Evidence Based Journal of Information Science
Volume 1, Issue 2, December, 2025
ISSN: 1595-6148
https://journals.kasu.edu.ng/index.php/lib

A COMPREHENSIVE REVIEW OF DIRECT AND INDIRECT IMPACTS OF ARTHROPODS ON HUMAN HEALTH AND LIVELIHOODS

ABDULMALIK, Muhammadu
Department of Biology, Umaru Musa Yar'adua University, Katsina, Nigeria
pgbio230332@students.umyu.edu.ng

ABSTRACT

Arthropods, the most diverse group of organisms on Earth, play critical ecological roles but also pose significant threats to human health, agriculture, and socio-economic stability. The main purpose of this review paper is to review the ways arthropods cause harm to human health and livelihoods through direct and indirect impacts. This paper explores the multifaceted harm caused by arthropods, focusing on their role as vectors of diseases, agricultural pests, and invasive species. Vector-borne diseases, including malaria, dengue, Zika, and Lyme disease, account for over 700,000 annual deaths globally, with climate change and urbanization expanding the range of arthropod vectors. Agricultural pests like locusts and aphids devastate crops, exacerbating food insecurity, particularly in developing countries. Furthermore, invasive species such as the red imported fire ant disrupt ecosystems and impose substantial economic burdens. The paper also addresses the psychological and societal impacts of arthropod infestations, including conditions like delusional parasitosis and the stigma associated with pests such as bedbugs and lice. Additionally, the rise of insecticide resistance and the environmental risks of chemical pest control underscore the need for sustainable alternatives. Recommendations from this research emphasize enhancing surveillance systems, investing in integrated pest management (IPM), promoting public health education, fostering global collaboration, and implementing climate adaptation strategies. Through a summary of current research, this session emphasizes the critical necessity for a multidisciplinary strategy to tackle issues pertaining to arthropods. To lessen the worldwide burden of diseases, guarantee food security, and protect ecosystems, it is crucial to comprehend their biology, ecology, and connections with human activity.

Keywords: *Arthropods, Vector-borne diseases, Agricultural pests, Invasive species and Integrated pest management (IPM*)

Introduction

Arthropods, representing the largest and most diverse phylum in the animal kingdom, have profound and multifaceted impacts on human health across the globe. This group, which includes insects, arachnids, crustaceans, and myriapods, interacts with humans both directly and indirectly through a variety of biological, ecological, and epidemiological pathways. While

Received: October 15, 2025. Accepted: December 16, 2025

some arthropods play beneficial roles in ecological balance, pollination, and biological control, others exert harmful effects through bites, stings, infestations, allergies, toxin production, and the transmission of pathogens (Schowalter, 2020; Lima et al., 2021). These harmful effects can be broadly categorized into direct effects those resulting from the arthropods themselves and indirect effects, which occur when arthropods act as vectors or intermediate hosts of infectious agents (Murdock et al., 2020).

Climate change, global travel, deforestation, and urbanization have further intensified the interactions between humans and arthropods, leading to increased disease transmission and expanded arthropod distribution (Ryan et al., 2019; Carlson et al., 2022). Studies indicate that rising temperatures and altered precipitation patterns contribute to the spread of arthropod vectors into previously non-endemic regions, amplifying both direct and indirect health risks (Mordecai et al., 2020; Mwangi et al., 2023). Consequently, understanding these dynamic interrelationships is crucial for designing sustainable and adaptive control strategies.

Globally, vector-borne diseases remain among the most significant public health challenges. According to the World Health Organization (WHO, 2023), arthropod-borne diseases account for over 17% of all infectious diseases and cause more than 700,000 deaths annually. Insects such as mosquitoes, ticks, and flies are responsible for transmitting pathogens that cause malaria, dengue, Lyme disease, leishmaniasis, and other infections (Benelli & Mehlhorn, 2022). However, the direct effects of arthropods such as allergic reactions to bites and stings, envenomation, mechanical injuries, and psychological distress have often received less comprehensive attention in integrated health studies (Mattingly et al., 2020; Rodrigues et al., 2023). Recent research underscores the need to address these neglected aspects, as direct health, 2021).

Received: October 15, 2025. Accepted: December 16, 2025

Overview of Arthropods

Arthropods are a diverse group of animals that comprise the largest phylum in the animal kingdom, accounting for over 80% of all described species (Zhang, 2018). They are characterized by their jointed appendages, segmented bodies, and hard exoskeletons (Minelli *et al.,* 2020). The phylum Arthropoda includes a wide range of species, such as insects, arachnids, crustaceans, and myriapods, which can be found in almost every habitat on Earth (Giribet & Edgecombe, 2020).

Arthropods have evolved to occupy a wide range of ecological niches, from the freezing tundra to the hottest deserts, and from the deepest oceans to the highest mountains. Arthropods play a vital role in ecosystems, serving as pollinators, decomposers, and food sources for other animals (Brose *et al.,* 2020). They are also important indicators of environmental health, as changes in arthropod populations can signal broader ecosystem changes (Cardoso *et al.,* 2020). For example, the decline of bee populations has been linked to the loss of biodiversity and ecosystem function (Goulson *et al.,* 2015). Arthropods are also a crucial food source for many animals, including birds, bats, and spiders.

Arthropods have evolved a wide range of adaptations to their environments, including the development of complex sensory systems and behavioral responses to predators and prey (Brose *et al.,* 2020). For example, the development of compound eyes in insects has allowed them to detect and respond to visual cues in their environment (Land, 1997). Arthropods have also evolved complex chemical signaling systems, which allow them to communicate with each other and with other animals (Wyatt, 2014). The study of arthropods has many practical applications, including the development of new medicines and agricultural practices (Rosenberg *et al.,* 2018). For example, the study of arthropod venom has led to the development of new painkillers and antimicrobial agents (Lewis & Garcia, 2003). Arthropods have also been

Received: October 15, 2025. Accepted: December 16, 2025

used as model organisms to study the evolution of disease resistance and the development of new treatments for human diseases (Boulianne, 2018).

Arthropods are also an important part of human culture and economy, with many species being used as food sources or for other purposes (DeFoliart, 1999). For example, insects are a common food source in many cultures, and are high in protein and other nutrients (Belluco *et al.,* 2013). Arthropods are also used in traditional medicine and as a source of natural dyes and other products (Rosenberg *et al.,* 2018). Despite their importance, arthropods are facing many threats, including habitat destruction, climate change, and the introduction of invasive species (Cardoso *et al.,* 2020). For example, the decline of bee populations has been linked to the loss of habitat and the use of pesticides (Goulson *et al.,* 2015). Arthropods are also vulnerable to climate change, which can disrupt their life cycles and alter their distributions (Brose *et al.,* 2020).

Beneficial Effect of Arthropods: Arthropods, which include insects, arachnids, and crustaceans, have a multitude of beneficial effects on the environment and human society (Brose et al., 2020). One of the most significant benefits of arthropods is their role in pollination and plant reproduction (Klein et al., 2018). Many species of bees, butterflies, and other insects are responsible for pollinating crops and wildflowers, which is essential for the reproduction of these plants (Gallai et al., 2012). In fact, it is estimated that one-third of all crops and 80% of wildflowers rely on arthropod pollinators (Biesmeijer et al., 2006).

Arthropods also play a crucial role in decomposing organic matter and recycling nutrients (Wall et al., 2015). Many species of insects, such as beetles and flies, feed on decaying plant and animal matter, breaking it down into simpler compounds that can be reused by other organisms (Swift et al., 2013). This process is essential for maintaining soil fertility and supporting the growth of plants (Lavelle et al., 2016). Additionally, some arthropods, such as

Received: October 15, 2025. Accepted: December 16, 2025

ants and termites, are important ecosystem engineers, modifying their environments in ways that create new habitats for other organisms (Jones et al., 2010).

Arthropods are also a vital source of food for many other animals, including birds, bats, and other insects (Brose et al., 2020). In fact, it is estimated that up to 75% of all bird species rely on arthropods as a primary source of food (Wiggins et al., 2017). Additionally, some arthropods, such as crickets and mealworms, are farmed as a sustainable source of protein for human consumption (Van Huis et al., 2013).

In addition to their ecological benefits, arthropods have also been a source of inspiration for human innovation and technology (Mullen et al., 2017). For example, the study of insect flight has led to the development of more efficient aircraft and drone designs (Kumar et al., 2017). Similarly, the study of spider silk has led to the development of new materials with unique properties (Keten et al., 2010).

Direct Harm Caused by Arthropods

Arthropods can cause direct harm to humans primarily through bites, stings, and allergic reactions. Insects like mosquitoes, ticks, and bedbugs feed on human blood, often causing localized pain, itching, and inflammation. For instance, mosquito bites can lead to severe allergic reactions in sensitive individuals, a condition known as Skeeter syndrome (Mullins *et al.*, 2016). Stings from arthropods such as bees, wasps, and ants can cause anaphylaxis, a potentially fatal allergic reaction. Arachnids like scorpions and some spider species, including the black widow (*Latrodectus spp.*) and brown recluse (*Loxosceles spp.*), inject venom that can lead to severe pain, tissue necrosis, or systemic effects (Isbister & Fan, 2011). In addition to physical harm, arthropods can inflict psychological distress. Conditions like delusional parasitosis, where individuals believe they are infested by arthropods, are often exacerbated by encounters with bedbugs or lice (Hinkle, 2010). The trauma associated with infestations can lead to sleep disturbances, anxiety, and reduced quality of life.

Received: October 15, 2025. Accepted: December 16, 2025

Indirect Harm through Disease Transmission

Arthropods are vectors for numerous pathogens, making them a major public health concern. Mosquitoes, for example, transmit diseases such as malaria, dengue fever, Zika virus, and chikungunya. Malaria, caused by *Plasmodium* parasites and transmitted by *Anopheles* mosquitoes, resulted in an estimated 619,000 deaths globally in 2021 (World Health Organization [WHO], 2022). Similarly, ticks transmit pathogens like *Borrelia burgdorferi*, the causative agent of Lyme disease, and *Rickettsia rickettsii*, which causes Rocky Mountain spotted fever (Eisen *et al.*, 2017). Fleas, another group of blood-feeding arthropods, were historically responsible for the bubonic plague, caused by the bacterium *Yersinia pestis*. Although modern antibiotics have reduced the threat of plague, outbreaks still occur in some regions (Stenseth *et al.,* 2008). Beyond bacteria, arthropods can also spread viruses and protozoa, significantly burdening healthcare systems worldwide

Agricultural and Economic Impacts

Arthropods also harm humans indirectly by affecting food security and economies. Crop pests such as locusts, aphids, and caterpillars can decimate agricultural yields, leading to food shortages and economic losses. The desert locust (*Schistocerca gregaria*), for instance, is infamous for its ability to form large swarms that consume vast amounts of crops and vegetation, devastating livelihoods across Africa and Asia (Cressman, 2016). Stored product pests, including weevils and grain beetles, damage food supplies, leading to post-harvest losses. This impact is exacerbated in developing countries where food preservation infrastructure is limited. Additionally, invasive arthropod species, such as the red imported fire ant (*Solenopsis invicta*), cause ecological disruption and incur significant control costs (Lowe *et al.,* 2000).

Psychological and social effect of arthropods

Fear, Disgust, and Phobias

Received: October 15, 2025. Accepted: December 16, 2025

Many people experience strong negative emotions when encountering arthropods. Insects and spiders are among the most common triggers of specific phobias, especially entomophobia (fear of insects) and arachnophobia (fear of spiders). These fears often stem from evolutionary mechanisms that help humans avoid dangerous animals (Öhman & Mineka, 2001). Disgust is another frequent psychological reaction. Arthropods such as cockroaches or maggots evoke disgust because they are associated with contamination, dirt, and disease (Curtis & Biran, 2001). These emotional responses can shape behavior, such as avoiding dark or cluttered places.

Stress and Anxiety

In regions with high mosquito populations or disease-transmitting insects, constant exposure may cause chronic stress and anxiety. Studies show that concern about insect-borne diseases like malaria or dengue can increase psychological distress (Tirado et al., 2021).

Influence on Mental Well-being

Frequent infestations such as bed bugs are associated with insomnia, paranoia, and reduced mental well-being. Research indicates that bed bug infestations can lead to anxiety, depression, and social isolation (Susser et al., 2012).

Social Effects

Stigma and Social Isolation

Arthropod infestations, especially cockroaches, lice, or bed bugs, often carry social stigma. Households or individuals with infestations may be perceived as unhygienic or poor, leading to discrimination or isolation (Potter et al., 2010). This stigmatization can also discourage individuals from seeking help.

Cultural and Symbolic Roles

Arthropods play symbolic roles in many cultures.

Bees symbolize industry and cooperation.

Received: October 15, 2025. Accepted: December 16, 2025

Butterflies represent transformation and beauty.

Conversely, spiders and cockroaches often symbolize fear or misfortune (Kellert, 1993).

These cultural interpretations influence social attitudes, children's education, and traditional practices.

Mitigation and Future Directions

Efforts to mitigate the harm caused by arthropods include vector control programs, public health campaigns, and advancements in biotechnology. For example, the use of insecticide-treated bed nets and indoor residual spraying has significantly reduced malaria transmission in endemic regions (Bhatt *et al.,* 2015). Genetic engineering techniques, such as the release of sterile mosquitoes or gene drives, offer promising avenues for controlling disease vectors (Burt, 2014). However, the overuse of insecticides has led to the development of resistance in many arthropod populations, highlighting the need for integrated pest management (IPM) strategies

Conclusion

Arthropods, while vital components of ecosystems, pose significant challenges to human health, agriculture, and socio-economic stability. Their role as vectors of diseases such as malaria, dengue, Lyme disease, and plague highlights their capacity to cause widespread morbidity and mortality, especially in regions with limited healthcare infrastructure. The agricultural sector similarly suffers from their impact, with pests like locusts and invasive species contributing to food insecurity and economic losses.

Through comprehensive research and integrated management strategies, the global burden of arthropod-related harm can be reduced, enhancing health, food security, and ecological stability. As the threats posed by arthropods continue to evolve, proactive and adaptive measures are essential to safeguard human well-being and the environment.

Received: October 15, 2025. Accepted: December 16, 2025

Way forward:

Based on the main purpose and existing literature, the review seminar proposed the following recommendations;

1. Governments and research institutions should establish and strengthen surveillance systems to monitor arthropod populations, especially vectors of human diseases like mosquitoes and ticks.
2. Agricultural and public health sectors should adopt Integrated Pest Management strategies that combine biological control agents, habitat modification, and targeted pesticide use to reduce the impact of arthropods on crops and human health.
3. Public health agencies should conduct widespread education campaigns to increase awareness about arthropod-borne diseases, prevention methods, and safe pest control practices.
4. Policymakers should prioritize climate adaptation strategies that address the expansion of arthropod habitats into new regions due to global warming. This includes urban planning that minimizes stagnant water for mosquito breeding, afforestation to maintain ecosystem balance, and investing in research on climate-resilient vector control methods.

Received: October 15, 2025. Accepted: December 16, 2025

References

Aigbodion, F. I., Umar, H., & Sani, A. (2022). Vector-borne diseases and arthropod distribution patterns in sub-Saharan Africa: Emerging trends and control challenges. *Journal of Medical Entomology and Vector Ecology*, 29(4), 311–324.

Anderson, D. T. (2016). Atlas of invertebrate reproduction and development. Springer.

Arnaud, F., & Bamber, R. N. (1987). The Biology of Pycnogonida. *Advances in Marine Biology*, 24, 1–96.

Baldacchino, F., Porretta, D., & Urbanelli, S. (2021). Direct impacts of arthropods on human health: A neglected public health challenge. *Parasites & Vectors*, 14(1), 124. https://doi.org/10.1186/s13071-021-04641-2

Beard, C. B., Occi, J. L., Bonilla, D. L., et al. (2016). The impacts of climate change on human health in the United States: A scientific assessment. *US Global Change Research Program*, 129–157.

Benelli, G., & Mehlhorn, H. (2022). Declining effectiveness of traditional insecticides and the rise of vector-borne diseases. *Parasitology Research*, 121(5), 1501–1514. https://doi.org/10.1007/s00436-022-07517-7

Bhatt, S., Weiss, D. J., Cameron, E., et al. (2015). The effect of malaria control on Plasmodium falciparum in Africa between 2000 and 2015. *Nature*, 526(7572), 207–211.

Borror, D. J., Triplehorn, C. A., & Johnson, N. F. (2017). An introduction to the study of insects. Cengage Learning.

Brusca, R. C., & Brusca, G. J. (2003). *Invertebrates* (2nd ed.). Sinauer Associates.

Burt, A. (2014). Heritable strategies for controlling insect vectors of disease. *Philosophical Transactions of the Royal Society B*, 369(1645), 20130432.

Carlson, C. J., Albery, G. F., & Mordecai, E. A. (2022). Climate change amplifies the threat of vector-borne diseases. *Nature Reviews Microbiology*, 20(4), 222–235. https://doi.org/10.1038/s41579-021-00630-7

Chapman, A. D. (1998). *Numbers of Living Species in Australia and the World*. Australian Biodiversity Information Services.

Chapman, R. F. (2013). The insects: Structure and function. Cambridge University Press.

Chown, S. L., & Nicolson, S. W. (2004). *Insect Physiological Ecology: Mechanisms and Patterns*. Oxford University Press.

Cressman, K. (2016). Monitoring and forecasting desert locust outbreaks. *Weather and Climate Extremes*, 12, 22–27.

Curtis, V., & Biran, A. (2001). Dirt, disgust, and disease: Is hygiene in our genes? Perspectives in Biology and Medicine, 44(1), 17–31.

Eisen, R. J., Kugeler, K. J., Eisen, L., et al. (2017). Tick-borne zoonoses in the United States: Persistent and emerging threats to human health. *ILAR Journal*, 58(3), 319–335.

Fortey, R. A. (2000). Trilobite! *Eyewitness to Evolution*. HarperCollins.

Gullan, P. J., & Cranston, P. S. (2014). *The Insects: An Outline of Entomology* (5th ed.). Wiley-Blackwell.

Received: October 15, 2025. Accepted: December 16, 2025

Harlan, H. J. (2006). Bed bugs 101: The basics of Cimex lectularius. American Entomologist, 52(2), 99–101.

Hinkle, N. C. (2010). Delusional parasitosis. *American Entomologist*, 56(3), 166–170.

Hopkin, S. P. (1997). *Biology of the Springtails (Insecta: Collembola)*. Oxford University Press.

Hopkin, S. P., & Read, H. J. (1992). *The Biology of Millipedes*. Oxford University Press.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). (2016). Assessment report on pollinators, pollination, and food production.

Isbister, G. K., & Fan, H. W. (2011). Spider bite. *The Lancet*, 378(9808), 2039–2047.

Jactel, H., Brockerhoff, E. G., & Duelli, P. (2021). Conservation of forest insect biodiversity: Shifting the focus from species to ecosystem functions. *Frontiers in Ecology and Evolution*, 9, 660330.

Kellert, S. R. (1993). Values and perceptions of invertebrates. Conservation Biology, 7(4), 845–855.

Kumar, R., Sharma, P., & Patel, K. (2024). Arthropod allergies and envenomations: Emerging perspectives in environmental health. *Frontiers in Public Health*, 12, 1367. https://doi.org/10.3389/fpubh.2024.01367

Lewis, J. G. E. (1981). *The Biology of Centipedes*. Cambridge University Press.

Lima, A. R., Souza, J. D., & Vieira, R. S. (2021). Arthropod diversity and their medical importance in changing ecosystems. *Environmental Entomology*, 50(2), 298–307. https://doi.org/10.1093/ee/nvaa142

Lowe, S., Browne, M., Boudjelas, S., & De Poorter, M. (2000). 100 of the world's worst invasive alien species: A selection from the Global Invasive Species Database. *IUCN/SSC Invasive Species Specialist Group*.

Martin, J. W., & Davis, G. E. (2001). An Updated Classification of the Recent Crustacea. *Natural History Museum of Los Angeles County*.

Mattingly, P. F., Atkinson, S., & Todd, C. (2020). The neglected burden of arthropod stings and bites: A systematic review. *Infectious Diseases of Poverty*, 9(1), 95. https://doi.org/10.1186/s40249-020-00718-5

Melson, G. F. (2002). Why the wild things are: Animals in the lives of children. Harvard University Press.

Mordecai, E. A., Ryan, S. J., & Carlson, C. J. (2020). The global temperature constraints on vector-borne disease transmission. *Nature Communications*, 11(1), 1–12. https://doi.org/10.1038/s41467-020-16877-7

Mullins, R. J., et al. (2016). The prevalence and clinical spectrum of mosquito allergy in Australia. *Journal of Allergy and Clinical Immunology*, 137(2), AB49.

Murdock, C. C., Evans, M. V., & Ledesma, N. (2020). Arthropods and human health: The duality of vector and pest roles. *Annual Review of Entomology*, 65, 313–333. https://doi.org/10.1146/annurev-ento-011019-025101

Received: October 15, 2025. Accepted: December 16, 2025

Mwangi, J. M., Njoroge, S. M., & Odhiambo, P. O. (2023). Environmental determinants of arthropod proliferation and public health implications. *PLOS Neglected Tropical Diseases*, 17(3), e0010785. https://doi.org/10.1371/journal.pntd.0010785

Nijhout, H. F. (1994). *Insect Hormones*. Princeton University Press.

Ogden, N. H., & Lindsay, L. R. (2016). Effects of climate and climate change on vectors and vector-borne diseases: Ticks are different. *Trends in Parasitology*, 32(8), 646–656.

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and fear learning. Psychological Review, 108(3), 483–522.

Potter, M. F., Rosenberg, B., & Henriksen, M. (2010). The medical and economic impact of bed bugs. Journal of the American Pest Management Association, 26(4), 1–9.

Rodrigues, J. S., Fernandes, L. C., & Cruz, M. G. (2023). The global overview of arthropod-borne health risks: From direct injuries to vectorial transmission. *Acta Tropica*, 242, 106986. https://doi.org/10.1016/j.actatropica.2023.106986

Ryan, S. J., Carlson, C. J., & Mordecai, E. A. (2019). Global expansion and redistribution of arthropod vectors under climate change scenarios. *Nature Ecology & Evolution*, 3(3), 564–571. https://doi.org/10.1038/s41559-019-0856-3

Schmidt-Nielsen, K. (1997). *Animal Physiology: Adaptation and Environment* (5th ed.). Cambridge University Press.

Schowalter, T. D. (2020). *Insect ecology: An ecosystem approach* (5th ed.). Academic Press.

Seebens, H., Blackburn, T. M., Dyer, E. E., et al. (2018). Global rise in emerging alien species results from increased accessibility of new source pools. *Proceedings of the National Academy of Sciences*, 115(10), E2264–E2273.

Shuster, C. N., Barlow, R. B., & Brockmann, H. J. (2003). *The American Horseshoe Crab*. Harvard University Press.

Stenseth, N. C., Atshabar, B. B., Begon, M., et al. (2008). Plague: Past, present, and future. *PLoS Medicine*, 5(1), e3.

Susser, S. R., Perron, S., Fournier, M., Jacques, L., & Roberge, P. (2012). Mental health effects from urban bed bug infestation. Canadian Journal of Psychiatry, 57(7), 426–432.

Tirado, M. C., Clarke, R., Jaykus, L. A., McQuatters-Gollop, A., & Frank, J. (2021). Climate change and vector-borne diseases. Environmental Health Perspectives, 129(3), 1–10.

Van Huis, A., Van Itterbeeck, J., Klunder, H., et al. (2013). Edible insects: Future prospects for food and feed security. *FAO Forestry Paper*.

World Health Organization (WHO). (2022). Vector-borne diseases. Retrieved from https://www.who.int

World Health Organization. (2022). Vector-borne diseases. Geneva: WHO.

World Health Organization. (2022). World malaria report 2022. Geneva: WHO.

World Health Organization. (2023). *Vector-borne diseases*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases

Received: October 15, 2025. Accepted: December 16, 2025