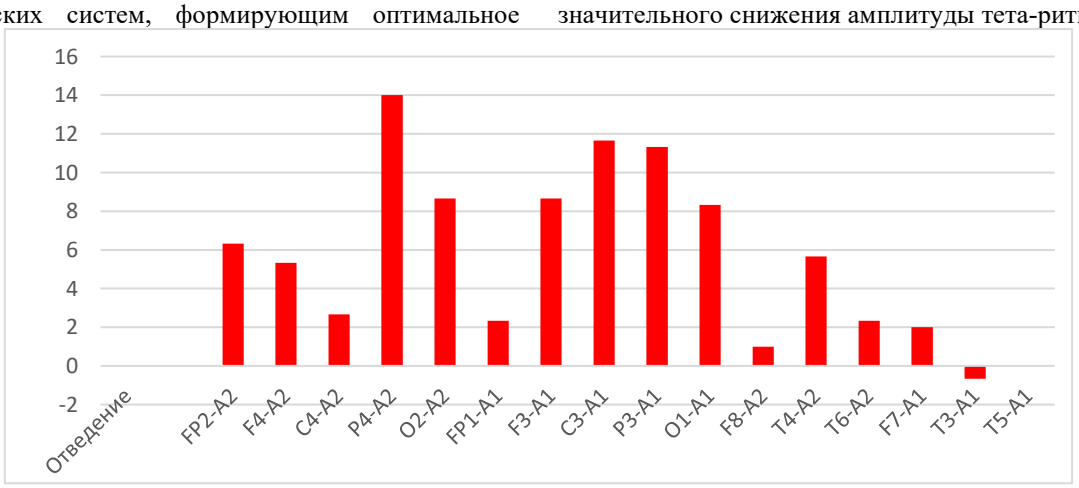

Рис 6. Гистограмма разницы амплитуды альфа-ритма при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Ось абсцисс – области коры (отведения) обеих гемисфер, по оси ординат – динамика выраженная разницей величин амплитуды дельта-ритма в состоянии умственного напряжения и в покое.

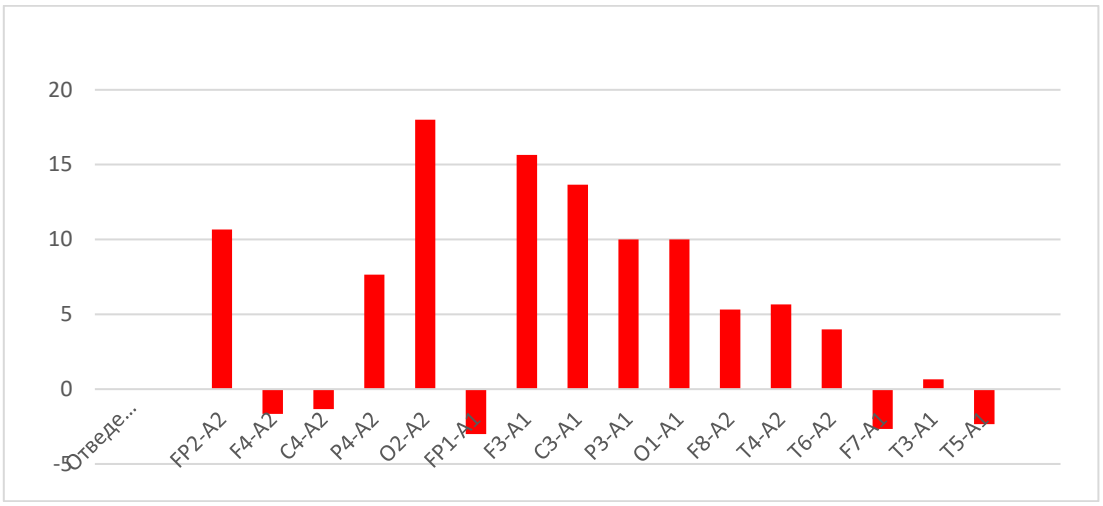

Рис. 7 Гистограмма разницы амплитуды бета-1 при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Остальные обозначения те же, что на рис. 6

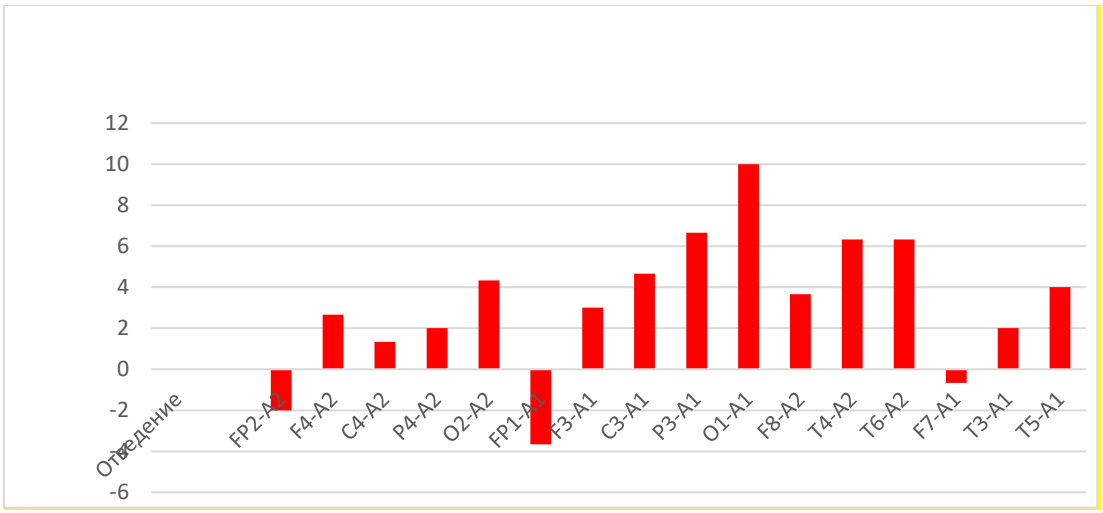

Рис. 8 Гистограмма разницы амплитуды бета -2 при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Остальные обозначения те же, что на рис 6

Из представленных рисунков видно, что в дни со спокойной геомагнитной обстановкой практически по всем отведениям смена покоя умственной деятельностью сопровождается повышением амплитудных показателей альфа и бета ритмов. При этом значимых изменений в амплитудных показателях медленных ритмов при смене состояний не наблюдалось. Динамика амплитуды ритмов при переходе от покоя в состояние умственной деятельности, свидетельствует о формировании структуры ЭЭГ с большей энергией, главным образом быстрочастотных диапазонов. отражающих более оптимальный вариант функционального состояния, необходимого для решения поставленной цели Значимые различия в частотных характеристиках наблюдались в диапазонах тета- и бета-2 ритмов. Так, переход в состояние решения задачи сопровождался увеличением частоты тета ритма и выраженным увеличением частоты бета-2 ритма.

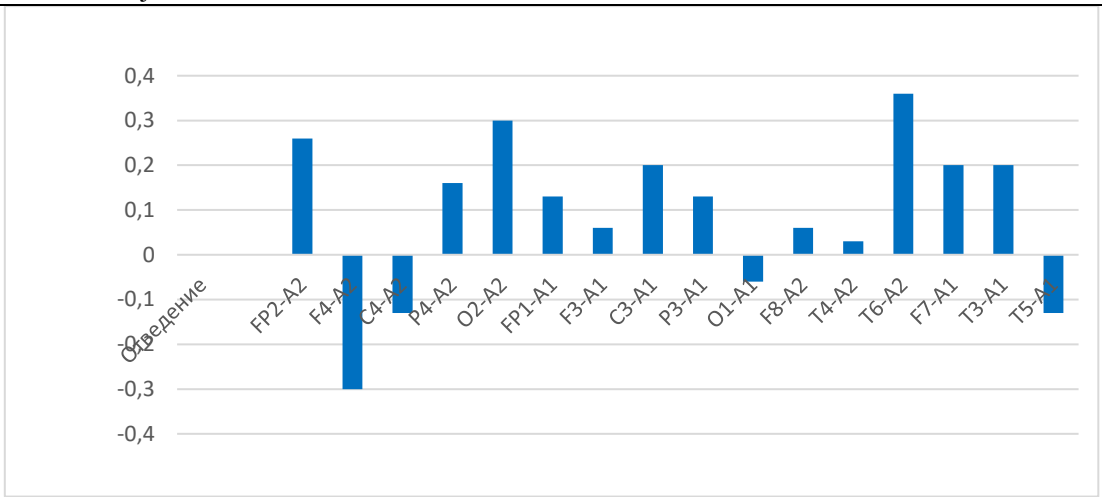

Рис. 9. Гистограмма разницы частоты тета-ритма при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Ось абсцисс – области коры (отведения) обеих гемисфер, по оси ординат – динамика выраженная разницей величин частоты дельта-ритма в состоянии умственного напряжения и в покое.

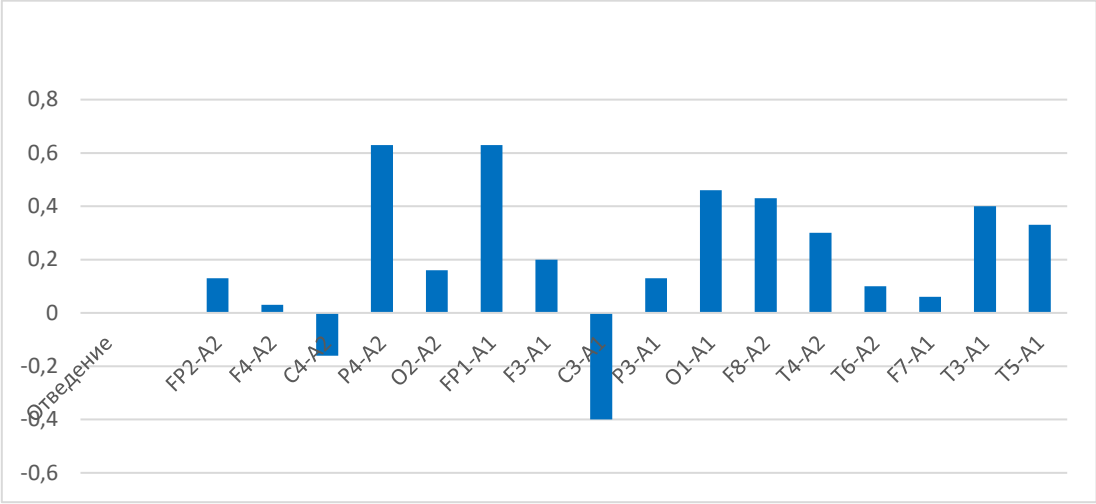

Рис. 10 Гистограмма разницы частоты бета-2 ритма при переходе от состояния покоя в умственное напряжение у женщин 30-35 лет. Остальные обозначения те же, что и на рис. 9

Таким образом, результаты проведенного исследования свидетельствуют, что в геомагнитно-спокойные дни у молодых женщин смена состояния покоя активной мыслительной деятельностью, сопровождается выраженными изменениями частотно-амплитудных и индексных характеристик медленного и быстроволнового компонентов ЭЭГ. При этом рассматривая соотношения медленные-быстрые ритмы можно отметить их противоположную зависимость, наиболее ярко выраженную в индексных и амплитудных характеристиках ритмов. Повышение процентной представленности быстрых ритмов, с увеличением амплитуды и учащением частоты, сопровождается снижением индекса медленных ритмов. Интерес представляет в состоянии умственной деятельности диффузное учащение частоты тета-ритма и увеличение его индекса в височных областях, что с одной стороны свидетельствует об активации гиппокампальной системы и с другой стороны по-видимому о особой роли височных областей, гиппокампально-височных связей в мыслительных процессах.

Подытоживая, следует отметить, что у молодых женщин в геомагнитно-спокойные дни, переход от состояния покоя к умственной деятельности, регулируется адекватным усилением деятельности активирующей неспецифической системы при ослаблении ее тормозных влияний на кору головного мозга. Настоящие результаты являются основой для проведения дальнейших исследований, касающихся влияния геомагнитных возмущений на деятельность головного мозга, находящегося в различных функциональных состояниях

Список литературы

1. Аллахвердиева А. А., Бабаев Э. С., Аллахвердиев А. Р. Психофизиологическое состояние женщин зрелого и пожилого возрастов в дни слабых магнитных бурь. Международная научно-практическая конференция. Киргизия. Ош. 15-18 мая 2018г, Ж. «Медицина Кыргызыстана» Бишкек, 2018, N1, с. 47-51.

2. Аллахвердиева А. А., Аллахвердиев А. Р. Воздействие гелиогео-магнитных аномалий на био-

электрическую активность головного мозга женщин 30-35 лет, Судак, 30 мая-10 июня, 2021, с. 56-57

3. Аллахвердиев А. Р Аллахвердиева А. А Функциональное состояние головного мозга женщин 30-35 лет в дни возмущения геомагнитной обстановки Земли. Материалы 12- Международной научно-практической конференции «Наука и Социум»: Инновации в медицине, психологии, педагогике» (часть 1). Россия, Новосибирск – Турция, Кемер 2-8 мая 2021 г. с 7-13.

4. Белобрыкина О. А., Аллахвердиев А. Р., Аллахвердиева А. А. Геомагнитные колебания как фактор риска эмоционального неблагополучия (на примере женщин зрелого и пожилого возрастов) Материалы IV Всероссийской научно-практической конференции с международным участием, РФ, Новосибирск, 4–5 марта 2020 г. с. 75-82.

5. Дорджиева Д. Б., Пантина Е. Е. Биоэлектрическая активность головного мозга индивидов с различным уровнем качества мыслительной деятельности // Естественные и математические науки в современном мире. 2015. №29. С. 142-146.

6. Иваницкий Г. А., Наумов Р. А., Роик А. О., Иваницкий А. М. Как определить, чем занят мозг, по его электрическим потенциалам? Устойчивые паттерны ЭЭГ при выполнении когнитивных заданий. Вопросы искусственного интеллекта. 2008, Т. 1, № 1, С. 93-102

7. Каратыгин Н. А Электрофизиологические корреляты различной результативности интеллектуальной деятельности: Автореф. дис…канд. биолог. наук. М., 2015. – с. 25

8. Коробейникова, И. И. Связь результативности интеллектуальной тестовой деятельности человека с различными спектральными характеристиками альфа-ритма фоновой ЭЭГ // Тюменский медицинский журнал. 2014. Т. 16, № 3. С. 50-53

9. Лобасюк Б. А., М. И. Боделан, В. В. Мартынюк, К. В. Аймедов, Системный анализ электрогенеза при счете в уме. Психиатрия, Психіатрія, Неврологія та Медична Психологія. Том 2, No2 (4) 2015 р. 17-22

10. Марютина Т. М., Кондаков И. М. Психофизиология. Учебник для вузов- Москва: МГППУ, 2004 с. 183

11. Новикова С. И Ритмы и когнитивные процессы, Современная Зарубежная Психология, Т: 4 , № 1 Год: 2015 С: 91-108

CULTURAL SCIENCES

DIGITAL TOOLKIT IN PROMOTING THE ACTIVITIES OF CULTURAL INSTITUTIONS ON THE EXAMPLE OF USING SEO-AUDIT

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Abstract
The article analyses the effectiveness of using digital tools in assessing the effectiveness of positioning the activities of cultural institutions in the Internet environment. On the example of SEO-audit of loading the mobile version of the pages of a cultural institution's website, the author draws attention to the need for an integrated approach in providing technical analytics and relevant competences of humanitarian specialists, which will improve the visibility of resources in search engines and create a quality user experience. The author stresses the importance of optimising web content and applying analytical data to improve communication with the client. The use of digital tools can significantly increase interest in cultural projects and events of cultural institutions, and will contribute to the successful promotion of their activities in the Internet environment.

Keywords: SEO (Search Engine Optimisation), promotion, mobile website, mobile formats, relevance, adaptability.

Introduction. The activities of cultural institutions in the digital age actively use SEO-promotion, i.e. technologies aimed at improving interaction with the audience through web resources or mobile devices. Adapting websites for mobile formats and optimising content is becoming a key success factor for organisations and brands to effectively attract and retain the attention of potential users.

Experts emphasise that simply creating a website is only the first step. It is necessary to systematically promote it to the first positions in Internet search engines. This process involves SEO-promotion and without these technologies users may not find the necessary resource and, consequently, do not use the necessary information or its services. If the site will not only meet the requirements of search robots, but will also be unique and useful content, then, from the point of view of economics, it will create a sustainable financial basis for further development of the organisation and long-term communication with the target audience [5].

In today's environment, when mobile technologies continue to actively develop, the loading speed of the pages of the website of cultural institutions on mobile devices becomes an important aspect for bringing users. Here, technical capabilities, correct operation of resources and their speed are key in bringing in customers.

According to research, more than 53% of users of mobile sites leave the page if it does not load within three seconds [8].

Mobile Internet is one of the most in-demand technologies today, thanks to which users can quickly and conveniently get information anywhere and anytime. As of January 2025, 61, 72% of all web traffic is on mobile phones. Over the last ten years, the share of mobile web traffic in the world has doubled, while desktop traffic has dropped by 80% [1].

However, not all cultural institutions systematically test the loading speed of mobile versions of the website, which affects the decreased level of interest of potential customers who cannot get the necessary information due to low adaptability of the content. This problem remains relevant for many cultural institutions. It is important that the loading speed of the main page of a cultural institution's website is adaptive for mobile devices and ensures that the web resource loads quickly and correctly.

Therefore, the purpose of the article is to justify the application of SEO-audit as a tool to analyse the correctness of loading the main pages of cultural institutions' websites in the digital space for effective interaction with the target audience.

The article also considers the relevance of adapting web resources of cultural institutions for various devices (mobile phones, tablets, etc.), which will provide them with an increase in the number of users and promote their activities in the Internet environment.

Main part. SEO (search engine optimisation) is a set of measures aimed at optimising a website in order to increase its visibility in search engines for certain user queries. The main goal of SEO is to increase organic traffic on the website by improving its position, thanks to internal and external customisation methods [4, c. 14].

The whole set of optimisation measures can be divided into two groups: optimisation of internal and external factors. The first includes work on content, site structure, tags. External optimisation consists in building up the link mass, which is taken into account by almost all search engines when ranking [10, c. 11].

In recent years, the trend for the growth of mobile traffic does not slow down, according to various estimates it ranges from 50% to 84% of the total flow: to ignore this - means to lose a large share of the audience. Lack of adaptability also negatively affects SEO - for search engines it is one of the ranking criteria [6].

A mobile version of a website is a specially adapted web page design for smartphones and tablets that provides easy reading and navigation without the need to zoom. Controls are optimised for touch screens,

and content and images are scaled to facilitate user interaction with the site on small screens [6].

To evaluate a web resource in SEO-analysis, experts use terms-characteristics that describe: the potential of the site, usability, visuals of the home page (beautiful/unpretty), navigation tools.

Beautiful means a resource that is not only superior to competitors in terms of appearance, but also helps the user to choose specific services of the organisation. The concept of 'beautiful site' also includes visual elements and technical characteristics, such as, for example, loading speed, adaptability, performance, friendliness [2, c. 111].

Being mobile friendly is not a prerequisite for high rankings. But most ranking sites are adaptive. Having a well-formatted web page code for them to be successfully indexed by search engines, especially in Google has an impact on its algorithms. Essentially, Google's bot deducts points from a website that is not properly configured and blocks its promotion.

If a web page's code and algorithms are properly formatted, it helps the page play better with search engine robots and can have a positive impact on its ranking in the search area. Otherwise, if the site contains errors or is not compliant, this can lead to indexing problems and a reduction in the site's code in search.

That is, the Google search engine cannot visually see the site, but the bot knows how the right site should be set up to become adaptive at any screen resolution. Google is known to consider two main coding factors: performance (speed of code structure and images) and adaptive design.

Google categorizes adaptive designs differently than non-adaptive designs. Ultimately, for a website to rank higher in Google search results, it must have adaptive properties [9].

Why is it necessary to optimise a cultural institution's website for mobile devices? First of all, optimisation allows [3]:

– to occupy higher positions in search results;

– increase interaction with users. More than half of search queries on Google.com are performed by users of mobile devices;

– expand traffic for many advertisers, as it consists predominantly of visits from mobile devices;

– adapt the mobile version of the institution's website to meet technical requirements. Users are five times more likely to leave non-optimised resources.

Optimisation of the mobile version of the site is performed according to the same scheme that was used for the desktop - the version of the site that is viewed by users from desktop computers [7]:

– compilation of relevant meta tags;
– optimising old or preparing new content;
– performing micro markup;
– optimising images;
– elimination of technical errors;
– re-linking, other works.

The algorithm of SEO-optimisation of websites of cultural institutions for mobile devices implies, first of all, checking their loading speed and convenience of searching for the necessary information from the user's point of view.

The convenience of the resource plays an important role in the user's decision to stay on the page or leave. Optimising the loading speed of a site for mobile devices means implementing simple and clear navigation that allows you to quickly find the content you need.

Conducting a speed audit of the mobile version of a cultural institution's website is a mandatory step in ensuring its efficiency and accessibility. The audit allows you to identify bottlenecks that can slow down the loading of pages, and thus negatively affect the user experience and positions in search queries.

A loading speed audit can be performed using various tools such as Google PageSpeed Insights, mobile website speed testing tool and others. The general audit algorithm includes the following steps:

1. Select a tool: Determine which tool will be used for the analysis. For example, Google PageSpeed Insights provides detailed performance reports for both mobile and desktop versions of the site.

2. Input URL: Enter the URL of the page to be examined in the description of the field connection tool.

3. Data Analysis: Once the analysis tool is run, a report is generated that includes key metrics such as First Content Posting (FCP), Speed Index and Time to Interaction (TBT). These metrics help to understand how fast the content loads and how fast the user can interact with the site (detailed characteristics of the metrics are described below).

4. Identify problems: Pay attention to the optimisation tips that the tool provides. These usually include tips on image size reduction, code minimisation and shared caching.

5. Bug Fixing: Based on the findings, develop a plan to fix the identified problems. This may include technical changes to the site or content optimisation.

6. Re-audit: After making changes, it is common to re-audit to evaluate the effectiveness of the measures taken beforehand and to see if load speeds have improved.

Conducting a page load speed audit of an organisation's website is necessary to achieve several objectives:

- improving user experience: Fast page load speeds ensure improved user satisfaction, which is especially important for cultural institutions seeking to attract and retain visitors' attention;

- improving search engine performance: Loading speed is a factor in search engine ranking. Optimised sites have a better chance of ranking high in search positions;

- reducing bounce rates: Slow sites often result in high bounce rates, which negatively affects overall traffic and user accessibility.

Therefore, page load speed audits of mobile versions of cultural institution websites represent a traceable part of an SEO optimisation strategy that ensures compliance with the site's technical specifications, as well as its overall effectiveness in the digital space.

Conclusion. In summary, the SEO optimisation process involves both internal and external methods. Internal optimisation is related to working with content, meta tags, site structure and usability, while external

optimisation is related to building link mass and increasing the authority of the site through interaction with other competitors. Conducting a mobile page load speed audit becomes not just a technical decision, but a strategic step to ensure the competitiveness of cultural institutions in the digital space.

In today's environment, where page load speed is a crucial factor for improving the performance of cultural institutions' web resources, SEO tools allow optimising and improving technological solutions. Effective tools such as Google PageSpeed Insights, Pingdom Tools and GTmetrix provide detailed reports on website performance, including necessary metrics and recommendations for optimisation. These tools not only measure page load times, but also identify low performing options that can negatively impact user experience. With users' growing dependence on mobile devices, slower loading speeds of mobile versions of web resources can lead to high risks and lower conversion rates. Therefore, the use of specialised tools for speed analysis is becoming a reasonable requirement in improving the efficiency of site loading in search resources and the timeliness of delivering advertising information to users.

As a result, a systematic approach to SEO-audit of the loading speed of the mobile version of the website of cultural institutions allows not only to meet the modern requirements of search engines, but also to create a positive user experience, which ultimately affects the reputation of the brand and increase customer loyalty.

References

1. Бегин, А. Мобильный интернет доминирует в мире 2025 // INCLIENT.RU. – URL: https://inclient.ru/mobile-internet-stats// (дата обращения: 15.01.2025).

2. Дыкан, А. Увеличение продаж с SEO / А. Декан, И. Севостьянов. – СПб.: Питер, 2016. – 272с.

3. Как оптимизировать сайт для мобильных устройств // материалы поисковой системы Google. URL: https://support.google.com/google-ads/answer/7323900?hl=ru. (дата обращения: 03.01.2025).

4. Мелькин, Н. В. Искусство продвижения сайта. Полный курс SEO: от идеи до первых клиентов: руководство / Н. В. Мелькин, К. С. Горяев. — 2-е изд. — Вологда: Инфра-Инженерия, 2018. – 268 с.

5. Молочков, В. П. Создание сайта, его SEO-продвижение и монетизация. Самоучитель. – СПб.: БХВ-Петербург, 2022. – 512 с.

6. Оптимизация сайта под мобильные устройства: [сайт]. – AskUsers.ru. – URL: https://askusers.ru/blog/seo/optimizatsiya-sayta-pod-mobilnye-ustroystva/. (дата обращения: 02.02.2025).

7. С чего начать оптимизацию мобильного сайта? // Веб студия «ВебРост». – URL: https://vebrost.ru/blog/optimizatsiya-mobilnoy-versii-sayta-instruktsiya-s-primerami// (дата обращения: 17.01.2025).

8. Толкач, А. Значение оптимизации скорости загрузки страниц для продвижения сайтов в поисковых системах / А. Толкач // медиа-ресурс Maxi.by. – URL: https://media-maxi.by/articles/znachenie-optimizatsii-skorosti-zagruzki-stranits-dlya-prodvizheniya-saytov-v-poiskovykh-sistemakh/. (дата обращения: 21.01.2025).

9. Media Genesis' responsive design test: is your site responsive? // Media Genesis. URL: https://mediag.com/blog/responsive-design-checker-by-media-genesis-is-your-site-responsive/ (accessed on: 02.02.2025).

10. SMM и SEO-технологии: учебное пособие / Ю. П. Беленькая, А. Ю. Бережнов, А. С. Новикова, П. И. Срыбная. — Ставрополь: СКФУ, 2017. — 62 с.

EARTH SCIENCES

VITALITY STRUCTURE OF *SALIX ROSMARINIFOLIA* POPULATIONS IN FOREST AND MEADOW PHYTOCENOSES

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Abstract

In the face of aggressive anthropogenic pressure on natural ecosystems, the urgent task of ecology is the study and preservation of rare species of flora. The paper presents studies of model populations of *Salix rosmarinifolia* L. in particular their vitality structure in forest and meadow phytocenoses of the Desniansko-Starohutsky National Nature Park and Roztochchya Biosphere Reserve. An analysis of the ecological and coenotic conditions of the species' existence showed that flat areas of land in deciduous and mixed forests, forest edges and meadows are quite favorable for the normal functioning of its populations. Vitality analysis showed that in Betuleto (pubescens)-salicetum (repentis) conditions on floodplain meadows and forest edges, thriving populations of S. rosmarinifolia were formed with quality indices of 0.46-0.49 and a predominance of plants of the middle vitality class (B). In the associations *Peucedano-pinetum, Salicetum (pentandro)-cinereae, Betuletum (humilis)-sphagnosum* equilibrium populations with quality indices of 0.26-0.34 were formed.

Keywords: *Salix rosmarinifolia L.*, vitality analysis, population quality index, ontogeny, phytocenoses, rare species, biodiversity, association.

Introduction

The National Program for the Conservation of Biological Diversity for 2005-2025 [11] provides for monitoring and protection of populations of rare and endangered plant species. Species included in the nature conservation lists require special attention. This is due to the destruction of their biotopes and the reduction of their natural habitats. As a rule, rare species are represented by small populations, are characterized by low competitiveness and are confined to certain ecological niches [13].

In the period 2021-2023, field research was conducted on the territory of the Desniansko-Starohutskyi National Park and Roztochchya Biosphere Reserve. Object of study - *Salix rosmarinifolia* - a regionally rare species that is protected in the Sumy regionis [10]. It is a deciduous, squat shrub up to 1 m tall. The species is widespread in Europe, Siberia, the northern regions of Central Asia, and the Far East [6]. It grows on moist soils - floodplain meadows, peat bogs, forest edges, forest glades, pine terraces both on plains and in mountainous areas [12].

Methods

In the process of conducting geobotanical observations, methods were used [1, 7, 9]. Population studies were conducted according to generally accepted methods [8].

To compare the impact of ecological and coenotic conditions on the development of populations of rare plant species, their vitality analysis was conducted, the theoretical foundations of which were formulated by Yu.A. Zlobin [14]. The assessment of the vitality of populations was carried out on the basis of morphometric indicators of plants with the establishment of a quality index for each studied population.

Quantitative traits that reflect the vital state of plants in populations are selected taking into account the following criteria: they must be biologically significant for the species in different growth conditions, the set of traits includes those that, according to the results of factor analysis, have a valid confidence level. Traits that are highly correlated with each other are not used for analysis - for example, such pairs of traits as leaf length and its area. The integral morphoparameters that highlight the vitality of the population often include leaf surface area, plant height, number of generative organs, total phytomass of the plant or mass of inflorescences. But since the work investigated rare species, only those parameters were used, the collection of which does not cause damage to the plant.

There are 3 classes of vitality of individuals and populations: higher (A) within 0.66-1.0: average (B) within 0.33-0.66; lower (C) within 0-0.33.

The population quality index Q can vary from 0 to 0.5. Quality index values from 0 to 0.17 indicate that the population is depressed; if Q is within 0.18-0.34, the population is in equilibrium; Q values from 0.35 to 0.5 indicate that the population is thriving.

In the process of collecting morphometric data, due to the rarity of the studied species, exclusively non-destructive methods were used [3, 5]. This methods involve the use of only those morphometric parameters in the analysis of populations that can be measured without harm to plants, which is provided for by the provisions of the Convention on Biological Diversity and the

Convention on International Trade in Endangered Species of Wild Flora and Fauna [2].

For the convenience of statistical processing of actual data and graphical presentation of results, the Statistics for Windows, Excel, Vital application packages were used.

Results

Salix rosmarinifolia occurs in several habitats in the park, in floodplain meadows, peat bogs, and in depressions near water bodies. The area of population fields of *S. rosmarinifolia* varies depending on the ecological and coenotic conditions of existence within 50 - 400 m2.

The first population (P1) is located in the floodplain of the Desna River south of the village of Borovichi (Fig. 1) in the ass. *Betuleto (pubescens)-salicetum (repentis)*. The dominant species are Frangula alnus, Salix rosmarinifolia, *S. cinerea, Deschampsia cespitosa, Lysimachia vulgaris, Potentilla erecta*. The projective cover of the herbaceous-shrub layer is 70%, the moss layer is absent. The area of the population field of the willow is 50 m2, the population density is 3 pcs./10 m2.

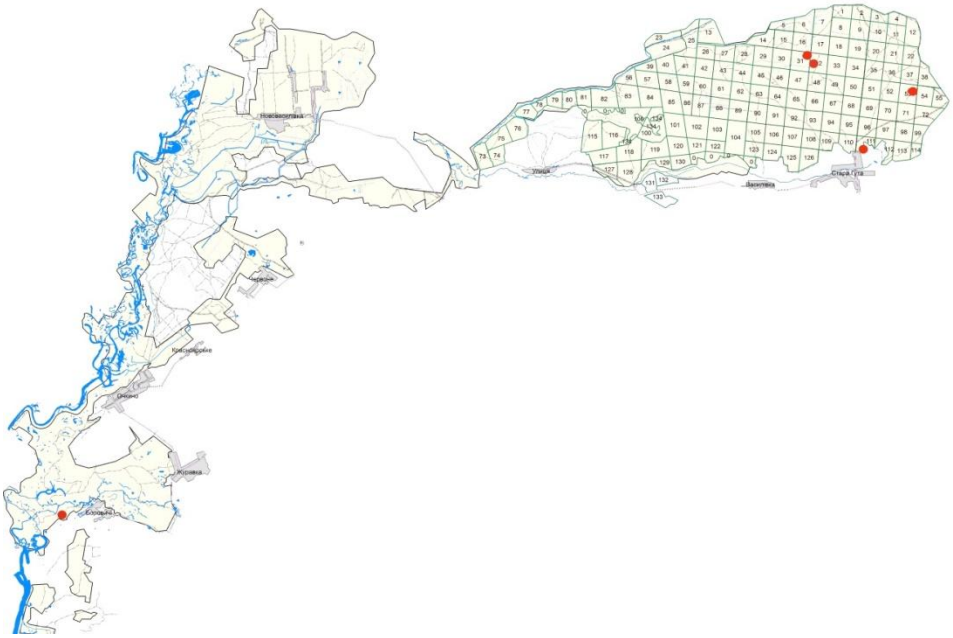


Fig. 1. Locations of Salix rosmarinifolia populations in the Desniansko-Starohutsky National Nature Park [4]

The second population (P2) is located in square 53 on section 5 of the Starohutsky forest massif in the Peucedano-pinetum group. The canopy cover of the tree stand is 80%, the shrub layer cover is 45%, the projective cover of the herbaceous-shrub layer is 45%, and the moss layer is 80%. The area of the population field is 40 m2. The tree layer is dominated by *Pinus Sylvestris* (80%) and *Betula pendula* (10%), while the shrub layer is dominated by *Corylus avellana, Frangula alnus* with a projective cover of 30%, *Salix cinerea, and Sorbus aucuparia.* The herbaceous-shrub layer is dominated by *Vaccinium myrtillus* with a projective cover of 50%, *Molinia caerulea, Trientalis europaea, Rubus saxatilis*, and *Festuca ovina*. The moss layer is represented by the species *Dicranum polysetum, Pleurozium schreberi*. The population density of *S. rosmarinifolia* is 0.25 pcs./10 m^2.

The third population (P3) of S. rosmarinifolia is located in the area 111 of the Starohutsky forest massif in the ass. *Salicetum pentandro – cinereae*. The canopy cover of the tree stand is 20%, shrubs – 80%. The projective cover of the herbaceous and shrub layer is 60%, moss layer – 40%. The dominant species of the tree layer: *Alnus glutinosa, Betula pendula*, shrub layer - *Salix cinerea, Frangula slnus*, herbaceous and shrub layer - *Carex elongata, Caltha palustris, Thelypteris palustris, Filipendula ulmaria, Gallium palustre, Potentilla palustris, Phragmites australis.* The moss layer is represented by *Climacium dendroides, Aulacomnium palustre, Calliergonella cuspidata.* The area of the population field is 100 m2, population density - 1 pc./10 m^2.

The fourth population (P4) of S. rosmarinifolia, which was studied, is located in the area 31 of the Starohutsky forest massif in the ass. *Betulo-Salicetum repentis*. The canopy cover of the tree stand is 20%, the canopy cover of the shrubs is 60%. The projective cover of the herbaceous-shrub layer is 55%, the moss layer is 45%. The dominant tree layer is *P. Sylvestris* (20%), the shrub layer is *S. rosmarinifolia* (50%), *S. cinerea* (10%), including the undergrowth of *P. sylvestris, B. pubescens*. The herbaceous-shrub layer is dominated by *Calamagrostis canescens, Geum rivale, Filipendula ulmaria, Lysimachia vulgaris, Phragmites australis, Potentilla palustris, Agrostis stolonifera, Carex juncella, C. rostrata, Equisetum palustre.* The moss layer is dominated by *Aulacomnium palustre* and *Climacium dendroides*. The area of the population field of the willow is 50 m2, the population density is 5 pcs./10 m^2.

For comparison, the fifth population (P5) of *S. rosmarinifolia* was examined in more humid conditions on the territory of the Roztochchya biosphere reserve, namely to the northeast of the village of Zhornyska, Yavoriv district, Lviv region. The landscape is a reclamation site on a peat bog. The population is located in the

Betuletum (humilis)-sphagnosum on an area of about 100 m2. The woody layer is absent in places, and in some areas it reaches 40%, *B. pubescens* prevails. The shrub layer is dominated by *Frangula alnus, Betula humulis, S. rosmarinifolia*. The herbaceous-shrub layer is dominated by *Molinia caerulea, Deshampsia caespitisa, Gallium boreale, Festuca ovina.* The moss layer is dominated by *Brachythecium campestris, Dicranum bonjeani, Plagimonium ellipticum*. Population density of *S. rosmarinifolia* – 4 pcs./10m^2.

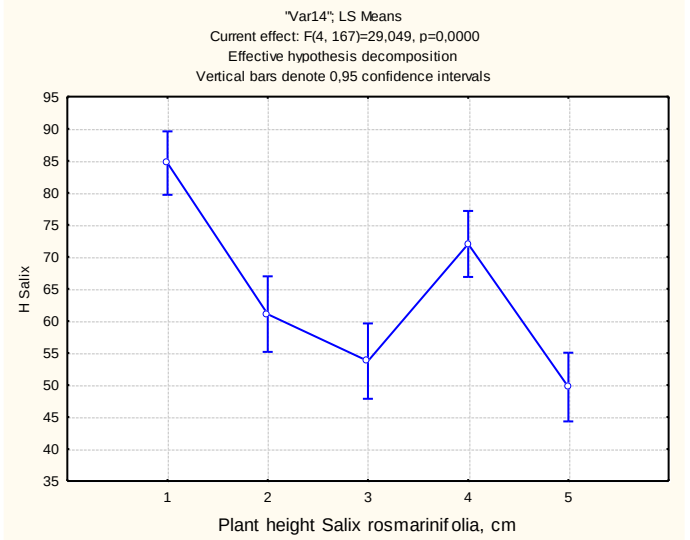
During the study, metric and allometric morphological parameters of *S. rosmarinifolia* plants were determined using non-destructive methods (Table 1).

Table 1

Confidence levels of morphometric data *S. rosmarinifolia*

Dependnt Variable	Test of SS Whole Model vs. SS Residual (+ Salix Marukhat1.sta) Multiple R	Multiple R?	Adjusted R?	SS Model	df Model	MS Model	SS Residual	df Residual	MS Residual	F	p
H Salix	0,640549	0,410303	0,396178	29973	4	7493	4,307768E+04	167	258	29,04906	0,000000
IL Salix	0,823824	0,678687	0,670990	49	4	12	2,333752E+01	167	0	88,18541	0,000000
SL Salix	0,647996	0,419899	0,406004	0	4	0	3,114586E-01	167	0	30,22023	0,000000
AL Salix	0,826126	0,682483	0,674878	34	4	8	1,578913E+01	167	0	89,73921	0,000000
A-Salix	0,393931	0,155181	0,134946	186428009	4	46607002	1,014927E+09	167	6077409	7,66889	0,000011
Nl- Salix	0,240518	0,057849	0,035283	5126022	4	1281506	8,348420E+07	167	499905	2,56350	0,040249
D - Salix	0,471090	0,221926	0,203290	7	4	2	2,529767E+01	167	0	11,90815	0,000000
Dk - Salix	0,168275	0,028316	0,005042	2	4	1	7,810371E+01	167	0	1,21666	0,305660
Pr-Salix	0,618904	0,383042	0,368264	1376	4	344	2,215913E+03	167	13	25,92070	0,000000
B1-Salix	0,358997	0,128879	0,108013	1341	4	335	9,066850E+03	167	54	6,17672	0,000117
Ng - Salix	0,453947	0,206068	0,187052	1186410	4	296603	4,570959E+06	167	27371	10,83637	0,000000
H/Ng Salix	0,147495	0,021755	-0,001676	0	4	0	4,270105E+00	167	0	0,92846	0,448848
H/A Salix	0,176823	0,031266	0,008063	0	4	0	4,720039E-03	167	0	1,34750	0,254487
NL/Ng Salix	0,333830	0,111443	0,090160	418	4	104	3,329484E+03	167	20	5,23628	0,000535
RE1- Ng/A *100 Salix	0,275202	0,075736	0,053598	86	4	22	1,053411E+03	167	6	3,42107	0,010203

To determine the quality of S. rosmarinifolia populations, such parameters as plant height, leaf surface area and number of inflorescences were used. These parameters had a sufficient coefficient of variation in different ecological-cenotic conditions. (Fig. 2).



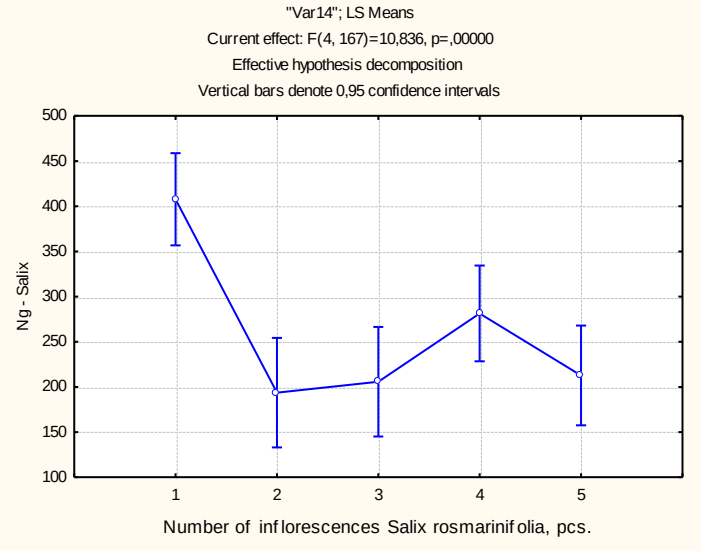


Fig. 2. The value of key morphometric parameters of S. rosmarinifolia in different ecological and coenotic conditions

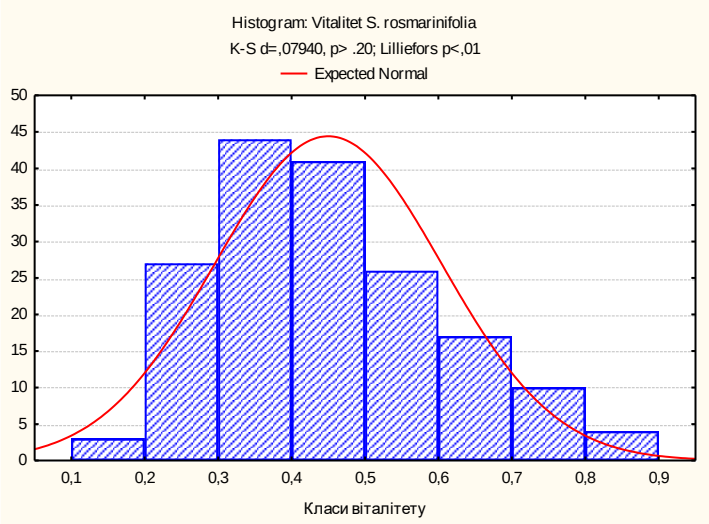


Fig. 3. Histogram of the frequency distribution of vitality classes of S. rosmarinifolia in the total sample

The histogram of the frequency distribution of vitality classes of *S. rosmarinifolia* shows that the main group of plants in the population is made up of individuals of the middle vitality class (Fig. 3).

Table 2

Vitality structure of Salix rosmarinifolia populations in different ecological and coenotic conditions

Phytocoenotic conditions	Vitality classes			Quality index Q	Population type	Location
	A	B	C			
Betuleto (pubescens)-salicetum (repentis)	0,27	0,71	0,02	0,49	Prosperous	Desna River floodplain
Peucedano -pinetum	0,0	0,62	0,38	0,31	Equilibrium	Square 53
Salicetum (pentandro)-cinereae	0,0	0,69	0,31	0,34	Equilibrium	Square 111
Betuleto (pubescens)-salicetum (repentis)	0,24	0,68	0,08	0,46	Prosperous	Square 31
Betuletum (humilis)- sphagnosum	0,0	0,51	0,49	0,26	Equilibrium	"Roztocha"

According to the ratio of vitality classes, two populations of *S. rosmarinifolia* were found to be thriving, both in *Betuleto (pubescens)-salicetum (repentis)* conditions (Table 2). The highest quality index of 0.49 was in the population that formed in the floodplain of the Desna River southwest of the village of Borovichi on an area of 50 m^2. The quality index of 0.46 was in the population that formed in the area of 5 m^2 in the area of 31 of the Starogut forest massif. The remaining populations are in equilibrium with different quality indices: Q 0.34 was in the conditions of Salicetum (pentandro)-cinereae in the area of 111 SLM, Q 0.31 - in the population of S. rosmarinifolia in the area of 5 m^2. 53 SLM in the Peucedano - pinetum association with an area of

40 m^2, Q 0.26 - in the population under Betuletum (humilis)-sphagnosum conditions on an area of 100 m^2 on the territory of the Roztochchya biosphere reserve, namely to the northeast of the village of Zhornyska, Yavoriv district, Lviv region, on a reclaimed peatland.

Anthropogenic impact on populations of rare plants in the park is constant, but during the years of military aggression from the east, the main factor in such impact was forest fires, which became more frequent as a result of regular bombing of the border area.

During the long-term fires in 2023, according to observations by the Global Fire Information Management System, 2,529.2 hectares of the Starogutsky forest massif in the eastern part were affected, which is 15.6% of the park's territory (Fig. 4).

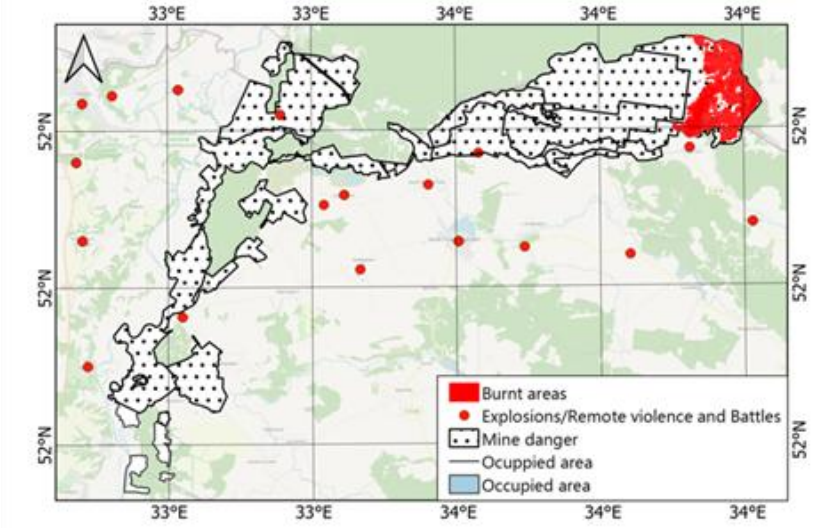


Fig. 4. The territory of the Desniansko-Starohutskyi National Park during the fire in May 2023 according to the Global Fire Information Management System

An extensive ground fire that broke out in the rainless spring of 2023 due to the use of heavy firearms and probable arson significantly affected the populations of the grass-shrub layer in the eastern part of the Starogutskyi forest massif. Populations of local species such as *Pinus sylvestris, Ulmus glabra Acer campestre, A. platanoides Primula veris, Corydalis solida, Clinopodium vulgare, Gallium boreale, Cardamine bulbifera, Steris viscaria, Pimpinella saxifrage, Trifolium montanum, Vaccinium vitis-idaea, V. myrtillus, Filipendula vulgaris* were affected to varying degrees.

Due to the effects of high temperatures, populations of rare flora species listed in the Red Book of Ukraine have suffered: *Huperzia selago, Diphasiastrum zelleri, Lycopodium annotium, Epipactis helleborine, Dactylorhiza incarnata, D.fuchsia, Platanthera bifolia, Carex brunnescens, Salix starkeana, S. rosmarinifolia.* The final determination of the state of their populations will be possible only after the end of hostilities. The probability of their underground diasporas remaining in moist areas of soil in relief depressions where the fire did not reach.

Conclusions and suggestions

Vitality analysis is an important tool for comparative analysis of the viability of plant populations in certain ecological and coenotic conditions. But to protect populations of rare species, including S.rosmarinifolia, it is necessary to overcome the consequences of military aggression on the territory of the Desniansko-Starohutskyi National Park.

To restore disturbed forest and meadow ecosystems and revive populations of rare flora species on the territory of the National Park of Forests and Forests, it is necessary to:

- After the end of hostilities, carry out measures to demine the territory, clear the soil of military artifacts, and level deep craters with the involvement of military specialists.
- Monitor the state of the park's vegetation cover to assess the current state of the park's forest and meadow ecosystems. Carefully investigate the areas that have been significantly affected by explosions and fires. Based on the monitoring results, develop strategic programs for the restoration of disturbed phytocenoses; organize groups of volunteers for the artificial restoration of damaged perennial plantings and undergrowth to feed phytophagous plants.
- Forest reclamation works. In the process of restoring damaged forest ecosystems, it is necessary to pay attention to the undergrowth, namely to plants that provide food and shelter for wild birds.
- To protect and preserve rare species of flora in the park, it is necessary to review and improve the legislative framework in the field of environmental protection and nature management in the recreational and economic functional zones of national natural parks.
- Continue the formation of an ecological network that will connect all natural zones of Ukraine with ecological corridors. This process is one of the most effective ways to preserve biological diversity. The sustainable functioning of the ecological network is ensured by introducing special regimes of economic activity and regulations for the use of natural resources within the territories of ecological corridors, which can be achieved by establishing a special nature protection status for such territories.

References

1. Bondarieva L.M., Kyrylchuk K.S., Skliar V.H., Tykhonova O.M., Zhatova H.O., Bashtovyi M.G. (2019). Population dynamics of the typical meadow species in the conditions of pasture digression in flooded meadows. Ukrainian Journal of Ecology. 9 (1). 2019. C.

2. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITIES), Appendices I, II, III of 25.05.2024 URL: https://cites.org/eng/app/appendices.php

3. Deswart E. Groenwold R., Kanne H. (2004). Non-destructive estimation of leaf area for different plant ages and accessions of Capsicum annuum L. The Journal of Horticultural Science and Biotechnology, 79, № 5. 764-770.

4. Desnyansko-Starohutskyi National Park. Official website. Access mode: http://www.nppds.inf.ua/

5. Flombaum P., Sala O. (2007). A non-destructive and rapid method to estimate biomass and aboveground net primery production in arid environments. The Journal of Arid Environments, 69, № 2. 352-358.

6. GBIF (2024) Global Biodiversity Information Facility. URL: https://www.gbif.org/ru/species/2816250

7. Kagalo O.O., Tsaryk Y.V., Skibitska N.V. et al. Proposals for the methodology for monitoring populations of plant species included in the Red Book of Ukraine. Bulletin of the Vasyl Stefanyk Precarpathian National University. Biology Series. 2012. Issue 17, 3–8.

8. Klymenko G., Kovalenko I., Lykholat Yu., Khromykh N., Didur O., Alekseeva A. (2017). The integral assessment of the rare plant populations. Ukrainian Journal of Ecology, 7(2). 201-209. doi: 10.15421/2017_37

9. Kovalenko I.M. Features of grass and subshrub reproduction in forest phytocoenoses. Biologichni Studii. Studia Biologica, 2016, 10 (1). 187–196. http://dx.doi.org/10.30970/sbi.1001.471

10. Official lists of regionally rare plants of the administrative territories of Ukraine (reference edition) / T. L. Andrienko, M. M. Peregrym. Kyiv: Alterpress, 2012. 148 p.

11. Resolution of the Cabinet of Ministers of Ukraine “On approval of the Concept of the National Biodiversity Conservation Program for 2005-2025 dated September 22, 2004 No. 675-p. https://zakon.rada.gov.ua/laws/show/675-2004-%D1%80#Text

12. Salix rosmarinifolia L. - rosemary willow]. Website "Natura Bogemica" URL: http://www.naturabohemica.cz/salix-rosmarinifolia/

13. Seidl, R., Albrich, K., Thom, D. & Rammer, W. (2018). Harnessing landscape heterogeneity for managing future disturbance risks in forest ecosystems. Journal of Environmental Management, 209, 46–56. https://doi.org/10.1016/j.jenvman.2017.12.014

14. Zlobin Yu.,. Kovalenko I., Klymenko H., Kyrylchuk K., Bondarieva L., Tykhonova O., Zubtsova I. (2021). Vitality Analysis Algorithm in the Study of Plant Individuals and Populations. The Open Agriculture Journal, 15, 119-129. https://doi.org/10.2174/1874331502115010119

ECONOMICS

CHALLENGES OF GEORGIAN INSURANCE MARKET AND SOLUTIONS TO OVERCOME THEM

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Abstract

The implementation of the principles of inclusive economy in Georgia created a competitive environment in business sector and motivation for successful activity.

Insurance business helps Georgian state to implement active social policies

Agriculture is one of the leading sectors of Georgian economy, therefore development of Agricultural insurance is an important guarantee of social protection and financial stability of farmers in Georgia.

The intensive growth of road traffic in Georgia and the increase in road traffic accidents made the need to create a low in Georgia about "mandatory civil liability insurance of a motor vehicles registered in Georgia". According to this law, third-party road users will be compensated for damage caused by the operation of motor vehicles.

During the "Covid 19" pandemic in Georgia, the form of direct sale of insurance products to corporate and individual clients was introduced in the insurance industry.

Keywords: Inclusive economics, risks, Insurance business, Agricultural insurance, Civil liability insurance.

Implementation of the principles of inclusive economy in Georgia, demanded from Georgian government to increase the targeting of socio-economic policies, which means the effective use of the material, financial and human resources available in the country. The active participation of citizens in industrial relations and the effective use of labor potential should be accompanied by a synergy that ensures the increase in the well-being of the population and the improvement of living conditions.

The main principle of the inclusive economy is establishment of justice mechanisms and tools in the distribution of wealth, which increases the importance of civil sector involvement in economic and public life.

The implementation of the principles of inclusive economy in Georgia created a competitive environment in the business sector and created motivation for successful activity.

Currently, Georgian economic has to deal with two challenges. These are adaptation to the applicable regulations related to joining the European Union and on the other hand protection of the internal market of Georgia.

Social imperatives take an important place in the inclusive economy as a process of socialization of the economy. According to Klaus Schwab, the founder and director of the World Economic Forum, "the existing perception of capital today must be changed. Modern consumers not only want more goods and services for less price, but also expect more social responsibility from corporations. The reset should give everyone who is in the back rows today the right to vote. Some of the pillars of the existing system should be changed, some should be corrected. This is what is needed for universal progress." [1]

Insurance business helps Georgian state to implement active social policies, since it compensates legal and physical persons for the losses caused by the realization of insured risks.

The challenges related to the process of world globalization (Capital concentration in the hands of large corporations, climate changes, pollution of the ecological environment, epidemics and others) have significantly increased the likelihood of risks and the demand for insurance products necessary to protect oneself from these risks.

In 2022, the global insurance business collected more than 5.6 trillion euros in insurance premiums for life, health, property and accident insurance, which is a record compared to previous years and is 4.9% higher than the same rate of the previous year. [2]

The insurance business of Georgia also grew stably from year to year. "In 2023, the insurance premium collected by insurance companies from direct insurance activities amounted to 1,063.6 million GEL; the similar figure in 2017 was only 441.40 million GEL. According to the results of 2023, the net profit of insurance companies amounted to 73.5 million GEL, while in 2017 their net profit was 20.34 million GEL.''[3]

From year to year, the value of the assets of Georgian insurance companies also increases. In 2023, the total assets of insurance companies amounted to 1300.9 million GEL, and the capital amounted to 374.3 million GEL. While the total amount of assets of insurance companies in 2020 was 915.8 million GEL, and the amount of capital was 279.1 million GEL. "[4]

[1] Schwab K., Zahidi S. (2018), 10 Things You - and Your Government - Should Know about Competitiveness in the Fourth Industrial Revolution, [online] 16 October;

[2] https://www.interfax.ru/business/904910

[3] https://insurance.gov.ge/ka/Statistics

[4] https://insurance.gov.ge/ka/Statistics

Although the insurance industry in Georgia is developing dynamically, its share in the country's economy is still small. "According to the data of 2023, the ratio of the volume of the total insurance premium in relation to the gross domestic product amounted to only -2.0%" [5], while in the same period the same indicator was11.6% in the USA, 10.5% in Britain, 5.9% in Germany." [6]

In recent years, new trends in the development of insurance business have appeared in the European insurance market, which is due to new technologies, (including artificial intelligence) demographic changes, and new legislative regulations. Technological innovations have significantly changed the practices of risk assessment, customer relations and database processing in the insurance industry.

The increase in life expectancy in Europe has significantly changed the structure of insurance services, which was reflected in the increase in demand for life and health insurance.

Increased risks from natural disasters due to climate change and meeting their insurance demand have also become one of the significant problems for the European insurance industry.

As for the insurance industry of Georgia, it is characterized by certain specificities and trends, which were formed in the course of the historical development of this branch of the economy since the 1990s. Specificity and trend mean that the leading position in insurance services is occupied by auto insurance and medical insurance. "According to the data of 2023, the share of auto insurance in the total insurance premium was 19.3%, medical insurance - 42.1%."[7]

Agriculture is one of the leading sectors of the Georgian economy, therefore the development of agricultural insurance is an important guarantee of social protection and financial stability of farmers in Georgia. Agricultural insurance not only protects the income of farmers from various risks, but also stimulates the production of agricultural products and increases the export potential of the country. Agricultural insurance has been growing rapidly for the last few years. "In 2023, the amount of premiums raised in this field increased by 112.2% compared to the previous year and amounted to 18.4 million GEL, and according to the data of the nine months of 2024, this number was 21.6 million GEL. We must notice that agricultural insurance is one of the riskiest insurance product. The amount of insurance lose in 2023 amounted to 18.7 million GEL, which means that agricultural insurance was not profitable for the insurance business in 2023.'[8]

The agricultural industry in Georgia is significantly affected by natural risks, which are mainly related to climatic conditions. These are: drought, hail, flood and others. Since the production of agricultural products is associated with high costs and risks, it is extremely important to better adjust the state program of agricultural insurance to the needs of farmers and their financial capabilities in order to increase the interest of farmers in agricultural insurance in Georgia.

The intensive growth of road traffic in Georgia and the increase in road traffic accidents made the need to create a low in Georgia about "mandatory civil liability insurance of a motor vehicles registered in Georgia". According to this law, third-party road users will be compensated for damage caused by the operation of motor vehicles. Only from this line of insurance, business will have an income of approximately 200 million GEL, and insured individuals will be compensated for losses of 120 million per year. "[9] In order to create this effective mechanism of social protection, each vehicle owner is obliged to purchase a compulsory insurance policy and pay insurance premium.

During the "Covid 19" pandemic in Georgia, the form of direct sale of insurance products to corporate and individual clients was introduced in the insurance industry. It is really a convenient form of marketing, because considering the still low purchasing power of the population of Georgia, the value of these products is low and affordable. The ability to obtain insurance services is easy because they are obtained by phone or using the Internet.

References

1. Schwab K., Zahidi S. (2018), 10 Things You - and Your Government - Should Know about Competitiveness in the Fourth Industrial Revolution, [Online] 16 October;

2. Khizanishvili S., Gabisonia I., Taliashvili A. Justice, philosophical-legal aspects. "Universal" Publishing House, Vol. 2019 p. 5;

3. Gabisonia I., Taliashvili A., Khizanishvili S. Social justice and market economy, "Meridian" publishing house, tb. 2021. p. 9;

4. Vekua D., Tsertsvadze A. "Some aspects of overcoming property inequality in Georgia under the conditions of an inclusive economy", „New Economist" N1, 2024;

5. Vekua D, Taliashvili A. "bout the necessity of legal regulation of the economy of Georgia New Economist", INTERNATIONAL SCIENTIFIC-PRACTICAL QUARTERLY JOURNAL, PRECISE AND REVIEWED N2-3 (73-74), 2024, VOL.19, ISSUE 2;

6. https://www.interfax.ru/business/904910;

7. https://insurance.gov.ge/ka/Statistics;

8. https://www.geostat.ge/ka;

9. https://www.swissre.com/dam/jcr:0e365e0b-cb43-4c35-a72a-db4fb4a0ea51/2023-07-10-sri-sigma-world-insurance-en.pdf;

10. http://insurance.org.ge/index.php?a=main&pid=584&lang=geo;

11. https://www.ingos.ru/company/blog/2024/trendy-strahovaniya-v-evrope;

12. http://bin.com.ua(BusinessInformationNetworkh).

[5] https://www.geostat.ge/ka

[6] https://www.swissre.com/dam/jcr:0e365e0b-cb43-4c35-a72a-db4fb4a0ea51/2023-07-10-sri-sigma-world-insurance-en.pdf

[7] https://insurance.gov.ge/ka/Statistics

[8] https://insurance.gov.ge/ka/Statistics

[9] http://insurance.org.ge/index.php?a=main&pid=584&lang=geo

JURISPRUDENCE

A NEW BILL AGAINST FOOD WASTE TO GO FURTHER

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Abstract

The objective of this analysis is to highlight the urgency of quickly obtaining a new effective law against food waste.

Indeed, the alarming situation with regard to the social and environmental emergency requires a change in the law.

Indeed, with on the one hand an increase in impoverishment in our country and increasingly long queues at the « soup kitchen » and on the other hand the emergence of worrying global warming, citizens expect effective, innovative and adapted legal tools.

Let us recall that the French law of 3rd February 2016 had positive consequences that we will study.

However, we must go further with a new bill against food waste in order to adapt the legal framework to the current situation.

This is the objective of this legal analysis.

Keywords: Food Waste, European Law, sustainable development, Food lost, Bill, French Law, Food Waste, FAO.

INTRODUCTION

The Food and Agriculture Organization of the United Nations (FAO) estimates that thirty percent of the food produced worldwide is wasted.

This amounts to one out of every three foods worldwide.

However, according to the Food and Agriculture Organization (FAO), 783 million people globally faced hunger in 2022, and 3.1 billion people lacked access to a good food in 2021.

At the same time, the organization estimates that, globally, « 13% of food is lost in the distribution chain, from post-harvest to pre-retail and that an additional 17% of food is wasted at the household, food service and retail levels. »[11] [12]

The demand for food items has increased globally in recent decades due to changes in eating patterns and demographic growth.

The restrictions that agriculture faces—such as yield limits, technological integration, natural disasters, climate change, urbanization-related loss of agricultural lands, and scarcity of water resources—are placing growing pressure on agricultural productivity.

To fulfill the food supply, reducing losses and waste might be a key lever in addition to raising agricultural productivity.

It is impossible to distinguish clearly between the two concepts of « losses » and « waste » due to the wide variety of circumstances under which they arise across nations.

According to the FAO, 30% of food produced worldwide is wasted.

1.3 billion tons of food, or more than half of the world's grain supply, are lost or wasted annually worldwide, from agricultural production to ultimate consumption.

The issue at hand is worldwide: 670 million and 630 million tons of food are wasted annually in wealthy and developing nations, respectively.

According to FAO estimates, there will be an additional 2.3 billion people on Earth by 2050, bringing the total population to more than 9 billion. By 2100, there will be more people on the planet than 11 billion.

Food production will need to expand in order to keep up with the population's continued need for food.

Demand for food will continue to increase and it will be necessary to intensify food production to feed this population.

If this trend continues, the FAO estimates that global food production will have to increase by 40 to 70% by 2050 to meet needs.

It won't be sufficient to increase output at this rate of waste.

By examining the true demands of the consumer, we must investigate the strategies that should be used at every link in the food chain.

At every level, progress is achievable.

To create solutions that both « feed more » and « feed better » for a growing population, all stakeholders must band together.

Food waste and food insecurity are therefore two complex and interdependent phenomena. Food waste is a major problem, both environmentally and socially.

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[10] «Nobel Prize for sustainable development: lawyer Arash Derambarsh rewarded»: https://clever-energies.com/en/nobel-prize-for-sustainable-development-lawyer-arash-derambarsh-rewarded/

[11] FAO - 2022

[12] United Nations Environment Program, 2021

It represents a loss of valuable resources and can have a negative impact on people in food insecurity.

Therefore, the concept of food insecurity is often reduced to the question of access to sufficient food in quantity and quality.

The French law of 3rd February 2016 quickly proved its beneficial effects:

- More than 10 million meals are distributed each year in France.
- A 22% increase in food donations to charities.

However, due to the increase in impoverishment within the middle class and the establishment of increasingly long queues for the "soup kitchen", added to this a decrease in food donations to charities, it is necessary to provide even bolder responses.

Hence the filing of a new French bill against food waste in order to go further.

It is precisely because there is a social emergency and a crisis at the level of the food chain that it is appropriate to legally regulate these dysfunctions and economic imbalances.

So, can a new legal framework better regulate the food donation system ?

Our analysis responds to this problem with a requirement to accelerate the legislative process at the national level.

MAIN PART

I- A food scandal in front of social and environmental emergency

For a long time, food contributions were the subject of a controversy as most supermarkets tossed away their unsold stock instead of donating it to the underprivileged or nonprofit organizations. [13]

The fact that the Observatory of Inequalities estimates that 5.3 million individuals in France lived below the poverty level in 2023 makes this scenario much more concerning.[14]

Therefore, in order to put an end to this plague, specific answers had to be given.

The #StopFoodWaste movement led to the adoption of a legislation in France requiring retailers to give unsold food, preventing over 10 million meals from ending up in landfills and resulting in a 22% increase in food contributions to charitable organizations.[15]

Every grocery store in the European Union continues to discard more than 40 kg of food every night, despite the fact that more than 95.3 million people (or 22% of the population) live in poverty and frequently struggle to provide for their families in 2022.[16]

The #StopFoodWaste campaign's straightforward solution to this issue was to pass a national law encouraging stores to donate unsold food instead of throwing it out.

Passed on 3rd February 2016 [17], the new law seeks to tackle food waste by obliging all French supermarkets to give away their unsold food and distribute it to those in need, ensuring that nothing is wasted. Supermarkets are free to support the aid association or charity of their choice, and every citizen can apply to create an authorised association to assist in food distribution.

Over 10 million meals are prevented from ending up in landfills each year thanks to the regulation, which has also increased food donations to social assistance organizations by more than 22%. In addition to mobilizing volunteers and streamlining the distribution of food contributions through affiliated organizations, the initiative has increased public awareness of the problem of food waste at the municipal level.

II- The French city of Courbevoie as a driving force against food waste

Since the adoption of the law against food waste, voted on 11th February 2016, supermarkets have been required to donate their unsold food to charities. A world first.

In accordance with **LAW No. 2016-138** of 11th February 2016 relating to « *the fight against food waste* »[18], supermarkets whose sales area exceeds the surface area threshold of 400 square meters are required to donate their unsold consumable food to a charity. Failing this, the fine is 3,750 euros.

In 2019, an amendment increased the penalties in force. The one targeting food retailers that have not signed a donation agreement with an association, goes from a third-class fine (of a maximum amount of 450 euros) to a fifth-class fine (1,500 euros maximum). The amount of the administrative fine incurred for the destruction of consumable foodstuffs increases from 3,750 euros to 10,000 euros.[19]

Senator Esther BENBASSA explained the purpose of her amendment in the following terms on 20th September 2019:

«*It has been noted that some distribution players are still recalcitrant when it comes to applying the 2016 Law. It is therefore deemed necessary by the information report of June 12, 2016 on the evaluation of Law No. 2016-138 to make the penalties incurred more stringent so that they are more dissuasive.*

The penalty for non-compliance is currently punishable by a fixed penalty of the third class. This

[13] The Telegraph « Iceland staff 'pour bleach onto waste food to stop homeless people eating it' »: https://www.telegraph.co.uk/foodanddrink/foodanddrinknews/7564402/Iceland-staff-pour-bleach-onto-waste-food-to-stop-homeless-people-eating-it.html

[14] France Info: https://www.francetvinfo.fr/societe/plan-pauvrete/precarite-en-2023-5-3-millions-de-personnes-vivaient-sous-le-seuil-de-pauvrete-en-france_6304863.html

[15] Anti-food waste law: what results after 18 months ? (Le Figaro – 2018): https://www.lefigaro.fr/economie/le-scan-eco/2018/10/16/29001-20181016ARTFIG00007-loi-anti-gaspillage-alimentaire-quel-bilan-apres-18-mois.php

[16] Poverty in Europe (Statista 2023): https://fr.statista.com/infographie/17748/niveaux-de-pauvrete-en-france-et-en-europe/

[17] Law No. 2016-138 of 11th February 2016 relating to the fight against food waste: https://www.legifrance.gouv.fr/jorf/id/JORFARTI000032036290

[18] LOI n° 2016-138 du 11 février 2016 relative à la lutte contre le gaspillage alimentaire: https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000032036289/

[19] Amendement présenté par la sénatrice Esther BENBASSA: https://www.senat.fr/amendements/2018-2019/728/Amdt_213.html

amendment therefore proposes to increase it to a fine of the fifth class.

The penalty for destroying consumable foodstuffs is an administrative fine of 3,750 euros, which currently only applies to distributors in the food sector. This amendment proposes to increase this fixed fine to 10,000 euros ».

Thus, this law has quickly proven its beneficial effects:

- More than 10 million meals are distributed each year in France.

- A 22% increase in food donations intended for charitable associations.

This assessment is therefore positive, but we must go further and improve the law due to the increase in impoverishment in our country and the long queues for the « Meal Center ».[20]

Indeed, charities complain of a drop in donations. We must therefore find new solutions.

Since 2020, the City of Courbevoie has been pursuing a dynamic and bold policy to combat food waste and hunger.

And the results are remarkable: more than 500,000 meals saved and distributed to charities.

On 31st Friday January 2025, Courbevoie city welcomed agents of the Food and Agriculture Organization of the United Nations (FAO) for a major international conference.[21]

Many guests were present, including **Jacques KOSSOWSKI** (Mayor of Courbevoie city), **Divine NAGANJE NIJE** (Deputy Director of the Agri-Food Systems and Food Safety Division of FAO), **Myriam ANNETTE** (International Expert, Prevention and Reduction of Food Losses and Waste, at the FAO Regional Office for Europe and Central Asia), **Reza NAJIB** (FAO Programme Officer), **Roselyne BACHELOT-NARQUIN** (former Minister), **Jean-Jacques BOUYA** (Minister of State of Congo Brazzaville), **Frédéric SIMONIN** (Starred Chef, Meilleur Ouvrier de France 2019**), Franck PAPAZIAN** (President MediaSchool and co-president of the CCAF), **Manon MONTESSUIT** (chef), **Nabil ZEMMOURI** (Anti-waste Chef), Karim BOUAMRANE (Mayor of Saint-Ouen-sur-Seine city), **Joelle CECCALDI RAYNAUD** (Mayor of Puteaux city and President of POLD) and **Marie-Do AESCHLIMANN** (French Senator).

The United Nations agents were able to note that indeed, more than 500,000 meals were saved and redistributed to charitable associations so that the poor (middle class representing single mothers or fathers raising several children, retirees, unemployed or students) could eat their fill.

And thanks to these results, the city of Courbevoie has been recognized as an « ***FAO Green City*** ». [22]

And this change provides solutions to the current social situation in our country which is alarming.

This social situation also demonstrates that even in a city that appears « well-off », poverty has multiple facets. Poverty is increasing and the middle class is declining.

Thus in an alarming report, Secours Catholique estimated that nearly 10% of French people resort to food aid.[23]

Indeed, « between 5 and 7 million people » had recourse to food aid in 2020, warns Secours Catholique in its annual report on the state of poverty in France published on the basis of data from the General Directorate for Social Cohesion (DGCS).[24]

The city of Courbevoie has therefore shown inventiveness in its fight against food waste. [25]

The city of Courbevoie has therefore shown inventiveness in its fight against food waste.

It was therefore decided that with the help of several start-ups and social and economic actors, a charter against food waste would be voted on each year in all spheres of activity in the city:

• 2020 with all supermarkets located in the city without delimitation of surface area

• 2021 with hospital catering

• 2022 with school catering

• 2023 with food stores (food stores, restaurants, bakeries, markets)

• 2024 with retirement homes and nursing homes.

These commitment charters, a first in France, have a multiple objective:

• Create synergies so that everyone can take part in this fight and adapt their practices

• Participate in raising awareness among the general public about the fight against food waste

• Contribute to reducing the economic impact of this waste

• Set up food donation partnerships for associations in accordance with the law

• Promote partnerships with municipal associations

• Organize « anti-waste » promotions, particularly for products close to their use-by date (UBD)

• Offer wholesale or unit sales in order to adapt the quantities purchased and reduce packaging

• Promote the development of fresh products, and develop awareness-raising marketing operations (operation « Ugly Fruits and Vegetables », etc.)

• Conduct a discussion with suppliers in order to define a control strategy against food waste (product quality charters, etc.)

[20] « L'appel des Restos du cœur, révélateur des difficultés de tout un secteur face à la hausse des besoins »: https://www.lemonde.fr/societe/article/2023/09/07/l-appel-des-restos-du-c-ur-revelateur-des-difficultes-de-tout-un-secteur-face-a-la-hausse-des-besoins_6188233_3224.html

[21] « Le combat de Courbevoie contre le gaspillage alimentaire inspire d'autres élus et collectivités »: https://www.echoidf.fr/de-nouvelles-actions-contre-le-gaspillage-alimentaire/

[22] « Green Cities Initiative » (FAO): https://www.fao.org/green-cities-initiative/network/en

[23] « Pauvreté en France: 10% de la population a eu besoin d'une aide alimentaire en 2020 » (Université Paris Saclay): http://www.ritm.universite-paris-saclay.fr/poverty-in-france-10-of-the-population-needed-food-aid-in-2020/

[24] Site Ville de Courbevoie: https://www.ville-courbevoie.fr/2195/lutte-contre-le-gaspillage-alimentaire.htm

[25] The law on Food Waste - From Courbevoie to Assembly: https://resource.co/article/law-food-waste-courbevoie-assembly-10198

• Act to recover waste.

On the strength of all this work, the FAO designated the city of Courbevoie as a «***World Green City*** » in 2024, thus granting it formal recognition.

III-A new bill proposal to go further

It is precisely on this alarming situation that Senator Marie-Do AESCHLIMANN was asked to propose a new law to go further.

A « *Bill to strengthen the fight against food waste* » was therefore submitted to the Senate on 20th January 2025 and whose Text bears the reference number 247 (2024-2025).

The proposal was simple: modify the law against food waste promulgated on February 11, 2016.

• Reduce the current ceiling of 400 m2 imposed on supermarkets to reduce it to at least 100 m2 in order to include more than 5,000 additional points of sale.

• Increase the current fines of the 5th class representing 10,000 euros to 20,000 euros against supermarkets that continue to throw away unsold edible food.

It is precisely Senator Marie-Do AESCHLIMANN who is carrying this « *Bill to strengthen the fight against food waste* » tabled in the Senate on 20th January 2025 and whose Text bears the reference number 247 (2024-2025).

Here is the explanatory statement of ***Senator Marie-Do AESCHLIMANN***

Ladies and Gentlemen,

Every year, millions of tons of food are wasted in France, even though part of the population struggles to eat properly. This aberration, which is at once ethical, social and economic, requires renewed mobilization against food waste. Under Article L. 541-15-1 of the Environmental Code resulting from Law No. 2020-105 of 10th February 2020 relating to the fight against waste and the circular economy, food waste is defined as "any food intended for human consumption which, at any stage of the food chain, is lost, thrown away or degraded".

On a global scale, the equivalent of one billion meals would have been wasted every day in 2022, according to a report by the United Nations Environment Programme (UNEP). A waste that the director of UNEP1(*) describes as a "global tragedy".

In France, according to data from the Ministry of Agriculture and Food Sovereignty, food waste represented 4.3 million tons of food in 2022.

The worrying increase in food insecurity - which today affects 16% of the French population2(*) - makes throwing away edible food even more unacceptable. For the year 2023, it is estimated that 2 to 3 million3(*) people benefited from food aid distributed by associations.

This development is closely linked to the context of food inflation. After an 11% price increase in 2022, the Observatory published by rural Families recorded a further 16% price increase for fruits and vegetables in 2023.

In addition, according to the Observatory of Food Vulnerabilities created by the Nestlé Foundation, 37% of French people declared themselves to be food insecure in 2023, compared to 11% in 2015. This study also reveals that young people aged 18-24 are particularly affected, as are women, single people and single-parent families4(*).

With an estimated cost of 16 billion euros per year in France and 1,000 billion dollars for the global economy5(*), food waste has consequences that are not negligible on the economic level.

Finally, its environmental cost is particularly significant since it represents 8 to 10% of global greenhouse gas emissions6(*). According to the Waste and Resources Action Program (WRAP), if it were considered a country, food waste would be the "third largest emitter of greenhouse gases behind the United States and China". In France, the Agency for Ecological Transition (ADEME) estimates this impact at 15.3 million tonnes of CO2 equivalent, or 3% of all our emissions7(*).

The fight against food waste is therefore a major ethical, ecological, social and economic challenge for our society. Since signing the National Pact to Combat Food Waste in 2013, France has resolutely taken up this issue by strengthening its legislative arsenal in order to raise awareness and involve all stakeholders in the food chain in the fight against food waste, in particular through the practice of food donations, which is an essential lever in the fight against poverty.

Thus, as a result of the successive laws adopted over the last ten years, the list of stakeholders affected by the obligation to conclude food donation agreements with associations has continued to grow. Initially applied to distributors with a sales area of more than 400 m², this obligation has been extended to operators of collective catering serving more than 3,000 meals per day as well as to operators in the agri-food industry and wholesale trade whose turnover exceeds 50 million euros.

At the same time, the associative world, communities, but also companies and players in the food sector, have also committed to developing virtuous initiatives aimed at reducing waste. This is the case, for example, of the city of Courbevoie, in Hauts-de-Seine, where under the leadership of Arash Derambarsh, deputy mayor, a Charter of Commitment against Food Waste signed with local stakeholders has made it possible to save and redistribute 400,000 meals in four years. In 2024, this proactive approach earned Courbevoie the title of "green city" awarded by the Food and Agriculture Organization (FAO), the specialized agency of the United Nations (UN)8(*).

Despite real awareness at all levels since 2013, due to a lack of tools and indicators, it has not been possible to accurately assess the volume of food waste sources and their evolution. The objective assigned by the anti-waste law for a circular economy (AGEC) of February 20, 2020, proclaiming a goal of reducing food waste by 50% by 2025 compared to 2015, has consequently proven to be ineffective. However, the 2025 horizon is nonetheless a pivotal date in the fight against this scourge. The volume of 4.3 million tons of wasted food, measured in 2022, remains alarming in light of the food insecurity issues facing our country. This figure highlights the contrast between stated ambitions and concrete actions, recalling the urgency of intensifying our efforts to reduce waste while ensuring a better

redistribution of food resources to vulnerable populations.

At the origin of more than a third of food waste, the agri-food industry, distribution and out-of-home consumption still represent a considerable source of food that should be valorized in order to limit losses, develop donations and meet the growing need for food aid.

This law intends to act more specifically on this source by broadening the scope of the actors concerned, by strengthening the obligation for these actors to communicate their data on wasted food annually and by toughening the sanctions applicable to companies that make them unfit for consumption.

***Article 1st** extends the scope of the obligation for businesses and operators to propose agreements to donate their unsold goods to food aid associations in order to combat waste. On the one hand, by lowering the threshold of businesses concerned by the said obligation from 400 m2 to 200 m2, which would allow the inclusion of some 5,000 local businesses in the scope of the law. On the other hand, by including food wholesale operators whose annual turnover exceeds 25 million euros, agri-food industry operators whose turnover exceeds 25 million euros and collective catering operators whose number of meals prepared exceeds 2,000 meals per day in this system. This article provides for the submission of a summary document of the donations made by these operators no later than 1 February of each year. This must be sent to the services of the General Directorate for Competition, Consumer Affairs and Fraud Control (DGCCRF). The Government must also submit, within twelve months, a report on the quality and compliance of donations to associations.*

***Article 2nd** draws conclusions from the shortcomings in the application of the law by strengthening its control. Indeed, the DGCCRF investigation carried out throughout 2021 resulted in 345 establishments visited, 66 warnings, and 2 injunctions. The rate of establishments in anomalous is 20.87%. The anomalies noted are the absence of a proposed agreement, agreements not signed or not respecting the required formalities9(*). The operators concerned will also have to establish a quantified and exhaustive assessment, on an annual basis, of the quantities of food wasted.*

***Article 3rd** toughens the sanctions against companies that make food unfit for consumption by replacing the fixed fine set at a maximum of 0.1% with a fine of between 0.1% and 0.5% of turnover. The aim is to combat the downward trend in donations within the large-scale distribution sector, deplored by many associations10(*).*

***Article 4th** constitutes the financial guarantee of this bill.*

** 1 UN, "UN Food Waste Index Report: World Wastes More Than a Billion Meals a Day," UN Environment Programme, March 27, 2024.*

** 2 Marianne Bléhaut, Mathilde Gressier, Antoine Bernard de Raymond, "The Resourcefulness of People Who Don't Always Have Enough to Eat," Crédoc, September 2023.*

** 3 Food Bank Study: "Profiles" Who Are the People Who Receive Food Aid?*

** 4 Nestlé France Foundation, "1st Observatory of Food Vulnerabilities," November 16, 2023.*

** 5 Ministry of Ecological Transition and Territorial Cohesion, Food Waste, June 12, 2024.*

** 6 UN, op. cit..*

** 7 "State of play of the masses of food waste and its management at the different stages of the food chain", ADEME, May 2016.*

** 8 Louise Simondet, "Fight against food waste: the city of Courbevoie rewarded by the United Nations", France 3 Paris-Île-de-France, October 25, 2024.*

** 9 Directorate General for Competition, Consumer Affairs and Fraud Control, "Professionals: how to avoid food waste".*

** 10 In their 2023 activity report, the ANDES association notes, for example, that the share of donations from large retailers in the supply of solidarity grocery stores has fallen, from 35% in 2022 to 22% in 2023.*

The overhaul of the agri-food system, aid for charitable associations and the fight against hunger therefore require the vote on this « Bill aimed at strengthening the fight against food waste » put forward by Senator Marie-Do AESCHLIMANN and which should be supported.

CONCLUSION

As we have analyzed, the social situation is alarming. And faced with this, citizens are legally helpless.

Indeed, the legal tools made available to citizens must be updated and systematically adapted in order to respond to daily concerns: combating food waste and helping to reduce hunger.

As studied in the main part, it is necessary to vote on a new law against food waste because food donations have decreased. However, since the legal framework is insufficiently adapted, this bill will be welcome.

References

1. «Food waste: why we had to make supermarkets give it away» (Arash Derambarsh – Resource): https://resource.co/article/food-waste-why-we-had-make-supermarkets-give-it-away-10853

2. «For a European law against food waste» (The president of the Hauts-de-France region, Xavier Bertrand, Arash Derambarsh, deputy mayor in Courbevoie and Marc Simoncini, entrepreneur, are calling for a European law against food waste - JDD): https://www.lejdd.fr/Politique/xavier-bertrand-veut-une-loi-europeenne-contre-le-gaspillage-alimentaire-3772679

3. «French councillor calls on Europe to adopt 'food waste' supermarket law» (Arash Derambarsh – Guardian): https://www.theguardian.com/world/2015/jul/09/french-food-waste-councillor-calls-on-ec-supermarkets-law

4. «Let's put an end to food waste in Europe» (Arash Derambarsh – Le Monde): https://www.lemonde.fr/idees/article/2015/07/21/mettons-fin-au-gaspillage-alimentaire-en-europe_4692338_3232.html

5. «Why we had to bring mass distribution to bear on food waste» (Arash Derambarsh – Huffington

Post): https://www.huffingtonpost.fr/actualites/article/pourquoi-nous-devions-faire-plier-la-grande-distribution-sur-le-gaspillage-alimentaire_71285.html

6. Åsa Stenmarck (IVL), Carl Jensen (IVL), Tom Quested (WRAP), Graham Moates (IFR): «Estimates of European food waste levels» FUSIONS (2016)

7. BAKKER E. DE, DAGEVOS H., 2012, «Reducing Meat Consumption in Today's Consumer Society: Questioning the Citizen-Consumer Gap», Journal of Agricultural and Environmental Ethics, 25, 6, p. 877-894.

8. Balanza, R, Garcıa-Lorda, P. Perez-Rodrigo, C., Aranceta, J., Bullo Bonet, M., Salas-Salvado, J. (2007) Trends in food availability determined by the Food and Agriculture Organization's food balance sheets in Mediterranean Europe in comparison with other European areas. Public Health Nutrition: 10(2), 168–176.

9. BARNARD A.V., 2016, Freegans: Diving into the Wealth of Food Waste in America, Minneapolis, Univ Of Minnesota Press, 280 p.

10. BLAIR D., SOBAL J., 2006, "Luxus Consumption: Wasting Food Resources Through Overeating", Agriculture and Human Values, 23, 1, p. 63-74.

11. BRADSHAW C., 2013, "The environmental business case and unenlightened shareholder value", Legal Studies, 33, 1, p. 141-161.

12. COHEN L., 2003, A Consumers' Republic: The Politics of Mass Consumption in Postwar. America, New York, Vintage, 576 p.

13. DESOUCEY M., 2010, «Gastronationalism: Food Traditions and Authenticity Politics in the European Union», American Sociological Review, 75, 3, p. 432 455.

14. ERIKSSON M., STRID I., HANSSON P.-A., 2015, «Carbon footprint of food waste management options in the waste hierarchy – a Swedish case study», Journal of Cleaner Production, 93, p. 115-125.

15. EVANS D., 2014, Food Waste: Home Consumption, Material Culture and Everyday Life, Londres, Bloomsbury Academic, 136 p.

16. EVANS D., MCMEEKIN A., SOUTHERTON D., 2012, «Sustainable Consumption, Behaviour Change Policies and Theories of Practice», dans WARDE A., SOUTHERTON D. (dirs.), The Habits of Consumption, Helsinki, Finland, Helsinki Collegium for Advanced Studies, p. 123-129.

17. EVANS, D., CAMPBELL, H., MURCOTT, A. (dirs.), 2013, Waste Matters: New Perspectives on Food and Society, 1e édition, Malden, MA, Wiley-Blackwell, 250 p.

18. Farmers: the reasons for despair. Bankruptcies, lobbies, malnutrition, pollution - the consequences of a system » (Arash Derambarsh, Eric de la Chesnais - Plon): https://www.lisez.com/livre-grand-format/agriculteurs-les-raisons-dun-desespoir/9782259252522

19. For a European law against food waste » (Arash Derambarsh – Le Figaro): https://www.lefigaro.fr/vox/politique/2016/06/03/31001-20160603ARTFIG00377-pour-une-loi-europeenne-contre-le-gaspillage-alimentaire.php

20. For a rehabilitation of the French agri-food system » (Arash Derambarsh – Huffington Post): https://www.huffingtonpost.fr/economie/article/pour-une-remise-en-etat-du-systeme-agroalimentaire-francais_95926.html

21. FRIEDMANN H., MCMICHAEL P., 1989, «Agriculture and the State System: The Rise and Decline of National Agricultures, 1870 to the Present», Sociologia Ruralis, 29, 2, p. 93–117.

22. GENTIL E.C., GALLO D., CHRISTENSEN T.H., 2011, « Environmental evaluation of municipal waste prevention », Waste Management, 31, 12, p. 2371-2379.

23. GENTILINI U., 2013, «Banking on Food: The State of Food Banks in High-income Countries», IDS Working Papers, 415, 18 p.

24. GEREFFI G., HUMPHREY J., STURGEON T., 2005, «The governance of global value chains », Review of International Political Economy, 12, 1, p. 78-104.

25. GEREFFI G., KORZENIEWICZ M., 1994, Commodity Chains and Global Capitalism, Praeger (Contributions in economics and economic history), 350 p.

26. GILLE Z., 2012, «From Risk to Waste: Global Food Waste Regimes», The Sociological Review, 60, p. 27–46.

27. GOODMAN D., DUPUIS E.M., GOODMAN M.K., 2013, Alternative Food Networks: Knowledge, Practice, and Politics, 1ère édition, New York, Routledge, 320 p.

28. HALL K.D., GUO J., DORE M., CHOW C.C., 2009, «The Progressive Increase of Food Waste in America and Its Environmental Impact», PLoS ONE, 4, 11, p. e7940 (en ligne).

29. Law No. 2016-138 of 11th February 2016 relating to the fight against food waste in France

30. Law of January 2, 2023 relating to the fight against food waste in Spain

31. Manifesto against Food Waste» (Arash Derambarsh - Fayard): https://www.fayard.fr/livre/manifeste-contre-le-gaspillage-9782213693866/

32. MICHELETTI M., 2003, Political Virtue and Shopping: Individuals, Consumerism, and Collective Action, Palgrave Macmillan, 262 p.

33. MIDGLEY J.L., 2013, «The Logics of Surplus Food Redistribution», Journal of Environmental Planning and Management, 57, 12, p. 1872-1892.

34. MOURAD M., 2016, «Recycling, recovering and preventing "food waste": competing solutions for food systems sustainability in the United States and France», Journal of Cleaner Production, 126, p. 461-477.

35. NEFF R.A., SPIKER M.L., TRUANT P.L., 2015, «Wasted Food: U.S. Consumers' Reported Awareness, Attitudes, and Behaviors», PLoS ONE, 10, 6, p. e0127881 (en ligne).

36. PACKARD V., 1960, The Waste Makers, New York, Pocket Books, 340 p.

37. Proposed law aimed at combating food waste in France (17th January 2023)

38. QI D., ROE B.E., 2017, «Foodservice Composting Crowds out Consumer Food Waste Reduction Behavior in a Dining Experiment», American Journal of Agricultural Economics, 99, 5, p. 1159–1171.

39. REDLINGSHÖFER B., COUDURIER B.,

GEORGET M., 2017, «Quantifying food loss during primary production and processing in France», Journal of Cleaner Production, 164, p. 703-714.

40. Report of the debates in the Senate concerning the vote on the law against food waste (3rd February 2016)

41. SMIL V., 2004, «Improving Efficiency and Reducing Waste in Our Food System», Environmental Sciences, 1, 1, p. 17-26.

42. Supermarket food waste 'must be banned by EU and US» (Arash Derambarsh - The Independent): https://www.independent.co.uk/news/world/europe/supermarket-food-waste-must-be-banned-by-eu-and-us-demands-french-politician-arash-derambarsh-a6884191.html

43. "Investigation of consumer attitudes, practices and food waste for three food items, to use as input in new packaging designs that aim to reduce food waste" (Helén Williams, Fredrik Wikström, Annika Lindström, Kristina Wickholm, Ann Lorentzon, 2017)

44. Fredrik Wikström, Helén Williams: "Packaging design that reduces food waste and increases recycling" (2023)

45. GARCIA-GARCIA G., WOOLLEY E., RAHIMIFARD S., 2015, «A Framework for a More Efficient Approach to Food Waste Management», International Journal of Food

46. Lisa Mattsson, Helén Williams: "Avoidance of Supermarket Food Waste—Employees' Perspective on Causes and Measures to Reduce Fruit and Vegetables Waste" (2022)

47. Ng, M. et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013.The Lancet. May 29, 2014

48. "Avoiding food becoming waste in households - The role of packaging in consumers' practices across different food categories" (Helén Williams, Annika Lindström, Jakob Trischler, Fredrik Wikström, Zane Rowe, 2020): https://kau.diva-portal.org/smash/record.jsf?pid=diva2%3A1440471&dswid=-1009

49. "Avoiding food becoming waste in households: The role of packaging in consumers' practices across different food categories" (Helén Williams, Annika Lindström, Jakob Trischler, Fredrik Wikström): https://kau.diva-portal.org/smash/record.jsf?pid=diva2%3A1440471&dswid=-1009

50. "COP26 as the convergence of the corporate food-climate agendas" (Tomaso Ferrando): https://repository.uantwerpen.be/desktop/irua

51. "Food Waste In America: One Big Issue, Many Possible Solutions" (Refed): https://refed.org/articles/guest-blog-food-waste-in-america-one-big-issue-many-possible-solutions/#:~:text=35%25%20of%20all%20food%20goes,the%20food%20and%20beverage%20industry.

52. "Food Waste In America: One Big Issue, Many Possible Solutions" (Branch Food): https://www.branchfood.com/blog/food-waste-in-america-refed

53. ADEME (2014). Source: http://ecocitoyens.ademe.fr/mes-dechets/stop-au-gaspillage-alimentaire/a-savoir

54. ALBAL. Source: http://www.al-bal.fr/save_food_abal_fr,2910.html

55. Buurman, R., Velghe, J. Les supermarchés et le gaspillage alimentaire. CRIOC. Edition 2013. Source: www.oivo-crioc.org

56. Buzby, Jean C., Hodan Farah Wells, Bruce Axtman, and Jana Mickey. Supermarket Loss Estimates for Fresh Fruit, Vegetables, Meat, Poultry, and Seafood and Their Use in the ERS Loss-Adjusted Food Availability Data. EIB-44, U.S. Dept. of Agriculture, Econ. Res. Serv. March 2009. Source: http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib44.aspx#.U6QmY_l_v1Q

57. Combris, P. 2006. Le poids des contraintes économiques dans les choix alimentaires. Cahiers de nutrition et de diététique. 41 (5): 279-284 in: Esnouf, C. Russel, M. Bricas, N. (Coord), 2011. duALine - durabilité de l'alimentation face à de nouveaux enjeux. Questions à la recherche, Rapports Inra-Cirad (France), 236 p. Source: http://www.cirad.fr/publications-ressources/edition/etudes-et-documents/dualine

58. de Sadeleer, Nicolas; Poncelet, Charles. Contestation des actes des institutions de l'Union européenne à l'épreuve de la Convention d'Ahrus. In: Revue Trimestrielle de Droit Européen, no.1, p. 7-34 (janvier-mars 2013). http://hdl.handle.net/2078.3/143196

59. de Sadeleer, Nicolas. Climate Change Litigation in the EU. In: ANU Center for European Studies Briefing paper, (2021). http://hdl.handle.net/2078.3/253340

60. de Sadeleer, Nicolas. Droits fondamentaux et protection de l'environnement dans l'ordre juridique de l'UE et dans a CEDH. In: Revue européenne du droit de la consommation, no.1, p. 25-51 (2011). http://hdl.handle.net/2078.3/143065

61. de Sadeleer, Nicolas. Enforcing EUCHR Principles and Fundamental Rights in Environmental Cases. In: Nordic Journal of International Law, no.81, p. 39-74 (2012). http://hdl.handle.net/2078.3/143136

62. de Sadeleer, Nicolas. Les droits fondamentaux menacés par le changement climatique selon la Cour constitutionnelle allemande. In: Justice en ligne, (2021). http://hdl.handle.net/2078.3/253366

63. de Sadeleer, Nicolas. Les enjeux de l'harmonisation des règles de protection de l'environnement. In: Revue du Droit de l'Union Européenne, Vol. 2021, no.3, p. 149-163 (2021). http://hdl.handle.net/2078.3/253355

64. de Sadeleer, Nicolas. Les pouvoirs publics belges responsables pour une politique climatique déficiente. In: Justice en ligne, (2021). http://hdl.handle.net/2078.3/253361

65. Decree relating to the Walloon Agricultural Code (27th March 2014)

66. Esnouf, C., Jean, S., Redlingshöfer, B. Les nouveaux enjeux liés à la durabilité des systèmes alimentaires. Innovations Agronomiques. 24 (2012), 121-132. Source: http://www6.inra.fr/ciag/Revue/Volume-24-Novembre-2012

67. EUFIC. Food Today. How to minimise food waste. 05/2012.

68. Eurostat 2010 in: Pertes et gaspillages

alimentaires: causes, impacts et propositions. Barilla Center for Food & Nutrition (BCFN). 2012. Source: http://www.barillacfn.com/wp-content/uploads/2012/11/WEB_FRA.pdf

69. FAO 2011. Food Loss Reduction Strategy. Source: http://www.fao.org/fileadmin/user_upload/ags/publications/brochure_phl_low.pdf

70. FAO 2011. Gustavsson, J., Cederberg., C. Sonesson, U. 2011. Source: http://www.fao.org/docrep/014/mb060e/mb060e00.pdf

71. FAO 2011. Produire plus avec moins. Guide à l'intention des décideurs sur l'intensification durable de l'agriculture paysanne. Rome. 2011. Source: http://www.fao.org/docrep/014/i2215f/i2215f.pdf

72. FAO 2013. Food wastage footprint. Impacts on natural resources. Summary report. 2013. Source: http://www.fao.org/docrep/018/i3347e/i3347e.pdf

73. FAO 2014. Save food: global initiative on food loss and waste production. Source: http://www.fao.org/save-food/principaux-resultats/fr/ Angl. http://www.fao.org/save-food/key-findings/en/

74. FINE F., LUCAS J.-L., CHARDIGNY J.-M., REDLINGSHÖFER B., RENARD M., 2015a, «Food losses and waste in the French oilcrops sector», OCL, 22, 3, p. A302 (en ligne)

75. Fondation Louis Bonduelle. Les 7èmes Rencontres de la Comportements alimentaires et gaspillage: pertes alimentaires, déni et contradictions. 20 mai 2014. Source: http://www.fondation-louisbonduelle.org/france/fr/tout-sur-la-fondation/les-rencontres-de-la- fondation-louis-bonduelle.html

76. Food in the lives of Paris and Chicago residents" (Thesis Coline Ferrant – 17th december 2020): https://www.theses.fr/2020IEPP0006

77. Food supply procurement: the influence of politics on food supply chains and the governance of local public food services" (Thesis Yoan Robin – 22nd december 2017): https://www.theses.fr/2017PA01E055

78. Foresight. The Future of Food and Farming: Challenges and choices for global sustainability (2011). Final Project Report. The Government Office for Science, London. Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/288329/11-546-future-of-food-and-farming-report.pdf

79. France Nature Environnement. Du gaspillage alimentaire à tous les étages. Dossier thématique. Décembre 2013. Source: http://www.fne.asso.fr/fr/nos-dossiers/dechets/gaspillage-alimentaire/agir.html

80. Gooch, M., Marenick, N., Laplain, D. Dent, B. Cut Waste, GROW PROFIT. Reducing food waste by addressing the disconnect between the attitude and behaviour of producers and managers of businesses situated along the value chain. Value Chain Management International. May 30, 2013.

81. Guardian: https://www.theguardian.com/world/2015/may/25/french-supermarkets- donate-food-waste-global-law-campaign

82. Gunders, D. Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill. Natural Resources Defense Council. August 2012. IP:12-06-B2012. Source: http://www.nrdc.org/food/files/wasted-food-ip.pdf

83. History Food Banks. Source: http://www.banquealimentaire.org/

84. Independent: https://www.independent.co.uk/life-style/food-and-drink/news/man-behind-campaign-for-french-supermarkets-to-donate-waste-food-wants-to-take-law-global- 10276028.html

85. La lutte contre le gaspillage alimentaire en France et aux Etats-Unis: mise en cause, mise en politique et mise en marché des excédents alimentaires" (Thesis Marie Mourad – 2nd october 2018): https://www.theses.fr/2018IEPP0014

86. Laisney, C., Soyeux, A., Redlingshöfer, B. (Juillet 2013) Source: http://agriculture.gouv.fr/IMG/pdf/CEP_Document_de_travail_no7_Gaspillages_alimentaires_cle0a419d.pdf

87. L'autorégulation en tant que stratégie hors marché. Une étude exploratoire sur les mécanismes transformant l'environnement hors marché des entreprises" (Thesis Agnieszka Majewska – 14th february 2023): https://www.theses.fr/2023UPSLD012

88. Lundqvist, J., C. de Fraiture and D. Molden. Saving Water: From Field to Fork – Curbing Losses and Wastage in the Food Chain. SIWI Policy Brief. Stockholm International Water Institute (SIWI), 2008. Source: http://www.siwi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf

89. Luxemburger Wort: https://www.wort.lu/de/international/gaspillage-alimentaire-appel-a- juncker-57504feeac730ff4e7f615c3

90. McWhirter JP, Pennington CR. Incidence and recognition of malnutrition in hospital. BMJ. 1994; 308(6934): 945–948.Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2539799/pdf/bmj00435-0025.pdf

91. Ministère de l'Écologie, du Développement durable, des Transports et du Logement (2011). Rapport intermédiaire de l'étude relative au gaspillage alimentaire. Juillet 2011. Source: http://www.developpement-durable.gouv.fr/IMG/Rapport%20interm%C3%A9diaire_VF-1.pdf

92. Misonne, Delphine. Droit du climat et de l'environnement - Chronique 2022. In: Journal de droit européen, Vol. 290, no.290, p. 310-318 (2022). http://hdl.handle.net/2078.3/265290

93. Misonne, Delphine. L'actualité des communs à la croisée des enjeux de l'environnement et de la culture. In: Revue interdisciplinaire d'études juridiques, Vol. 81, no. 81, p. 59-82. http://hdl.handle.net/2078.3/207747

94. Misonne, Delphine. L'ambition de l'Accord de Paris sur le changement climatique. Ou comment, par convention, réguler la température de l'atmosphère terrestre ?. In: Aménagement - environnement: urbanisme et droit foncier, Vol. Double numéro spécial "Climat", no. 4, p. 8-26 (2018). http://hdl.handle.net/2078.3/190896

95. Misonne, Delphine. Lire le rapport du GIEC à la lumière de l'affaire Urgenda (et vice-versa). In: Plateforme wallonne pour le GIEC - Lettre d'information, Vol. 11, no.Octobre 2018, p. 11 (2018). http://hdl.handle.net/2078.3/207759

96. Nanocarbon from food waste: dispersions and

applications" (Thesis Aikaterini Kampioti – 9th december 2016): https://www.theses.fr/2016BORD0364

97. O'Brien, D., Aldeen, H.T. Hunger in America 2006. America's second harvest - the nation's food bank network fourth national hunger study. Source: www.hungerinamerica.org

98. Oxfam 2013. Cooper, N., Dumpleton, S. Walking the breadline. Oxfam, Church Action on Poverty. 2013. Source: http://historyofsocialwork.org/1967_food_banks/2013%20OXFAM%20Walking%20the%20Breadline.pdf

99. Pacte national de lutte contre le gaspillage alimentaire. Ministère de l'Agriculture, de l'Agroalimentaire et de la forêt. 2013. Dossier de presse. 14 juin 2013. Source: http://alimentation.gouv.fr/IMG/pdf/250913-Pacte-gapillageAlim_cle4da639.pdf

100. Poverty USA. 2014. Source: www.povertyusa.org

101. Preparatory study on food waste across EU 27. Bio Intelligence Service. European Commission (DG ENV). October 2010.

102. Réduction du gaspillage alimentaire - État des lieux et pistes d'action. Rapport final. Ministère de l'Écologie, du Développement durable, et de l'Energie. Novembre 2012. Source: http://www.developpement-durable.gouv.fr/IMG/pdf/Rapport_final_gaspillage_alimentaire_nov2012.pdf

103. Résolution du Parlement européen du 19 janvier 2012 sur le thème «Éviter le gaspillage des denrées alimentaires: stratégies pour une chaîne alimentaire plus efficace dans l'Union européenne». Parlement européen. Source: Europa (2011/2175(INI)).

104. Restaurants du cœur. Source: http://www.restosducoeur.org/

105. Sambon, Jacques. Les voies de recours en matière d'accès à l'information environnementale: diversité et complexité des régimes applicables. In: Aménagement - environnement, Vol. 2021, no.2, p. 73 (2021). http://hdl.handle.net/2078.3/267609

106. SMED (2011) in Food waste volumes in Sweden. 2012. Swedish Environment Protection Agency. Source: http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-8695-4.pdf?pid=11892

107. Source: http://ec.europa.eu/environment/eussd/pdf/bio_foodwaste_report.pdf

108. Source: http://www.eufic.org/article/en/artid/How-to-minimise-food-waste/

109. Source: www.cutwastegrowprofit.com

110. Soyeux, A. La lutte contre le gaspillage, une solution d'avenir ? Ministère de l'Agriculture et de la Pêche. Service de la statistique et de la prospective. Prospective et Evaluation. Analyse N° 5. Mars 2009. Source: http://agriculture.gouv.fr/IMG/pdf/_Analyse_5_La_lutte_contre_le_gaspillage.pdf

111. Süddeutsche Zeitung: https://www.sueddeutsche.de/wirtschaft/lebensmittel-verschwendungcontainern-1.4331886

112. The "greening" of empire: the European Green Deal as the EU first agenda - Political geography - ISSN 0962-6298-105 (2023) p. 1-10 (Diana Vela Almeida, Vijay Krishnan Kolinjivadi, Tomaso Ferrando, Brototi Roy, Héctor Herrera, Marcela Vecchione Gonçalves, Gert Van Hecken): https://repository.uantwerpen.be/desktop/irua

113. TNS SOFRES. Les Français et le gaspillage alimentaire. 2012. Source: http://www.tns-sofres.com/etudes-et-points-de-vue/les-francais-et-le-gaspillage-alimentaire

114. Tomaso Ferrando and Julie Mansuy: «The European Action against Food Loss and Waste: Co-Regulation and Collisions on the Way to the Sustainable Development Goals» (University of Warwick - November 2018): https://wrap.warwick.ac.uk/109189/

115. University of Stuttgart. Too good for the bin. 2012. Source: https://www.zugutfuerdietonne.de/uploads/media/TooGoodForTheBin.pdf

116. USDA 2014. Source: http://www.usda.gov/oce/foodwaste/

117. Venkat, K. The Climate Change and Economic Impacts of Food Waste in the United States. Int. J. Food System Dynamics 2 (4), 2011, 431-446. Source: http://www.cleanmetrics.com/pages/ClimateChangeImpactofUSFoodWaste.pdf

118. WRAP 2012. Household Food and Drink Waste in the United Kingdom. Final report. 2012. Source: www.wrap.org.uk

119. "D(i)ritto al cibo" (Andrea Segré - 2022);

120. "Lo spreco alimentare in Italia e nel mondo" (Andrea Segré, E. Risso - 2023).

121. L'insosténibile pesatezza dello spreco alimentairere: dallo spreco zero alla dieta mediterranea (Andrea Segré - 2022);

MEDICAL SCIENCES

CHILDHOOD ASTHMA. DIAGNOSTIC AND THERAPEUTIC PROBLEMS. GINA 2024 RECOMMENDATIONS

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Abstract
Childhood asthma is the most common chronic disease in childhood (12-14%) worldwide and 3-10% of asthmatics suffer from severe asthma. Despite the enormous progress in the diagnosis and treatment of childhood asthma, there are still some challenges in terms of diagnosis, as well as in the selection of adequate and timely maintenance treatment, which remain problematic. Overdiagnosis leads to unnecessary drug therapy and associated side effects, and on the other hand, underdiagnosis carries the risk of daily symptoms, potentially serious exacerbations and long-term remodeling of the airways and unnecessary use of antibiotics to treat the so-called "recurrent respiratory infections with BOS". Furthermore, the use of a personalized asthma action plan(PAAP) remains limited and a significant number of children with asthma do not have one and over 70-80% of asthma patients do not use their inhaler correctly. The population goal of asthma management is to prevent deaths from asthma and to minimize the burden of asthma on individuals, families, communities, health systems and the environment.

Keywords: Childhood asthma - diagnosis, over- and under-diagnosis, differential diagnosis, management, PAAPs.

Abbreviations
BOS: broncho-obstructive syndrome
GERD: gastroesophageal reflux disease
TSLP: Thymic stromal lymphopoietin
DD: differential diagnosis
OCS: oral corticosteroids
ICS: inhaled corticosteroid
SABA: short-acting beta2 agonist
HDM SLIT: home dust mite sublingual immunotherapy
PAAPs: personalized asthma action plans
MART: maintenance and reliever Therapy
pMDI: pressurized metered-dose inhaler
RF: respiratory failure

Introduction:
Childhood asthma is a heterogeneous disease usually characterized by chronic airway inflammation. This is determined by a history of respiratory symptoms such as wheezing, difficulty breathing, chest tightness, and cough of varying variability, frequency, and intensity, along with variable expiratory airflow obstruction [4]. These variations are often triggered by triggers such as exercise, exposure to an allergen or irritant, weather changes, or viral respiratory infections. Asthma is associated with hyperreactivity and airway inflammation, but these are not necessary or sufficient for the diagnosis. Risk factors for the development of asthma in childhood include: Personal or family history of atopy (eczema, allergic rhinitis or nasal polyposis); Family history of asthma; Exposure to cigarette smoke; Premature birth; Low birth weight; Obesity; Bronchopulmonary dysplasia; Respiratory infections – bronchiolitis; Home allergens (dust, animal hair, cockroaches, mold); Air pollution (outdoor allergens – pollens, spores, industrial chemicals, insects).[3][4]

Asthma exacerbations usually occur after exposure to one or more triggers. The most frequent triggers of an asthma attack are: Viral infections of the respiratory tract; Physical effort; Meteorological changes in temperature and humidity; Household contaminants (e.g. pests, mold and mites); Environmental pollutants (e.g. air pollution); Exposure to secondhand smoke; Pets and animals; Strong odors; Anxiety or strong emotions; Medicines (e.g. non-steroidal anti-inflammatory drugs and beta-blockers); Gastroesophageal reflux.[4] [24] [25] [,27]

For individuals with asthma of all ages, the goal of asthma management is to achieve the best possible long-term patient outcomes, including: Few/or no asthma symptoms; No sleep disturbances due to asthma; Unimpaired physical activity; No exacerbations; Improved or stable personal best lung function; No OCS support requirement; There are no side effects from the medication. The patient's goals for their asthma may be different from medical goals; and patients with few or no asthma symptoms can have severe or fatal exacerbations, including from external triggers such as viral infections, allergen exposure (if sensitized) or pollution[4]. In allergic asthma, most cells exhibit a T-cell helper type 2 (Th2) cytokine secretion profile (IL1, IL4, IL5, IL9, and GM-CSF). Biomarkers of type 2 inflammation include eosinophils in sputum and blood, levels of exhaled nitric oxide(FeNO), and serum periostin. However, some patients do not exhibit eosinophilic inflammation and a Th2 cytokine response and are less responsive to ICS and other medications targeting Th2 cytokines, and they have a predominantly mononuclear inflammatory cell response in the airways, with T lymphocytes and activated macrophages[4]. Potential applications of biomarkers in severe asthma [55] include: Understanding the biology; Diagnosis and screening; Assessment of severity, control, or prognosis; Identification of endotypes; Application in clinical trials and safety monitoring. Regarding the assessment of asthma control, GINA 2024 clarified that

the assessment of symptom control cannot be limited to the last 4 weeks, but there are no validated instruments to assess symptom control for a longer period than this. GINA continues to emphasize that the assessment of symptom control is not sufficient and that patients' risk factors for exacerbations, accelerated decline in lung function, and adverse drug effects should also be assessed.[4] [23] [26] [28] [29] [30]

Assessment of asthma control in adults, adolescents, and children 6-11 years of age[4] includes:

1**. Recent symptom control**. In the past 4 weeks, has the patient had:

• Daytime asthma symptoms more than twice a week?

• Any nighttime awakenings due to asthma?

• SABA reliever for symptoms more than twice a week?

• Is there any activity limitation due to asthma?

Absence of any of the above criteria indicates well-controlled asthma; 1-2 of them indicates partially controlled asthma; and the presence of 3 - 4 of these criteria indicates uncontrolled asthma.

2. **Risk factors for poor asthma outcomes**. Assess risk factors at diagnosis and periodically, especially in patients with exacerbations, and measure FEV1 at baseline, after 3-6 months of ICS-containing treatment to determine the patient's best lung function, then periodically for ongoing risk assessment.

a. **Risk factors for exacerbations** are: Uncontrolled asthma symptoms; High SABA use(≥3 x 200 canisters/year are associated with an increased risk of exacerbations and ≥1 canister/month increases the risk of mortality); Unprescribed ICS, poor adherence or incorrect inhaler technique; Obesity, chronic rhino-sinusitis, GERD, confirmed food allergy, pregnancy; Smoking, e-cigarette, allergen exposure during sensitization, air pollution; Major psychological or socioeconomic problems; Low FEV1 (especially < 60% predicted), high bronchodilator response; Type 2 inflammatory markers (higher blood eosinophils, high FeNO in adults with allergic asthma on ICS); Exacerbation history (≥ 1 severe exacerbation in the past year, ever intubated or in an asthma intensive care unit).

b. **Risk factors for permanent airflow limitation, include:** History of preterm birth, low birth weight and greater infant weight gain, chronic mucus hypersecretion**;** Lack of ICS treatment in patients with a history of severe exacerbation**;** Tobacco smoke, noxious chemicals; occupational or household exposures**;** Low baseline FEV1, sputum or blood eosinophilia.

c. **Risk factors for adverse drug reactions, include:** Frequent OCS, long-term, high-dose and/or potent ICS, P450 inhibitors and poor inhaler technique.

Differential diagnosis (DD) of asthma.

Before making a diagnosis of "asthma", a thorough differential diagnosis should first be performed, taking into account the most common alternative diagnoses [1], Table 1 [4]

Table 1

Differential diagnosis (DD) of asthma by age.

Up to 5 years old	Recurrent viral infections of the respiratory system; Gastroesophageal reflux; Foreign body aspiration; Persistent bacterial bronchitis; Tracheomalacia; Tuberculosis; Pertussis; Congenital heart disease; Cystic fibrosis; Primary ciliary dyskinesia; "Vascular ring"; Bronchopulmonary dysplasia; Immune deficiency.
6 – 11 years	Chronic upper respiratory tract cough syndrome (posterior nasal drip syndrome); Aspirated foreign body; Bronchiectasis; Primary ciliary dyskinesia; Congenital heart disease (CHD), Bronchopulmonary dysplasia and Cystic fibrosis.
≥ 12 years of age	Chronic upper airway cough syndrome; Inducible laryngeal obstruction; Hyperventilation and dysfunctional breathing; Bronchiectasis, Cystic fibrosis; CHD; Alpha1-antipsin deficiency; Foreign body aspiration.

Asthma diagnosis.

Diagnosing asthma in childhood can be challenging, and the diagnosis should be reviewed during follow-up to ensure it is correct. It should be emphasized that there is no single "gold standard" test that can be used to accurately diagnose asthma. In practice, diagnosis should be made based on characteristic symptoms, evidence of variability in airflow limitation in the presence of airway inflammation, exclusion of alternative diagnoses, and response to treatment. Making the correct diagnosis is key to optimal management of childhood asthma. Guidelines vary across countries and regions regarding diagnostic criteria.[1][4][54]

The main steps in diagnosing asthma include:

- History of persistent and recurrent symptoms of bronchial obstruction (cough, wheezing and/or chest tightness, difficulty breathing) and family history of atopy (allergic rhinitis, atopic dermatitis, asthma).
- Physical examination. Physical examination is often normal in patients with asthma unless the disease is severe or the examination is performed during an exacerbation. In the latter cases, "wheezing" can be heard on auscultation, with prolonged exhalation or signs of severe bronchial obstruction(tachypnea, dyspnea, tachycardia, and in advanced RF, cyanosis, retractions and impaired consciousness are also noticed).
- **Functional testing of breathing**. The diagnosis of asthma also requires objective measurements to support the diagnosis. Peak expiratory flow (PEF) and spirometry are commonly used to assess the severity of airflow obstruction and reversibility (after inhalation of SABA). PEF-metry can also be used to detect diurnal variation, which is a typical feature of asthma, and is the most useful test in severe and labile (unstable) asthma. Although PEF is less reliable than spirometry in aiding the diagnosis of asthma, it can be relied upon rather than relying on symptoms alone.[4] The

Global Initiative for Asthma (GINA) specifically recommends the use of either PEF or spirometry in the diagnosis of asthma in children over 5 years of age. Objective testing should be repeated if there is poor response to treatment or diagnostic uncertainty. A reduced FEV1 with a low FEV1/FVC ratio (forced expiratory volume in 1 second/forced vital capacity) indicates the presence of airway obstruction. Significant reversibility after bronchodilator administration is generally defined as an increase in FEV1 of ≥ 12% and at least a 200 ml change. With regular ICS treatment, FEV1 begins to improve within days and reaches a plateau after about 2 months. The patients' highest FEV1 reading (personal best) should be documented, as this provides a more useful comparison for clinical practice than predicted percentage. If FEV1 predicted values are used, GINA recommends measuring children's height at each visit. In children under 5 years of age, pulmonary function testing is rarely practical outside of a research setting, making diagnosis in this age group an additional challenge. [4]

- BPT (Broncho-provocation tests) - "direct" and "indirect". "Direct" include the pharmacological agents - histamine and methacholine (an analog of acetylcholine) [19]. But it is assumed that the bronchial hyper-responsiveness (BHR) induced by them is not specific for the diagnosis of asthma, since healthy people without asthma [4][7][20], patients with chronic obstructive pulmonary disease[21][22], as well as smokers may also have hyper-reactivity to these agents[23]. "Indirect" tests include physical stimuli such as exercise, hyperventilation with dry air, distilled water, hypertonic NaCl, mannitol, and the pharmacological agent adenosine monophosphate. It is suggested that these stimuli cause narrowing of the airways by an "indirect" mechanism through the release of various mediators from inflammatory cells in the bronchi themselves, these mediators subsequently activating their specific receptors in the bronchial smooth muscle, which consequently contracts and leads to narrowing of the airways [26].
- FeNO - test. FeNO is a practical, rapidly performed test in school-aged children and provides information about the severity of lung inflammation. The primary role of FeNO in clinical practice continues to be to aid in treatment decisions in patients with severe asthma, i.e., it is used to detect and quantify eosinophilic airway inflammation, with elevated levels in patients with eosinophilic asthma.[54] According to GINA [4], FeNO has not been shown to be useful in making or ruling out a diagnosis of asthma, as while FeNO is higher in asthma characterized by type 2 airway inflammation (with elevated interleukin (IL)-4 and IL13), FeNO is also elevated in non-asthmatic conditions (e.g., eosinophilic bronchitis, atopy, allergic rhinitis, eczema) and is not elevated in some asthma phenotypes (e.g., neutrophilic asthma, obesity-related asthma). FeNO is low in smokers and during bronchoconstriction and the early phases of an allergic response, and may be elevated or decreased during viral respiratory infections.[4]

Criteria for the initial diagnosis of asthma in adults, adolescents and children aged 6 to 11 years [4] include:

1. History of typical variable respiratory symptoms, including wheezing; shortness of breath; chest tightness and cough. Provided that the symptoms appear variable over time and with different severity; often worse at night or upon awakening; they are often triggered by exercise, laughter, allergens, cold air, and often occur or worsen with a viral infection.

2. Confirmed variable expiratory airflow limitation. Established excessive variability in expiratory lung function in the presence of one or more of the following measurements:

- Positive bronchodilator test for reversibility of bronchial obstruction with spirometry or PEF (peak expiratory flow rate assessed by peak flow meter). Asthma is characterized by marked or complete reversibility of bronchial obstruction, this is a fact when in children the values of FEV1 increase ≥12% or PEF ≥15% (highest value of 3 measurements) from their initial value, 10-15 minutes after 200 - 400 mcg Salbutamol or equivalent and provided that bronchodilator treatment has been discontinued before the test (≥4 hours for SABA and 24-48 hours for LABA). This variability is related to underlying BHR and inflammation.
- Excessive variability in PEF measured twice daily for 2 weeks, resulting in an average daily PEF variability of more than 13% in children.
- Improvement of lung function after 4 weeks of CS treatment - content. For children, a positive result is obtained with increased values of FEV1 ≥12% predicted (or PEF ≥15%) of the baseline value.
- Positive **BPT** test in children, if results in reduced FEV 1 values > 12% predicted (or reduction in PEF ≥15%) of the baseline value after a standard physical effort test. If FEV1 decreases during a challenge test, verify that the FEV1/FVC ratio also decreases, as incomplete inspiration, due to possible laryngeal obstruction or poor effort, may cause a false decrease in FEV1.
- Excessive variation in lung function between visits (good specificity but poor sensitivity) in children, was defined as a change in FEV1 of ≥12% predicted (or in PEF ≥15%) between visits. As with PEF measurements, the highest value of three trials should be selected.

Asthma phenotypes.

A phenotype is the visible structural and functional characteristics of an organism, determined by its genotype and modulated by environment," Rice JP et al. Adv Genet 2001. Endotype is "a subtype of a condition that is defined by different functional or pathophysiological mechanisms," Lötvall et al. JACI 2011. Phenotypes reflect the heterogeneity of asthma. Asthma is a heterogeneous disease with several phenotypes and underlying endotypes. Phenotypes are subtypes of asthma that share clinical characteristics such as symptoms, atopic features, disease severity, and response to treatment. Endotypes are subtypes of asthma that are characterized by similar underlying biological mechanisms.[37] Key endotypes include asthma - inflammation type 2-high and type 2-low.[50] Identification of asthma phenotypes and endotypes may facilitate targeted treatment based on the pathophysiology occurring in a particular individual [38] for example, allergic

or eosinophilic asthma, which often begins in childhood is type 2-high and is characterized by eosinophilic airway inflammation, elevated IgE and fractional levels of exhaled nitric oxide (FeNO)[36]. Typically, high-type 2 asthma responds well to inhaled corticosteroid (ICS) treatment.[51] According to GINA[4], asthma is a heterogeneous disease with distinct underlying disease processes and recognizable groups of demographic, clinical and/or pathophysiological characteristics, often referred to as "asthma phenotypes". Some phenotype-specific treatments are available for patients with more severe asthma. However, except in patients with severe asthma, no strong association between specific pathological features and specific clinical patterns or responses to treatment has been found, and more research is needed to understand the clinical utility of phenotypic classification in asthma. Many clinical phenotypes of asthma have been identified, some of the most common of which are:

- **Allergic asthma**. This is the most easily recognized asthma phenotype, which often begins in childhood and is associated with past and/or family history of allergic diseases, such as eczema, allergic rhinitis, and food or drug allergy. Examination of sputum from these patients before treatment often reveals eosinophilic inflammation of the airways. Patients with this asthma phenotype usually respond well to ICS treatment.
- **Non-allergic asthma**. Some patients have asthma that is not associated with an allergy. The sputum cellular profile of these patients may be neutrophilic, eosinophilic, or contain few inflammatory cells. Patients with non-allergic asthma often respond less well to ICS.
- **Cough variant of asthma**. The cough variant as a clinical phenotype of asthma can hardly be distinguished from other causes of chronic cough in clinical practice, as spirometry is normal and variable expiratory airflow obstruction can only be identified by **BPT**. Some patients subsequently also develop "wheezing" and a bronchodilator reaction. And the treatment of the cough variant of bronchial asthma is the same as for asthma in general. Responds well to ICS-containing treatment.[4] This phenotype must be distinguished from the cough syndrome of URT, which is associated with diseases such as chronic rhinosinusitis, gastroesophageal reflux disease (GERD), etc.[1]
- **Late-onset asthma** (asthma in adults). Some adults (especially women) present with asthma for the first time in late life. These patients are usually non-allergic, and often require higher doses of ICS or are relatively refractory to CS treatment.
- **Asthma with fixed airflow obstruction (FAO)**. Some patients with long - standing asthma develop persistent or irreversible FAO.
- **Asthma with obesity**. Some obese patients have asthma with pronounced symptoms and mild eosinophilic inflammation of the airways.
- **Exercise Asthma**. Sometimes symptoms induced by physical exertion are the only manifestation of asthma. In this regard, the term exercise-induced asthma has been proposed to describe the occurrence of transient airway narrowing after exercise.

Treatment.

Effective asthma management involves a comprehensive approach aimed at both pharmacological and non-pharmacological control. The latter includes education on how to undertake effective treatment, avoidance of triggers, modifiable risk factors and actions to be taken during acute attacks through personalized asthma action plans (PAAP), consideration of the cost of treatment, patient preferences and treatment of comorbidities (chronic rhino-sinusitis, GERD, etc.) and last but not least at each stage of treatment, if asthma control is not maintained, the patient should be monitored for therapy and inhaler treatment technique. PAAPs have been shown to reduce emergency room visits and missed school days and increase caregiver confidence in managing asthma attacks.[55] Age and phenotype-specific characteristics are important in individualizing the approach.[13]

Pharmacological treatment includes two main groups of medications (medications to relieve acute symptoms and medications to control asthma).

a. **Quick-relief medications** to relieve acute asthma symptoms such as wheezing, chest tightness, and coughing during exacerbations of all forms of childhood asthma. This group includes:

- Short-Acting β2-agonists (SABA) in adequate doses are the drug of choice, especially in children up to 5 years of age. The inhaler route of administration is preferred. While for adults, teenagers and children from 6 to 11 years a combination of ICS – Formoterol / beclomethasone is recommended as fixed-dose combination within the MART plan [4] [15]
- Short-acting (SAMA) muscarinic antagonists. Inhaled muscarinic receptor antagonists (IMA), also called M-cholinolytics fall into two groups: short-acting (SAMA) and long-acting (LAMA) muscarinic antagonists. IMAs are competitive antagonists of acetylcholine versus muscarinic receptors, so they selectively reduce or eliminate parasympathetic stimulation, therefore reducing bronchial spasm, bronchial mucus secretion, and inhibiting bronchial expectoration. SAMA(the main representative is Ipratropium bromide) are the second important group of drugs that are recommended for pharmacological control as inhaled bronchodilators in asthma and are mainly recommended in patients who either do not tolerate or have insufficient effect from SABA treatment. Ipratropium bromide usually used in combination with SABA in acute asthma. [31] [32] [33][34] [35]
- Methylxanthines. Theophylline is a major representative and has modest bronchodilator activity, and its use in the treatment of asthma is limited due to concerns about toxicity and less efficacy than other long-term control agents.
- Systemic corticosteroids. Systemic corticosteroids do not cause rapid bronchodilation, but nevertheless they are used in view of their strong anti-inflammatory effect for the treatment of more severe asthmatic exacerbations.

Treatment of asthma exacerbations for adults, adolescents and children aged 6-11 years.

First, the severity of the exacerbation must be determined.

• In a mild or moderate-severe asthmatic exacerbation patient speaks phrases, prefers to sit or lie down, does not disturbed, does not use accessory respiratory muscles when breathing, increased respiratory rate; Pulse - 100 - 120 b/min.; O2 saturation (on air) 90 - 95%; PEF more than 50% predicted or best. In this case, start treatment with 4 - 10 puffs of salbutamol (albuterol) metered dose aerosol with a spacer or 5 mg with nebulizer every 20 minutes during the 1st hour. In case of insufficient effect, prednisolone is administered (for adults: 40-50 mg, and for children > 6 years: 1-2 mg/kg, max. 40 mg); oxygen therapy to a target O2-saturation of 93-95% (for children: 94-98%). If there is no effect, continue the treatment with SABA (4-10 puffs every 3-4 hours to 6-10 puffs every 1-2 hours). On improvement, assess for discharge if: Symptoms improved, no need for SABA; Improved PEF, and > 60% predicted or best; O2 saturation above 94% in atmospheric air; Adequate resources at home.

• If the patient's condition worsens despite the treatment provided so far or in case of severe asthma exacerbation (patient sits hunched forward, excited or sleepy, confused, with respiratory rate over 30/min, pulse - over 120 beats /min, activated accessory muscles; O2 saturation (in air) < 90%; PEF ≤50% predicted or best), while waiting for transfer to emergency care, continue SABA, give ipratropium bromide (500 μg via nebulizer/20 minutes or 4-8 puffs/20 minutes with pMDI and spacer for 1 hour, then, if necessary), systemic corticosteroids and O2 therapy.

b. **Asthma maintenance medications**. They are used daily for a long time to achieve and maintain asthma control and include:

• **Inhaled and systemic corticoids**. Corticosteroids, especially ICS, are agents of first choice for the maintenance treatment of asthma. Corticosteroids have a powerful anti-inflammatory effect, reduce bronchial hyper-reactivity, mucus secretion and swelling of mucous membranes, increase the number of beta – adrenergic receptors in the lungs and increase their sensitivity to the action of β2-agonists. The use of oral or systemic corticosteroids increases the risk of fractures [16,15]. It is recommended to check the height of children with asthma treated with ICS at least once a year (GINA 2018). ICS are the most effective anti-inflammatory therapy in the treatment of childhood asthma and are used to control persistent asthma regardless of severity [15][3]. Early initiation of ICS modifies the course of the disease [17]. ICS reduce symptoms, exacerbations and prevent airway remodeling, reduce mortality and morbidity in asthma, Daily doses of ICS by age are given in **table 2 and 3** [19] [4]. Although ICS significantly reduces asthma exacerbations and serious exacerbations in patients not taking ICS are associated with greater decline in lung function, there is no clear evidence that ICS use prevents the long-term development of permanent airflow limitation [4]. When high-dose ICS are offered as a treatment option for adults and adolescents, it is again stated that this is for short-term use only, e.g. for 3–6 months, to minimize the potential for side effect [4].

• **Leukotriene modifiers** (LTRA). LTRAs include montelukast and zafirlukast. These medications are recommended in the treatment of mild and moderate asthma as adjunctive treatment in children with asthma not fully controlled by ICS [15, 21].

• **Long-acting beta2-agonists** (LABA). LABAs include salmeterol, formoterol and others, which are inhaled bronchodilators that improve airflow by relieving obstruction for 12 – 24 hours. They should not be used alone in asthma for safety reasons and are usually given in combination with ICS (budesonide - formoterol; fluticasone - salmeterol and mometasone – formoterol). When used in combination with ICSs, LABAs lead to greater control of asthma and exacerbations. [22]

• **Long - acting muscarinic antagonist** (LAMA). The main representative is Tiotropium bromide. This group of drugs is recommended as additional treatment in step 4 in children aged 6 - 11 years and in steps 4 and 5 in adults and children ≥12 years.

• **Cromolyns**. They are non-steroidal anti-inflammatory drugs that inhibit the release of mast cell mediators. Cromolyn group drugs exhibit an anti-inflammatory effect associated with stabilization of the mast cell membrane and are now less often used to control asthma. Representatives of this group are sodium cromoglycate (cromolyn sodium), nedocromil sodium. [2]

• **Immunotherapy** (desensitization, allergen immunotherapy). It can be part of the complex treatment of mild and moderately severe asthma in children over 5 years. The development of an allergy to an otherwise harmless antigen such as pollen or dust mite is called sensitization. Desensitization is the treatment that aims to reduce sensitivity and reactivity to the allergen. Immunotherapy consists of administering the allergen to which the patient is allergic, with increasing doses. The goal is to modulate the immune system by increasing case-specific regulatory T lymphocytes. The therapy is carried out with subcutaneous injections or sublingually (sublingually - there are tablets and drops).

• **Biological therapy** (monoclonal antibodies). Biologic therapy with monoclonal antibodies targets inflammatory cytokines (interleukins, GM - CSF and others), which are biologically active mediators involved in the pathogenesis of asthma and responsible for the symptoms of the disease (bronchial inflammation, bronchospasm, hypersecretion). These medications are administered by injection at 2- to 8-week intervals in addition to standard control treatment. They mainly lead to a reduction in the number of exacerbations and the dose of ICS, as well as to a varying degree to an improvement in lung function and quality of life [44,45]. They are mainly recommended for patients with severe asthma (in Step 5)[4]. The following monoclonal antibodies are authorized for use in Bulgaria:

• Omalizumab (anti-IgE) is an immunomodulator available as an injectable monoclonal antibody that binds to IgE, thereby preventing it from binding to its receptor. Currently, omalizumab is mainly recommended for patients with severe asthma in adults and children over 12 years of age and for those for whom there is evidence of IgE-dependent asthma (positive skin test or serological evidence of allergen-specific IgE). Long-term safety and efficacy in children with asthma have not been well studied.

• Mepolizumab (anti IL-5). It is indicated for the treatment of severe eosinophilic asthma in adults and children over 6 years of age.

• Benralizumab (anti CD125). It is indicated in severe eosinophilic asthma in adults only.

Table 2

Inhaled corticosteroids - daily doses for children over 12 years.

Medicine	Low doses	Moderate doses	High doses
Beclomethasone dipropionate (standard particle)	200-500 μg	>500-1000 μg	>1000 μg
Beclomethasone dipropionate (extrafine particle)	100 – 200 μg	> 200 – 400 μg	> 400 μg
Budesonide(standard particle)	200-400 μg	> 200-800 μg	>800 μg
Ciclesonide(extrafine particle)	80 -160 μg	>160 -320 μg	> 320 μg
Fluticasone propionate	100-200 μg	> 200-500 μg	>500 μg

Table 3

Inhaled corticosteroids - daily doses for children aged 6-11years.

Медикамент	Low doses	Moderate doses	High doses
Beclomethasone dipropionate (standard particle)	100-200 μg	>200- 400 μg	> 400 μg
Beclomethasone dipropionate (extrafine particle)	50 – 100 μg	> 100 – 200 μg	> 200 μg
Budesonide(standard particle)	100-200 μg	> 200-400 μg	>400 μg
Budesonide(nebules)	250 – 500 μg	> 500 – 1000	>1000
Ciclesonide(extrafine particle)	80 μg	>80 -160 μg	>160 μg
Fluticasone propionate	50 – 100 μg	>100-200 μg	>200 μg

Stages of treatment in adults and adolescents diagnosed with asthma [4]:

First, assess patients' symptom control and their risk factors for exacerbations, for decreased lung function, and for adverse drug reactions.

Second, adjust patient management based on these assessments. This includes education and skills training and, adjusting medications as needed, treating modifiable risk factors causing exacerbations and concomitant diseases (rhino-sinusitis, allergic rhinitis, GERD, food allergy, obesity, anxiety and depression), relevant non-pharmacological strategies (physical activity, healthy diet including fruits and vegetables, smoking cessation, pulmonary rehabilitation programs, avoiding medications that would worsen asthma, reducing body weight, breathing exercises, avoiding exposure to external allergens, household and occupational irritants and allergens, avoidance of pollutants in closed facilities/atmospheric conditions, avoidance of food - allergens).

Third - examine the patient in accordance with the goals of treatment.

Stepwise control depends on the severity of asthma (GINA 2024) in steps from 1 to 5, table 4 and 5.

• Mild asthma is asthma that is well controlled with low-intensity treatment, i.e. low-dose ICS or SABA, as needed.

• Moderate asthma is asthma that is well controlled on Step 3 or Step 4.

• Severe asthma is asthma that remains uncontrolled despite optimal treatment with high-dose ICS-LABA or asthma that requires high-dose ICS-LABA to prevent it from becoming uncontrolled. Before making a diagnosis of severe asthma, the following should be ruled out: poor inhaler technique, lack of adherence to treatment, misdiagnosis of asthma, multiple comorbidities, or prolonged exposure to sensitizing or irritating agents in the home or work environment, including tobacco smoke.

• Labile (unstable) asthma. Presents with sudden life-threatening attacks without prodromes. Unlike milder asthma, labile asthma tends to be resistant to inhaled corticosteroids.

In patients with persistent symptoms and/or exacerbations despite high-dose ICS therapy (with good adherence and correct inhalation technique), the clinical or inflammatory phenotype should be assessed, as this may guide the choice of additional treatment, which may to include LAMAs, LTRAs, low-dose azithromycin (adults), and biologic agents for severe asthma. And in patients with severe asthma, allergen immunotherapy may be considered as an adjunctive treatment, but only after asthma symptoms and exacerbations have been controlled.[4] For safety reasons, GINA does not recommend treating asthma with SABA alone in adults, adolescents, and children aged 6 – 12 years. They should instead receive treatment containing ICS to reduce their risk of serious exacerbations and to control symptoms. And for children who are unlikely to adhere to ICS maintenance therapy, ICS can be taken whenever the child uses their reliever SABA. A common question is which patients should start treatment at step 3, i.e. with low-dose ICS - formoterol taken as MART, there is no specific evidence to support this choice, but clinical factors in which it is recommended to consider initiation of MART include symptoms every day, currently smoking, low lung function, recent severe exacerbation or history of life-threatening exacerbation. GINA (2024) recommends Daily maintenance treatment is recommended only from Step 3 for all ages, but in children up to 5 years (double low-dose ICS) is allowed only after a confirmed diagnosis of asthma and lacks the effect of low-dose ICS maintenance treatment in step 2 and also recommends possible addition of LAMA in children from 6 – 11 years in Step 4 and in step 4 and 5 in in adults and children ≥12 years and medium doses of ICS – formoterol or medium/high doses of ICS-LABA and high dose ICS – formoterol only for adults and children ≥12 years in step 5.

Table 4.

Stepwise personalized asthma management for adults and adolescents over 12 years to control symptoms and minimize future risk.

If the patient has	**Steps**	**Start** with Track 1 **(Preferred)**	Track 2	Other controller options
In case of lack of control of symptoms in step 4	5	Add-on LAMA Refer for assessment of phenotype. Consider high dose ICS - formoterol maintenance +- anti – IgE, anti – IL5/5R, anti – IL4Ra, anti- TSLP	Add-on LAMA Refer for assessment of phenotype. Consider high dose ICS – LABA maintenance +- anti – IgE, anti – IL5/5R, anti – IL4Ra,anti-	Add azithromycin (adults) or add LTRA, consider adding low dose OCS but consider side -effects
Daily symptoms waking at night once a week or more and low lung function, or recent exacerbation	4	Medium dose ICS - formoterol maintenance and reliever(MART)	Medium/high dose ICS–LABA + as - needed SABA (or ICS – SABA)	Add LAMA or add LTRA, or add HDM SLIT, or switch to high dose ICS – only. Note: Short course of OCS may also be needed for patients presenting during an exacerbation
Symptoms most days waking at night once a week or more and low lung function	3	Low dose ICS – formoterol maintenance and reliever(MART)	Low dose ICS – LABA + as –needed SABA (or ICS – SABA)	Medium dose ICS or add LTRA, or add HDM SLIT
Symptoms less than 3 -5 days a week, with normal (or mildly reduced) lung function	2	As-needed-only Low dose ICS - formoterol	Step 2: Low dose ICS + as needed SABA (or ICS –SABA)	**other options common to step 1 and 2:** low dose ICS whenever SABA is taken or daily LTRA, or add HDM SLIT Note: In patients with symptoms 1-2 days a week or less, adherence with daily ICS would be very poor, so taking low dose ICS whenever SABA is taken could reduce the risk of exacerbations
	1		Step 1: Take low dose ICS whenever SABA is taken	

GINA Table 5.

Stepwise personalized asthma management for children aged 6–11 years to control symptoms and minimize future risk.

If the patient has	Steps	Start with	Notes	Other controller options
No symptom control on step 4	Step 5	Refer for phenotypic assessment. Consider high dose ICS - LABA or add-on therapy, e.g. +- anti – IgE, , anti – IL4Ra, anti – IL5		As last resort, consider add-on low dose OCS but consider side -effects
Symptoms most days waking at night once or more a week and low lung function,	step 4	Refer for expert advice, or medium dose ICS – LABA plus as – needed SABA or low - dose MART	Short course of OCS may also be needed for patients presenting during an exacerbation	Add tiotropium or add LTRA
Symptoms most days waking at night once or more a week	step 3	Low dose ICS – LABA or medium -dose ICS plus as-needed SABA; or very-low - dose MART		Low dose ICS + LTRA
Symptoms 2 – 5 days a week,	Step 2	Daily Low dose ICS plus as-needed SABA	In patients with symptoms 1 -2 days a week or less, adherence with daily ICS is likely to be very poor, so taking low dose ICS whenever SABA is taken may be a better option for reducing exacerbation risk	Daily LTRA, or low dose ICS whenever SABA is taken
Symptoms less than 2 days a week	Step 1	Take low dose ICS whenever SABA is taken		

Note: when assessing the response to 3 – 6 months asthma treatment, review: Symptom control; exacerbations since previous visit; and how they were managed; medication side-effects; Inhaler technique and adherence; Lung function; Patient satisfaction and concerns. The possibility of refractory type 2 inflammation should be considered if any of the following are found while the patient is taking high – dose ICS or daily OCS: Blood eosinophils ≥150 /mcl, and or FeNO ≥ 20 ppb, and or Sputum eosinophils ≥ 2%, and or Asthma is clinically allergen – driven.

Causes of asthma treatment failure include: Poor inhaler technique; Lack of cooperation or poor adherence to the therapeutic regimen; Inadequate choice of anti-inflammatory medication or inappropriate dose; Poor control of the underlying inflammation from the dose of steroid used; Inadequate education of the patient and/or caregivers; Environmental triggers; Over diagnosis (especially in children under 2 years old).

Spirometric criteria for hospitalization or discharge from the emergency department [4]:

• Hospitalization is recommended if pre-treatment FEV1 or PEF is less than 25% predicted or personal best, or post-treatment FEV1 or PEF is less than 40% predicted or personal best.

• If lung function after treatment is 40 – 60% predicted, discharge may be possible after assessment of patient risk factors and availability of follow-up care.

• If pulmonary function after treatment is greater than 60% predicted or personal best, discharge is recommended after assessment of patient risk factors and availability of follow-up care.

Other factors associated with an increased likelihood of needing hospital treatment include:

• Female, elderly, non-white

• Use of more than 8 beta 2 agonist puffs in the previous 24 hours.

• Severe exacerbation (e.g., tachypnea, need for resuscitation or rapid medical intervention on arrival, O2 saturation < 95%, final PEF less than 50%)

• Past history of severe exacerbation (e.g., intubations, asthma hospitalizations)

• Previous unscheduled office and emergency department visits required use of OCS.

Recommendations to refer patients for expert advice when and where possible [4] in the following cases: 1. Difficulty in confirming the diagnosis of asthma (inconclusive objective tests, lack or poor response to asthma treatment despite correct inhaler technique and good adherence); 2. Presumed occupational asthma; 3. Persistent or severely uncontrolled asthma or frequent exacerbations; 4. Risk factors for asthma-related death – e.g., a near-fatal asthma attack (ICU admission or mechanical ventilation for asthma) at any time in the past; suspected or confirmed anaphylaxis or food allergy in a patient with asthma); 5. Evidence of or risk of significant side effects from treatment; 6. Symptoms suggesting complications or subtypes of asthma; 7. Additional responses for referral in children

6 - 11 years include: Doubts about the diagnosis of asthma; Symptoms or exacerbations that remain uncontrolled despite moderate-dose ICS with proper inhaler technique and good adherence; Suspected side effects of treatment (e.g., growth retardation); Concern for the child's welfare or well-being.

Conclusion. In view of the increasing incidence of under- and overdiagnosis, it is important to first discuss age-specific DD before making a diagnosis of "asthma", "viral wheezing" or "recurrent respiratory infections with BOS", and, if necessary, consultation with a pediatric pulmonologist is recommended if one or more of the indications mentioned in the article are present, or with a specialist from other pediatric specialties (if extrapulmonary pathology is suspected). Many patients have not benefited from the progress in the treatment of asthma in general and often lack even basic care. To improve asthma control, timely and accurate diagnosis, timely and adequate maintenance treatment, tailored to the individual characteristics and preferences of patients and the socio-economic status of the family and preferably with a reduced frequency of medication, as well as avoidance of asthma triggers and treatment of concomitant diseases, timely treatment of exacerbations, based on an easily implemented written, clear and accurate individual action plan, are of paramount importance. Evidence-based asthma treatment guidelines should be disseminated and implemented at national and local levels and integrated into health systems and clinical practice. Review after an asthma exacerbation is essential to optimize maintenance therapy and prevent future exacerbations, and a new treatment plan should be developed. Continuing education of pediatricians directly involved in the management of children with asthma, as well as education of patients and their relatives or caregivers in the correct use of technique and timely administration of medications, are key to improving asthma outcomes.

References

1. Abdulhamid A.K. Differential diagnostic approach to cough in children. Scientific Polish Journal "Medical Sciences" 2025; 82: 10–13.

2. DIAGNOSIS, PREVENTION AND TREATMENT OF BRONCHIAL ASTHMA - NATIONAL CONSENSUS, SOFIA, 2000.

3. Perenovska P. Modern treatment of bronchial asthma in childhood. MEDINFO Magazine ISSUE 10 2018 (36 - 39).

4. Global Strategy for Asthma Management and Prevention(2024).

5. Pattemore PK, Asher MI, Harrison AC, Mitchell EA, Rea HH, Stewart AW. The interrelationship among bronchial hyperresponsiveness, the diagnosis of asthma, and asthma symptoms. Am Rev Respir Dis 1990;142:549–54.

6. Woolcock AJ, Peat JK, Salome CM, Yan K, Anderson SD, Schoeffel RE, et al. Prevalence of bronchial hyperresponsiveness and asthma in a rural adult population. Thorax 1987;42: 361–8.

7. Curry JJ. The action of histamine on the respiratory tract in normal and asthmatic subjects. J Clin Invest 1946;25:785–91.

8. Cockcroft DW, Murdock KY, Berscheid BA, Gore BP. Sensitivity and specificity of histamine PC20 determination in a random selection of young college students. J Allergy Clin Immunol 1992;89:23–30.

9. Godfrey S, Springer C, Noviski N, Maayan C, Avital A. Exercise but not methacholine differentiates asthma from chronic lung disease in children. Thorax 1991;46:488–92.

10. Carlsen KH, Engh G, Mork M, Schroder E. Cold air inhalation and exercise-induced bronchoconstriction in relationship to methacholine bronchial responsiveness: different patterns in asthmatic children and children with other chronic lung diseases. Respir Med 1998;92:308–15.

11. Lim TK, Taylor RG, Watson A, Joyce H,PrideNB.Changes in bronchial responsiveness to inhaled histamine over four years in middle aged male smokers and ex-smokers. Thorax 1988; 43(8):599–604.

12. Page S, Ammit AJ, Black JL, Armour CL. Human mast cells and airway smooth muscle cell interactions: implications for asthma. Am J Physiol Lung Cell Mol Physiol 2001;281(6):L1313–23.

13. Bateman ED, Clark TJ, Frith L, Bousquet J, Busse WW, Pedersen SE; Goal Investigators Group. Rate of response of individual asthma control measures varies and may overestimate asthma control: an analysis of the goal study. J Asthma 2007, Oct;44(8):667 _73.

14. Global Initiative for Asthma (GINA) What's new in GINA 2021!

15. Guilbert TW, Morgan WJ,Krawiec M, Lemanske RF, Jr., Sorkness C, Szefler SJ, et al. The prevention of early asthma in kids study: Design, rationale and methods for the Childhood Asthma Research and Education network. Control Clin Trials. 2004;25:286-310.

16. Castro-Rodriguez JA, Rodrigo GJ. Beta-agonists through metered-dose inhaler with valved holding chamber versus nebulizer for acute exacerbation of age: A systematic review with meta-analysis. J Pediatr 2004;145:172-7.

17. British guideline on the management of asthma – a national clinical guideline.- Scottish Intercollegiate Guidelines Network.- London, 2012

18. Bisgaard H, Szefler S. Prevalence of asthma-like symptoms in young children. Pediatr Pulmonol 2007;42:723-8.

19. Zhou J, Liu DF, Liu C, Kang ZM, Shen XH, Chen YZ, Xu T, Jiang CL, Allergy 2008: 63: 1177–1185. Glucocorticoids inhibit degranulation of mast cells in allergic asthma via nongenomic mechanism.

20. Bisgaard H, Le Roux P, Bjamer D, Dymek A, Vermeulen JH, Hultquist C. Budesonide/formoterol maintenance plus reliever therapy: a new strategy in pediatric asthma. Chest 2006;130:1733-43.

21. Bateman ED, Clark TJ, Frith L, Bousquet J, Busse WW, Pedersen SE; Goal Investigators Group. Rate of response of individual asthma control measures varies and may overestimate asthma control: an analysis of the goal study. J Asthma 2007, Oct;44(8):667 - 73.

22. Rodrigo GJ, Castro-Rodriguez JA. Safety of long-acting beta agonists for the treatment of asthma: clearing the air. Thorax 2012;67:342–349.

23. Global Initiative for asthma (GINA) 2015, 2016, 2017, 2018.

24. Physicians RCo. The National review of asthma deaths (NRAD, 2014. [DOI]

25. Gautier C, Charpin D. Environmental triggers and avoidance in the management of asthma. J Asthma Allergy 2017;10:47–56. 10.2147/JAA.S121276 [DOI]

26. Been JV, Lugtenberg MJ, Smets E, et al. Preterm birth and childhood wheezing disorders: a systematic review and meta-analysis. PLoS Med 2014;11:e1001596. 10.1371/journal.pmed.1001596 [DOI]

27. Win PH, Hussain I. Asthma triggers: what really matters? Clinical Asthma 2008:149–56.

28. Tarasidis GS, Wilson KF. Diagnosis of asthma: clinical assessment. Int Forum Allergy Rhinol 2015;5 Suppl 1:S23–6. 10.1002/alr.21518 [DOI]

29. Mu M, Ye S, Bai M-J, et al. Birth weight and subsequent risk of asthma: a systematic review and meta-analysis. Heart Lung Circ 2014;23:511–9. 10.1016/j.hlc.2013.11.018 [DOI]

30. Egan KB, Ettinger AS, Bracken MB. Childhood body mass index and subsequent physician-diagnosed asthma: a systematic review and meta-analysis of prospective cohort studies. BMC Pediatr 2013;13:121. 10.1186/1471-2431-13-121 [DOI]

31. Cazzola M, Page CP, Calzetta L, Matera MG. Pharmacology and therapeutics of bronchodilators. Pharmacol Rev 2012; 64(3): 450-504.

32. Cazzola M, Matera MG. Bronchodilators: current and future. Clin Chest Med 2014; 35(1): 191-201.

33. Cazzola M, Segreti A, Matera MG. Novel bronchodilators in asthma. Curr Opin Pulm Med 2010; 16(1): 6-12.

34. Cazzola M, Matera MG. Emerging inhaled bronchodilators: an update. Eur Respir J 2009; 34(3): 757-69

35. Cazzola M, Matera MG. Novel long-acting bronchodilators for COPD and asthma. Br J Pharmacol 2008; 155(3): 291-9.

36. McCormack MC, Enright PL. Making the diagnosis of asthma. Respir Care 2008;53:583–90.

37. Licari A, Castagnoli R, Brambilla I, et al. Asthma Endotyping and biomarkers in childhood asthma. Pediatr Allergy Immunol Pulmonol 2018;31:44–55. 10.1089/ped.2018.0886 [DOI]

38. Brusselle GG, Koppelman GH. Biologic therapies for severe asthma. N Engl J Med 2022;386:157–71. 10.1056/NEJMra2032506 [DOI]

39. Asthma GIf. Global strategy for asthma management and prevention. Available: https://ginasthma.org/gina-reports/2021

40. Townshend J, Hails S, McKean M. Management of asthma in children. BMJ 2007;335:253–7. 10.1136/bmj.39255.692222.AE [DOI]

41. Suissa S, Ernst P, Benayoun S, et al. Low-Dose inhaled corticosteroids and the prevention of death from asthma. N Engl J Med 2000;343:332–6. 10.1056/NEJM200008033430504 [DOI]

42. Wanrooij VHM, Willeboordse M, Dompeling E, et al. Exercise training in children with asthma: a systematic review. Br J Sports Med 2014;48:1024–31. 10.1136/bjsports-2012-091347 [DOI]

43. Lu KD, Forno E. Exercise and lifestyle changes in pediatric asthma. Curr Opin Pulm Med 2020;26:103–11. 10.1097/MCP.0000000000000636 [DOI]

44. Chung KF, Wenzel SE, Brozek JL, et al. International ERS/ATS guidelines on definition, evaluation and treatment of severe asthma. Eur Respir J 2014; 43(2): 343-373.

45. Buhl R. Asthma. Pneumo Update Europe 2016, Prague.

46. Xie M and Wenzel SE. A global perspective in asthma: from phenotype to endotype. Clin Med J 2014:126;166-175.

47. Weatherall M. Travers J, Shirtcliffe PM et al. Distinct clinical phenotypes of airways disease defined by cluster analysis. Eur Respir J 2009;34:812-818.

48. Wenzel S. Severe asthma: from characteristics to phenotypes to endotypes. Clinical et experimental allergy 2012:42:650-658.

49. Joanne Martin [1,2,3], Jennifer Townshend [4,#], Malcolm Brodlie [1,4]. Diagnosis and management of asthma in children. BMJ Paediatr Open. 2022 Apr 26;6(1):e001277. doi: 10.1136/bmjpo-2021-001277

50. Fahy JV. Type 2 inflammation in asthma--present in most, absent in many. Nat Rev Immunol 2015;15:57–65. 10.1038/nri3786 [DOI]

51. Bush A, Pavord ID. The Lancet Asthma Commission: treating children in primary care. Prescriber 2018;29:28–32. 10.1002/psb.1719 [DOI]

52. Guevara JP, Wolf FM, Grum CM, et al. Effects of educational interventions for self management of asthma in children and adolescents: systematic review and meta-analysis. BMJ 2003;326:1308–9. 10.1136/bmj.326.7402.1308 [DOI] [PMC free article] [PubMed]

53. Gillette C, Rockich-Winston N, Kuhn JA, et al. Inhaler technique in children with asthma: a systematic review. Acad Pediatr 2016;16:605–15. 10.1016/j.acap.2016.04.006 [DOI] [PubMed]

54. Capanoglu M, Dibek Misirlioglu E, Toyran M, et al. Evaluation of inhaler technique, adherence to therapy and their effect on disease control among children with asthma using metered dose or dry powder inhalers. J Asthma 2015;52:838–45. 10.3109/02770903.2015.1028075 [DOI]

55. Lakupoch K, Manuyakorn W, Preutthipan A, et al. The effectiveness of newly developed written asthma action plan in improvement of asthma outcome in children. Asian Pac J Allergy Immunol 2018;36:88–92.

56. Xiao Chloe Wan, Prescott G Woodruff. Biomarkers in Severe Asthma. Published in final edited form as: Immunol Allergy Clin North Am. 2016 Aug;36(3):547–557. doi: 10.1016/j.iac.2016.03.004.

ИЗУЧЕНИЕ ВЛИЯНИЯ ЛЕКАРСТВЕННОЙ ФОРМЫ КАК ФАРМАЦЕВТИЧЕСКОГО ФАКТОРА НА ТЕРАПЕВТИЧЕСКУЮ ЭФФЕКТИВНОСТЬ ЛЕКАРСТВЕННЫХ ПРЕПАРАТОВ

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THE INFLUENCE OF THE PHARMACEUTİCAL FACTOR İN DOSAGE FORMS ON THE THERAPEUTİC EFFECTİVENESS OF DRUGS

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Аннотация

Основной целью биофармации является изучение значимых фармацевтических факторов. Среди этих факторов особую роль играет форма, в которой приготовлен лекарственный препарат, поскольку она оказывает значительное влияние на его терапевтическую эффективность. В этом контексте изучение данного влияния является одной из актуальных и важных задач фармацевтической технологии. Рассматривая лекарственные формы с точки зрения биофармации, необходимо применять новые критерии их классификации. С этой точки зрения классификация лекарственных форм с учетом способа введения является более целесообразной, так как метод введения определяет возможный транспорт вещества в организме, а также позволяет проводить сравнительное исследование биоэффективности лекарственных форм.

Abstract

The primary goal of biopharmaceutics is to study significant pharmaceutical factors. Among these factors, the form in which drugs are prepared plays a crucial role in ensuring their high therapeutic effectiveness. From this perspective, studying these effects is currently one of the most important and relevant issues in the field of pharmaceutical technology. When considering dosage forms from a biopharmaceutical standpoint, it is necessary to apply new criteria for their classification. In this regard, classification based on the route of administration is more appropriate, as the method of administration determines the possible transport of the substance within the body and enables a comparative study of the bioeffectiveness of dosage forms.

Ключевые слова: биофармация, лекарственное вещество, лекарственная форма, терапевтический, фармакокинетика.

Keywords: biopharmaceutics, drug substance, dosage form, therapeutic, pharmacokinetics.

In the modern era, several directions of biopharmaceutical research have been identified, including the study of the role of pharmaceutical factors, absorption conditions, biotransformation, biological affinity and its determination methods, the development of methods for identifying drugs in biological fluids, the study of drug pharmacokinetics, and the determination of clinical effects.

The primary goal of biopharmaceutics is to study significant pharmaceutical factors. Among these factors, the form in which drugs are prepared plays a crucial role in ensuring their high therapeutic effectiveness. From this perspective, studying these effects is currently one of the most important and relevant issues in the field of pharmaceutical technology. Considering this relevance, we set out to study the biopharmaceutical aspects of drug dosage forms and their constituent drug substances. To achieve this goal, we conducted several studies.

During our research, we first determined that the therapeutic or prophylactic activity of any drug substance is explained by its chemical structure and physi-

cochemical properties. However, the therapeutic activity of the substance is significantly influenced by the "secondary" properties acquired through targeted technological interventions during drug formulation. For example, changes in particle size, combination with excipients, and the development of an optimal dosage form.

The physical properties of the drug substance, the technological processes affecting the properties of the drug substance during formulation, and the excipients included in the dosage form are referred to in the literature as "pharmaceutical factors." From a biopharmaceutical perspective, studying these factors is essential, as they influence the dynamics of drug substances, affect drug stability during storage, and impact many other important parameters.

Throughout human history, drug therapy has held a leading role in the treatment of diseases. Physicians have used various dosage forms in their daily practice, including tablets, ointments, suppositories, and others. However, for a long time, the focus in drug development, production, and prescription was placed not on the dosage form as a pharmacostructural unit but on the active pharmaceutical ingredient (API) and its dosage. The selection of excipients, dosage forms, and formulation technologies was considered a secondary factor that had no significant impact on the treatment process. The dosage form was mainly discussed in terms of its ability to protect the drug substance and ensure its delivery to the site of absorption. Pharmaceutical technology was primarily concerned with developing dosage forms that could maintain their properties over a certain period.

Research and testing were conducted mainly on properties and functions of dosage forms considered decisive based on official pharmaceutical specifications, including:

- The stability of the drug substance within the developed dosage form, despite accompanying challenges (ease of use, dosage accuracy, appearance, smell, taste);
- Economic properties (compactness, transportability, storage conditions);
- Destruction characteristics (disintegration, complete deformation, etc.).

At that time, the identification and quantification of drug substances in pharmaceutical formulations were considered the main priorities.

However, the discovery of the biological role of pharmaceutical factors, the dependence of drug pharmacokinetics on these factors, and the phenomenon of therapeutic non-equivalence in drugs led to the recognition of the dosage form as the fundamental structural unit in pharmacy. This realization necessitated a reassessment of its significance. Experimental and clinical studies have demonstrated that the dosage form plays a crucial role in determining the absorption rate and concentration of the drug substance in biological fluids, directly influencing its effectiveness.

For example, the concentration of spironolactone in biological fluids, when administered in oral dosage forms (tablets, capsules, dragees, granules) at the same dose, varies between 0.06 and 3.75 mcg/L, despite these forms fully complying with pharmacopoeial requirements (disintegration, mechanical strength, color, appearance, uniformity of content, etc.). Unfortunately, pharmacopoeial standards do not currently account for bioequivalence as a parameter dependent on the type of dosage form.

Biopharmaceutical research has demonstrated that not only the therapeutic efficacy of a drug substance but also the occurrence of adverse reactions in the body upon administration is significantly influenced by the type of dosage form. In many cases, changing the dosage form has been sufficient to eliminate adverse effects and achieve the desired therapeutic outcome.

For instance, long-term therapy with indomethacin suppositories provides effective treatment with minimal side effects, whereas the use of indomethacin tablets often leads to adverse effects such as headaches, dizziness, drowsiness, nausea, vomiting, appetite disturbances, and even ulcers and bleeding in the gastrointestinal tract. Similarly, adverse reactions have been observed with some oral dosage forms containing cardiac glycosides, whereas injections and suppositories can eliminate these negative reactions entirely.

The impact of dosage form selection on the therapeutic efficacy of a drug substance must be studied in modern biopharmaceutics without disregarding other objective properties of drugs. The investigation of dosage forms and their effects remains an essential and urgent area of research.

A dosage form is a convenient form of drug administration and storage that ensures the optimal therapeutic effect of the active substance with minimal adverse effects from a pharmaceutical standpoint.

According to this definition, the primary task in the development and production of a dosage form is to create optimal conditions for the release and subsequent absorption of the active substance. All other requirements of the dosage form are subordinate to these conditions. The new interpretation of dosage forms establishes their pharmacotherapeutic role, preventing arbitrary substitution or empirical selection.

From a biopharmaceutical perspective, new classification criteria for dosage forms are necessary. The classification based on the route of administration is more appropriate, as it determines the potential transport of the substance within the body and enables comparative studies of the bioeffectiveness of different dosage forms.

For example, comparing different ophthalmic dosage forms containing the same active ingredient—eye drops, eye ointments, and ocular drug films—it becomes evident that the major drawback of drops and ointments is their lower therapeutic effectiveness compared to films. The necessary therapeutic concentration is maintained for 20 minutes with drops, 50 minutes with ointments, and 24-48 hours with ocular films. Drops must be applied 12 times per day, ointments 6-8 times per day, while films are required only once per day. Additionally, after applying drops or ointments, an initial overdose is possible within the first few minutes, followed by the removal of up to 80% of the active substance from the eye surface.

When using ocular drug films, their dissolution rate in tear fluid is regulated by using a triblock copolymer as a carrier. Additionally, these drug forms have different characteristics in terms of treatment course frequency, storage duration, and other parameters. Despite having the same route of administration, their manufacturing methods, or more precisely, their technologies, differ.

The classification of drug forms based on technological parameters appears less attractive from the perspective of comparing their therapeutic effectiveness. For instance, grouping pressed suppositories and tablets together because they are produced using similar technologies (from granulated material or powder) may seem logical. However, due to differences in administration routes, they exhibit entirely different absorption rates and concentration profiles in the body.

For example, when using pressed suppositories, after their disintegration in the rectum, the active substance bypasses the liver and other digestive barriers, directly entering the systemic circulation, where it can be detected in biological fluids within five minutes. In contrast, when a tablet is ingested, a complex process occurs involving various factors, including the diffusion of the released drug substance through the stomach or intestines. Once absorbed, the substance enters the liver’s portal system. During its passage through the gastrointestinal tract, it undergoes chemical interactions with enzymes, gastric juice, bile, pancreatic secretions, and other digestive components.

From a biopharmaceutical and clinical perspective, attention is given to different administration routes and the varying conditions under which a drug substance moves through the body. For this reason, ointments, suppositories, and other soft drug forms classified based on their aggregate state can be grouped together.

Essentially, with the emergence of biopharmaceutics, dosage forms have transitioned from being studied as a commodity classification to being considered a structural unit of pharmacotherapy. Only those dosage forms that pass bioavailability (bioequivalence) tests receive approval for production.

References

1. Thummel KE, Shen D, "Appendix II: Design and optimization of dosage regimens: Pharmacokinetic Data", Eds: JG Hardman, Limbird LE, Gilma AG, Goodman & Gilman's The Pharmacological Basis of Therapeutics, 10th ed, Mc Graw-Hill Med.Pub.Div., New York s.1917- 2023, 2001.

2. Baldessarini RJ, "Drugs and the treatment of psychiatric disorders", Eds: JG Hardman, Limbird LE, Gilman AG, Goodman & Gilman's The Pharmacological Basis of Therapeutics, 10th ed., Mc Graw-Hill Med.Pub.Div., New York s.447-520,2001. 13- İlaç prospektüsleri, 2002.

3. Bourgeois BFD, "Pharmacokinetics And pharmacodynamics in clinical practice", Eds: E Wyllie, The Treatment of Epilepsy: Principles and Practice, 2nd. Ed. Williams and Wilkins, Baltimore, 1997, s.728-736.

4. Blaise FD, Bourgeois BFD, "Pharmacokinetic properties of current antiepileptic drugs: What improvements are needed?", Neurol., 55, Suppl. 3, SI 1-S16,2000.

5. Perucca E, Pharmacokinetic profile of topiramate in comparison with other new antiepileptic drugs, Epilepsia, 37(Suppl.2), 58-S13,1996.

6. Biology of C-peptide." Cebix. N.p., n.d. Web. 07 Apr. 2013. http://www.cebix.com/index.php/science/.

7. Brunton LL, Lazo JS, Parker KL. Goodman and Gilman Tedavinin Farmakolojik Temeli, Çev. Ed. Süzer O. Nobel Tıp Kitabevleri, İstanbul (2009).

8. Katzung BG, Trevor AJ and Masters SB. Katzung ve Trevor Farmakoloji, Sınav ve Gözden Geçirme, Çev. Eds. Akkan AG ve ark., Nobel Tıp Kitabevleri, İstanbul (2005).

9. Kayaalp SO. Rasyonel Tedavi Yönünden Tıbbi Farmakoloji, 11. Baskı, Hacettepe-TAŞ, Ankara (2005).

10. Drug and Biological Development from Molecule to Product and Beyond, R. P. Evens (ed.), Springer Science -f Business Media, LLC (2007).

11. L.D. Edwards, A.J. Fletcher, A.W. Fox, P.D. Stonier, Principles and practice of pharmaceutical medicine, John Wiley & Sons Ltd. (eds.), The Atrium, Southern Gate, Chichester, West Sussex P019 8SQ, England (2007).

12. L. Ochoa, M. Igartua, R. Ma, et al, J. Pharm. Pharm. Sci., 8 (2), 132- 140 (2005).

13. The US Pharmacopeia, 28л rev., NT 23. USP Convention, Roc- kville, MD (2005).

14. US Department of Health and Human Services. Guidance for Industry: Nonclinical Studiesfor the Safety Evaluation of Pharmaceutical Excipients. Food and Drug Administration (2005).

15. https://zdorovieinfo-ru.ru/az/adenoidy/biofarmaciya-farmacevticheskie-faktory-i-ih-rol-v-poluchenii-terapevticheski/

BENEFITS OF INFLUENZA VACCINATION IN PATIENTS WITH DIABETES MELLITUS

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Abstract

The severity of seasonal influenza infection and illness heavily depend on the immune and general health status of infected people. However, flu-related complications are observed mainly with elderly patients and people with comorbidities, including diabetes mellitus. Patients with diabetes are at increased risk of influenza infection. Vaccination against influenza is one of the effective preventive measures for reducing and controlling flu. Influenza vaccine use is low among the population and increasing the vaccination rate among individuals with diabetes must be a priority in the coming years.

Keywords: seasonal influenza, diabetes mellitus, influenza vaccination.

463 million people worldwide suffer from diabetes mellitus[1]. According to the Global Burden of Disease 2010 survey, the number of deaths attributed to diabetesdoubled in the period from 1990 to 2010, with a 30% increase in disability adjusted life years (DALYs)[2-4]. Investigations conducted in the 90s underestimated the problem, and current projections predict that the number of diabetic cases will reach 600 million by 2035 and 700 million by 2045.

Due to metabolic and immune dysfunction, diabetic patients have lower resistance to bacteria and viruses and are more prone to various respiratory infections. Influenza and pneumonia are the most common respiratory infections in patients with diabetes.

Seasonal influenza is caused by influenza A and B viruses and affects 5-15% of the global population each year[7]. Severity of infection and disease depends largely on the immune and general health status of infected individuals. Most seasonal influenza infections are associated with mild or self-limiting respiratory complaints and most patients do not seek medical care. However, influenza infection can be aggravated by complications, especially in older people and people with comorbidities[7].

After infection with the influenza virus, there is an increase in plasma glucose levels in diabetic patients, which is difficult to control[8]. Hyperglycaemia not only worsens the underlying disease, but also induces toxic pneumonia, secondary bacterial pneumonia, co-infections with other viruses and bacteria, and leads to an increased risk of death[8].Numerous studies have shown that influenza vaccination is one of the effective preventive measures forreducing and controlling influenza[9]. A systematic review and meta-analysis of 11 observational studies showed that the risk of all-cause hospitalization in elderly patients with diabetes can be reduced by 58% after administration of vaccines against influenza and pneumonia, and the risk of hospitalization due to influenza and pneumonia is reduced by 43%. These studies have also shown that the risk of all-cause mortality in elderly patients with diabetes, the risk of hospitalization and the risk of hospitalization due to influenza and pneumonia decreased by 38%, 23% and 45%, respectively[10].

Annual seasonal influenza vaccination can significantly reduce the spread of influenza, but vaccination coverage remains low in Asia compared to Western countries[11].Between 30 and 65% of the population in

the USA receives an influenza vaccination annually[12]. However, the vaccination rate in China is below 2%[13]. Form October 2009 to December 2011, the coverage of influenza vaccination in patients with diabetes in China was 9.4%[14]. In Bulgaria, vaccination coverage is even lower. A significant gap remains from the World Health Assembly's 2013 goal, which aimed for 75% influenza vaccination coverage in high-risk groups by 2010[15].

Diabetes mellitus has been associated with a worsened outcome of influenza infection. Therefore, annual influenza vaccination is recommended for individuals with diabetes by the World Health Organization, the Centers for Disease Control and Prevention, the European Union, and many national and international diabetes associations.

Viral infection increases the risk of developing deep vein thrombosis and pulmonary embolism**.** Influenza infection leads to microvascular and macrovascular complications. Epidemiological studies have shown that influenza infection is associated with an increased risk of developing cardiovascular disease, including myocardial infarction. Experimental animal models of influenza virus infection demonstrate hemostatic alterations both at the circulatory and at the tissue level upon influenza virus infection. Pro-coagulant changes potentially resulting from influenza virus infection may well addup to the already increased risk of developing vascular disease in individuals with diabetes.

Diabetes, infections and complications

Prospective and retrospective studies have sought to answer whether diabetes (type 1 or type 2) is a risk factor for increased susceptibility to viral, bacterial and fungal infections and a more severe outcome. However, these studies do not provide a definitive answer, and sometimes even provide contradictory observations on the relationship between diabetes and the incidence and/or severity of infectious diseases as comorbidities.

Diabetes is characterized by chronic vascular and/or renal complications and a chronic inflammatory condition, which further complicate the interpretation of the observed increased morbidity rates and mortality associated with influenza infection in patients with diabetes compared to non-diabetes patients**.** It is also believed that comorbidities, such as obesity, rather than diabetes itself, increase the risk of infection related mortality[22]**.** Nonetheless, it is generally accepted that diabetes is associated with an increased incidence of certain infections and/or with more frequent complications. Diabetes is a risk factor for premature death due to some infections.

Diabetes and influenza infection

Observational studies have shown that diabetes may be a risk factor for complication during an influenza infection. For example, the frequency of concomitant influenza infection is higher in deceased patients with diabetes compared to those without diabetes, and increased morbidity and mortality associated with influenza infection have been observed in patients with diabetes compared to non-diabetic patients. Diabetes has been associated with an increased number of hospitalizations during the flu season, however not all observational studies confirm such a dependence for seasonal influenza H3N2 subtype. The correlation between diabetes and disease severity was strong duringe H1N1 influenza pandemic, during which the incidence of intensive care admissions and mortality in patients with diabetes is higher than in those without diabetes[8].Influenza infection has also been studied in animal models.In mice with streptozotocin-induced diabetes, elevated titers for the pandemic strains H1N1, H5N1, and H3N2 have been observed. The mechanisms of the more severe clinical course of influenza in people with diabetes have not been clarified. The more severe course of influenza infection in people with diabetes is probably due to aggravating factors such as obesity. New studies have shown an increased risk of severe influenza in obese patients. The more severe course of influenza infection in patients with diabetes is probably due to metabolic disorders - hyperglycemia, underlying comorbidities and glycemic oscillations.

Diabetes mellitus and immune response to influenza virus

The pathophysiological mechanisms that increase the susceptibility to infection and its complicated course in patients with diabetes are not well understood, but are probably related to specific diabetes disorders. This confirms the fact that type 2 diabetes (often associated with obesity) is an inflammatory disease.

In a diet-induced model studying rodents, an increase in mortality upon seasonal influenza was observed, which was associated with decreased or delayed production of antiviral and pro-inflammatory cytokines and impaired functions of dendritic cells. The mechanisms of innate cellular immunity are reduced *in vitro*, and the mechanisms of humoral immunity are impaired in people with diabetes. Defects in innate immune responses, similar to those seen in obese people, may contribute to an increase in morbidity and mortality rates due to influenza infection in people with diabetes. Lower production of interferon-alpha (IFN-α) from dendritic cells has been observed in patients with type 1 and type 2 diabetes. BaselineIFN-α levels are lower in non-obese diabetic mice compared to mice with prediabetes, but IFN-α levels are similarly increased in both types of mice after immunization with influenza virus peptides with similar clonal expansion of IFN-γ-producing CD8(+) T-cells.

Taken together, these data suggest that the overall immune response is reduced in people with diabetes and in laboratory *in vivo* and *ex vivo* models.

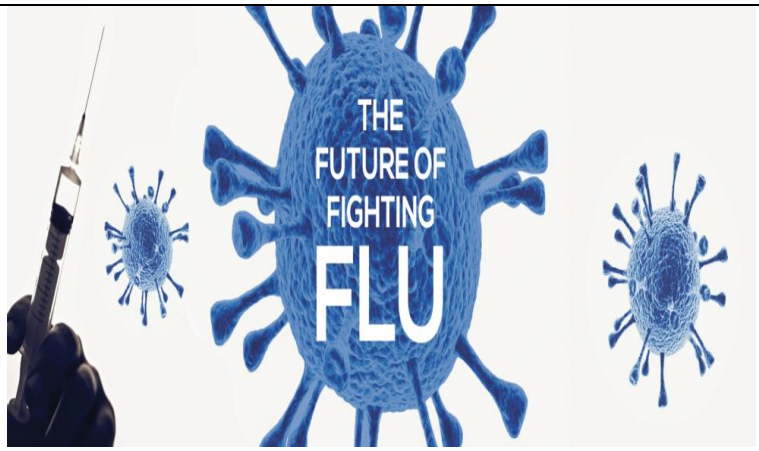
Efficacy and safety of the influenza vaccine in people with diabetes

A meta-analysis showed that the overall efficacy of the influenza vaccine was 58% in terms of reducing hospitalizations, without a significant effect on overall mortality and influenza-like illness in patients with diabetes in the active age group[10]. The adjusted vaccine effectiveness was 38% against all-cause mortality based on cohort studies, 56% against overall mortality, and 23% against total hospitalizations based on case-control studies involving older adults with diabetes[10].

Few studies on vaccine safety have been conducted in patients with diabetes. Reactogenicity and severe adverse reactions in patients with diabetes are rare and similar to those seen in healthy individuals in both the active and elderly populations[10].

Recommendations for influenza vaccination and coverage

Influenza vaccination is recommended for all people with diabetes. The WHO approved a resolution during the 65th World Health Assembly encouraging countries to implement strategies to increase influenza vaccination coverage among all high-risk groups—such as elderly people, patients with conditions like diabetes, and other metabolic disorders. Globally, influenza vaccination coverage among people with diabetes is below the target value of 75%, with notable variations between countries and age groups. However, in most countries, the rate of influenza vaccination is higher among high-risk elderly individuals compared to those at lower risk. The influenza vaccination rate varies between 50% and 62% of patients with diabetes in the USA, but only 10% in Poland, 40% in Germany, and 70% in the Netherlands between 2004-2006. In Spain, 66% of people with diabetes included in the MADIABETES study received an influenza vaccination in 2013. Of seven European countries reporting influenza vaccination data for patients with chronic diseases during the 2012-2013 flu season, only one country (Northern Ireland) covered more than 75% of high-risk patients. Patients with diabetes who experience more severe and prolonged influenza and more frequent visits to their general practitioner tend to adhere more strictly to influenza vaccinations Fear of vaccine side effects and lack of belief in being part of a high-risk group are among the most common reasons for refusing vaccination among people with diabetes.



Health policy and future development

The nature of influenza epidemics - with varying levels of virus circulation, circulation of different types and subtypes, and antigenic drift with the risk of vaccine mismatch, probably affects the results and conclusions of meta-analyses.Nonetheless, available data show that influenza vaccination in people with diabetes, both in active and older age groups, is effective and safe. The growing burden of diabetes cases worldwide requires randomized placebo-controlled trials in people with diabetes –both children and adults - to provide validated information on the real effect of influenza vaccination in this high-risk group of patients. The recommendations of the WHO and many national and international diabetes organizations promoting influenza vaccination in diabetic patients question the ethics of such recommendations. Strategies need to be designed in order to introduce influenza vaccination to reach all at-risk patients, including patients with diabetes who would benefit most from the influenza vaccine. A Canadian prospective study showed that vaccinated patients with type 2 diabetes often have access to well-organized preventive medicine programs that promote the use of prophylactic medications and regular medical check-ups. This is important for interpreting vaccine effectiveness in this patient group due to the potential for optimizing future vaccination campaigns.

Increasingly, influenza prevention is being considered as an integral part of a "healthy ageing" strategy, as most non-infectious diseases occur later in life and pose risk factors for developing severe influenza and its complications. However, overall influenza vaccine coverage rates in high-risk groups remains below the target level globally.Vaccination coverage in nursing homes for elderly people with type 2 diabetes is 30% lower than in other diabetic patients. This suggests that the conventional vaccination programmes are not sufficiently successful among high-risk patients and additional strategies, such as integrated healthcare provision, are needed. Due to the decreased vaccine effectiveness in older and immunocompromised patients, consideration should be given to achieving herd immunity as a prevention strategy. For example, in the UK, vaccination is recommended for all household contacts to protect the most at-risk family members.

National Vaccination Program for Individuals Aged 65+

In 2019, Bulgaria launched the National Vaccination Program for individuals aged 65 and over[52]. Influenza vaccination coverage in Bulgaria is low, with an average of 2.17%-2.61% between 2013 and 2017. These estimates are based on sales, not actual doses administered, which are likely lower. Safe and effective vaccines have been developed and administered for over 60 years. In healthy people, influenza vaccines can prevent 70%-90% of influenza illnesses. Among the elderly, the vaccine reduces severe illness and complications by up to 60% and reduces mortality by 80%[52]. Vaccination is especially important for individuals at higher risk of serious complications from influenza and for those who live with or care for them.

The Program’s goal is to reduce morbidity and mortality from seasonal influenza and its related complications by increasing vaccination coverage in adults over 65 years of age, with the possibility of including target groups of patients with chronic illnesses, in accordance with Ordinance No. 15 of May 12, 2005, on immunizations in the Republic of Bulgaria. Through the Vaccination Program, coverage has increased to 5%-7% of the total population, and this year the Program aims to cover 17% of patients aged 65 and over, with a focus on comorbid patients.

Conclusion

Influenza vaccination is one of the most effective preventive measures for reducing and controlling influenza[8]. Patients with diabetes are at high risk for influenza infection. Vaccination coverage against influenza is low, and increasing the rate of influenza vaccination among people with diabetes is crucial. Although awareness has increased, vaccination coverage has not significantly changed. A possible reason is the lack of recommendation for influenza vaccination from general practitioners. An epidemiological study showed that "influenza vaccination not recommended" is the most common reason for lack of vaccination in high-risk populations. Another study found that 78% of respondents over the age of 60 are willing to follow the advice of general practitioners regarding influenza vaccination. Although people with diabetes are becoming more aware of influenza vaccination through public information campaigns, this does not necessarily mean they are ready to get vaccinated. When directly recommended by their general practitioners, they may decide to get vaccinated against influenza.

To encourage influenza vaccination among patients with diabetes, we need to raise awareness among general practitioners, who should inform their diabetic patients about the benefits of influenza vaccination and prescribe it accordingly.

References

1. Damstra T, Barlow S, Bergman A, et al.: International Programme on Chemical Safety: Global Assessment of the State-of-the-Science of Endocrine Disruptors. WHO/PCS/EDC/02.2. Geneva, World Health Organization, 2002.

2. Diamanti-Kandarakis E, Bourguignon JP, Giudice LC, et al. Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement. *Endocr Rev*. 2009; 30: 293-342.

3. Skakkebaek NE, Toppari J, Söder O, Gordon et al. Exposure of Fetuses and Children to Endocrine-Disrupting Chemicals: A Call for Action from the European Society for Paediatric Endocrinology (ESPE) and the Pediatric Endocrine Society (PES). *J Clin Endocrinol Metab*. 2011; 96: 3056-3058.

4. Kortenkamp A. Low Dose Mixture Effects of Endocrine Disruptors: Implications for Risk Assessment and Epidemiology. *Int J Androl*. 2008; 31: 233-240.

5. Skinner MK. Endocrine Disruptor Induction of Epigenetic Transgenerational Inheritance of Disease. *Mol Cell Endocrinol*. 2014; 398: 4-12.

6. Mantovani A. Risk Assessment of Endocrine Disruptors: The Role of Toxicological Studies. *Ann NY Acad Sci*. 2006; 1076: 239-252.

7. European Food Safety Authority. Scientific Opinion on Polybrominated Diphenyl Ethers (PBDE) in Food. *EFSA J*. 2011; 9: 2156.

8. LaRocca C, Mantovani A. From Environment to Food: The Case of PCBs. *Ann Ist Super Sanita*. 2006; 42: 410-416.

9. European Food Safety Authority. Opinion of the Scientific Panel on Additives and Products or Substances Used in Animal Feed (FEEDAP) on the Use of Iodine in Animal Feed. *EFSA J*. 2005; 168: 1-42.

10. Patandin S, Dagnelie PC, Mulder PG, et al. Dietary Exposure to Polychlorinated Biphenyls and Dioxins from Infancy to Adulthood: A Comparison Between Breastfeeding, Formula Feeding, and Long-Term Exposure. *Environ Health Perspect*. 1999; 107: 45-51.

11. European Food Safety Authority. Cadmium in Food: Scientific Opinion of the Panel on Contaminants in the Food Chain. *EFSA J*. 2009; 980: 1-139.

12. Montaño M, Gutleb AC, Murk AJ. Persistent Toxic Burden of Halogenated Phenolic Compounds in Humans and Wildlife. *Environ Sci Technol*. 2013; 47: 6071-6081.

13. Herman-Giddens ME, Slora EJ, Wasserman RC, et al. Secondary Sexual Characteristics and Menses in Young Girls Seen in Office Practice: A Study from the Pediatric Research in Office Settings Network. *Pediatrics*. 1997; 99: 505-512.

14. Tankova, Ts. *Science Endocrinology*. 2020; (3): 91.

15. Lozano R et al. Global and Regional Mortality from 235 Causes of Death for 20 Age Groups in 1990 and 2010: A Systematic Analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012; 380: 2095-128.

PEDAGOGICAL SCIENCES

TEACHING OF PATRIOTISM IN THE PROCESS OF TEACHING HISTORY IN MODERN TIMES

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Abstract

All the subjects taught at the school not only provide students with scientific knowledge, but also serve to grow the young generation in national and moral qualities, especially in the spirit of patriotism. In this regard, history has a greater responsibility. More precisely, education of citizens useful to society and with a broad outlook is the direct duty of the history subject and history teachers. all the subjects taught in the school not only provide scientific knowledge to the students, but also serve to grow the young generation in national and moral qualities, especially in the spirit of patriotism. In this regard, history has a greater responsibility.

Key words: society, citizen, responsibility, teaching, youth.

Introduction

The level of development of society is related to education, which reflects the essence of socio-economic processes. In all civilized countries, giving importance to education as the basis of development, its acceptance as a superior activity field of special strategic importance for the society and the state is related to the role played by education in the life of the society, its being the beginning of all kinds of development and progress.

Today, the development of our independent republic depends, first of all, on the correct organization of the education and training of the growing generation, and the preparation for citizenship. The role of family and society are great in the development of children as citizens. Children receive their first education as a person, a citizen in the family, including in society. Here they have moral and spiritual qualities, physical strength, rules of conduct, etc. they gain such qualities. Undoubtedly, the main goal of education is to train a perfect personality and citizen. Educating a citizen means educating a person who works for the development of the state to which he belongs, looks after its interests, and is responsible for its security.

Main part

A person is born as an individual, acts as a citizen and undergoes civil training in the process of education and labor. A real citizen means a person who directly serves the country and the state with his necessary activities and has great moral qualities. Experience shows that the correct establishment of citizenship education in the family depends very much on the level of the citizenship position of the parents themselves. Citizenship education means acquiring high moral and spiritual qualities of children and bringing them up as individuals. [5] In other words, children should know the history, geography, culture, national traditions of their homeland, love the homeland, be responsible, honest, and fighters. In order to evaluate the moral education of children, it is very important to instill in them human qualities such as distinguishing good from evil, respecting truth, justice, elders, and family members. The mentioned reflects the essence of citizenship education. As the Republic of Azerbaijan develops, special attention is paid to the education of patriotism, including military-patriotic education of the growing generation. Of course, the people of Azerbaijan do not want war. Our people have supported peace and tranquility throughout history. In historical events, the brave sons of our nation only stood guard and defended our homeland.

Education in the military-patriotic spirit cannot be limited to ordinary words and advice. In order to achieve success in this field, schools must, first of all, plan their work correctly and determine the work they will do during the year. At this time, the connection between the measures, their complementarity should be taken into account, and the organization of the work should be justified. Our great leader, the architect and founder of our independent Azerbaijan, Heydar Aliyev, attaches special importance to patriotic education and the growth of children and youth in a patriotic spirit, and he repeatedly recommended this in his speeches.

The feeling of love for the motherland should be manifested in the commitment of young people to the state language, national music, folklore, religious values, historical traditions, and the fact that they are ready to protect the integrity of the country's territory through practical work. In order to work for the progress of the motherland, it is also an important factor that young people have a certain art, profession, and actively participate in state building. It is important for the young generation to acquire education, have a broad outlook, and love work. To protect the material and spiritual wealth of the motherland, to achieve the rise of its economic power, to always be able to fight against the riots, provocations and natural disasters that may occur comes from the love of the motherland. .[6] It is possible to better inculcate military-patriotic education in young people when students studying in X-XI grades of secondary school and students-young people studying in higher school are given military-related knowledge while teaching separate subjects and specialized courses.

During the time of the Soviet Union, in the existing textbooks, teaching aids and methodical literature, information instilling military-patriotic feelings and military-related knowledge were given little space. In fact, this was done consciously so that young people would be deprived of patriotism and national feelings. The feeling of citizenship is a high manifestation of love for the country. Patriotism, which is one of the highest human feelings, stems from love for the village, land, and country where everyone is born and raised. But patriotism is not only loving the country. Patriotism is also working for the sake of the motherland, being ready to protect the motherland at all times, showing heroism and sacrifices in its path, and having a share in every success of the motherland and the people. Although this feeling is innate in a person, like all other feelings, it needs education and is strengthened through education. .[7] Since patriotism is one of the most important qualities characterizing a person, its instillation in the growing generation, upbringing of children, teenagers and young people in the spirit of patriotism has always been one of the most important directions of education.

National leader Heydar Aliyarv has always prioritized citizenship education in his political course, and emphasized the importance of patriotic education in all his speeches. [4] As a result of his successful political course, a real civil society and patriotic sons were formed. As a successful result of this policy, President Ilham Aliyev and the brave Azerbaijani army, patriotic sons of Azerbaijan demonstrated true patriotism to the world in the 44-day Second Karabakh War.

Conclusion

In modern times, the task of educating active citizens is realized precisely as a result of systematic and consistent patriotism education. It is known that the foundation of patriotism education is laid in primary classes, as in all fields and directions of education and training, and it is further developed in the subsequent stages of education. In this sense, primary school teachers have a great responsibility in the patriotism education of the growing generation. They should try to instill love for the motherland in the hearts of young children entering school from the very first days, and turn this love into a strong feeling of patriotism.

References

1. Əmirov. M. M. Tam orta məktəbdə tarixin fəal/interaktiv təlimi metodikası (Ali məktəblərin tarix fakültəsi tələbələri üçün dərs vəsaiti). Bakı, 2011, 707s.

2. Əmirov. M.M. Tarixin tədrisində şagirdlərdə siyasi mədəniyyətin formalaşdırılması üzrə işin sistemi. Bakı, Mütərcim, 2004, 176 səh.

3. Əmirov. M. M Orta məktəbdə tarixin interaktiv/fəal təlimi metodikası. Ali məktəblərin tarix fakültəsi tələbələri üçün dərs vəsaiti. Bakı, Mütərcim, 2011, 508 səh.

4. Paşayev. T.S. Tarixin tədrisi:tarixilik və müasirlik(monoqrafiya). Bakı 2006, 280 s.

5. https://www.mual-lim.edu.az/news.php?id=5154

6. https://nuhcixan.az/news/cemiyyet/2058-genclerin-vetenperverlik-terbiyesi-gunumuzun-vacib-meselesidir

7. https://multiurok.ru/files/v-t-np-rv-rlik-t-rbiysi-v-t-ndasliq-t-rbiy-sinin.html

DEVELOPMENT OF LISTENING SKILLS IN TEACHING ENGLISH

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Abstract

Listening is a fundamental skill in language acquisition, serving as the foundation for effective communication and overall language proficiency. This paper explores the significance of developing listening skills in teaching English and examines various pedagogical approaches to enhance learners' auditory comprehension. It discusses challenges such as varying accents, speech speed, and lack of contextual understanding, which often hinder students' ability to grasp spoken English. Additionally, the study highlights effective teaching strategies, including the use of authentic audio materials, interactive listening activities, and technology-enhanced learning tools such as podcasts, videos, and AI-driven applications. The integration of these methods fosters active engagement and improves learners' ability to process and interpret spoken language in real-life contexts. The findings suggest that a well-structured listening curriculum not only enhances comprehension skills but also strengthens speaking, reading, and writing abilities, leading to overall language proficiency.

Keywords: listening, listening skills, listening materials, writing abilities, pre-listening, post-listening, contextualization, effective communication.

INTRODUCTİON

In today's world, teaching students to be effective, active listeners is a vital task. In an environment of quick click, constant scrolling, pithy sound bites, the ability to be fully present to the people speaking around us is a significant skill to develop. But that is just it: it is a skill to be mastered and constantly worked on; it requires plenty of practice to fully develop the effective habits of a good listener. As teachers, we need to provide students with opportunities to discuss, exchange ideas, and listen meaningfully and give them the tools to do so effectively.

There are countless reasons why learning to become a good listener is important: not just in terms of developing critical thinking abilities, but also learning to be an empathetic human being. Some such reasons include (but are not limited to) the following:

When we listen effectively, we open ourselves up to opportunities for learning and personal growth. As good listeners, we improve our ability to think critically by fully engaging in a more informed way.

Displaying the attributes of a good listener makes space for others to be able to express themselves openly, helping to build relationships and exchange ideas. True listening helps avoid misunderstandings and limits the potential for just talking past one another. When listening to the thoughts and ideas of others, we can develop empathy and compassion.

Almost every lesson should provide students with ample opportunities to exercise their listening skills. Whether it is through listening to instructions and lectures, paired conversations, class discussions, or media experiences: students should be encouraged to actively listen to others, over and over again. Yet, more importantly, they should be regularly reminded, when doing so, that they need to be exercising the skills of a good listener, and they should be reflecting on their own skill development in this area.

Model Good Listening Skills

This one cannot be emphasized enough: students are highly observant of the behaviours we exhibit in the classroom. We cannot expect them to be effective listeners if they see us not valuing the skill. While it can be difficult to be fully present to what a student is saying when we have a million and one thoughts rushing around our brain during a lesson, we need to make sure that when a student is expressing thoughts and ideas, we - as the teacher - are engaging fully with eye contact, giving visual cues to listening, echoing back what has been said, validating contributions, etc. The more we do this, the more opportunities we give students to learn from our demonstrations.

By developing their ability to listen well we develop our students' ability to become more independent learners, as by hearing accurately they are much more likely to be able to reproduce accurately, refine their understanding of grammar and develop their own vocabulary.

In this article, we intend to outline a framework that can be used to design a listening lesson that will develop your students' listening skills and look at some of the issues involved.

The basic framework

Pre-listening

While listening

Post-listening

Applying the framework to a song

The basic framework

The basic framework on which you can construct a listening lesson can be divided into three main stages.

Pre-listening, during which we help our students prepare to listen.

While listening we help to focus their attention on the listening text and guide the development of their understanding of it.

Post-listening, during which we help our students integrate what they have learnt from the text into their existing knowledge.

Pre-listening. There are certain goals that should be achieved before students attempt to listen to any text. These are motivation, contextualization, and preparation.

Motivation It is enormously important that before listening students are motivated to listen, so you should try to select a text that they will find interesting and then design tasks that will arouse your students' interest and curiosity.

Contextualization

When we listen in our everyday lives we hear language within its natural environment, and that environment gives us a huge amount of information about the linguistic content we are likely to hear. Listening to a tape recording in a classroom is a very unnatural process. The text has been taken from its original environment and we need to design tasks that will help the students to contextualize the listening and access their existing knowledge and expectations to help them understand the text.

Preparation

To do the task we set students while they listen there could be specific vocabulary or expressions that students will need. We must cover this before they start to listen as we want the challenge within the lesson to be an act of listening not of understanding what they have to do (3, 155).

While listening

When we listen to something in our everyday lives we do so for a reason. Students too need a reason to listen that will focus their attention. For our students to develop their listening skills they will need to listen several times - three or four usually works quite well - as I've found that the first time many students listen to a text they are nervous and have to tune in to accents and the speed at which the people are speaking.

Ideally, the listening tasks we design for them should guide them through the text and should be graded so that the first listening task they do is quite easy and helps them to get a general understanding of the text. Sometimes a single question at this stage will be enough, not putting the students under too much pressure.

The second task for the second time students listen should demand a greater and more detailed understanding of the text. Make sure though that the task doesn't demand too much of a response. Writing long responses as they listen can be very demanding and is a separate skill in itself, so keep the tasks to single words, ticking or some sort of graphical response.

The third listening task could just be a matter of checking their own answers from the second task or could lead students towards some more subtle interpretations of the text.

Listening to a foreign language is a very intensive and demanding activity and for this reason, I think it's very important that students should have 'breathing' or 'thinking' space between listening. I usually get my students to compare their answers with listening as this gives them the chance not only to have a break from the listening but also to check their understanding with a peer and so reconsider before listening again.

Post-listening There are two common forms that post-listening tasks can take. These are reactions to the content of the text and analysis of the linguistic features used to express the content.

Reaction to the text

Of these two I find that tasks that focus on students' reaction to the content are most important. This is something that we naturally do in our everyday lives again. Because we listen for a reason, there is generally a following reaction. This could be discussed as a response to what we've heard - do they agree or disagree or even believe what they have heard? - or it could be some kind of reuse of the information they have heard.

Analysis of language

The second of these two post-listening task types involves focusing students on the linguistic features of the text. This is important in terms of developing their knowledge of language, but less so in terms of developing students' listening skills. It could take the form of an analysis of verb forms from a script of the listening text or vocabulary or collocation work. This is a good time to do form-focused work as the students have already developed an understanding of the text and so will find dealing with the forms that express those meanings much easier. (3, 55)

Applying the framework to a song

Here is an example of how you could use this framework to exploit a song:

Pre-listening

Students brainstorm kinds of songs

Students describe one of their favourite songs and what they like about it

Students predict some words or expressions that might be in a love song

While listening

Students listen and decide if the song is happy or sad

Students listen again and order the lines or verses of the song

Students listen again to check their answers or read a summary of the song with errors in and correct them.

Post-listening

Focus on content

Discuss what they liked/didn't like about the song

Decide whether they will buy it / who they will buy it for

Write a review of the song for a newspaper or website

Write another verse for the song

Focus on form

Students look at the lyrics from the song and identify the verb forms

Students find new words in the song and find out what they mean

Students make notes of common collocations within the song Earnest Hemmingway said: “When people talk, listen completely. Most people never listen.” Let’s take his advice and teach our students to listen completely. (2, 23)

Conclusion

The development of listening skills is essential in teaching English, as it serves as a foundation for effective communication and overall language proficiency. This study has highlighted the importance of incorporating diverse teaching strategies, including the use of authentic materials, interactive exercises, and technology-enhanced learning tools, to improve students' listening comprehension. Despite challenges such as varying accents, speech speed, and unfamiliar vocabulary, a structured and engaging approach to listening practice can significantly enhance learners' ability to process and understand spoken English. Furthermore, strengthening listening skills positively impacts other language competencies, such as speaking, reading, and writing. Therefore, educators should prioritize the systematic development of listening skills, integrating innovative methods that foster active engagement and real-world application. By doing so, learners can achieve greater fluency and confidence in using English effectively in diverse communication settings.

References

1. Celce, M. & Marianne. (2001). Teaching English as a Second or Foreign Language. New York: Thomson Learning, Inc. 550 p.

2. Djurayeva, Y. (2020). The Role of Phonetics in Languages Teaching. International Engineering Journal for Research and Development, 5(1), 44-49.

3.Harmer, J. (2007). How to Teach English. United Kingdom: Pearson Education Limited. 288 p

4. Richard, J. & Renandya, W. (2002). Methodology in Language Teaching. New York: Cambridge University Press 422 p

PHILOLOGY

A COMPARATIVE ANALYSIS OF PHRASEMES IN THE KHOREZM DIALECT OF UZBEK LANGUAGE AND ENGLISH: A LINGUISTIC AND CULTURAL PERSPECTIVE

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Abstract

This study examines the linguistic and cultural characteristics of phrasemes in the Khorezm dialect of Uzbek and English. Through a comparative analysis, we explore the semantic, grammatical, and cultural dimensions of phrasemes in both languages. The findings reveal that Khorezm phrasemes are deeply rooted in regional traditions and agricultural practices, while English phrasemes reflect broader historical and global influences. This research highlights the importance of preserving regional dialects and underscores the role of phrasemes in understanding cultural identity and linguistic diversity. The comparison highlights several key aspects: (1) **semantic structure**—Khorezm dialect phrasemes often draw from local traditions, agriculture, and social practices, while English phrasemes frequently derive from historical events, literature, and global influences; (2) **linguistic form**—the grammatical and lexical structures of phrasemes in the Khorezm dialect align with Uzbek linguistic norms, whereas English phrasemes follow the syntactic patterns of English; and (3) **cultural context**—Khorezm phrasemes are closely tied to the regional identity and lifestyle of the Khorezm people, while English phrasemes reflect broader, often universal, cultural themes.

Keywords: phrasemes, linguistic forms, cultural context, patterns, events, dialects.

Introduction

Phrasemes, or fixed expressions with figurative meanings, are a vital component of language, offering insights into the cultural and historical contexts of their speakers. This study compares phrasemes in the Khorezm dialect of Uzbek, a regional variant of the Uzbek language, with those in English. The Khorezm dialect is characterized by unique phonetic, lexical, and grammatical features, while English phrasemes are shaped by the language's diverse historical and cultural influences. By analyzing these two linguistic systems, this study aims to uncover the ways in which phrasemes reflect cultural identity and linguistic diversity. This comparative study underscores the importance of phrasemes as a reflection of cultural identity and linguistic diversity. The Khorezm dialect's phrasemes highlight the richness of regional languages and the need to preserve them in the face of globalization. At the same time, English phrasemes demonstrate the language's ability to adapt and evolve, incorporating influences from various cultures and historical periods.

The findings of this study have implications for linguistics, translation studies, and cultural anthropology. They emphasize the need for a nuanced understanding of phrasemes when translating between languages, as their meanings are often deeply rooted in cultural contexts. Furthermore, this research highlights the value of regional dialects and their unique linguistic features, which contribute to the overall diversity of human language. Phraseological units, or phrasemes, are an integral part of any language, serving as a window into the cultural, historical, and social fabric of its speakers. This article explores the similarities and differences between phrasemes in the Khorezm dialect of the Uzbek language and those in English, highlighting their linguistic structures, semantic meanings, and cultural significance. By comparing these two distinct linguistic systems, we aim to uncover the unique ways in which language reflects and shapes cultural identity. This study presents a comparative analysis of phraseological units (phrasemes) in the Khorezm dialect of the Uzbek language and English, focusing on their linguistic, cultural, and semantic characteristics. Phrasemes, as fixed expressions with figurative or idiomatic meanings, reflect the unique cultural and historical contexts of their respective languages. The Khorezm dialect, a regional variant of Uzbek, exhibits distinct lexical, phonetic, and grammatical features that influence its phrasemes. In contrast, English phrasemes, particularly idiomatic expressions, are deeply rooted in the cultural and historical evolution of the English-speaking world.

Methods

The study employs a qualitative comparative approach, analyzing phrasemes from the Khorezm dialect and English in terms of their semantic structure, linguistic form, and cultural context. Data for the Khorezm dialect were collected through interviews with native speakers and a review of regional literature. English phrasemes were drawn from established linguistic corpora and idiomatic dictionaries. The analysis focused on identifying common themes, grammatical structures, and cultural references in both sets of phrasemes.

Results

1. **Semantic Structure**:
   - **Khorezm Dialect**: Phrasemes in the Khorezm dialect often derive from local traditions, agriculture, and communal life. Examples include "қўлидан келмаслик" (inability to do something) and "бошига тушмаслик" (to avoid responsibility), which reflect pragmatic values and social dynamics.
   - **English**: English phrasemes frequently originate from historical events, literature, and global interactions. Examples include "break the ice" (to initiate a conversation) and "spill the beans" (to reveal a secret), which carry metaphorical meanings.

2. **Linguistic Form**:
   - **Khorezm Dialect**: The grammatical and lexical structures of Khorezm phrasemes align with Uzbek linguistic norms, often incorporating dialect-specific vocabulary.
   - **English**: English phrasemes follow the syntactic patterns of English and may include archaic or borrowed words, reflecting the language's evolution.
3. **Cultural Context**:
   - **Khorezm Dialect**: Phrasemes are closely tied to the regional identity and lifestyle of the Khorezm people, serving as a means of preserving local traditions.
   - **English**: Phrasemes reflect broader cultural narratives and are used to convey ideas that resonate across English-speaking communities.

Common English Phrasemes

1. **Break the ice**
   - *Meaning*: To initiate a conversation or ease tension in a social situation.
   - *Example*: "He told a joke to break the ice at the meeting."
2. **Spill the beans**
   - *Meaning*: To reveal a secret or confidential information.
   - *Example*: "She accidentally spilled the beans about the surprise party."
3. **Hit the nail on the head**
   - *Meaning*: To describe exactly what is right or true.
   - *Example*: "You hit the nail on the head when you said the problem was communication."
4. **Bite the bullet**
   - *Meaning*: To face a difficult situation with courage.
   - *Example*: "I didn't want to do the presentation, but I had to bite the bullet."
5. **Let the cat out of the bag**
   - *Meaning*: To reveal a secret unintentionally.
   - *Example*: "He let the cat out of the bag about their engagement."
6. **Kick the bucket**
   - *Meaning*: A euphemism for dying.
   - *Example*: "I'm not ready to kick the bucket yet!"
7. **Burn the midnight oil**
   - *Meaning*: To work late into the night.
   - *Example*: "She burned the midnight oil to finish her project."
8. **Cost an arm and a leg**
   - *Meaning*: To be very expensive.
   - *Example*: "That designer bag costs an arm and a leg."
9. **Piece of cake**
   - *Meaning*: Something very easy to do.
   - *Example*: "The exam was a piece of cake."
10. **Under the weather**
    - *Meaning*: To feel unwell or sick.
    - *Example*: "I'm feeling under the weather today, so I'll stay home."

Phrasemes with Historical or Cultural Origins

11. **Meet one's Waterloo**
    - *Meaning*: To face a final defeat or downfall.
    - *Origin*: Refers to Napoleon's defeat at the Battle of Waterloo.
    - *Example*: "The team met their Waterloo in the championship game."
12. **Cross the Rubicon**
    - *Meaning*: To pass a point of no return.
    - *Origin*: Refers to Julius Caesar crossing the Rubicon River, an act of defiance.
    - *Example*: "By quitting his job, he crossed the Rubicon and started his own business."
13. **Bury the hatchet**
    - *Meaning*: To make peace or end a conflict.
    - *Origin*: Refers to a Native American tradition of burying weapons to symbolize peace.
    - *Example*: "After years of arguing, they finally buried the hatchet."
14. **Throw someone under the bus**
    - *Meaning*: To sacrifice someone for personal gain.
    - *Origin*: Likely from political or workplace contexts.
    - *Example*: "He threw his colleague under the bus to save himself."
15. **The ball is in your court**
    - *Meaning*: It is now your turn to take action or make a decision.
    - *Origin*: From tennis, where the ball is hit into the opponent's court.
    - *Example*: "I've done all I can—now the ball is in your court."

Phrasemes with Animal Metaphors

16. **Let sleeping dogs lie**
    - *Meaning*: To avoid stirring up old conflicts or problems.
    - *Example*: "I decided to let sleeping dogs lie and not bring up the argument."
17. **A fish out of water**
    - *Meaning*: Someone who feels out of place or uncomfortable.
    - *Example*: "At the formal dinner, he felt like a fish out of water."
18. **The elephant in the room**
    - *Meaning*: An obvious problem or issue that everyone avoids discussing.
    - *Example*: "The budget deficit is the elephant in the room during the meeting."
19. **Kill two birds with one stone**
    - *Meaning*: To accomplish two tasks with a single action.
    - *Example*: "By taking the train, I killed two birds with one stone—saving money and time."
20. **Hold your horses**
    - *Meaning*: To wait or be patient.
    - *Example*: "Hold your horses! We're not ready to leave yet."

Phrasemes with Food Metaphors

21. **The icing on the cake**
    - *Meaning*: Something that makes a good situation even better.
    - *Example*: "Winning the award was great, but meeting my idol was the icing on the cake."
22. **In a nutshell**
    - *Meaning*: To summarize something concisely.

- *Example*: "In a nutshell, the project was a success."

23. **Spice things up**

- *Meaning*: To make something more exciting or interesting.
- *Example*: "Let's spice things up by trying a new restaurant."

24. **Bring home the bacon**

- *Meaning*: To earn a living or provide for a family.
- *Example*: "She works hard to bring home the bacon."

25. **Cool as a cucumber**

- *Meaning*: To remain calm and composed.
- *Example*: "Even during the crisis, he was as cool as a cucumber."

Phrasemes with Nature Metaphors

26. **Weather the storm**

- *Meaning*: To endure a difficult situation.
- *Example*: "The company managed to weather the storm during the recession."

27. **A drop in the ocean**

- *Meaning*: A very small amount compared to what is needed.
- *Example*: "The donation was a drop in the ocean compared to the total cost."

28. **Blow off steam**

- *Meaning*: To release pent-up energy or frustration.
- *Example*: "After work, I go to the gym to blow off steam."

29. **On cloud nine**

- *Meaning*: To be extremely happy or elated.
- *Example*: "She was on cloud nine after hearing the good news."

30. **Throw caution to the wind**

- *Meaning*: To take a risk without worrying about the consequences.
- *Example*: "He threw caution to the wind and quit his job to travel the world."

Proverbs and Wise Sayings

31. **Actions speak louder than words**

- *Meaning*: What someone does is more important than what they say.
- *Example*: "Don't just promise to help—actions speak louder than words."

32. **Better late than never**

- *Meaning*: It's better to do something late than to never do it at all.
- *Example*: "I finally finished my degree—better late than never!"

33. **Don't count your chickens before they hatch**

- *Meaning*: Don't assume something will happen before it actually does.
- *Example*: "I know you're excited about the promotion, but don't count your chickens before they hatch."

34. **Every cloud has a silver lining**

- *Meaning*: There is something positive in every difficult situation.
- *Example*: "Losing the job was tough, but every cloud has a silver lining—I found a better one."

35. **When in Rome, do as the Romans do**

- *Meaning*: Adapt to the customs of the place you are in.
- *Example*: "I don't usually eat spicy food, but when in Rome, do as the Romans do."

Discussion

The findings reveal significant differences in the semantic, linguistic, and cultural dimensions of phrasemes in the Khorezm dialect and English. Khorezm phrasemes are deeply embedded in the region's agricultural and communal practices, highlighting the importance of local traditions in shaping language. In contrast, English phrasemes demonstrate the language's adaptability and its ability to incorporate influences from various cultures and historical periods.

This study underscores the role of phrasemes as a reflection of cultural identity and linguistic diversity. The Khorezm dialect's phrasemes provide valuable insights into the worldview and values of the Khorezm people, while English phrasemes illustrate the global reach and historical depth of the English language. These findings have implications for linguistics, translation studies, and cultural anthropology, emphasizing the need to preserve regional dialects and their unique linguistic features.

Conclusion

Phrasemes in the Khorezm dialect of Uzbek and English offer a fascinating lens through which to explore the interplay between language, culture, and cognition. While Khorezm phrasemes are closely tied to regional traditions, English phrasemes reflect broader cultural and historical influences. This comparative analysis highlights the importance of preserving regional dialects and their unique linguistic heritage, contributing to a deeper understanding of linguistic diversity and cultural identity. Future research could expand this study to include other dialects and languages, further enriching our understanding of phrasemes and their cultural significance.

References

1. Cowie, A. P. (1998). Phraseology: Theory, Analysis, and Applications. Oxford University Press.
2. Moon, R. (1998). Fixed Expressions and Idioms in English: A Corpus-Based Approach. Oxford University Press.
3. Wray, A. (2002). Formulaic Language and the Lexicon. Cambridge University Press.
4. Boeschoten, H. (1998). Uzbek Grammar. Otto Harrassowitz Verlag.
5. Johanson, L. (1998). The Turkic Languages. Routledge.
6. Karimov, A. (2005). Uzbek Dialectology: Khorezm Dialect. Tashkent: Uzbekistan National Library. (Hypothetical reference; search for similar works in Uzbek or Russian.)
7. Ergashev, B. (2010). Phraseology in the Uzbek Language. Tashkent: Fan Publishing. (Hypothetical reference; look for works by Uzbek linguists.)
8. Abdullaev, F. (2000). The Khorezm Dialect: Linguistic and Cultural Features. Tashkent: Uzbekistan Academy of Sciences. (Hypothetical reference; search for regional studies.)
9. Khudoyberganova, D. (2015). Cultural and Linguistic Aspects of the Khorezm Dialect. Journal of

Uzbek Linguistics, 12(3), 45-60. (Hypothetical reference; look for similar studies.)

10. Comrie, B. (1989). Language Universals and Linguistic Typology. University of Chicago Press.

11. Johanson, L., & Csató, É. Á. (Eds.). (1998). The Turkic Languages. Routledge.

12. Levin, B. (1993). English Verb Classes and Alternations: A Preliminary Investigation. University of Chicago Press.

13. Sharifian, F. (2011). Cultural Conceptualisations and Language: Theoretical Framework and Applications. John Benjamins Publishing.

14. Palmer, G. B. (1996). Toward a Theory of Cultural Linguistics. University of Texas Press.

15. Wierzbicka, A. (1997). Understanding Cultures Through Their Key Words: English, Russian, Polish, German, and Japanese. Oxford University Press.

PHYSICS AND MATHEMATICS

THE PHYSICAL POSSIBILITY FOR PEOPLE ON EARTH TO TIME TRAVELS[1]

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Abstract

The article argues that the version of the special theory of relativity (SRT), which is generally recognised and studied in all physics textbooks, is incorrect. Therefore the author has created the corrected version of SRT, from which relativistic formulas and new scientific knowledge received after creation of incorrect version of SRT it followed that in the nature there is not only our visible universe, but besides it there are many other mutually invisible universes and antiuniverses. And besides existing in universes of matter, space and time, in antiuniverses there exist antimatter, anti-space and anti-time. And the existence of anti-time makes travelling not only in space but also in time possible. And the article explains how it can be done now.

Keywords: imaginary numbers; special theory of relativity, invisible universes and anti-universes, hidden Multiverse, portals, anomal zones.

1. Introduction

The 20th century in physics turned out to be rich in new interesting scientific ideas. But many of them, even called theories, have not yet received experimental confirmation. For example, one of the most prominent and currently studied in all physics textbooks is the special theory of relativity (SRT) [1]-[3], which was nominated 66 times for the Nobel Prize, nevertheless, due to the lack of experimental confirmation, it has not received it.

And from the very beginning, the generally accepted version of SRT was criticised by Oliver Heaviside, Nikola Tesla, Nobel Prize winner Albert Abraham Michelson, Nobel Prize winner Wilhelm Frederick Ostwald, Nobel Prize winner Joseph John Thomson, Nobel Prize winner Svante August Arrhenius, Nobel Prize winner Philipp Eduard Anton von Lenard, Nobel Prize winner Alvar Gulstrand, Nobel Prize winner Wilhelm Carl Werner Otto Fritz Wien, Nobel Prize winner Walter Hermann Nernst, Nobel Prize winner Ernest Rutherford, Nobel Prize winner Johannes Stark, Nobel Prize winner Frederick Soddy, Nobel Prize winner Percy Williams Bridgman, Nobel Prize winner Edwin Mattison Macmillan, Nobel Prize winner Hideki Yukawa, Nobel Prize winner Hannes Olof Jösta Alven and many other distinguished scientists.

And in the XXI century this wrong version of STO was even by the above-mentioned arguments experimentally refuted [4]-[37] in the most indisputable way. However being unable to object, the authors of existing physics textbooks simply ignored these refutations and the incorrect version of SRT still continues to be taught even in the most prestigious universities in all countries.

All modern science is in a similar state. In the 21st century Jean de Climont in his books [34]-[37] writes about 9671 scientists who refuted the currently recognised scientific truths in all sciences. But the trouble is not that one or another infidelity has been discovered in the modern sciences. The author of the concept of 'open society' Sir Karl Raimund Popper, a member of the Royal Society of London, wrote [38]: *"...the struggle of opinions in scientific theories is inevitable and is a necessary condition for the development of science"*. From which he made, at first glance paradoxical, but in fact correct conclusion that the most valuable results of scientific research are precisely the refutations of generally recognised theories, because they allow them to develop. And this is inevitable. There is no doubt that all scientific knowledge in a thousand years, much less in a million or a billion years, will be quite different. Therefore, we should not naively assume that we have already learnt everything and hinder the research of colleagues who propose new ideas.

2. The version of the special theory of relativity taught in all physics textbooks is incorrect

So what are the refutations of the generally recognised version of SRT obtained during the last century? They are the following:

- the relativistic formulas obtained in this SRT are incorrect;
- the relativistic formulas received in this SRT are incorrectly explained with use of incorrect principle of non-exceeding of speed of light;
- from relativistic formulas of this SRT wrong conclusions about physical unreality of imaginary numbers and existence in the nature of our only visible universe are made.

And these conclusions are available for experimental verification. Indeed, the relativistic formulae

$$\boldsymbol{m(v) = m_0 \,/\, \sqrt{1 - (\frac{v}{c})]^2}} \quad (1)$$

$$\boldsymbol{\Delta t(v) = \Delta t_0 \sqrt{1 - (\frac{v}{c})^{\,2}}} \quad (2)$$

$$\boldsymbol{l(v) = l_0 \sqrt{1 - (\frac{v}{c})]^2}} \quad (3)$$

[1] This is reprint of the article "Antonov A. A. 2025. Time travels for people on Earth are already possible. European Journal of Applied Sciences, Services for Science and Education. UK. 13(1). 163-180. DOI:10.14738/aivp.131.18239".

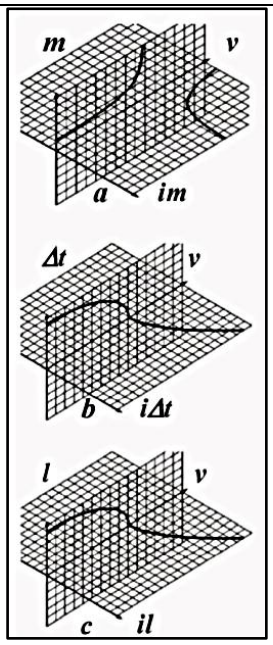

Fig. 1. Graphs of functions $m(v)$, $\Delta t(v)$ *and* $l(v)$ *corresponding to the existing versions of the STR in the subluminal* $v < c$ *and superluminal* $v > c$ *ranges*

where m_0 is the rest mass of a moving body;

m - relativistic mass of a moving body;

Δt_0 - rest time of a moving body;

Δt - relativistic time of a moving body;

l_0 - rest length of a moving body;

l - relativistic length of a moving body;

v is the velocity of the moving body;

c - speed of light;

are explainable (see Fig. 1a,b,c) only in the range of pre-light velocities *v*<*c*, in which the values m, and l take values measured by real numbers. And in the range of superluminal velocities ***v>c*** these quantities m, and l already take values measured by imaginary numbers discovered 500 years ago [39],[40], but still unexplained. After all, what is, for example, 10 grams, 20 seconds and 30 metres, everyone can explain, but what is 10***i*** grams, 20***i*** seconds and 30***i*** metres, where $\boldsymbol{i} = \sqrt{-1}$, is not explained in any textbook. Moreover, the graph in Fig. 1a in the range of velocities ***v>c*** corresponds to a physically unstable process, which cannot exist in nature at all.

And since such a theory, the formulas of which even its creators could not explain, would be of no use to anyone, a postulate called the principle of not exceeding

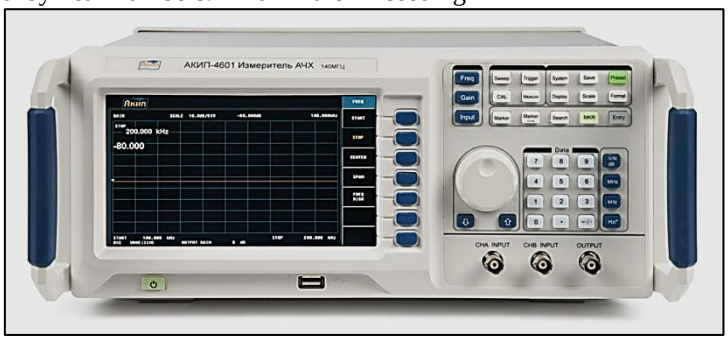

Fig. 2. In any radio engineering laboratory there are devices called frequency characteristic meters, which by their very existence prove the physical reality of imaginary and complex frequencies, and consequently, of any imaginary and complex numbers.

the speed of light was introduced into it. From this postulate it followed that imaginary numbers are physically unreal. Therefore, it was concluded that there was no need to explain them.

But there are other sciences besides physics. And in the theory of linear electric circuits used in radio engineering, electrical engineering and computer technology, according to Ohm's law as interpreted by Charles Proteus Steinmetz [41], there are imaginary resistances of capacitors and inductors (also called inductance coils), which are measured by devices available in any radio engineering laboratory (Fig. 2). This proves [42]-[53] that imaginary numbers are physically real[27] and

[27] Since you can only measure what actually physically exists.

the principle of non-exceeding the speed of light is incorrect. And therefore relativistic formulas (1)-(3) are incorrect[28].

3. **Corrected version of the special theory of relativity**

But even from the uncorrected relativistic formulas (1)-(3) follows an important conclusion, which the authors of SRT have overlooked and by their principle of non-exceeding of the speed of light have made this conclusion impossible – the velocity ***v*** in these formulas is an additional, besides length, width and height, spatial dimension.

Therefore in the corrected version of SRT the corrected relativistic formulas [54[-[61] are received

$$m(q,r,s)=\frac{m_0 i_1^q i_2^r i_3^s}{\sqrt{1-[v/c-(q+r+s)]^2}} \quad (4)$$

$$\Delta t(q,r,s)=\Delta t_0 i_1^q i_2^r i_3^s \sqrt{1-[v/c-(q+r+s)]^2} \quad (5)$$

$$l(q,r,s)=l_0 i_1^q i_2^r i_3^s \sqrt{1-[v/c-(q+r+s)]^2} \quad (6)$$

where $\boldsymbol{q(v)=\lfloor v_q/c \rfloor}$ – is the "floor" function of discrete mathematics from the argument ***v/c***, which is the fourth spatial dimension (Fig. 3);

$\boldsymbol{r(v)=\lfloor v_r/c \rfloor}$ – is the "floor" function of discrete maths from the argument ***v/c***, being the fifth spatial dimension (Fig. 3);

$\boldsymbol{s(v)=\lfloor v_s/c \rfloor}$ – is the "floor" function of discrete maths from the argument ***v/c***, being the sixth spatial dimension (Fig. 3);

$\boldsymbol{v_q, v_r\, v_s}$ – projections of the velocity vector v on orthogonal coordinates ***q, r, s*** (see Fig. 4).

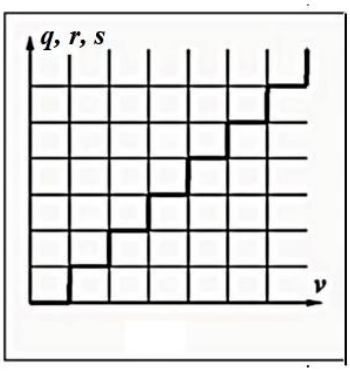

Fig 3. Graphs of functions q(v), r(v), s(v) illustrating the meaning of the "floor" function of discrete mathematics

From them it follows that we live in a Multiverse [62]-[77],which is six-dimensional – three dimensions ***x, y, z*** has each universe and three more dimensions ***q, r. s*** are coordinates of universes in the Multiverse (Fig. 4) – and is described by quaternions $\boldsymbol{f_{q,r,s}(x,y,z)+i_1 q+i_2 r+i_3 s}$, the number of which is equal to the number of universes in the Multiverse. This is exactly what Lisa Randall predicted: *"We could be living in a three-dimensional pocket of higher dimensional space."*

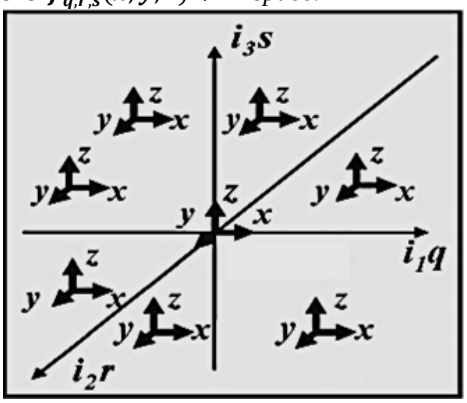

Fig. 4. Six-dimensional space of the hidden Multiverse, where q, r, s are the coordinates of invisible parallel universes, and x, y, z are the coordinates of the matter content in each parallel universe

[28] Since the derivation of correct relativistic formulas due to absence in the 20th century of necessary experimental and theoretical knowledge simply was not completed.

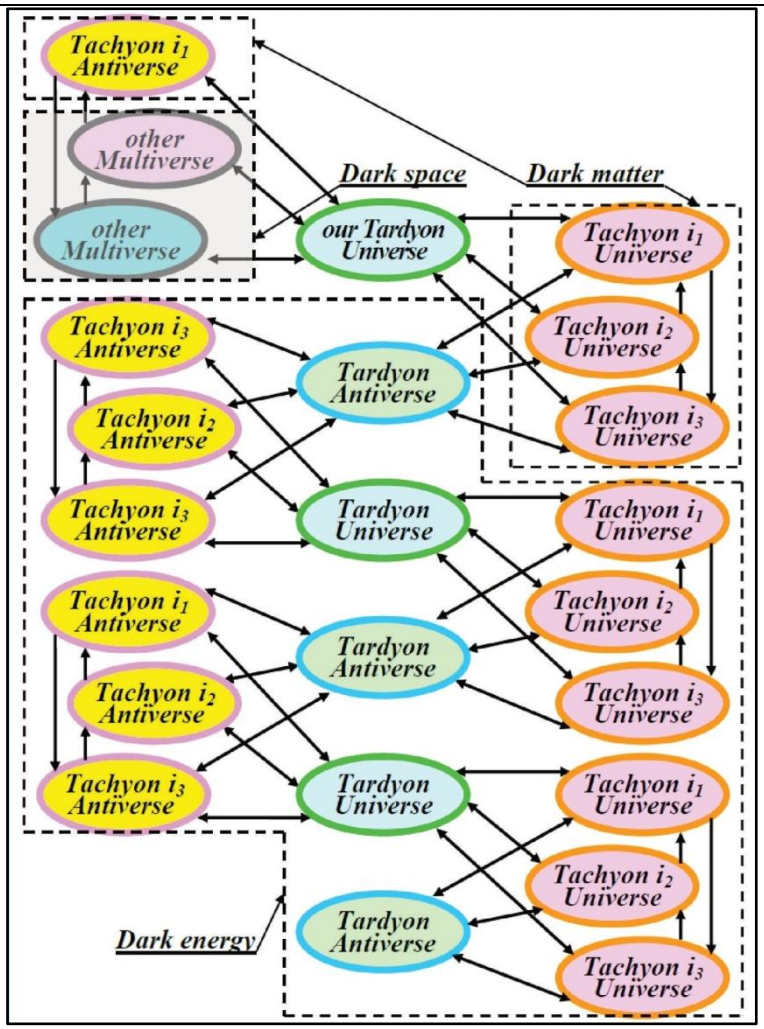

Fig. 5. Possible version of the quaternion structure of the hidden Multiverse

$$i_1^2 = i_2^2 = i_3^2 = -1 \quad (7)$$

$$i_1 i_2 i_3 = i_2 i_3 i_1 = i_3 i_1 i_2 = -1 \quad (8)$$

$$i_1 i_3 i_2 = i_2 i_1 i_3 = i_3 i_2 i_1 = 1 \quad (9)$$

In the mathematics of hypercomplex numbers, the function $i_1^q\, i_2^r\, i_3^s$ can be calculated only for integer values[29] ***q, r, s,*** but can take both positive and negative values, as well as both real and imaginary values. But we have already proven that imaginary numbers are physically real. Therefore, we must also explain them. Therefore, let us now consider the values of the quantities $m(v)$, $\Delta t(v)$ and $l(v)$, and in the range of velocities $\boldsymbol{v > c}$ for successive values of the argument ***q + r + s*** equal to ***0, 1, 2, 3, 4, 5,*** … Then for our visible universe with coordinates ***q = 0, r = 0, s = 0,*** i.e. located at we get $i_1^q\, i_2^r\, i_3^s$ = **–1.** This situation also corresponds to an invisible universe, since it is located beyond the event horizon. We will call it a tardyon[30] antiuniverse. For the value ***q + r + s=3*** in the velocity range $\boldsymbol{v > c}$ we get $i_1^q\, i_2^r\, i_3^s$ = – ***i.*** This situation corresponds to an invisible universe, since it is also located beyond the event horizon. We will call it a tachyon[31] antiuniverse. For the value ***q + r + s=4*** in the velocity range $\boldsymbol{v > c}$ we get $i_1^q\, i_2^r\, i_3^s$ = +1. This situation corresponds to an invisible tardyon universe (but a different one), since it is also located beyond the event horizon. For the value ***q + r + s=5*** in the velocity range $\boldsymbol{v > c}$ we get $i_1^q\, i_2^r\, i_3^s$ = +*i*. This situation corresponds to an invisible tachyon universe (but a different one), since it is also located beyond the event horizon. Thus, all universes are mutually invisible. Therefore, we will call our Multiverse hidden. And to make sure that invisible universes and antiuniverses neighbouring our visible universe exist, one can try to see them [79]-[84] from portals, the entrances to which are probably more than two hundred thousand so-called anomalous zones [85]-[88] existing on Earth. People avoid visiting them - and rightly so –

[29] And for non-integer values of the argument q the author obtained [78] the formula $i^q = \cos(q\pi/2) + i\sin(q\pi/2)$. It, in particular, will be needed in mathematical processing of experimental data of geophysical investigations of portals

[30] The term tardyon-universe was proposed by Isaac Asimov in short story “Take a match”.

[31] The term tachyon-universe was proposed by Isaac Asimov in short story “Take a match”.

as the portals are invisible labyrinths, once in which it is almost impossible to get out of them. These portals are analogous to a corridor in your flat, from which you can look into the next room and see something in it. And to make sure that you really see something about the neighbouring universe in the portal, you should look at the starry sky through a telescope and see that the constellations on it are at least a little bit different from those outside the portals.

In other words, it is necessary to do an experiment similar to the famous experiment of Sir Arthur Stanley Eddington in 1919 [89] by which he confirmed the prediction of the general theory of relativity about the deflection of light rays in the Sun's gravitational field.

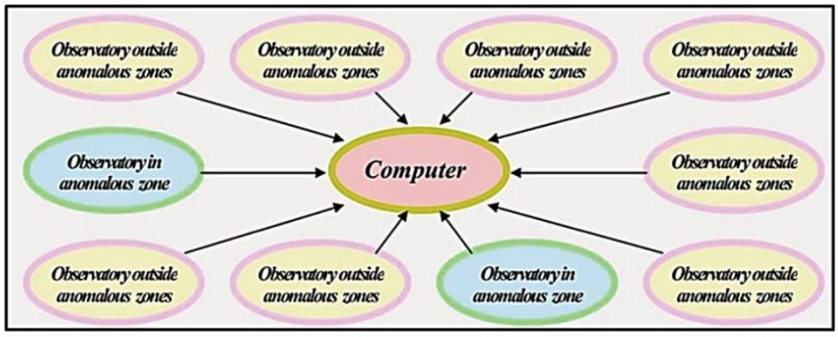

Fig. 6. Scheme of an astronomical experiment to detect invisible universes

And we're in luck. Since there are many anomalous zones on Earth, some of them may already host astronomical observatories, through whose telescope one can see these traces of the invisible out-of-portal neighbouring universe or antiuniverse. Such, for example, is the Main Astronomical Observatory of the National Academy of Sciences of Ukraine, which is located in the Goloseevsky forest 12 km from the centre of the capital of Ukraine, Kiev. But since in the anomalous zone, i.e. at the very edge of the portal, the differences of the constellations observed by neighbouring observatories located in anomalous zone and outside the anomalous zone are very small and may be not visible to the naked eye, it is necessary to compare the observations of these observatories on the computer (Fig.6). And if these differences turn out to be too small, the telescope will have to be moved deeper into the portal. After all, Sir Arthur Stanley Eddington moved the telescope much further away – from England to the island of Principe in the Atlantic Ocean in order to perform his famous experiment.

4. Time Travels

As is easy to notice, in Fig. 5 half of the universes of the hidden Multiverse are called antiuniverses in order to draw the readers' attention to the fact that they are cosmic antipodes of other universes. For them, the quantities $m(v)$, $\Delta t(v)$, $l(v)$ in formulas (4)-(6) differ only in sign. That is, the concepts of matter, time and space in the universes correspond to the concepts of antimatter, anti-time and anti-space in the antiuniverses [90]-[93]. But, as on Earth, inhabitants-antipode in space do not notice this difference, since the same physical, chemical, biological and other natural scientific laws operate in the universes and antiuniverses.

And when observed from Earth, in all universes and anti-universes, as they move away from our visible universe, not only the distance increases, but also time (like in time zones on Earth). Moreover, in universes it becomes greater than on Earth, and in anti-universes it becomes less than on Earth. And this circumstance makes time travel really possible both in the past and in the future.

Here are a couple of quotes that explain the current state of understanding of this problem. *"Time is the most frequently used word in the English language and the third most frequently used word in Russian. It is in every other language, too, because synchronizing actions in time is just as important as coordinating them in space. Without knowing the exact time, it is impossible to organize your life and plan it in advance. If in ancient times you could rely on natural cycles and an internal sense of time, then in our days you need to constantly have a watch or a phone with you. Time is the most important of the abstract concepts that we pronounce every day. Every thinking person has thought about the problem of time at least once in his life, and a huge amount of philosophical and scientific literature has been written on this topic. Nevertheless, no one can say for sure what time is."* [94]

Here is what Stephen William Hawking writes about this: "In everyday life, there is a huge difference between moving forward and backward in time. Imagine that a cup of water falls from a table and breaks into pieces. If you film this fall, then when you watch the film, it will immediately become clear whether the film is running forward or backward. If it is running backward, then we will see how the fragments lying on the floor suddenly come together and, having formed a whole cup, jump onto the table. And you will be able to say that the film was running backward, because in everyday life this does not happen. Otherwise, the faience factories would have to be closed" [95].

This phenomenon, known as the arrow of time, is one of the most amazing problems in physics. And the name "arrow of time" was proposed by the British physicist Sir Arthur Stanley Eddington at the beginning of the 20th century [96]. And all our life experience, it would seem, confirms this opinion.

The corrected version of the STR, in which the new concept of 'anti-time' has appeared, allows this life experience to be corrected. Indeed, if we assume that one day travel through the vastness of the hidden Multiverse will become possible for people on Earth, then time travel [97] will also become possible, both in the past and in the future. Let us show this.

But first, let us explain what we need to learn to do for this. And the main thing we need to learn is to master portals [98], [99], i.e. understand what they are and learn to navigate in them. Just as people once learned to navigate with a compass in the boundless expanses of the seas and oceans. Or even in the forest, in the desert, in the mountains, in any unfamiliar area. Even in labyrinths. So, a portal is an unfamiliar area that has become an invisible labyrinth for people. Portals are transitions from one universe to another, which turn these universes into communicating vessels. Therefore, at the entrance and exit of portals, according to the law of communicating vessels, the habitat should be almost the same – the same air, the same water, the same vegetation and animals[32]. Only the area is unfamiliar. But in order not to get lost in the portals and find the way back, you can use, as in mythology, the 'thread of Ariadne'. Or, in order not to risk ourselves, we can send unmanned vehicles to explore the portals, which people have now learned to make very well. It is also not difficult to create something like a radio compass, taking into account that as you dive into the portals, the electromagnetic field intensity from earthly radio stations should decrease. And on the way back, it should increase. Having got through the portal to some other planet, in order to move further in the hidden Multiverse, you will need to use unmanned aerial vehicles to search for anomalous zones on it, which are entrances to portals that lead to other neighboring universes. And so on. But all these problems are quite solvable.

And now we will show that the concept of the 'arrow of time' in the corrected version of STR is already partially refutable, since although we will not restore the cup mentioned by Hawking, we will be able to move into the past and future time. For this, we will use Fig. 7 and 8. In them, the positive branch of the vertical coordinate axis corresponds to time ***t***, measured in tardyon (including our visible tardyon) universes by positive real numbers, and its negative branch corresponds to negative time ***t*** in tardyon antiuniverses. Similarly, the positive branch of the horizontal coordinate axis corresponds to positive imaginary time[33] ***it***, measured in tachyon universes by positive imaginary numbers, and its negative branch corresponds to negative time it in tachyon antiuniverses. On the vertical axis of real time ***t*** and on the horizontal axis of imaginary time ***it***, thick black arrows show our comparatively long-term activity in tardyon and tachyon universes and anti-universes. And thin красными и синими стрелками показаны red and blue arrows show transitions through portals (staying in which is short-lived) between neighboring universes and antiuniverses.

Then we will consider the simplest options for traveling to the future and the past, since they would be very useful to us. Indeed, traveling to the future would allow us to refuse to continue all types of our unsuccessful activities and make them much more effective. But after such a search for the most effective option for activity, it will be necessary to return to the original state in order to start doing something differently and to do this. Traveling to the past would also be useful if, despite the search for an acceptable option for subsequent activity, it still turned out to be bad. Then it would be necessary, again having returned to the past, to somehow correct it. Therefore, having received the opportunity to travel through time, people could make their lives much more successful and happier. And since such searches for happiness are often a rather intimate activity, it would obviously be useful to begin them with the transition from our tardyon universe through the necessary portal to one of the neighboring tachyon universes or antiuniverses, since our activity in them is not visible from our tardyon universe due to the fact that time in them flows in mutually perpendicular directions[34]. And we will have to move to the tachyon universe if we are interested in something in the future. And we will have to move to the tachyon antiuniverse if we need to do something in the past.

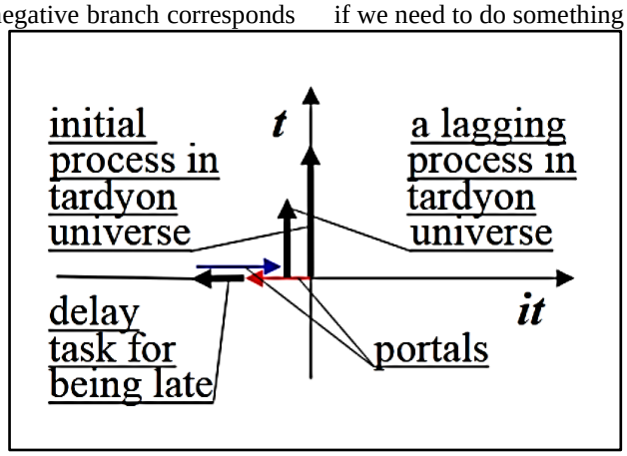

Fig. 7. Possible route of travel to the past time

[32] And if at least one portal on Earth ended in open space, then there would have been no air, no water, no anything else on Earth, like on the Moon or Mars.

[33] Despite the fact that the physical reality of imaginary numbers is denied in the generally accepted version of SRT, the term 'imaginary time' is used in modern physics. For example, in [95] Hawking writes: "Attempts to unify gravity with quantum mechanics have led to the concept of imaginary time".

[34] On the essence of imaginary time, Hawking holds the same opinion: "Imaginary time is a new dimension at right angles to ordinary real time" [95].

And Fig. 7 shows one of such simplest routes of travelling to the past time by successive travelling through portals through universes and antiuniverses of the hidden Multiverse. As it can be seen, this journey starts from the origin of coordinates, where in our visible tardyon universe there are conditionally two groups of researchers who spend the same biological time on the same duration of activity. And one of these groups of researchers through the portal (shown by the thin red arrow), moves to the tachyon antiuniverses and stays in it for some time (corresponding to the required lag time on the axis of imaginary time it, shown by the thick black arrow). All this time it is invisible from our tardyon universe, since imaginary time it is perpendicular to real time ***t***. Then it returns to our tardyon universe through the same or another portal (shown by the thin blue arrow) and completes the same work in the same time as the second group of scientists remaining in the tardyon universe. The duration of the activities of both groups in our tardyon universe is shown by thick black arrows of different lengths, which would both have to be on the actual time axis ***t***. But to make the figure more understandable, we have conventionally placed the short thick arrow next to the long thick arrow. And as a result, both groups of researchers, having spent the same amount of time on their identical activity, will nevertheless finish it in our tardyon universe at different times. Thus, the effect of delay was obtained due to the travel into the past time of one group of scientists relative to the other. Naturally, the same result can be obtained using other routes of travel through the Multiverse.

Fig. 8 shows another version of the time travel route, which differs from that shown in Fig. 7 in that this travel is carried out into the future. As in the previous case, it begins with the movement of the first group of researchers from the origin of coordinates, but in the opposite direction - through the portal shown by the thin red arrow into one of the (see Fig. 5) neighboring tachyon universes i_1. Then this group of researchers spends some time, corresponding to a given interval of advance time, in the tachyon universe i_1 and through another portal (shown by the thin blue arrow) moves to the next tachyon universe i_2. in the same dimension *v*. And from it through the third portal (shown by the thin red arrow) moves to the third tachyon universe i_3 in the same dimension ***v***.

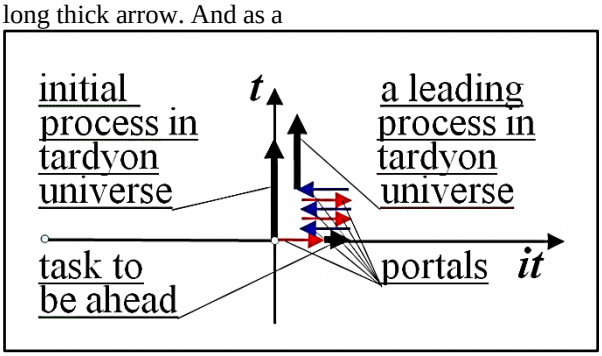

Fig. 8. Possible route of travel to the future time

And finally, from this third tachyon universe i_3. with a triple time advance (obtained due to successive visits to three tachyon universes) returns to our tardyon universe via the portal shown by the thin blue arrow. But with some lead over the second group of researchers, who were in our tardyonta universe all the time. And therefore, when both groups, having spent their equal biological time on their activity, finish it, it will turn out that they finish it at different times. And such a result can be interpreted as follows: the group of researchers who traveled through the hidden Multiverse, was ahead in time of the group of researchers who did not leave our tardyon universe, i.e., they traveled into the future. The same effect, naturally, can be obtained using other time travel routes.

5. Conclusions

So, in the article by the analysis of numerous existing in the nature and created by people processes it is experimentally proved and theoretically explained that the version of SRT studied in all textbooks of physics is incorrect, as in it:

- relativistic formulae obtained by its authors are incorrect and incorrectly explained;
- the postulated principle of non-exceeding of the speed of light, used by the authors of this version of SRT because of inability to explain and correct the relativistic formulas received by them, is incorrect;
- the conclusions about physical unreality of imaginary numbers and about existence in the nature of our visible universe, in which everything existing is measured only by real numbers, made from the received by them incorrect relativistic formulas, are incorrect.

Therefore physicists, forced according to the incorrect version of SRT to search for explanations of all physical problems in our only visible universe, could not explain much. They could not explain dark matter and dark energy, they could not discover dark space, they could not solve the problem of baryonic asymmetry and many other problems. For the same reason physicists still cannot explain the physical phenomenon of time and why it is unidirectional. They even created a special term for this concept 'time arrow'. But they are not sure that this term is irrefutable.

And the article refutes this term. For this purpose the corrected version of SRT was used, in which:

- the physical reality of imaginary numbers is experimentally proven and theoretically explained;
- by the experimentally proved principle of physical reality of imaginary numbers the principle of non-exceeding the speed of light was refuted and thus it was proved that the speed ***v*** gives rise to three additional spatial dimensions;

- it was found out that there exists in Nature a six-dimensional Multiverse containing about twenty mutually invisible three-dimensional universes and antiuniverses, whose position in the Multiverse space is determined by three additional dimensions.

It is explained that antimatter in the Multiverse is located in the antiuniverses, which are antipodes of other universes. In the same antiuniverses there are an anti-time, which is opposite to time of other universes. Examples of use of this anti-time are given, allowing already now to move both in the past and in the future time. And the existence of anti-time corrects the understanding of the phenomenon 'arrow of time'.

But anomalous zones in different countries on Earth may have different service advantages and disadvantages. Therefore, different countries may use different portals and different time travelling routes using them. And it will allow to get more valuable information about portals. Astro-geophysical researches of portals [99]-[115] made as a result of such time-travelling in our hidden Multiverse will allow to create time machines imitating on the Earth stay of people in portals. And this will significantly increase the effectiveness of scientific research and the corresponding accelerated intellectual and economic development of our entire human civilisation.

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References

1. Einstein A. (1920). Relativity: The Special and General Theory. H. Holt and Company. NY.

2. Bohm D. (2006). The Special Theory of Relativity. Routledge, Abingdon on Thames.

3. Penrose R. (2010). The Nature of Space and Time. Princeton University Press. Princeton.

4. Antonov A.A. (2021). The special theory of relativity stated in physics text-books is incorrect. 77th International Scientific Conference of the Eurasian Scientific Association. "Theoretical and practical issues of modern science". Moscow. ESA. 11-15. (In Russian)

5. Antonov A. A. (2021). Version of the special theory of relativity that is studied in all physics textbooks is incorrect. Österreichisches Multiscience Journal (Insbruck, Austria). 43(1). 17-22. http://osterr-science.com

6. Antonov A. A. (2021). Generally accepted version of the special theory of relativity contained in physics textbooks is incorrect. The scientific heritage. (Budapest, Hungary). 73(2). 39-43. DOI: 19.24412/9215-0365-2021-73-2-39-43

7. Antonov A. A. (2021). Special theory of relativity, which is studied in physics text-books, is incorrect. German International Journal of Modern Science. 16, 49-53. DOI: 10.24412/2701-8369-2021-16-49-53

8. Antonov A. A. (2021). Special theory of relativity, which is studied in all physics textbooks, is incorrect. Danish Scientific Journal. 51(1). 31-35. http://www.danish-journal.com

9. Antonov A. A. (2021). Special theory of relativity taught in all physics text-books is incorrect. Annali d'Italia. 22(1). 39-44. https://www.anditalia.com/

10. Antonov A. A. (2021). Special theory of relativity presented in physics text-books is wrong. Norwegian Journal of development of the International Science 68(1). 3-7. DOI: 10.24412/3453-9875-2021-68-3-7.

11. Antonov A. A. (2021). In all physics textbooks an erroneous version of special theory of relativity is given. International independent scientific journal. 31.34-39. http://www.iis-journal.com

12. Antonov A. A. (2021). Special theory of relativity taught in physics textbooks is wrong. Journal of science. Lyon. 23. 47-52. https://www.joslyon.com/

13. Antonov A. A. (2021). All physics textbooks study incorrect special theory of relativity. Sciences of Europe. (Praha, Czech Republic) 79(1). 30-35. DOI: 10/24412/3162-2364-2021-79-30-35

14. Antonov A. A. (2021). The version of STR stated in physics textbooks is incorrect because it denies the existence of radio engineering. 82nd International Scientific Conference of the Eurasian Scientific Association "Scientific result in theory and practice". Moscow. ESA. 11-15. (In Russian) https://esa-conference.ru/sborniki/?y=2021

15. Antonov A. A. (2022). The version of STR presented in physics textbooks is incorrect, since it follows from it that radio engineering should not exist. European Journal of Applied Sciences. Services for Science and Education. UK. 10(1). 440-445. DOI://doi.org/10.14738/aivp.101.2022

16. Antonov A. A. (2022). The existence of radio engineering refutes the physics text-books version of STR. The scientific heritage. (Budapest, Hungary). 83(1). 19-22. DOI: 10.24412/9215-0365-2022-83-1-19-22

17. Antonov A.A. (2022). The fundamental Ohm's law in radio engineering as interpreted by Steinmetz, which proves the physical reality on imaginary capacitive and inductive reactances, refuted the version of the STR presented in physics textbooks even before its creation. German International Journal of Modern Science. 26. 50-53. DOI: 10.24412/2701-8369-2022-26-50-63

18. Antonov A.A. (2022). The version of STR stated in physics textbooks is refuted by the existence of radio engineering. Danish Scientific Journal. 56. 56-59. http://www.danish-journal.com

19. Antonov A.A. (2022). The version of STR presented in physics textbooks is in correct because it denies the possibility of the existence of Ohm's law as intepreted by Steinmetz and, consequently, the existence of radio engineering. Annali d'Italia. 28(1), 43-47. https://www.anditalia.com/

20. Antonov A.A. (2022). The version of STR stated in physics textbooks is re-futed by the existence of radio engineering. Norwegian Journal of development of the International Science. 78(1). 63-67. DOI: 10.24412/3453-9875-2022-78-63-66.

21. Antonov A.A. (2022). If the physics textbook version of STR were true, then Ohm's law should not exist in nature, and therefore all radio engineering would not exist. International independent scientific journal. 36. 16-19. http://www.iis-journal.com

22. Antonov A.A. (2022). If the version of STR in physics textbooks were true, then there would be no ra-

dar, no television, no radio navigation, no telecommunication and many other things. Journal of science. Lyon. 28. 76-79. https://www.joslyon.com/

23. Antonov A.A. (2022). The version of STR set out in physics textbooks is in-correct because it states that Ohm's law as interpreted by Steinmetz does not really exist, and therefore radio engineering does not exist either. Sciences of Europe (Praha, Czech Republic). 87(1). 54-57. DOI: 10.24412/3162-2364-2022-1-54-57

24. Antonov A.A. (2022). Why the physics textbooks teach an incorrect version of the special theory of relativity which denies the existence of radio- and electrical engineering. III international scientific conference "Challenges and problems of modern science". London. Great Britain. 78-86. https://doi/org/10.528/zenodo.7486814

25. Antonov A. A. (2023). Why is the incorrect version of the special theory of relativity being studied in physics textbooks, refuted the existence of radio- and electrical engineering even before its creation? The scientific heritage. (Budapest, Hungary). 105. 83-89. DOI: 10.5281/zenodo.7560145

26. Antonov A.A. (2023). Why is an incorrect version of the special theory of relativity that denies the possibility of the existence radio and electrical engineering being studied in physics textbooks? German International Journal of Modern Science. 48. 23-29. DOI: https://doi.org/10.5281/zenodo.7541137

27. Antonov A.A. (2023). Who needs the incorrect version of special relativity taught in physics textbooks despite all its experimental refutations? Annali d'Italia. 39, 64-70. DOI: 10.5281/zenodo.7568916

28. Antonov A.A. (2023). Why is incorrect version of the special theory of relativity that denies the possibility of the existence of radio and electrical engineering being studied in textbooks of physics? Norwegian Journal of development of the International Science. 100. 27-33. https://doi.org/10.5281/zenodo.7528512

29. Antonov A.A. (2023). Why is incorrect version of the special theory of relativity, refuted by the existence of radio and electrical engineering, is still studies in all university physics textbooks? Danish Scientific Journal. 69. 66-72. https://doi.org/10.5281/zenodo.7692053

30. Antonov A.A. (2023). Why is incorrect version of the special relativity still being studied in physics textbooks, which denies Ohm's law for alternating current used worldwide by millions of radio- and electrical engineers? International independent scientific journal. 46. 38-44. https://doi.org/10.5281/zenodo.7525751.

31. Antonov A.A. (2023). Why is the generally accepted version of STR, which denies the possibility of the existence of radio engineering and electrical engineering, tsunamis and bell ringing, the physical phenomenon of resonance and Ohm's physical law for alternating current, music created by the piano and even swing swings on the playground, nevertheless is still considered correct and studied in physics textbooks? Sciences of Europe (Praha, Czech Republic). 112. 44-50. DOI: 10.5281/zenodo.7708515

32. Antonov A.A. (2023). Why is the incorrect version of the special theory of relativity still being studied in physics textbooks, despite all its experimental refutations. European Journal of Applied Sciences. Services for Science and Education. UK. 11(2). 61-71. DOI: https://doi.org/10.14738/aivp.112.14128

33 Antonov A.A. (2023). Why the incorrect version of the special theory of relativity, which denies the possibility of the existence of radio engineering and electrical engineering, has not yet been refuted. Journal of science. Lyon. 40. 19-25. https://doi.org/10.5281/zenodo.7704392

34. Jean de Climont. (2009), (2010), (2016), (2020), (2023). The Failure of Pure Science. Editions d'Assailly.

35. Jean de Climont. (2017). The alternative theories. Editions d Assailly.

36. Jean de Climont. (2019), (2020), (2023). The Worldwide List of Alternative Theories and Critic. Editions d'Assailly.

37. Jean de Climont. (2023). Einstein and Maxwell speculation. Editions d'Assailly.

38. Popper K.R. 2002. Conjectures and Refutations. The Growth of Scientific Knowledge. Routledge. London.

39. Weinstein E.W. (2005). The CRC Concise Encyclopedia of Mathematics. 3-rd ed. CRS Press. Roca Raton. FL.

40. Beckmann P. (1976). A history of π. 3rd edition. St. Martin Press. NY.

41. Steinmetz C. P. (2010). Theory and Calculation of Electric Circuit. Nabu Press.

42. Antonov A. A. (2008). Physical Reality of Resonance on Complex Frequencies. European Journal of Scientific Research. 21(4). 627-641. http://www.eurojournals.com/ejsr.htm

43. Antonov A. A. (2009). Resonance on Real and Complex Frequencies. European Journal of Scientific Research. 28(2). 193-204. http://www.eurojournals.com/ejsr.htm

44. Antonov A. A. (2010). New Interpretation of Resonance. International Journal of Pure and Applied Sciences and Technology. 1(2). 1-12. http://doi.org/10.17686/sced_rusnauka_2010-888

45. Antonov A. A. (2010). Oscillation processes as a tool of physics cognition. American Journal of Scientific and Industrial Research. 1(2). 342-349. doi:10.5251/ajsir.2010.1.2.342.349

46. Antonov A. A. (2010). Solution of algebraic quadratic equations taking into account transitional processes in oscillation systems. General Mathematics Notes. 1(9). 11-16. http://doi.org/10.17686/sced_rusnauka_2010-887

47. Antonov A. A. (2013). Physical Reality of Complex Numbers. International Journal of Management, IT and Engineering. 3(4). 219-230. http://doi.org/10.17686/sced_rusnauka_2013-898

48. Antonov A. A. (2014). Correction of the special theory of relativity: physical reality and nature of imaginary and complex numbers. American Journal of Scientific and Industrial Research. 5(2). 40-52. doi:10.5251/ajsir.2014.5.2.40.52

49. Antonov A. A. (2015). Physical reality of complex numbers is proved by research of resonance. General Mathematics Notes. 31(2). 34-53. http://www.emis.de/journals/GMN/yahoo_site_admin/asets/docs/4_GMN9212-V31N2.129701.pdf

50. Antonov A.A. (2015). Principle of physical reality of imaginary and complex numbers in modern

cosmology: the nature of dark matter and dark energy. Journal of the Russian physico-chemical society. 87(1). 328-355. (In Russian) http://doi.org/10.17686/sced_rusnauka_2015-1119

51. Antonov A. A. (2016). Physical Reality and Nature of Imaginary, Complex and Hypercomplex Numbers. General Mathematics Notes. 35(2). 40-63. http://www.geman.in/yahoo_site_admin/assets/docs/4_GMN-10932-V35N2.31895146.pdf

52. Antonov A. A. (2017). The physical reality and essence of imaginary numbers. Norwegian Journal of development of the International Science. 6. 50-63. http://www.njd-iscience.com

53. Antonov A. A. (2018). Physical Reality and Essence of Imaginary Numbers in Astrophysics: Dark Matter, Dark Energy, Dark Space. Natural Science. 10(1). 11-30. doi:10.4236/ns.2018.101002

54. Antonov A.A. (2023). The Corrected Version of the Special Theory of Relativity. European Journal of Applied Sciences. Services for Science and Education. UK. 11(5). 68-83. DOI:10.14738/aivp.115.15474

55. Antonov A. A. (2023). Corrected special theory of relativity. Journal of science. Lyon. 48. 27-36. https://doi.org/10.5281/zenodo.10277156

56. Antonov A. A. (2023). Corrected special theory of relativity. Annali d'Italia. 49, 25-35. DOI: 10.5281/zenodo.10214679

57. Antonov A. A. (2023). The Corrected Version of the Special Theory of Relativity. The scientific heritage. (Budapest, Hungary). 123. 72-81,

58. Antonov A. A. (2023). The Corrected Version of the Special Theory of Relativity. Norwegian Journal of development of the International Science. 118. 40-49. https://doi.org/10.5281/zenodo.10009500

59. Antonov A. A. (2023). Alternative Version of the Special Theory of Relativity. Sciences of Europe. (Praha, Czech Republic). 128. 62-71.

60. Antonov A. A. (2023). Special Theory of Relativity. German International Journal of Modern Science. 67. 64-73. DOI: 10.5281/ zenodo.10966458

61. Antonov A. A. (2023). Corrected Version of the Special Theory of Relativity. Danish Scientific Journal. 77. 88-97. https://doi.org/10.5281/zenodo.10054677

62. Antonov A. A. (2011), Structure of the Multiverse. British Journal of Science. 2(2). 51-60. http://doi.org/10.17686/sced_rusnauka_2011892

63. Antonov A. A. (2012). Multiverse. Time Travels. International Journal of Pure and Applied Sciences and Technology. 12(2). 43-56. http://doi.org/10.17686/sced_rusnauka_2012-896

64. Antonov A.A. (2012). Discovery of the real Multiverse. Encyclopaedia of Russian thought, Papers to the Russian Physical Society. 16(3). 3-20. (In Russian) http://doi.org/10.17686/sced_rusnauka_2012-1115

65. Antonov A.A. (2013). Cognition of the Multiverse as a factor in accelerating the development of human civilisation. Journal of Russian physical thought. 1-12, 6-77. (In Russian) http://doi.org/10.17686/sced_rusnauka_2011-1117

66. Antonov A. A. (2015). Hidden Multiverse. International Journal of Advanced Research in Physical Science. 2(1). 25-32.

67. Antonov A.A. (2015). The astrophysical phenomenon of dark matter and dark energy proves the existence of the hidden Multiverse. American Journal of Modern Physics. 4(4). 180-188. doi: 10.11648/j.jamp.20150404.14

68. Antonov A. A. (2015). Why dark matter and dark energy are invisible? Optics. 4(6), 43-47. doi: 10.11648/j.optics.20150406.12

69. Antonov A. A. (2015). Hidden Multiverse: explanation of dark matter and dark energy phenomena. International Journal of Physics. 3(2). 84-87. doi:10.12691/ijp-3-2-6

70. Antonov A. A. (2015). Principles and structure of the real Multiverse: explanation of dark matter and dark energy phenomena. American Journal of Modern Physics. 4(1). 1-9. doi:10.11648/j.ajmp.20150401.11

71. Antonov A. A. (2015). Explanation of dark matter and dark energy phenomena. Jour nal of Science Frontier Research: A Physics and Space Science. 15(1). 33-38. http://doi.org/10.17686/sced_rusnauka_2015-902

72. Antonov A. A. (2015). Review of publications by A. A. Antonov on the problem of explaining the fenomenon of dark matter and dark energy. Journal of the Russian physico-chemical society. 87(3). 63-76. (In Russian)

73. Antonov A. A. (2016). Explaining the Phenomenon of Dark Matter and Dark Energy by Existence of the Hidden Multiverse. Frontiers of Astronomy, Astrophysics and Cosmology. 2(1). 1-9. doi: 10.12691/faac-2-1-1

74. Antonov A. A. (2016). What Physical World do We Live in? Journal of Modern Physics. 7(14). 1933-1943

75. Antonov A. A. (2016). Hypothesis of the Hidden Multiverse: Explains Dark Matter and Dark Energy. Journal of Modern Physics. 7(10), 1228-1246. doi: 10.4236/jmp.2016.710111

76. Antonov A. A. (2017). Nature of dark matter and dark energy. Journal of Modern Physics. 8(4). 567-582. doi: 10.4236/jmp.2017.84038

77. Antonov A. A. (2017). Hypothesis of the hidden Multiverse explains the phenomenon of dark matter and dark energy. Applied Physics Research. 9(2). 30-41. doi: https://doi.org/10.5539/apr.v9n2p30

78. Antonov A. A. (2024). Mathematical Sciences: From the Experimentally Proved Principle of the Physical Reality of Imaginary Numbers it Follows that the Invisible Afterlife World, Mentioned in All Religions, Really Exists. European Journal of Applied Sciences, 12(5). 119-145. DOI:10.14738/aivp.125.17569.

79. Antonov A. A. (2020). How to See Invisible Universes. Journal of Modern Physics. 11(05), 593-607. DOI: 10.4236/jmp.2020.115039

80. Antonov A. A. (2020). Can invisible universes be seen? International independent scientific journal. 21(2). 51-60. http://www.iis-journal.com

81. Antonov A. A. (2020), How to discover invisible universes. Norwegian Journal of development of the International Science. 42(1). 36-48. http://www.njd-iscience.com

82. Antonov A. A. (2020). Universes Being Invisible on Earth outside the Portals Are Visible in Portals. Natural Science. 12(8). 569-587. https://doi.org/10.4236/ns.2020.128044

83. Antonov A. A. (2020). Invisible universes can be seen in anomalous zones. Danish Scientific Journal. 43(1). 9-24. http://www.danish-journal.com

84. Antonov A. A. (2021). Invisible universes can be seen in anomalous zones. International independent scientific journal. 23(1). 28-44.

85. Chernobrov, V. (2000). Encyclopedia of mysterious places of the Earth. Veche Publishing House. Moscow. (In Russian)

86. Chernobrov, V. (2004). Encyclopedia of mysterious places of Russia. Veche Publishing House. Moscow. (In Russian)

87. Chernobrov, V. (2007). Encyclopedia of mysterious places of Earth and space. Veche Publishing House. Moscow. (In Russian)

88. Chernobrov, V. (2009). Encyclopedia of mysterious places of Moscow and Moscow region. Helios ARV. Moscow. (In Russian)

89. Dyson F.W, Eddington A.S., Davidson C. (1929). A determination of the deflection of light by the sun's gravitational field, from observations made at the total eclipse of May 29, 1919. Philosophical transactions of the Royal Society A. 220. 291-333. https://doi.org/10.1098/rsta.1920.0009

90. Frazer G. (2004). Antimatter: The Ultimate Mirror. Cambridge University Press, Cambridge, UK.

91. Santilli R. M. (2006). Isodual Theory of Antimatter: With Applications to Antigravity, Grand Unification and Cosmology. Springer. Dordrecht. Netherlands.

92. Alain M., Le Brun V. (2012). Matter, Dark Matter, and Anti-Matter: In Search of the Hidden Universe. Springer-Verlag. NY.

93. Antonov A.A. (2016). Dark matter, dark energy and antimatter are located in the hidden Multiverse. PONTE. 72(8). 288-300.

94. Dionis Dimetor. The arrow of time, Loschmidt's demon and quantum . thermodynamics Why is time irreversible? https://habr.com/ru/articles/785014/

95. Hawking S.W. (1988). Brief History of Time: From the Big Bang to Black Holes. Bantam Dell Publishing Group. UK.

96. Eddington, A. S. (1928). Nature of the Physical World. Cambridge University Press, London.

97. Chernobrov, V. (1999). Secrets of Time. Helios ARV. Moscow. (In Russian)

98. Antonov A. A. (2012), Earth, portals, parallel universes. American Journal of Scientific and Industrial Research. 3(6). 464-473. doi:10.5251/ajsir.2012.3.6.464.473

99. Antonov A. A. (13 January 2016). How Portals of the Invisible Multiverse Operate. Science PG Frontiers. http://www.sciencepublishinggroup.com/news/sciencepgfrontiersinfo?articleid=7

100. Antonov A.A Geophysical exploration of portals will provide new knowledge about space. Proceedings of the III International Scientific Conference. Philadelphia. USA. “The modern vector of the development of science”. Philadelphia, USA. 2023. 85-101. https://doi.org/10.5281/zenodo.7709801

101. Antonov A.A. 2023. Geophysical researches of portals will allow to discover invisible universes and to explore them. European Journal of Applied Sciences. Services for Sciences and education. UK. 11(2). 370-391. DOI:10.14738/aivp.112.14323.

102. Antonov A.A. 2023. The necessity of geophysical researches of portals. The scientific heritage. (Budapest, Hungary). 110. 77-90. DOI: 10.5281/zenodo.7804563

103. Antonov A.A. 2023. Geophysical researches of portals will allow to prove the existence of invisible universes and to explore them. German International Journal of Modern Science. 53. 64-78. DOI: 10.5281/zenodo.7796151

104. Antonov A.A. 2023. The relevance of geophysical researches of portals. Danish Scientific Journal. 70. 75-89. https://doi.org/10.5281/zenodo.778944

105. Antonov A.A. 2023. Geophysical researches of portals will allow to prove the existence of hidden Multiverse and to research it. Annali d’Italia. 42. 71-85. DOI: 10.5281/zenodo.7865307

106. Antonov A.A. 2023. Why geophysical researches of portals are necessary. Norwegian Journal of development of the International Science. 105. 83-96. https://doi.org/10.5281/zenodo.7779019

107. Antonov A.A. 2023. Geophysical researches of portals will allow to prove the existence of hidden Multiverse and to research it. International independent scientific journal. 49. 23-37.

108. Antonov A.A. 2023. Geophysical researches of portals will allow to discover invisible universes. Journal of science. Lyon. 41. 26-38.

109. Antonov A.A. 2023. Geophysical researches of portals will allow to prove the existence of hidden Multiverse and to research it. Sciences of Europe. 114. 76-90

110. Antonov A. A. 2024. Astrophysical portals are a source of new knowledge. German International Journal of Modern Science 95. 34-44. DOI: 10.5281/zenodo.14609615

111. Antonov A. A. 2024. Scientific value of researches of astrophysical portals. 82. 41-51.

112. Antonov A. A. 2024. The relevance of research on astrophysical portals. Znanstvena misel journal. 98. 35-45

113. Antonov A. A. 2024. Scientific value of researches of astrophysical portals. Sciences of Europe (Praha, Czech Republic).153. 93-106.

114. Antonov A. A. 2024. The existence of astrophysical portals refutes the version of SRT studied in textbooks. Annali d’Italia. 63. 9-19. DOI: 10.5281/zenodo.14726250

115. Antonov A. A. 2025. Physical Sciences: Astrophysical Portals are a Source of New Knowledge. European Journal of Applied Sciences, Services for Science and Education. UK 13(1). 23-39. DOI:10.14738/aivp.131.18112.

PSYCHOLOGICAL SCIENCES

ОСОБЕННОСТИ ОСУЩЕСТВЛЕНИЯ СПОРТИВНОЙ ПОДГОТОВКИ ПО ОТДЕЛЬНЫМ СПОРТИВНЫМ ДИСЦИПЛИНАМ ПО ВИДУ СПОРТА ЛЁГКАЯ АТЛЕТИКА

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FEATURES OF IMPLEMENTING SPORTS TRAINING IN SPECIFIC SPORTS DISCIPLINES IN THE SPORT OF ATHLETICS

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Аннотация

В данной статье в основном рассматриваются особенности осуществления планирования спортивной подготовки по легкой атлетике.

Важнейшем компонентом является выбор соответствующих условий и средств для проведения подготовительных занятий и усовершенствования различных методов работы с юными атлетами.

Акцентируя цели и намеченные задачи спортивной подготовки определяются более конкретные методы, с помощью которых усовершенствуются спортивные умения и навыки как в индивидуальной так и в групповой работе юных атлетов.

Основными задачами являются подготовка высококвалифицированных спортсменов и сборных команд, подготовка инструкторов и судей по легкой атлетике.

В статье особое внимание уделено теоретической подготовке легкоатлетов, а также психологической подготовке спортивных команд.

Для успешной работы с юными атлетами большое значение имеет периодическая и объективная оценка их подготовленности на протяжении всего тренировочного процесса, а также сознательное отношение спортсмена к тренировкам на всех этапах совершенствования.

Abstract

This article primarily examines the features of planning athletic training in track and field.

A key component is selecting appropriate conditions and methods for conducting preparatory sessions and improving various techniques for working with young athletes.

By focusing on the goals and outlined objectives of athletic training, more specific methods are determined to enhance athletic skills and abilities, both in individual and group settings for young athletes.

The main objectives include the preparation of highly qualified athletes and national teams, as well as the training of instructors and referees in track and field.

The article pays special attention to the theoretical preparation of track and field athletes, as well as the psychological training of sports teams.

For effective work with young athletes, periodic and objective assessment of their readiness throughout the training process is of great importance, as is the athlete's conscious attitude toward training at all stages of improvement.

Ключевые слова: спорт, спортивная подготовка, легкая атлетика, спортивная школа, практические и теоретические занятия, организационно-педагогический процесс, подготовка спортсмена, периодическая и объективная оценка, психологическая подготовка спортсменов.

Keywords: sport, sports training, athletics, sports school, practical and theoretical classes, organizational and pedagogical process, athlete training, periodic and objective assessment, psychological training of athletes.

Одним из важнейших условий успешного осуществления спортивной подготовки является правильное планирование. Планирование спортивной подготовки – это предвидение условий, средств и методов решения задач, которые ставятся перед процессом спортивной подготовки, предвидение тех спортивных результатов, которые должны быть достигнуты спортсменами. Правильно спланировать подготовку юных спортсменов – это значит, исходя из анализа особенностей данного контингента спортсменов (или одного спортсмена), наметить основные показатели в процессе подготовки и распределить их во времени.

Планирование учебно – подготовительного процесса в спортивной школе осуществляется в следующих формах: перспективное (многолетнее), текущее (годичное), оперативное.

Основными документами планирования являются групповые и индивидуальные перспективные планы подготовки юных спортсменов.

Исходя из целей и задач спортивной подготовки, тренер определяет конкретные задачи, которые предстоит решить в итоге многолетней тренировки и на отдельных её этапах.

Основные задачи:

1. Укрепление здоровья, гармоничное продолжительное физическое развитие спортсменов.
2. Подготовка высококвалифицированных спортсменов для сборных команд.
3. Подготовка инструкторов – общественников и судей по лёгкой атлетике.
4. Приобретение теоретических знаний по спортивной тренировке, основам физиологии, лечебной физической культуре, психологии спорта [6].

Важным условием выполнения поставленных задач является систематическое проведение практических и теоретических занятий, контрольных упражнений, восстановительных мероприятий, регулярное участие в соревнованиях.

Подготовительная программа охватывает всю систему подготовки спортсменов (легкоатлетов), а именно:

- теоретическую
- техническую
- тактическую
- общефизическую
- специально – физическую
- психологическую
- соревновательную

Результатом реализации подготовительной программы является:

- формирование устойчивого интереса к занятиям
- формирование широкого круга двигательных умений и навыков
- освоение основ техники по виду спорта лёгкая атлетика
- всестороннее развитие физических качеств
- укрепление здоровья
- отбор перспективных юных спортсменов для дальнейших занятий по виду спорта лёгкая атлетика [1]

Современная система подготовки легкоатлета является сложным, многофакторным явлением, включающим цели, задачи, средства, методы, организационные формы, материально – технические условия и т. п., обеспечивающее организационно – педагогический процесс подготовки спортсмена к соревнованиям и достижение им наивысших спортивных показателей.

Спортивная подготовка является важным стимулом для молодых спортсменов, повышает стремление тренироваться упорно и настойчиво, вкладывать все силы в достижении цели. В то же время систематические занятия спортом – это мощный фактор, способствующий развитию лучших человеческих качеств.

В подготовке легкоатлетов важную роль играет теоретическая подготовка, которая включает:

- общие понятия о системе физического воспитания и теории спорта
- знание теории и практики легкоатлетического спорта
- знание перспектив развития физической культуры и спорта в стране и в мире
- знание вопросов психологической подготовки спортсменов

Во время работы со студентами ГИФКСА мы подчеркнули главную часть подготовки легкоатлетов – это физическая подготовка, направленная на развитие и воспитание основных двигательных качеств спортсмена. Высших результатов в лёгкой атлетике добиваются как правило, спортсмены, которые всесторонне физически развиты.

Физическая подготовка – это вид спортивной подготовки, который направлен на преимущественное развитие двигательных качеств легкоатлетов: силы, быстроты, выносливости, ловкости, гибкости и других, а также на укрепление здоровья [3].

Специальная физическая подготовка (СФП) легкоатлета должна быть направлена на развитие отдельных мышечных групп спортсмена, приобретение им тех двигательных навыков, которые непосредственно обеспечивают успешное овладение техникой и рост результатов в избранном виде спорта [1].

В своих многочисленных концепциях, посвященных рассмотрению личности индивида как ограниченной целостности, Адлер (Альфред Адлер: Индивидуальная теория личности) вывел его из самой жизни, а именно из того обстоятельства, что жизнь невозможно представить себе без непрерывного движения в направлении роста и развития. Только в движении по направлению личностно значимым целям индивидуум может быть воспринят как единое и самосогласующееся целое [5].

Утверждая, что человек стремится к совершенству, Адлер исходил из соображения, что люди не отталкиваются от внутренних или внешних причин, а скорее тянутся вперед – они всегда находятся в движении к личностно значимым жизненным целям [4].

Цели, которые спортсмены ставят перед собой, а также индивидуальные пути их достижения дают ключ к пониманию того, какое значение они придают своей жизни.

Жизненные цели в значимой степени выбираются индивидуально, а следовательно, в постоянном стремлении к совершенству. Спортсмен должен уметь планировать свои действия и определять собственную судьбу. Достигая намеченных целей, он не только повышает самооценку, но также находит своё место как в спорте, так и в жизни.

Нами был создан групповой годичный план тренировки студентов.

1. Краткая характеристика группы занимающихся (возраст, спортивный разряд, уровень спортивных достижений, уровень физической, технической, тактической и волевой подготовленности занимающихся). Основные недостатки в подготов-

ленности: состояние здоровья, уровень физического развития и другие данные (по усмотрению тренера и врача).

Рассматриваемая нами команда по баскетболу состояла из студентов (18 – 19 лет). Команда в предыдущем спортивном сезоне заняла четвёртое место в Ереване в межвузовских соревнованиях в своей возрастной группе.

Целью спортивной подготовки было на основе возрастания уровня разносторонней подготовленности войти в тройку сильнейших баскетбольных команд г. Еревана в своей возрастной группе.

Проводились контрольные нормативы (общая физическая подготовка (ОФП) – бег, прыжок в высоту с места), специальная физическая подготовка (СФП) – бросок мяча в корзину с дальнего расстояния, штрафные броски, передача мяча, ведение и бросок мяча в корзину и так далее.

Для успешной работы с юными спортсменами большое значение имеет периодическая и объективная оценка их подготовленности на протяжении всего учебно – тренировочного процесса [6]. Акцентируется владение совершенной техникой – наиболее рациональным и эффективным способом выполнения упражнений.

Под совершенной техникой следует понимать разумно обоснованные и целесообразные движения, способствующие достижению высших спортивных результатов. При этом следует всегда учитывать индивидуальные особенности спортсмена, а также условия, в которых приходится выполнять движения.

Рациональная спортивная техника не только правильная, обоснованная форма движения, но и умение проявлять значительные волевые и мышечные усилия, выполнять движения быстро, вовремя расслаблять мышцы.

Высокая спортивная техника базируется на отличной физической подготовке спортсмена; чтобы овладеть современной техникой, он должен быть сильным, быстрым, ловким, гибким, выносливым.

Одним из успешных условий успешного овладения эффективной техникой является сознательное отношение спортсмена к тренировкам на всех этапах совершенствования, осмысливания ими каждого движения. Спортсмен не должен слепо копировать движения или бездумно следовать чьим – либо советам. Он должен осознать, почему та техника, которую он применяет, действительно является рациональной [2].

Мы рекомендуем усилить психологическую подготовку юных спортсменов, включая общую психологическую (круглогодичную) подготовку, психологическую к соревнованиям и управление нервно – психологическим восстановлением спортсменов. В ходе подготовки формируется высокий уровень соревновательной мотивации, соревновательные черты характера, предсоревновательная и соревновательная эмоциональная устойчивость, способность к самоконтролю и саморегуляции в соревновательной обстановке. В ходе подготовки к конкретным соревнованиям формируется специальная психологическая боевая готовность спортсмена перед выступлением, характеризующаяся уверенностью в своих силах, стремлением к победе, оптимальным уровням эмоционального возбуждения, устойчивостью управления действиями, эмоциями и поведением, умением эффективно выполнять действия, необходимые для победы.

Список литературы

1. Алабин В. Г. Организационно – методические основы многолетней тренировки юных легкоатлетов: Учебное пособие, Челябинск, 1977

2. Вацула И. и другие Азбука тренировки легкоатлета: М.: Физ. И спорт, 1983

3. Ильин Е.П**.,** Психология спорта: СПб.: Питер, ил.- (Серия «Мастера психологии»), 2011. — 352 с.

4. Немов Р.С., Психология: М., Гуманист. изд. центр Владос, 2002,- Кн. 2-608 с.

5. Столяренко Основы психологии, Практикум Ред. – сост. Л. Д. Столяренко, изд. 3 – е, дополнение и переработка – Ростов п/Д “Феникс”, 2002 – С. 704

6. В. П. Филин, Н. А. Филин Основы юношеского спорта – М.: изд. Физ. и спорт, 1980 г. – С. 255

TECHNICAL SCIENCES

AI SYSTEM FOR PREDICTING NEONATAL PATIENT PROGNOSIS

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Abstract
According to the World Health Organisation (WHO), Globally 2.3 million children died in the first 28 days of life in 2022. Some neonatal conditions can rapidly deteriorate and be fatal even without diagnosis. This research aimed to develop an AI-based diagnostic model for predicting the prognosis of neonatal patients using routine blood tests. The study involved live-born patients, including premature and full-term infants. To build the AI model, we used Matlab software. AI model for the prediction of neonatal patients' prognosis is determined by the high predictive accuracy (94%). The findings suggest that routine blood tests may provide more information that can help predict the prognosis of neonatal patients.

Keywords: Neonatal care, machine learning, prognosis prediction, disease diagnosis, intensive care, AI model for patient's prognosys.

Introduction: According to the World Health Organisation (WHO), Globally 2.3 million children died in the first 28 days of life in 2022. There are approximately 6500 newborn deaths every day, amounting to 47% of all child deaths under the age of 5 years. Newborns cannot communicate their symptoms, which makes early diagnosis of disease difficult. Many neonatal diseases may not be apparent at birth. Some neonatal conditions, such as sepsis, internal bleeding, or cardiovascular diseases, can rapidly deteriorate and be fatal even without diagnosis.

Various studies have shown that routine blood tests may contain additional information that is not available to the doctors and that an AI system may be able to uncover ***(Simon Podnar at all. University Medical Center in Ljubljana)***

The goal of our research was to create an artificial intelligence-based model for predicting the prognosis of neonatal patients using the newborns routine blood tests.

Main part:

The study was retrospective, data was retrieved from the patient medical documentations In full compliance with the principles of medical ethics. Patients were treated in the neonatal intensive care unit of the Tbilisi Clinic "Pineo" Perinatal Center (2023-2024 year).

The medical documentations of 81 live-born patients were studied. Female 44, male 37, premature 60, full-term newborn 21, recovered 61. died 20. For creating AI model we used only the routine blood tests that were performed on all newborns within 8 hours of birth (Table 1).

Table. 1.

Routine tests used for the AI model.

Parameters for the AI Model			
Parameter	**Units**	**Parameter**	**Units**
WBC	10^3 / μL	**RDW-CV**	%
RBC	10^6/μL	**PLT**	10^3 / μL
HGB	g/dl	**MPV**	fl
HCT	%	**Neut**	%
MCV	fl	**LYMPH**	%
MCH	pg	**MONO**	%
MCHC	g/dl	**Eosino**	%
ABO	--	**Glucose**	mmol/l
CRP	mg/l		

To build the AI model, we used a classification (Supervised machine learning method). As a software tool Matlab was used (Classification learner App). After pre-processing the data (routine blood tests results of 81 patients) machine learning model was build using 5 fold cross-validation and was trained using various statistical methods.

Results:

Various statistical methods were used to train the model (Linear SVM, Quadratic SVM, Cubic SVM, ALL SVMs, Coarse Gaussian, Fine Gaussian, medium Gaussian, Neural Network). The best results were obtained using Optimizable SVM, AI model for neonatal patient's prognosis is determined by the high predictive accuracy (94%). The model was exported and checked using the new data (figure 1).

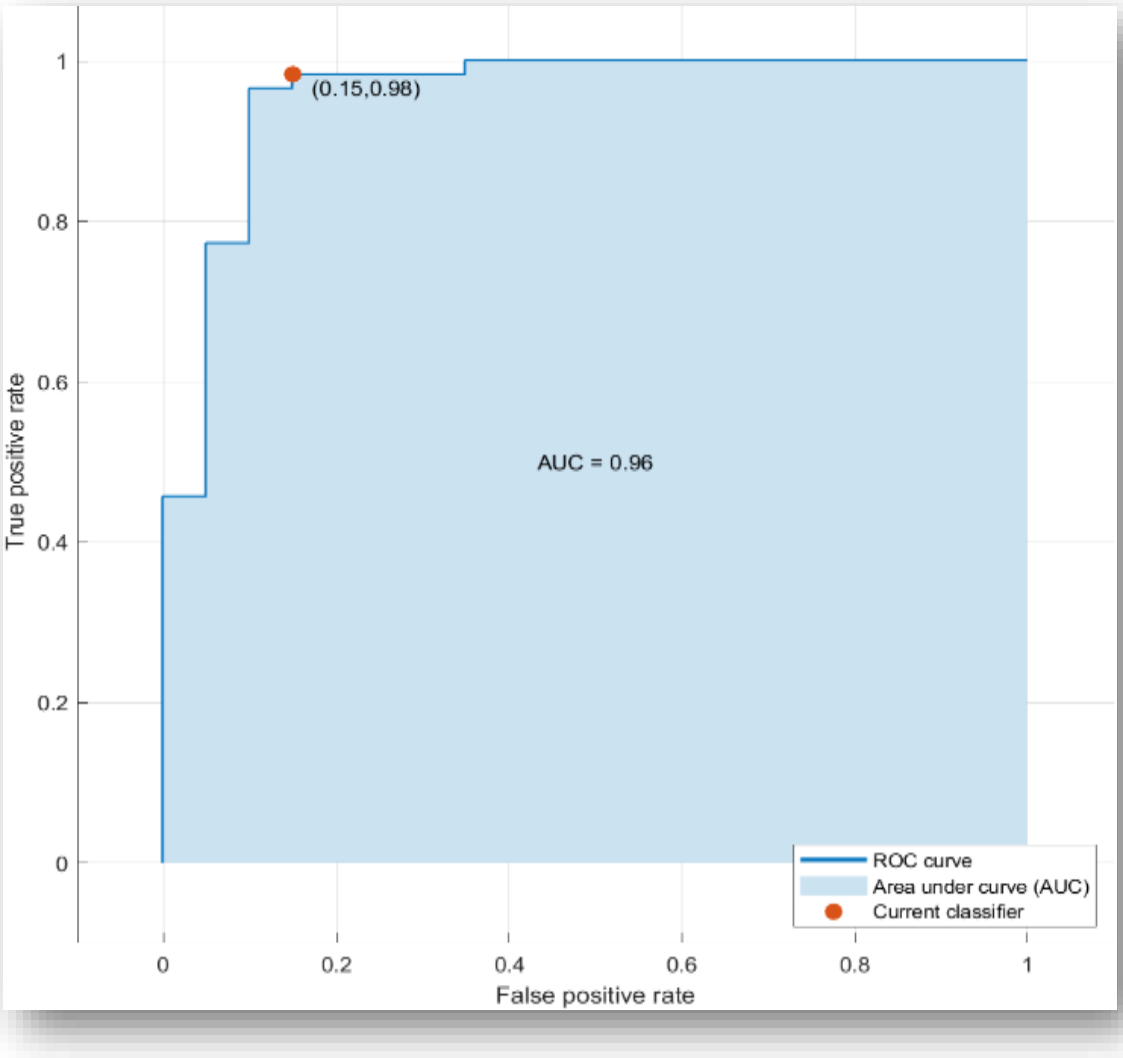

Figure 1. True positive and False positive rates of the AI model.

Conclusion:

We have created AI powered predictive model for the predicting prognosis of neonatal patients based on blood routine tests. The model is characterized by high predictive accuracy (94%). The study is significant because it used only routine blood tests, conducted on all patients in the clinic, to develop the AI model. The findings suggest that these tests may provide more information that can help predict the prognosis of neonatal patients. This advancement will greatly aid clinicians in identifying at-risk groups and, through intensive monitoring, reduce complications and mortality rates.

References

1. Simon Podnar at all. Diagnosing brain tumours by routine blood tests using machine learning. ResearchGate. (10/9/2019). DOI:10.1038/s41598-019-51147-3

2. Esteva, A. et al. A guide to deep learning in healthcare. Nat. Med. 25, 24–29 (2019).

3. Mesko, B. & Gorog, M. A short guide for medical professionals in the era of artificial intelligence. NPJ Digit Med. 3, 126 (2020).

4. Kwok, T. N. C. et al. Application and potential of artificial intelligence in neonatal medicine. Semin. Fetal Neonatal Med. 27, 101346 (2022).

5. Jeong, H. & Kamaleswaran, R. Pivotal challenges in artificial intelligence and machine learning applications for neonatal care. In Seminars in Fetal and Neonatal Medicine Vol. 27, 101393 (Elsevier, 2022)

6. Ambalavanan, N. et al. Prediction of death for extremely low birth weight neonates. Pediatrics 116, 1367–1373 (2005).

7. Bowe, A. K., Lightbody, G., Staines, A. & Murray, D. M. Big data, machine learning, and population health: predicting cognitive outcomes in childhood. Pediatr Res. (2022).

8. Pammi, M., Aghaeepour, N. & Neu, J. Multiomics, artificial intelligence, and precision medicine in perinatology. Pediatr Res (2022).

9. Knake, L. A. Artificial intelligence in paediatrics: the future is now. Pediatr Res. (2022).

RESEARCH ON THE APPLICATION OF NAVIGATION AND INFORMATION SYSTEMS TO ENHANCE NAVIGATION SAFETY

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Abstract

Currently, there is an intensive development of navigation and information systems (NIS), particularly their integration into the maritime safety system. Special emphasis is placed on their role in reducing the number of maritime incidents, improving the efficiency of routine operations, and ensuring the speed and promptness of decision-making in complex navigational situations. In this study, the authors have conducted an analysis of one of the most advanced types of NIS - the Electronic Chart Display and Information System (ECDIS).

The Electronic Chart Display and Information System has brought about a true revolution in the field of maritime navigation, providing an unprecedented level of accuracy and efficiency.

Keywords: Navigational information systems, electronic chart display and information systems, shipping, maritime safety, ECDIS.

Introduction. Modern maritime navigation is a complex field that requires a high level of coordination, effective management, and proper maritime safety assurance. The development and improvement of technologies contribute to the enhancement of navigation processes, the reduction of risks associated with emergency situations, and the minimization of human factor influence. One of the key achievements in the maritime industry is the implementation of navigation and information systems (NIS), which integrate advanced technologies for the collection, processing, and analysis of navigational data, thereby improving vessel traffic management efficiency and the overall level of maritime safety. The necessity of using such systems is increasing due to the active expansion of maritime trade routes and the growing volume of maritime transportation [1].

The role of navigation and information systems (NIS) in modern maritime navigation is to ensure fast and convenient access to information regarding the state of the marine environment, weather conditions, the current location of vessels, and potential threats. The main components of NIS include Electronic Chart Display and Information Systems (ECDIS), Automatic Identification Systems (AIS), radar technologies, and satellite communication tools. Their integration creates a unified, comprehensive platform that facilitates effective decision-making support for both ship captains and dispatchers [2].

The information received on the bridge during the execution of key ship operations may include data related to navigation, collision avoidance, vessel control, as well as its safety and security. During operations, the bridge may receive hundreds of alarm and warning signals. To avoid misinterpretation of the data provided by the Electronic Chart Display and Information System (ECDIS), the following recommendations can be followed:

1. It is necessary to thoroughly familiarize oneself with the symbols and abbreviations used in the ECDIS installed on the vessel.

2. One should not assume that the actual location of the vessel precisely corresponds to its representation on the electronic chart or that it is always within the 95% allowable position error.

3. It should not be assumed that the vessel's course and speed fully match the track angle and speed displayed on the information panel.

4. It is important to consider the errors and limitations of radar stations (RADAR) and Automatic Target Recognition Systems (ARPA), which may affect the display parameters of objects.

5. One should not assume that increasing the scale of the electronic chart automatically improves its level of detail and accuracy.

6. The scale and loading of electronic charts should be selected in accordance with the requirements of safe navigation.

7. It is essential to use navigation information sensors that are best suited to the current situation.

Additionally, modern navigation and information systems (NIS) are equipped with user-friendly interfaces designed for ease of use, ensuring intuitive data visualization. This allows the crew to respond quickly and accurately to changes in the navigational situation, which, in turn, helps reduce the risk of potential errors [5].

Main part. It was only in the 1970s that the technologies used in shipping and the creation of electronic charts began to approach various navigation systems, making it possible to realistically dream about the implementation of this idea. By the late 1970s, computer technologies had already appeared on ships, elevating navigation accuracy to a higher level. Therefore, by the early 1980s, it became clear to the International Hydrographic Organization (IHO) that the future belonged to digital technologies.

By the mid-1980s, the North Sea Hydrographic Commission, which at the time held a leading position in the field of maritime navigation development, began working on defining what was initially referred to as the electronic chart plotter system. Much later, a new concept was introduced, incorporating a crucial and

powerful word—"information." This ultimately led to the emergence of the now well-known and widely used term ECDIS, which continues to play a vital role in the maritime industry. It is hoped that this device will be utilized for a long time to come, ensuring and maintaining maritime safety at a sufficiently high level.

It is important to emphasize that until 1985, all these developments and advancements were carried out independently by various companies and countries, without a unified plan and with differing standards. It was only in 1985 that the International Maritime Organization (IMO) began to show its interest in ECDIS. This interest was primarily driven by the need to establish uniform standards for all systems to enable the reliable and safe use of electronic charting in ship navigation on an international scale.

When considering the history of ECDIS development as a significant breakthrough in recent years, there is a natural desire to look into the future, at least the near future. And the first thought that comes to mind is artificial intelligence, sometimes referred to as a "digital twin." This digital twin theory provides a connection between a real and a virtual object, raising questions about how future intelligent maritime navigation devices will operate—who will implement decisions and who will oversee their execution.

Thus, this "twin" will fully process all stages of navigation along a vessel's route using existing models, simulations, and algorithms, selecting the safest path while taking into account all aspects, from navigation to weather conditions along the maritime route, and even handling all necessary considerations when sailing in port waters.

In this way, we see that both the history of ECDIS development and its future have always been aimed at ensuring maritime safety by striving to integrate all navigation bridge information into a single system.

ECDIS can easily become overloaded with information, making the information load on the navigator a real hazard. It is necessary to train navigators as operators capable of working under multitasking conditions and managing an intense flow of diverse information. To mitigate information overload, it is recommended to use large ECDIS screens and take advantage of the passage plan saving function.

The purpose of ECDIS is to assist navigation, not to replace it entirely. Traditional navigator skills, such as analyzing the navigational situation, plotting courses, and determining position using various methods, remain essential and can be invaluable in case of an ECDIS failure.

There are approximately 40 different ECDIS systems available on the market. While the format of navigational information is standardized, the user interface is not. Most systems include numerous advanced features, settings, and customization options, often hidden within multiple menu levels [2].

Since different types of Electronic Chart Display and Information Systems (ECDIS) are installed on various vessels, many countries have introduced a mandatory specialized ECDIS course before a navigator assumes duty on a ship to address the issues that arise when operating different versions of these systems. Some large shipping companies have chosen to standardize the use of equipment by selecting a single ECDIS provider for all their vessels, which significantly simplifies crew training and improves the system’s operational efficiency.

It is necessary to consider the possibility of unexpected or unintentional changes in ECDIS operation, which may affect the functionality of the equipment and the decision-making process of the watch officer. Such changes may manifest as incorrect display of navigational characteristics, errors in object detection during route verification in voyage planning mode, improper hazard signaling, or incorrect management of the warning signal system.

One way to eliminate anomalies caused by system failures in ECDIS is to compare the electronic chart with its paper version, conduct a detailed study of sailing directions and manuals, and perform thorough visual monitoring of the navigational environment.

Any navigational chart, including electronic ones, should be approached critically, as cartographic data may vary in terms of the time of creation, level of detail, quality, and completeness. When using electronic charts for navigational tasks, it is important to assess the reliability of the information they contain.

It is evident that charts based on the latest hydrographic surveys have a higher level of accuracy. Taking into account the results of analysis and the evaluation of confidence in a particular chart, it is necessary to select the safest route for the vessel's movement.

Conclusion

Undoubtedly, with the introduction of electronic technologies in the maritime and inland waterway sectors, considering the continuous growth of cargo traffic, the level of water transport safety has significantly improved.

It is gratifying to note that progress in this field continues: navigation systems are being enhanced, additional functions are being implemented, new standards are being developed, and requirements for equipment are being standardized. This indicates that maritime safety continues to improve, contributing to the protection of valuable cargo, the environment, and, most importantly, human life.

The watch officer must not only be proficient in using the Electronic Chart Display and Information System (ECDIS) but also have a solid understanding of the key issues that may arise during its operation, be aware of possible ways to resolve them, and take every opportunity to verify the system's accuracy. Traditional navigation methods must remain relevant and be actively applied to ensure maritime safety.

Excessive reliance on ECDIS can lead to a loss of responsibility for continuously analyzing the vessel's position. A paradoxical phenomenon is observed in the maritime industry: although modern technologies are designed to enhance navigation safety, overconfidence in their infallibility may, on the contrary, become a cause of maritime incidents.

References

1. George Perez, Captain United States Navy. Improving Maritime Electronic Navigation Systems to Improve Collision Avoidance University of Oregon

Applied Information Management Program, 2019. URL: https://scholarsbank.uoregon.edu/server/api/core/bitstreams/72daa8e7-e6c4-4ac4-9d60-09b249994ebf/content

2. Krzysztoe Pleskacz, Janusz Uriasz, Understsndind of Navigational Information systems". Maritime University of Szczecin, Annual of navigation, december 2012. URL: https://www.researchgate.net/publication/272263935_Understanding_of_Navigational_Information_Systems

3. Bistrović M. Impact of -Navigation on ECDIS Development as a Decision Support System. 2015. P. 30-39.URL: http://surl.li/alhqn

4. Ivanov I. "Marine Safety: Modern Approaches". Springer, 2021

5. Human perception problems of ECDIS electronic chart displays. URL: https://www.maritime-ergonomics.com/ergos-hfe/articles/human-perception-problems-of-ecdis-electronic-chart-displays

6. Understanding the Disadvantages and Limitations of ECDIS: A Comprehensive Insight. URL: https://medium.com/@sarahelizabeth181120/understanding-the-disadvantages-and-limitations-of-ecdis-a-comprehensive-insight-f3e5e01afd23#:~:text=System%20Failures%3A%20Like%20any%20electronic,methods%20are%20not%20readily%20available

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