

POSSIBLE IMPACT OF DIRTY ENVIRONMENT ON THE BREEDING OF DISEASE VECTORS AND TRANSMISSION OF VECTOR-BORNE DISEASES

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Abstract

Disease vectors in dirty environments exposes the health of individuals to significant public health risks. These vectors are living components of the environment of which mosquitoes, houseflies, cockroaches and rodents are one. They play a pivotal role in the transmission of zoonotic vector-borne transmitted diseases. The favourable habitual preference of vectors to associated breeding sites proliferate the breeding of disease vectors in dirty environment. Breeding ground of dirty environment harbours and provides ideal habitats for vectors and wide range of pathogenic agents with zoonotic potential of humans. The disease vectors mentioned in this review, attest to the negative impact of dirty environment in transmitting vector -borne diseases. The abundance and transmission dynamics of these vectors in dirty environment like dumpsites is linked to poor environmental human activities and vector behaviour. This literature search enlightened the public of the possibility that dirty environment may have negative impact on the breeding of vectors and transmission of vector-borne diseases. Cultivating the habit of disease free environment will be favourable to human well-being and quality of life.

Keywords: Dirty Environment, Transmission, Disease vectors, Vector-borne Disease

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Introduction

Vectors are flies, insects and animals of medical importance that carry wide variety of pathogens and often breed in dirty environments. The infective stages of pathogens carried by these vectors are contagious to infect their human and animal hosts. Their existence and transmission effects serve as sources that intensify public health risks associated with disease transmission. Some are synanthropes species that are always found in proximity to human abode. This was the case with the species of flies in the family

Muscidae where Shima *et al.* (2024) opined that flies such as houseflies developed in close association with humans. Nmorsi *et al.* (2006) also noted that synanthropes such as flies carried pathogens of medical importance. The occurrence of some synanthropes disease vectors where humans reside have been reported (Nmorsi *et al.*, 2006; Nusrat *et al.*, 2021; Patil, 2023; Shima *et al.*, 2024). Their close association to humans can pose a danger to individual well-being, since dirty environments where these vectors thrive provide an ideal habitat for both vectors and

pathogenic microbes. Moreover, people around the periphery of such environments are constantly exposed to the risk of pathogen transmission. Pathogens have been recovered from vectors. For instance, the previous studies of (Nmorsi *et al.*, 2006; Bouamama *et al.*, 2007; Patil, 2023) who investigated on houseflies and cockroaches. Also, the studies of (Meerburg *et al.*, 2009; Nusrat *et al.*, 2021) examined rodent-borne disease pathogens. Infectious pathogens are transmitted by vectors through both mechanical and biological processes (Shima *et al.*, 2024). Medically important insect vectors such as mosquitoes transmit pathogens biologically, and cockroaches and flies (e.g., houseflies) spread germs mechanically. In addition, rodents such as rats and mice act as significant reservoirs of pathogens, which may also be mechanically transmitted to humans (Meerburg *et al.*, 2009; Himsforth *et al.*, 2013; Nusrat *et al.*, 2021). The biology of disease vectors is crucial for understanding the mechanisms of vector-borne disease transmission. It also highlights the variability in their behavioural activities and reproductive stages. For instance, Human malaria parasite (*Plasmodium* spp.) is transmitted by the bite of an infected female anopheles mosquitoes in which sexual phase occur in the mosquito midgut to produce infective sporozoites. As previously stated, there are studies that have reported on mosquitoes as transmitter of malaria parasite (Wirtz and Burkot, 1991; Arora and Arora, 2008; WHO, 2018; WHO, 2024; CDC, 2024). Vectors play an important role in the transmission of infectious diseases between humans or from animals to humans (WHO, 2024). However, certain other behavioral biological activities such as regurgitation into food or direct contact are associated with vectors like houseflies and cockroaches which may contribute to transmission of vector-borne infections. Furthermore, environmental conditions characterized by stagnant water, abandoned containers filled with dirty water, garbage rich

in decaying matter and other polluted materials will create favourable breeding sites for disease vectors and support transmission. Environmental health depends on health factors related to well-being in the environment. Infectious diseases also significantly depends on environmental conditions that may impact public health sustainability such as unsafe water, sanitation and hygiene and zoonoses rising due to ecosystem disruption (WHO, 2025). Factors contributing to the spread of infectious diseases in the environment severely constrain the health and well-being of the individuals. Diseases transmitted by vectors have been reported to cause 700,000 deaths and it is the highest disease burden particularly among the poorest in tropical and subtropical part (WHO, 2024) of the developing countries. According to World Health Organization (WHO, 2018), about 24% of the global burden of diseases is linked to the environment and dumpsites (Ogunrinola and Adepegba, 2012). However, the significant public health impact of dirty environment is evident in the prevalent rate of vector-borne infectious diseases. Vector-borne diseases account for more than 17% of all infectious diseases with about more than one million annual death (WHO, 2024). The emergence of global factors has significantly impacted disease transmission, and its public health implications cannot be overstated. The increasing human population, migration, and urbanization have contributed to significant environmental challenges, resulting in the deterioration of environmental health quality, particularly in poor developing countries. Thus, maintaining a sustainable environment can promote healthy environments and prevent approximately a quarter of global disease burden (WHO, 2018; WHO, 2025).

Environmental Habitat of Disease Vectors **(a) Natural Environment**

Disease vectors naturally live and thrive in their natural environment of natural water bodies of lakes, ponds, stream as well as

natural vegetation. These habitats are associated with the presence of adequate natural environmental conditions and resources for their continuous existence. Disease vectors of synanthrope species such as houseflies, cockroaches, rodents in their natural habitats play an important role in an ecosystems which ranges from serving as food sources to balancing the ecosystems. They live close to people, benefit and adapted to our created environment, whereby they exhibit both negative and positive impact on the ecosystem (David, 2022). For instance, dipteran flies such as houseflies are found virtually in all ecosystems and play important role in food chain and act as vector of diseases in humans and animals (Omonona *et al.*, 2021). However, their role in maintaining a functioning ecosystem particularly through their feeding habits that facilitate the transfer of energy materials within the food chain, is vital. Due to the breeding site requirement of these disease vectors, vectors such as non-biting synanthropic flies are associated with animal dung, organic waste and carcasses (Ahmed *et al.*, 2019), they feed on dirty and decomposed organic matters containing pathogenic microbes (Howard, 2001). The exposure of vectors like houseflies, mosquitoes, cockroaches and rodents to dirty environments create favorable breeding sites for these disease vectors. In fact, more than 50 species of synanthropic flies have been reported to be associated with polluted environments and transmit human disease agents (Olsen, 1998). More so, their presence in and around homes highlights their potential ability towards transmission of zoonotic diseases.

(b) Human-made Environment

A dumpsite is an important example of a modified human-made environment that contributes to accumulation of dirt which supports the development of vector-borne disease pathogens. The transmission of such diseases is strongly connected to various man-

made conditions, including unsanitary surroundings, poor environmental sanitation, lack of infrastructure maintenance and poor attitude towards hygiene, which collectively, creates an environment that harbors disease vectors. Studies have reported the occurrence of vector-borne pathogens in dumpsites where substrates for breeding, feeding and habitation are present (Angaye and Abowei, 2017; Adeyemo *et al.*, 2021). Although, vectors like houseflies, rodents and mosquitoes have natural breeding habitats, they have adapted to survive and thrive in modified environments. These human-built settings provide suitable conditions for vector breeding as well as pathogenic microbes' proliferation, thereby increasing microbial contamination. Generally, dumpsites function as filthy grounds where pathogens proliferate due to the presence of decaying organic matter, standing water and favourable temperatures that permit their growth and development. Furthermore, vectors carrying pathogenic microbes can transmit them to human while sourcing for food, thereby predisposing hosts to vector-borne diseases. Thus, information on disease vectors in human-modified environments such as dumpsites, which facilitate their survival and spread is essential for understanding their possible impacts and for improving sanitation.

The Effects of dirty environment on Environmental factors

The roles of dirty environments in altering ecological systems and contributing to epidemiological transmission of vector-borne infectious agents is well recognized, as such conditions foster the spread of infectious diseases. Eco-epidemiological systems provide useful insights into the dynamics of vector-borne pathogens in unsanitary environments, highlighting the environmental and ecological factors that drive disease transmission. The presence of disease vectors in the environment influences the eco-epidemiological system by creating breeding sites and increase their transmission dynamics.

Factors such as the proximity to inhabited places and frequent exposure to unhygienic environments could serve as major risk factors for vector-borne disease transmission, enhancing the risk of vector bites, microbial contamination from flies and human-vector interaction. Environmental exposure primarily affects individuals who are unaware of these risks, leaving them in direct link with disease-carrying vectors that transmit infection. Living environmental factors, such as organic waste and vegetation, can create conditions that allow dirt to accumulate and provide shelter, microbial reservoirs, and nutrient sources for pathogenic arthropods and opportunistic animals. In addition, the physical environmental parameters like temperature, humidity, urbanization and climate change can contribute to the transmission of vector-borne disease by creating favourable conditions for vectors. For instance, environmental changes created by human efforts can alter temperature and land use patterns, ultimately creating conditions that favour vector distribution, abundance, and the spread of vector-borne diseases (Lambin *et al.*, 2010). However, as part of the efforts in addressing the influence of environmental factors, the World Health Organization (WHO, 2023) recognizes the presence of poor environmental sanitation, contaminated water and inadequate waste management as contributing to the spread of diseases in the environment.

Breeding of Disease Vectors in the environment

The developmental breeding site of disease vectors, such as mosquitoes, houseflies, cockroaches and rodents are supported by environmental factors that favour their growth. These sites are usually characterized by stagnant contaminated water, availability of decaying organic matter that serves as nutrients, poor sanitation and temperature ranges beneficial to optimal breeding and development. Becker *et al.* (2010) found that environmental factors such as temperature,

humidity and availability of breeding reservoirs significantly influence the abundance of disease vectors. Consequently, the presence of these reservoirs in dirty environments contributes to the multiplication of vector population and potential disease transmission.

The Effects of Urbanization on dirty environment

While urbanization can bring health and economic benefits, rapid and unplanned urbanization can have many negative social and environmental health impact (WHO, 2025). The severe environmental consequences of urbanization could result to creation of breeding reservoirs for disease vectors that spread vector-borne diseases. Poorly structured urban centers with inadequate waste disposal facilities facilitate breeding ground for disease vectors. Poor waste management of these areas usually contributes to transmission and outbreak of diseases. The continued increase in human population has resulted in significant growth and expansion of urban areas, leading to overpopulation, limited spaces, and generation of large amounts of waste that eventually lead to environmental degradation, such as pollution from poor sanitation and waste management. In Nigeria, urbanization has driven significant urban population growth rate. Estimates suggest that by 2050, the Nigeria urban population growth will reach 79.9% of the country's total population (Fredrick, 2025). Also, continued urbanization is expected to lead to cities becoming epicentres of disease transmission, including vector-borne diseases (WHO, 2025). This rapid urbanization has resulted in the construction of illegal settlements in unhygienic and overcrowded environments, further increasing environmental degradation and public health menace.

Global Impact of vector transmitted diseases

Pathogens such as parasite, viruses and bacteria are disease agents that transmit vector-borne diseases in human and responsible for 700,000 representing 17% death globally (WHO, 2024). Vector borne diseases have been reported to occur in more than 100 countries that affect large population in tropical and subtropical regions. The distribution of vector borne diseases in tropical and subtropical regions is associated with demographic, environmental and social factors which result from global travel and trade, unplanned urbanization, environmental change and silent spread and adaptation of the vectors, contributing to spread of vector-borne diseases (WHO, 2024). Climate change is an important environmental factor, which substantially affects pathogens, vectors and reservoir hosts with implications for the transmission of many vector-borne diseases (WHO, 2024). This expands the geographical range of vectors, enabling pathogenic species to thrive and increasing the potential for disease spread in the environment.

Waste disposal and its impact on the Environmental health

Untidy living conditions and indiscriminate dumping of waste in and around human residence contributes to unhygienic environments, which in turn lead to poor living standards. Furthermore, Illegal waste disposal poses significant risks to environmental health. These uncontrolled activities according to Adeyemo and Morenikeji, 2017, could leave the environment vulnerable to various hazards. Land and soil pollutants, such as refuse, sewage, and garbage, are rich in decayed organic matter that provides a breeding ground for disease agents carried by vectors in affected areas. Agbaye and Abowei (2017), noted that Municipal Solid Waste dumpsites constituents provide the substrate where pathogens and vectors of public health hazards breed, habituate and obtain their food.

Disease vectors such as mosquitoes, cockroaches, houseflies and rodents are found to be associated with dirty and unhygienic environments. Close interaction between humans and these vectors negatively impact health through the transmission of diseases. Humans are exposed to germs carried on the body parts of these vectors, which can contaminate food and eating utensils when germs are dislodged during their activities. Houseflies, in particular, are synanthropic, non-biting dipteran vectors that mechanically transmit pathogens of parasites, viruses, bacteria and fungi (Isa, 2019). Their passive transmission activities can lead to illnesses such as typhoid fever and cholera outbreak. Cockroaches quickly breed in dumpsites and unhygienic dwelling environments, with presence of decaying organic matter from food waste (Schal and Hamilton, 1990), moisture that provides essential water for their survival (Pinto and Krafty, 2017) and availability of hiding sites. Researchers however have revealed the vectorial potential of Cockroaches (Zurek and Schal, 2004; Imamura *et al.*, 2003). Cockroaches' contamination of food can lead to risk of gastrointestinal disease, salmonellosis (Donkor, 2020). They are also reported to cause common respiratory allergies such as asthma (Chew, 2016) in the sufferer exposed to the agents they transmit. Moreover, improper disposal of containers such as cans, plastics, empty bottles in waste disposal areas can collect standing water, creating breeding sites for mosquitoes in both residential and dumping areas. Previous studies have statistically demonstrated that the presence of mosquito breeding sites is associated with malaria incidence. In fact, out of twenty-four scientific journal data based from Santa and Scopus, 15 representing 62.5% of the reviewed articles found a direct correlation between mosquito breeding sites and malaria incidence (Nani *et al.*, 2024). Female mosquitoes feed on blood (Becker *et al.*, 2010). These blood sucking insect vector

transmit germs which could be viruses or parasites (Centres for Disease Control and Prevention [CDC], 2024). Mosquito bites can cause malaria, a major public health concern in tropical and subtropical regions (WHO, 2024), as well as other mosquito-borne diseases such as Chikungunya (CDC, 2024), Zika virus, yellow fever and dengue fever (WHO, 2024). Indiscriminate dumping of waste and unkempt surroundings, often characterized by uncontrolled vegetation, promote conditions suitable for rodents' proliferation near human dwelling places. The uncontrolled proliferation of rodents has been implicated in affecting global health, including their involvement in the transmission of infectious agents and their contribution to unhealthy living conditions (Colombe *et al.*, 2019). Wild rats are popular rodents that are found in dumpsites. However, their close association with human dwellings pose a serious public health problem. This is because cognizance must be taken of their potential risk of infections to man. Rodents are known to spread diseases like plague, amoebic dysentery and rat-bite fever (Agbaye and Abowei, 2017). The fact that dirty and unhygienic environments contribute to the development of vectors and the transmission of their associated diseases implies that ongoing human activities may be supporting the persistence of vector breeding grounds. The most likely cause of this is poor environmental sanitation, including uncontrolled refuse and sewage disposal, as well as inadequate maintenance of the immediate surroundings to eliminate conditions that promote disease. Recognizing that the transmission potential of disease vectors poses a significant challenge to public health is crucial for raising awareness. Therefore, there is an urgent need to promote the maintenance of clean, disease-free environments that safeguard human well-being, support ecosystem sustainability, and enhance overall quality of life.

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