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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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No 10 (343) 2023

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INNOVATIONS IN FOCUS: MECHANISTIC DISEASE THEORIES, CLIMATE DYNAMICS, AND HOST-PARASITE ADAPTATIONS

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Abstract.

Objective: Infectious illnesses are predicted to experience a range of intricate responses from climate change, with some likely to rise, others to fall and many expected to undergo changes in prevalence.

Methods: The study uses extensive data on global temperature variations and infectious illness transmission in people and animals. We now know a lot more about how the temperature changes across the world and whether or not the spread of infectious diseases impacts people as well as animals. Three primary topics of research are investigated in this paper: improving mechanical disease modelling, investigating the role of environmental variation in sickness dynamics, and understanding the consequences of temperature imbalances between parasites and hosts.

Result: By incorporating the latest data stemming from these advancements into weather-disease models and bridging critical knowledge gaps, enhancing our ability to forecast the probable effect of rising temperatures on the prevalence of diseases among both human and animal communities is possible.

Conclusion: Through the establishment of important information gaps and the incorporation of new findings into models of climate-disease relationships, it will be possible to predict the effects of changes in climatic averages, variations and extremes on people and wildlife health.

Key words. Climate change, Temperature, Batrachochytrium dendrobatidis (BD), Host-Parasite.

Introduction.

The effects of universal warming on the nature and spread of deadly illnesses as well as parasites are among the most significant ecology and wellness issues facing humanity and the biodiversity of the planet [1]. Over half of all organisms on Earth are worms and shifts in their variety, resources and geographic distribution have an immediate impact on the processes of ecology, biological conservation, the food economy, and the health of humanity. Weather and temperature patterns are growing more erratic as the earth heats. This is demonstrated by a shift in climate along with a spike in the amount and duration of storms, shortages, and extremities of heat and cold [2]. The pace and course of these changes, as well as the capacity of certain species of parasites to adjust the novel and challenging environments, have an impact on the effects of these alterations on host-parasite interactions and parasitic populations. The effectiveness of parasites can be affected in a number of ways by harsh circumstances and sudden changes in the environment. Natural selection throughout several generations alters the prevalence of alleles in a population for example, some genotypes become more advantageous, and others vanish because the changing circumstances are more suited for the continued existence of specific people [3].

However, groups can either vanish or migrate if people are incapable to endure or adjust to the environmental shifts, which will cause an alteration in the geographic distribution of the organism. Parasites' species-specific responses to environmental factors, including freeze along with drying out acceptance, phenotypic plasticity, acclimation ability and interactions with the environment, can mitigate the adverse effects of novel environments, enhancing the probability of survival and adaptation [4]. To accurately forecast the impact of climatic changes on interactions between hosts and parasites, it is essential to comprehend the nuances in the life cycle routes of parasite that affect persons' and groups' capacity to adapt to their abiotic factors context. Here, the species discusses some of the physical and behavioural adaptations that worms have made to their bodies to survive in difficult conditions. It discusses how these modifications relate to their sustainable and life-history features, which can have an impact on the amount of time they are able to survive in and adjust to the harsh as well as erratic circumstances that global warming could bring about [5]. Researchers do this by concentrating mostly, but not solely, on nematode parasites from the Arctic, where relationships between hosts and parasites are changing, extreme temperatures are noticeable and global warming is occurring at the fastest rate [6]. We provide instances of nematode parasitism from moderate locations, in which there is a greater body of research and a better understanding of adaptation. Our primary objective is to characterize and gain a deeper comprehension of the different strategies used by worms to endure harsh environments and abrupt heat swings, dehydration, and phonological phenomena [7]. As a result of warming temperatures or additional environmental alterations, we address whether these processes can influence and determine the ability of parasites to adjust to their new surroundings and lead to propagation at the level of the area [8].

Objective of this study.

A comprehensive understanding of the underlying processes that drive the appearance, dissemination, and adaptation of diseases in settings that are changing can be attained by making

it the mission to decipher the intricate links that exist between mechanistic disease theories, the dynamics of the climate and host-parasite responses.

Combining infectious dynamics and temperature reactions utilizing mechanistic models.

Using mathematical frameworks, investigators are enhancing the modelling of disease propagation by adding various mechanisms impacted by weather (Figure 1). Unlike earlier linear models that connected infection processes to temperature, modern mechanical theories describe the intricate environmental interactions between hosts and parasites. With a more detailed knowledge of the many processes influencing disease transmission made possible by this integrated approach, more precise forecasts and focused treatments are made possible [9].

Which are accurate since most features show a hump-shaped connection with warmth because biological reactions become less effective as temperatures go away from the ideal, in fact, a recent study found that 15 unique mosquito's types' distribution of 11 distinct illnesses changed unmorally with warmth predicted weather circumstances [10]. Species distribution models (SDMs) see dynamical SDMs, but they are correlative and solely dependent on historical or present-day weather data as opposed to situations expected with warming temperatures. Certain writers have suggested that mechanical models execute better than SDMs to forecast species reactions in unusual or no equilibrium situations, like changes in the climate [11]. When forecasting energy purchases, SDMs and mechanistic models fared comparably, but they forecast distinct reactions of the species to global warming. Since 2013, changes to the technological Ross–MacDonald susceptible–infected–recovered (SIR) program representation have been implemented and utilized for predicting the propagation of the dengue virus strains all through temperatures. (Figure 2) It is a Simple vector-borne illness compartmental model. Blue squares indicate hosts, red diamonds vector compartments. Gc, Ac, and Jc reflect vectors' susceptible, exposed, and infected states, whereas SIR denotes host states. Solid lines represent compartment transitions, dashed lines infection paths, and dotted lines vector demographics. Given its complexity, we presented a vector-borne illness model instead of one with directly transmitted parasites [12]. In a subsequent inquiry into 11 mosquito-borne diseases, the peak transmission temperatures identified through mechanistic simulations exhibited a decrease of up to 6˚C compared to the temperatures derived from models based on general thermal ecological features [13]. Estimates regarding additional illnesses, such as dengue fever, Ross River viruses and citrus sustainability, were enhanced by taking consideration of quadratic temperature features in molecular simulations.

Mechanistic models that considered irregularities in heat features produced better forecasts for no vectored animal infections [14]. For example, to illustrate how warmer temperatures might split the unremitting mechanism-to-fall broadcast cycle of a frozen worm into two separate spread weeks with differing times. The company and colleagues created a mechanical host-macro parasite model that built multiple not linear Total Parasite Counts (TPCs) of the host organism and sponge [15]. Their forecasts correspond to experiential

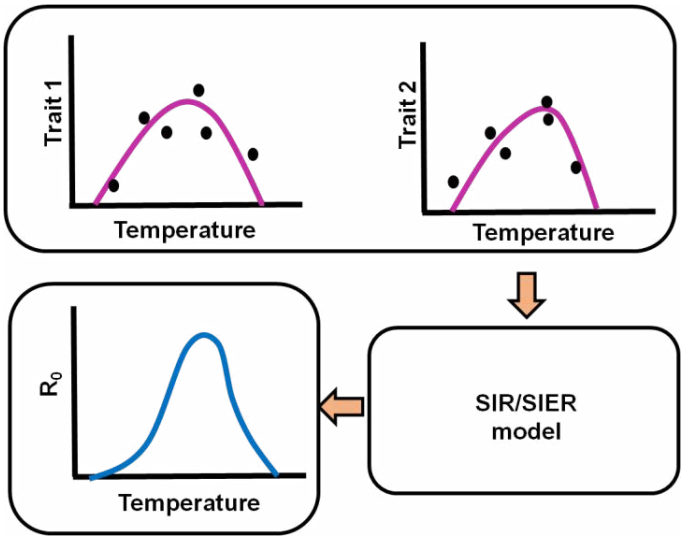

Figure 1. *Advancements to illness models mechanistic.*

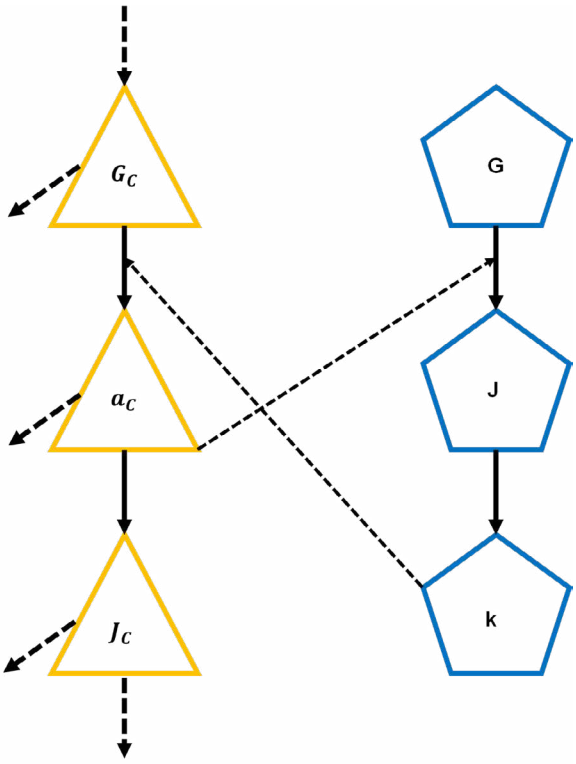

Figure 2. *Simple compartmentalised structure of disease transmitted by vectors shown graphically.*

evidence. They integrated this data after measuring the TPCs across various properties of both the parasite and crab host organisms, aiming to establish a susceptible-exposed-infected propagation system for predicting outbreaks under potential global environmental changes [16]. According to their model, a mere 2˚C increase in temperature will result in significant drops in pathogen prevalence and possibly localized extinction in the coastal southeast of the United States, while the northern part of a parasite's distribution is expected to see a surge in virus spread. These two examples show whether periodic patterns of infections might be impacted by global warming and the effects will differ based on the geographical location of the

particular pathogen. To achieve this, they integrate field data, epidemiological models, and interventional experiments [17].

Additionally, mechanical SIR theories have drawbacks. They require tests on many characteristics of the host; a vector that results organism and their relationships under different circumstances, making them, first and foremost, data-intensive [18]. In order to fill in data gaps, data are obtained from studies using various approaches and from closely related species, both having the potential to introduce mistake. Furthermore, because these representations are species-specific, it is difficult to address concerns about universality between host and pathogen taxa [19].

Certain restrictions on data-intensive, mechanical SIR modelling can be overcome with the aid of developments in mechanical illness models founded on the MTE. A number of scientists have proposed that MTE's basic concepts can be employed to explain the heat dependence of host and pathogen features, such as growth and longevity [20]. In that case, projections could possibly be made using established correlations in body size, humidity and metabolic processes, which might eliminate the need to measure the connection between the climate and characteristics that are crucial to the spread of parasites and provide null model projections for the species with insufficient data have demonstrated that an MTE-based model can be used to forecast the impact of temperature variations on disease [21]. This finding raises the possibility that MTE models, which take advantage of the well-established correlations between allometry, the temperature and metabolic processes, can be able to forecast how changes in the environment could affect the spread of parasites.

The application of MTE to infectious.

Despite the presence of comparable libraries for numerous host species, there is a gap in the scientific literature about the storage of parasites TPCs. A collection of data of coupled host and parasite TPCs could be useful in determining which kinds of parasites can see the greatest modifications in dissemination as a result of global warming, where on Earth infection rates can rise most as a result of climate shifts and how a lot of disease spans will shift or increase as a effect of change in the environment [22]. There is much to be discovered about TPCs, including the question of if TPCs developed in laboratories work as well as those found in the wild and TPC parts have the best chance of adapting along with acclimating to changing climates. Recent publications of useful instructions are used for the creation of modelling and studies utilizing TPCs and MTE in connection with enticement [23]. The use of change studies to determine exploratory objectives, guidance on creating experiments that measure TPCs and statistical methods for determining TPC factors.

Climate variability's impact on the spread of illness.

A fall in the diurnal temperature range (DTR), which is brought about by nocturnal temperature rising more than midday conditions and arise in fluctuations in climate are two characteristics of environmental change. These factors have sparked curiosity in how climatic variability affects illness and raised worries about the way that disregarding volatility can affect predictions of the relationship between climate change and disease [24]. Concerns regarding growing sickness prevalence originate from climate unpredictability since parasites adapt better to temperature changes than hosts. Figure 3 shows that parasite growth during rapid temperature variations depends on this adaptation. Studies show that (DTR) affects important rate mechanisms and viral maturation phases in vector-borne illnesses including dengue and malaria. Due to this complicated interaction, illness transmission patterns must be understood in a changing climate for successful public health interventions [25]. It has been demonstrated that variations in climate lead to an increase in wildlife diseases that are spread directly, such as the chytrid fungus, (Bd), which infects frogs and a pathogen similar to Rickettsiales that infects abalone.

Predicts parasite transmission.

Temperature variation can undoubtedly impact the spread of pathogens, but it is unclear whether or not this is due to: (1) organisms' lags in adapting their chemically and physiologic responses to heat shift, (2) TPCs' typical nonlinearity and asymmetry, (3) Jensen's disparities, which causes instance-averaged charge in random thermal environment to differ from rates in constant circumstances, or (4) an amalgamation of those variables [26]. Research is required to determine how linear averaged among TPCs measured at set temperatures models and the spread of parasites in habitats with changes in temperature. In addition, variations in the environment cause a decline in intra-daily volatility and a rise in inter-daily volatility. It is unclear, whether the type of pathogen influences those trends, how easily predicted the variation is, what temperature deviation timeframes prove most important and how these impact propagation [27]. In line with MTE, a recent meta-analysis found a negative relationship between body size, temperate breadths, and adaptation rates. Therefore, it is important to assess in future research if MTE can forecast the spread of parasites in both steady and variable contexts.

Infection results are predicted by host and pathogen temperature mismatch.

The Thermal Mismatch Hypothesis (TMH) states that parasites and hosts have distinct optimal fitness points at various laboratory temperatures. Empirical data supports this notion that temperature variations considerably affect infection rates between them (Figure 4). TMH shows a dynamic host-parasite biological dynamics-temperature interaction, improving our knowledge of laboratory infection outcomes. This paradigm emphasizes the relevance of environmental conditions in host-pathogen dynamics by showing that host-parasite fitness is temperature-dependent.

The TMH implies that parasites outperform hosts in unusual environmental settings, as seen in Figure 5. This contradicts the idea that parasites thrive alone. Parasites outnumber their native hosts in certain conditions, according to TMH. Instead of ideal settings, parasites are most abundant at limits when hosts' adaptation to changing environment is outcompeted. This complex view challenges standard knowledge by emphasizing host-parasite interactions in shifting ecological situations.

TMH develops crucial ideas. First, infection groups need a minimum number of members to flourish, suggesting some illnesses need a necessary host quantity to multiply

and spread. Second, TMH implies parasites may grow at different temperatures than hosts. Parasites and hosts have different temperature adaptations (Figure 6). These notions form a complete foundation for studying host-parasite thermal dynamics using TMH.

Cold-acclimated animals' thermal performance curves (TPCs) are unaffected by pharmacologic limitations. Note that TPC predictions are independent of parasite and host heat sensitivity.

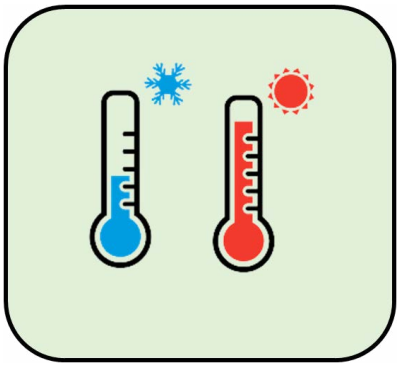

Figure 3. *Research on environmental variability's impact on diseases dynamics.*

Figure 4. *Climatic differences impact host–parasite interactions.*

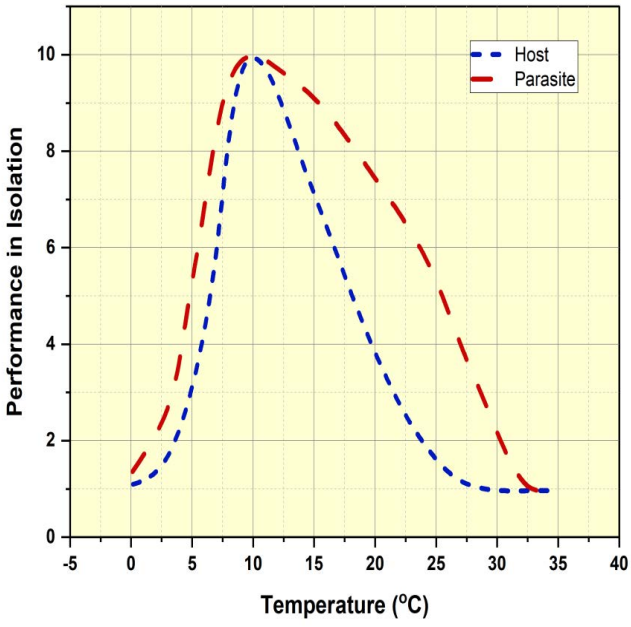

Figure 5. *Performance in Isolation.*

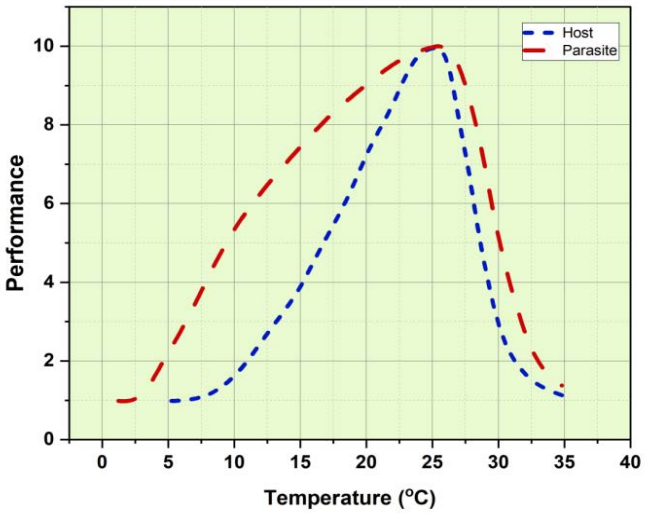

Figure 6. *Performance in Temperature.*

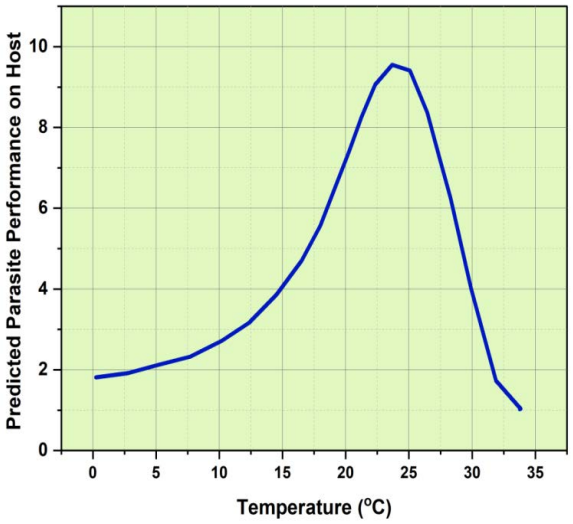

Figure 7A. *Predicated Parasite.*

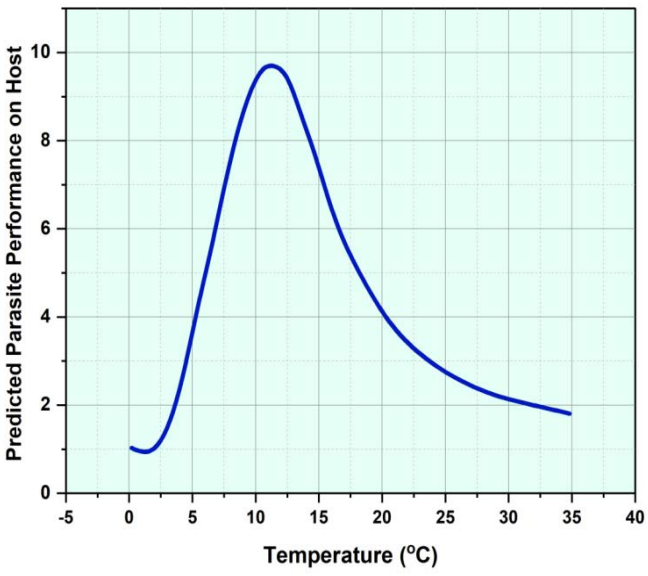

Figure 7B. *Predicated Parasite.*

The (TMH) posits that hosts used to hot and cold climes are more susceptible to infections at extreme temperatures. Figure 7(a,b) shows how TMH says extreme circumstances allow parasites to outcompete hosts. Climate change is expected to make hosts from colder locations more susceptible to sickness than those from warmer climes, illustrating the complex relationship between temperature, host adaptation, and disease processes.

The TMH's predictions, which suggest that hosts adapted to warmer and cooler temperatures should experience peaks in their respective thermal ranges, have garnered substantial support from multiple sources [30]. In addition, when compared to Bd growth in controlled environments, factors such as temperature variability, mean climate, climate change, or the spread and introduction of Bd, the TMH framework identified over 66 instances of decline in the Atelopus genus, linked to Bd. Furthermore, a global assessment demonstrated that larger, widely dispersed hosts of conservation concern, situated at higher altitudes and lower latitudes, were more susceptible to Bd following temperature mismatches. These findings furnish supplementary evidence indicating the potential impact of temperature mismatches on amphibian declines.

While it is true that variations in the TPCs of both hosts and fleas can effect in non linear interactions among hosts and parasites when temperatures change, TMH is valuable because it takes into account regional adaptation, which is based on the fundamentals of MTE and integrates the TPCs of the host as well as parasite without requiring the quantification of TPCs for every trait that is dependent on temperature on each [31]. Combining readily available field surveys of illnesses across temperature ranges with local meteorological and weather information makes testing it simple. In comparison to previous models, it provides more precise forecasts for the relationships between diseases and climate change. It makes forecasts for host populations, species and geographic locations that can see the biggest changes in illness due to climate change [32]. It suggests that cool-adapted ones will be more vulnerable to infection then warm-adapted ones. Inconsistencies in the phonology of hosts and parasites can result from differences in their thermal performance. The TMH has been found to have supports in 2,021 host-parasite pairings and 7,346 populations of wildlife. Yet, the degree of support varied depending on the pathogen taxon and it was higher for active hosts than endothermic hosts. In the future, the hypothesis of potential shifts in the geographic distribution of infectious diseases and a probable global rise in illnesses is bolstered by both statistical models and climate change forecasts [33]. The findings point to a notable increase in the risk of diseases among wildlife hosts in temperate and tropical zones, coupled with a moderate decline. This observation suggests that climate change might disrupt the timing of interactions between hosts and parasites. For instance, the extent of mismatch in timing between trematodes and hosts influenced the behavioural resistance and tolerance to these infections, resulting in either positive or negative effects. The disturbances in the timing of host-parasite relationships due to climate change were linked to reduced parasitic loads in sheep [34]. The temperature increase of 3˚C led to a significant shift in phenology, resulting in a 50% decrease in trematode burdens and a 67% reduction in disease incidence, even though the overall infection rate remained consistent across different temperature treatments. These findings propose that the interplay between host and pathogen, including host defences, parasitic transmission, disease manifestation and host mortality, might be impacted by the level of phenological alignment between hosts and pathogens [35].

TMH applies to human diseases.

TMH's efficacy in treating human illnesses has not been tested [36]. There remains uncertainty regarding its applicability to human diseases, as endothermic human hosts provide stronger support for TMH compared to exothermic hosts. Human populations exhibit diverse disease control strategies [37]. Furthermore, it appears plausible that the same fundamental ideas that enable parasites to have wider temperature ranges than hosts can enable parasites to have wider ranges for other climatic elements, such as moisture [38]. The relative significance for temperature in relation to other transmitting chauffeurs, such as rain, is unknown [39]. This is crucial in light of a recent meta-analysis that found positive correlations between diarrheal illnesses and severe rainfall and flooding, as well as evidence that temperature and moisture might combine to worsen epizootic illness [40].

Dose of parasites and infection of the host.

Microphallus eggs infect the snail from the inside after hatching in the snail's gut, spreading to the gonad, and digesting duct. Upon organization, the parasite undergoes a phase of asexual reproduction, supplanting a significant portion of the host's reproductive tissue with digestive gland. Table 1 exhibits the results of an experiment concerning reciprocal infection.

According to Table 2, the projected figures for the delayed samples .86·0.03, while the early samples exhibit an asymptotic behaviour was. “89±0.02 (denote±1 S.E.). For the Alexandrina hosts, the average estimate of the equilibrium was less than one. (88±0.02; Table 2). According to these findings, sympatric parasite resistance was present in about 12±0.04% (1×Asymptote±2S.E.) of the shells in the Alexandrina sample.

In the nonlinear model, the coefficient square was short (.25, Table 2) and no parameter estimations were different from zero. The estimation value for the quadratic model asymptotic was .16±0.42 (1 S.E.). Linear replica, frequency was linked towards dosage (b=.001, F=6.30, D.F.=,19, P=.02), although square (.25) was identical as in the quadratic.

Table 1. *Result of a mutual infection.*

The asymptote differs between allopatric and sympatric populations	**Compared to sympatric rates**		
	Greater	**Less**	**Equal**
Superior	MA	MA quantity-needy	MA
Identical	MA, quantity-needy	LA, quantity-needy	-
Fewer	LA or MA, dose-needy	LA	LA

Table 2. *Dose–infection regression models estimations.*

Host population	Sample	Parameter	1 S.E	Estimate	k^2
Alexandrina	Pooled	Asymptote	.0155	.8778	.94
		Interrupt	.0343	.0406	
		Speed	.0151	.1727	
	Behind	Asymptote	.0300	.8622	.86
		Interrupt	.1461	.1	
		Speed	.0438	.1853	
	Early	Asymptote	.0156	.8890	.98
		Interrupt	.0275	.0606	
		Speed	.0164	.1684	
Poerua		Speed	.0480	.0125	
		Asymptote	.3177	.1559	.26
		Interrupt	.0189	.0298	

Conclusion.

Despite significant advancements in our comprehension of the relationships between diseases and climate change, there are significant gaps in the research. The intertwining nature of mechanistic disease theories, climate dynamics and host-parasite adaptations elucidate a complex web of interactions that impact the health of ecosystems and organisms. By understanding the mechanistic underpinnings of diseases, such as the intricate cellular and molecular processes involved, we gain insights into potential intervention points for treatment and prevention strategies. It should be possible to more accurately predict how changes to climatic means, variations and extremes would impact illnesses for both humans and wildlife by filling in these urgent information gaps and incorporating new findings into climate-disease models. The integration of mechanistic disease theories, climate dynamics and host-parasite adaptations provide a holistic framework for comprehending and addressing the complexities of disease dynamics. By embracing interdisciplinary collaborations and leveraging advancements in technology and research, we can strive to mitigate the impacts of diseases, foster ecological resilience, and promote global health and well-being.

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