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Review Paper

Environmental Health Risks and Well-being among the Orang Asli in Peninsular Malaysia: A Review

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Abstract: Orang Asli community has a significantly higher prevalence of parasitic infections than mainstream society in Peninsular Malaysia. These diseases appear to be most prevalent among isolated populations across Peninsular Malaysia. The aim of this review study was to better understand the environmental health risks that Orang Asli communities in remote forests face. In this study, a qualitative content analysis research design is used. The study conducts a detailed review of studies on physical environmental problems that have been associated to poor health outcomes and are anticipated to be prevalent among remote indigenous communities. The review findings of selected literatures indicate that the primary issues were parasite infection and drinking water tainted with heavy metals and germs. Water-borne infections and other infectious diseases have been epidemiologically linked to these environmental conditions. They are anecdotally high in remote indigenous communities. These issues are a little-known issue that could have a big influence on the health of the indigenous people; more research in this field would be very beneficial. It is critical to identify and measure these physical environmental elements, as well as to understand the mechanisms by which they influence health, especially since these factors are adjustable and can be repressed with relatively simple, cost-effective adjustments in community infrastructure. The review concludes with a proposed cooperative collaboration between indigenous communities and Malaysian mainstream society. As such, the strategy aids in the realisation of the Sustainable Development Goals, which cover issues such as health and well-being, clean water and sanitation, and partnership.

Keywords: Environmental health; indigenous peoples; well-being; Orang Asli; Peninsular Malaysia

Introduction

There are an estimated 476 million indigenous peoples in the world, spread across 90 nations. They make up fewer than 6% of the global population yet account for 19% of the poorest (World Bank Group, 2023). They speak the vast majority of the world's estimated 7,000 languages and represent 5,000 distinct cultures (United Nations, 2024). Indigenous peoples have poorer health, higher rates of disability, lower quality of life, and a much shorter life expectancy than other residents in the same country. Living conditions, work and income levels, as well as limited access to food, water, and sanitation services, all have a significant impact on their health. Geographic remoteness, poverty, discrimination, and a lack of cultural knowledge all limit Indigenous peoples' access to health care (Dhir, 2015). Indigenous peoples globally endure a disproportionate burden of disease. The reasons for this are varied, but marginalisation following invasion of their ancestral homelands are recurring themes that have launched a legacy of unfairness and hardship, which is tragically pronounced among the 476 million Indigenous people globally today (Gracey and King, 2009; World Bank Group, 2023).

Indigenous peoples of Peninsular Malaysia (also known as Orang Asli) have a much greater disease burden than the broader Malaysian population, with newborn Indigenous Orang Asli expected to live a decade less than their non-indigenous counterparts. The health "gap" that persists across all tribes and age groups can be partially attributed to the fact that Orang Asli people are more prone to parasite infestations because of their reputation for poverty and prolonged living in remote rural areas far from public conveniences. The disease is still widespread among Orang Asli people because to a serious lack of personal cleanliness, untreated water, inadequate sanitation, and an unimproved source of drinking water (Hotez, 2014). Another source of concern is that the Orang Asli community is primarily a poor and low-income group with little purchasing power. They have difficulties in farming and food hunting, as well as a decreased food supply in their surroundings, which exacerbates food insecurity. Because the majority of Orang Asli live in rural and isolated places, they rely on agriculture and traditional food gathering (Gan et al., 2020).

This study will focus on the Orang Asli in Peninsular Malaysia, given the nation's numerous indigenous population groupings. It will provide a substantial amount of scientific research indicating the Orang Asli people's continued struggle with environmental and health challenges. Expanding the range of infrastructural amenities in Orang Asli village and raising the income of the Orang Asli community to the point where they are no longer considered impoverished are two primary objectives of the Department of Orang Asli Development (JAKOA). Furthermore, by raising the community's standard of health and education, JAKOA contributes to the empowerment of the Orang Asli people (Muhammad Fuad, 2023; Yew, 2021). The study's specific objectives are to: (1) perform a comprehensive review of earlier research on Orang Asli in order to gather secondary data on the rapidly changing environmental variables, including sociocultural conditions; and (2) look into how environmental changes are influencing Orang Asli health vulnerability.

Environmental health is primarily relevant to people living in poverty. A 2004 survey in Colombia showed that 71% of low-income households ranked environmental health as their top environmental priority, compared with only 30% of high-income households. The survey also found that low-income groups tended to focus more on clean air and clean water, suggesting that environmental health directly affects their quality of life and is therefore a priority (World Bank, 2008). According to Marans (2003), health and quality of life are related to environmental conditions, and he hypothesised that people's perceptions of environmental amenities, such as the quality of the ambient environment (air, water, noise, and hazardous waste), would influence their satisfaction, physical health, and use of such amenities. Every year, more than 12 million people worldwide die as a result of living or working in unhealthy conditions. The Healthy People 2030 initiative aims to reduce people's exposure to dangerous pollutants in air, water, soil, food, and materials in their homes and workplaces (Pruss-Ustun et al., 2016). Environmental contaminants can cause respiratory illnesses, heart disease, and some types of cancer (Brusseau et al., 2019). People with low earnings are more likely to live in polluted places and drink contaminated water. Globally, indigenous peoples constitute a sizable portion of the low-income population.

Literature Review

1. The Orang Asli and Customary Land

Indigenous peoples in Peninsular Malaysia are known as Orang Asli. According to the Malaysian Law, Aboriginal Peoples Act (1954, revised 1974) Section 3, an Aborigine (Orang Asli) can be defined as: any person whose male parent is or was a member of an aboriginal ethnic group, who speaks an aboriginal language and habitually follows an aboriginal way of life and aboriginal customs and beliefs, and includes a descendant through males of such persons (The Commissioner Of Law Revision, 2006). In Peninsular Malaysia, Orang Asli, or "original peoples" in Malay, refers to the three primary tribal groups: the Negrito, Senoi, and Proto-Malay, each with six sub-ethnic groups (Nicholas, 2012; Syamil Imran et al., 2024). According to the Department of Orang Asli Development (JAKOA) (Department of Statistics Malaysia, 2021; JAKOA, 2021), Peninsular Malaysia was home to 178,197 Orang Asli. Senoi is the largest tribe, accounting for 97,856 (54.9%), followed by Proto-Malay 75,332 (42.3%), and Negrito with 5,009 (2.8%). The majority of Orang Asli live in Pahang (37.9%), followed by Perak (29.9%).

From a biomedical approach, indigenous health is seen as an individual trait. Medicine and public health recognise that environmental factors contribute to illness and assign risk to specific exposures. Over the last

decade, biologists, ecologists, and medics have established the idea of ecosystem health. This concept acknowledges that humans are members of complex ecosystems, and that their capacity for health is proportionate to the health of the ecosystem. An ecosystem-based health viewpoint considers the health-related services provided by the natural environment (such as soil production, pollination, and water purification) and recognises the basic link between an intact environment and human health (McCally, 2000).

The phrase "customary land of the Orang Asli" has historically been used to describe a specific location that an indigenous people recognises as their territory or habitat. Because the indigenous people have inhabited, used, and settled the area in accordance with their customary laws and traditions, dating back thousands of years, the area is regarded as customary. It encompasses, but is not restricted to, the land itself as it pertains to housing and habitation, farming and sustenance, burial, and other ceremonial uses. It encompasses all natural resources found both above and below the surface of these areas, including water. In the strictest sense, a customary land is a special human-nature symbiosis where a community of indigenous people has identified itself in relation to certain lands that they have occupied for generations, and where they have adapted to a particular environment. The Orang Asli, like other indigenous peoples, regard customary land as an essential part of their lives. They see customary land as sacred because it contains their history and sense of identity while also ensuring their existence in the subsistence economy (Hamimah Hamzah, 2013).

According to Mohawk (2005), the significance of customary land for native peoples can be summed up as follows:

> *"Our roots are deep in the land where we live...The soil is rich from the bones of thousands of our generations. Each of us were created in those lands, and it is our duty to take great care of them, because from these lands will spring the future generation."*

Orang Asli are a minority people in Malaysia who lag behind in socioeconomic status, education, and health. For decades, the Orang Asli population was recognised for poor maternal health, iodine deficiency illnesses, anaemia, starvation, and intestinal parasite infection (Khor and Zalilah, 2008). Since the Second Malaysia Plan in the 1970s, the Malaysian government has assisted the Orang Asli communities by raising educational standards, renovating basic infrastructure, improving medical facilities and health status, and involving them in the Orang Asli resettlement scheme. Despite the Malaysian government's resettlement program, only a few (0.7%) of Orang Asli communities were willing to relocate and live in urban or semi-urban areas, while the majority remained in rural (62.0%) and remote (37.0%) areas (Pah et al., 2017; Mohd Shah et al., 2018). Despite the Malaysian government's financial assistance to Orang Asli people in areas such as health, education, and employment opportunities, many tribes prefer to maintain their culture and traditional beliefs, which have a direct impact on indigenous peoples' health, behaviour toward diseases, and treatment adherence.

Despite living in a rather small geographic area, the Orang Asli are subjected to a variety of environmental factors. The majority of Orang Asli traditionally reside in small, isolated forest camps and towns and make their living through horticulture, trading forest products, hunting, fishing, and gathering wild food (Endicott, 2016). Today, however, no Orang Asli community is fully isolated from outside economic and cultural influences due to Malaysia's fast expansion of businesses, governmental control, the market economy, and metropolitan regions over the last half-century (Denton et al., 1997). As a result, Orang Asli tribes have been subjected to a variety of environmental changes, including ecological degradation, acculturation, market integration, and urbanisation, all of which are occurring at a rapid pace and within the scope of indigenous communities in Peninsular Malaysia.

At one extreme, certain Orang Asli tribes remain very secluded and mostly follow traditional lifestyles, whilst at the other extreme, some communities are now bound by urban areas, highly acculturated, and completely integrated into the market economy. Not unexpectedly, while historical data imply that noncommunicable diseases (NCDs) were historically uncommon among the Orang Asli (Baer, 1999), recent research indicates that NCDs are becoming more prevalent, particularly in increasingly urbanised, acculturated, and market-integrated populations (Law et al., 2020). Infectious infections, which are the subject of this review, continue to pose significant health risks to Orang Asli (Muslim et al., 2019). Indigenous communities that live in remote areas are especially vulnerable to contaminated water. Water that is stagnant might encourage

mosquito hatching and make it easier for diseases carried by vectors to spread. Indigenous people, particularly children, continue to have skin, eye, and diarrhoeal ailments as a result of inadequate access to clean water and sewage systems (Bailie et al., 2005).

2. The Concept of Environmental Health

The World Health Organisation (1986) defines environmental health as the direct pathogenic effects on health of chemical, physical, and biological agents, as well as the impact of the overall physical and social environment on human health. On the other hand, according to previous studies (Lansbury et al., 2020; Steering Committee for the Review of Government Service Provision, 2020; Haynes et al., 2022), environmental health refers to the physical, chemical, and biological factors, which affect the health and well-being of people within their surroundings, primarily within their homes and communities. According to the studies, Aboriginal and Torres Strait Islander people are disproportionately affected by environmental health diseases due to factors such as community isolation, a lack of adequate housing and home health equipment, limited access to tradespeople and repairs, and the high cost of infrastructure maintenance. Finally, this idea of environmental health is just one of many examples that apply not just to air, water, and soil, but also to the pathological effect on the overall health of the physical and social environments.

According to Chakraborty et al. (2022) and Stewart (2022), poor environmental health conditions significantly contribute to the excess burden of infectious disease and chronic illness, such as trachoma and rheumatic heart disease (RHD), both of which disproportionately affect Aboriginal and Torres Strait Islander people living in remote communities. Other environmental health issues include respiratory, cardiovascular, and renal disorders, malignancies, skin infections, gastrointestinal illness, and vector-borne diseases (germ-borne illnesses transmitted to humans by the bites of organisms such as mosquitos or ticks).

People in indigenous cultures often take their health for granted. The World Health Organisation (1986) defines health as a condition of complete physical, emotional, and social well-being, as opposed to simply the absence of illness and incapacity. Furthermore, Koren (1980) indicates that health is more than just the absence of disease and harm; it is also happiness associated with an inner sense of well-being. The definition above clearly indicates that achieving health does not need individual effort. It is the product of the community's collaborative efforts to create a comfortable living and working environment. Health concerns such as the reckless use of pesticides in agriculture and the thoughtless dumping of industrial waste are beyond the control of the affected individual.

Accordingly, health is the responsibility of every individual, household, and community that influences the physical and social environment and bears significant responsibility for their own health (Annalee et al., 2001; World Health Organisation, 1992). Thus, developing a livable society and maintaining a high quality of life are regularly addressed aims by Malaysian local governments (Mohammad Yusup et al., 2016; Mariana, 2014). Risk factors referred to as "environmental" are typically ill-defined because the term "environment" can have a variety of meanings depending on the situation. The more traditional and limited scientific definition comprises biological, chemical, and physical substances that can cause harm when found in man-made and natural environments. Furthermore, we still don't understand much about the impact of traditional environmental risk factors on Indigenous people's health, let alone how they interact with one another.

The concept of environmental health provided by Koren (1980) is appropriate for this review study because it highlights the role that local government plays in keeping an eye on the health and welfare of Orang Asli people, especially those living in remote forest areas. Environmental health, according to Koren, is the art and science of preserving good health, advancing aesthetic principles, and preventing illness and harm by reducing potential chemical, biological, and physical risks as well as controlling favourable environmental elements. Therefore, in order to preserve the population's health, this is a field that is of concern to all levels of government, particularly local governments.

3. Environmental-based Diseases

Environmentally-based diseases are communicable or infectious diseases that can be avoided by altering a person's living conditions (Riley et al., 2022). There are various risk factors for different types of infectious diseases, and some can progress to chronic disease (Lansbury et al., 2023). These diseases can be transmitted by bacteria (e.g., whooping cough and tuberculosis), viruses (e.g., COVID-19, influenza, and HIV), fungi (e.g.,

tinea or athlete's foot), protozoan (microscopic) parasites (e.g., giardia and scabies), and bigger parasites (e.g., head lice). These diseases are caused by a number of risk factors, including untreated sewage-contaminated soil, overcrowding in homes, inadequate sanitation, and home health hardware (working plumbing and toilets) (Lansbury et al., 2023; Chakraborty et al., 2022). To lower these hazards, the Australian Government Department of Health (2022) states that it's critical to address and enhance the environmental health conditions both inside and outside the home. However, for the homes and communities, especially the indigenous ones, changes to personal and home hygiene (healthy living practices) are critically needed. Additionally, a study by Haynes et al. (2022) states that it is the duty of people, communities, government agencies, and non-governmental organisations to provide adequate infrastructure to limit environmental health risk factors.

4. Water, Sanitation and Hygiene

Approximately 80% of the global population resides in regions where water security is at high risk. The most serious concerns impact 3.4 billion people, nearly all of whom are in developing nations (Koncagul et al., 2021). In this case, the cumulative effects of 23 factors that affect water resources are threats to water security. The 23 drivers can be categorised into four groups: biological factors, pollution, water resource growth, and disturbance of watersheds. In the coming decades, more people are expected to experience acute water stress due to increased demand and changing precipitation patterns brought on by climate change. Data indicate that higher infrastructure investment in industrialised nations can improve human water security and make them more resilient to various threats to water resources, while lower infrastructure investment in developing nations leaves them in a less secure position with respect to water resources. Infrastructure development usually degrades aquatic biodiversity and environmental quality, therefore investment must be backed by enough institutional capabilities. Additionally, the environmental hazards associated with infrastructure development must be appropriately evaluated and addressed. This problem is comparable to the contaminated water that native tribes in Peninsular Malaysia have to deal with.

According to the World Health Organisation, water-related diseases (Patel and Pharm, 2022) include those caused by chemicals and microorganisms found in drinking water, illnesses such as schistosomiasis, in which the vector spends a portion of its life cycle in water, diseases such as malaria transmitted by vectors, and other illnesses spread by aerosols carrying specific microorganisms such as legionnaires' disease. These infections represent serious public health implications, especially in Africa. In 2004, diarrhoea caused by inadequate sanitation and water supply was the second leading cause of worldwide disease burden, accounting for 70 million disability-adjusted life years (DALYs) lost due to illness, disability, or premature death. According to worldwide health data, Africa and South Asia are the most vulnerable to waterborne infections. Orang Asli numbers in Peninsular Malaysia have caused concern among indigenous peoples in Southeast Asian countries.

Groundwater supplies, such as bore water and wells, are critical for isolated Orang Asli communities. Other sources of water include lakes and rivers. Water contaminants might include animal and human sewage, food waste, pesticides, and herbicides. Orang Asli villages, like distant Aboriginal and Torres Strait Islander groups, receive water for a variety of functions, including cooking, personal and household hygiene, swimming, and agriculture (Vanweydeveld, 2022). The Washroom Project, led by the Global Peace Foundation Malaysia, discovered that many Orang Asli villages in Pahang's Pekan and Rompin districts lacked basic sanitary facilities (Chew, 2020). Sanitation is a crucial component of well-being since it protects human health and increases life expectancy. The study discovered that the distant location of many Orang Asli settlements, combined with a lack of access to clean water, made it nearly impossible for the inhabitants to acquire basic sanitary services.

5. Environmental Hazards

A hazard is something that could endanger a person. It is defined as “a factor or exposure that may have a negative impact on health” (Pope et al., 1995). Thus, an environmental hazard is a source of danger that arises due to elements or exposure to the elements in the environment. These environmental hazards can be classified as below:

Biological Hazards

Biological hazards include "plant, insects, rodents, and other animals, fungi, bacteria, viruses and a wide variety of toxins and allergens" (Annalee et al., 2001). In the year 1348 to 1350, Europe was hit by bubonic plague, also known as "Black Death", a disease transmitted through an infected rat had decimated Europe population by a quarter and England population by one third (Weinstein, 1980). Smallpox, an extremely contagious and deadly virus without any known cure was the most devastating disease that struck in most continents with 30% mortality rate of infected person and was eradicated through vaccination in the 20th century (CDC).

Dengue fever, which is transmitted by Aedes mosquito bites, is a disease that is present and close to us. Furthermore, running barefoot on contaminated ground while playing football may expose us to worm or parasite infection. The majority of diseases originating from biological sources are contagious, meaning they can spread from one person to another. Corona virus has infected the present covid-19 pandemic.

Chemical Hazards

Chemical hazards (non-biological) and toxic substances pose a wide range of health hazards such as irritation, sensitization and carcinogenicity, and physical hazards such as flammability, corrosion and explosibility (OSHA, USA). According to Annalee et al. (2001), the most worrisome fact about chemical hazards is: millions of chemical compounds are synthesized and use widely for consumer and industrial, yet, they have not been adequately tested to determine their toxicity. Thus, our health risk is basically dependent on its severity of toxicity and the length of exposure.

Pesticide is one such toxic chemical substances where farmers used extensively and often not according to recommendation (in term of dosage and harvest before toxicity is reduced to minimal) to maximize productivity as well as salability (better appearance of products). Many of these pesticides are later banned for use, for example, DDT and paraquat (DOA. gov). The use of formaldehyde in paint caused indoor air pollution and it is carcinogenic in nature. Also, most cosmetics today are made of some common chemicals that are detrimental to health such as mercury is used in skin-lightening cosmetic products.

Physical Hazards

Physical hazards, according to Annalee et al. (2001), are types of potentially dangerous energy in the environment that, when conveyed in significant amounts to exposed humans, can cause either immediate or delayed damage. Noise or sound waves, radiation, light, heat energy, and electrical energy are all examples of these energies.

Noise is defined as the unwanted sound that exposure at high intensity for prolong period may cause hearing loss (75 dB, decibels) and at low intensity results in disturbed sleep, stress, hypertension and reduced well-being. Radiation due to ionization such as x-ray for imaging and therapy, nuclear energy and other sources, in which over-exposure may result in damage or mutation of DNA, resulting in cancer and other genetic defects. Light is a form of radiation, which is non-ionizing. For example, laser, is a highly concentrated narrow beam of light that may cause burns or blindness when projected on the skin or eyes. UV radiation is also known to cause skin cancer by over-exposure. Thermal energy, over-exposure to high temperature causes heat stroke resulting in deaths especially among older folks during summertime in temperate countries; whilst exposure to very low temperature may results frostbites and death due to hypothermia.

Mechanical Hazards

Mechanical hazards are related to motion. According to Annalee et al. (2001), it resulted from the transfer of mechanical or kinetic energy. There are injuries occurring at home, such as elderly people who are prone to fall, and elderly women that suffers from osteoporosis, a fall will likely cause hip fracture injury that resulting in disability or death. The workplace is another area fraught with hazards, workers suffer from injury while handling machinery. Also, back injuries due to heavy lifting are common at workplace.

Psychosocial Hazards

Psychosocial is defined as the inter-relation of social factors and individual thought and behavior. As humans are described as social animals, thus, the impact of social factors is major determinants of human thought and behavior. The psychosocial hazards are social factors that "create social environments of uncertainty, anxiety, and the lack of control" (Annalee et al., 2001) that manifests on individuals and causes stress related disorders.

Prolong exposure to such hazards without effective coping measures may seriously jeopardize an individual physical and mental health such as feeling lethargic, dispirited, anxiety, depression, hypertension and may develop cardiovascular diseases, and stomach ulcers (Annalee et al., 2001). Some examples of these hazards can be over-crowded housing for lacking personal space, living in a crime infested neighbourhood, an abusive superior in workplace, peer pressure and many others.

Methodology

Reviews of the literature are described as mostly qualitative synthesis. About 50 literature reviews published in peer-reviewed, English-speaking journals between 2000 and 2024 are reviewed using content analysis. This review study employs a content analysis research design in a qualitative manner. A content analysis based on a particular pattern of analytical categories established from a typical research approach follows a descriptive review of the body of literature. Hsieh and Shannon (2005) define qualitative content analysis as the subjective interpretation of text data through systematic coding to find themes or patterns. Secondary data from books on environmental health and indigenous studies, journals, dissertations, proceeding papers, and policy papers were used for the document analysis. The secondary data was subsequently analysed and interpreted using thematic analysis.

Denzin (1989) emphasises the importance of balancing description and interpretation when presenting the results of a qualitative content analysis. Text descriptions should be detailed and complete in order to give readers context and background information. Interpretation is crucial to qualitative research, reflecting both theoretical and personal understanding of the subject under study. Patton (2002) defines an engaging and easy-to-read report as one that has enough description to allow the reader to comprehend the basis for an interpretation, as well as enough interpretation to allow the reader to grasp the description.

In terms of article selection, this review study considered any English-language, peer-reviewed, primary research paper that contained a full explanation of data management in environmental health-related research involving indigenous populations in Peninsular Malaysia. Secondary research publications (e.g., literature reviews, comments) were included if they provided an in-depth examination of data management challenges or situations in environmental health-related research involving the populations of interest.

Findings and Discussion

The World Health Organisation (1992) states that globally, Indigenous Peoples view health and well-being as a holistic notion that includes not only physical and mental health but also spiritual, environmental, cultural, and social elements. According to them, everyone has a right to health, which is heavily influenced by one's community, geography, and environment. Indigenous peoples balance traditional medicine, spirituality, biodiversity, and the interconnection of all things in their approach to health. This results in a very different understanding of humanity than what is typically found in mainstream society. In addition, Indigenous Peoples have poorer health outcomes than non-Indigenous populations and frequently encounter significant obstacles when trying to receive medical care. They have an estimated 20-year less life expectancy than non-Indigenous peoples, and they are more likely to be disabled, have a lower quality of life, and pass away sooner. The death and morbidity rates are higher for mothers who are indigenous and their children.

The leaders of the world realised the value of funding improvements to people's health and environments, and they adopted the ideals of the Rio Declaration and Agenda 21 as a path to sustainable development in the twenty-first century (Synthesis, 2008). Environmental circumstances that have an impact on health outcomes fall under the umbrella of "environmental health." Environmental health refers to "aspects of human health, including quality of life, that are determined by chemical, physical, biological, social, and psychosocial factors in the environment," according to the World Health Organisation (WHO). Environmental health is particularly important to indigenous people who live in poverty. According to a 2004 survey in Colombia, 71% of low-income households prioritise environmental health, whereas only 30% of high-income households do. The survey also discovered that low-income groups prioritised clean air and water, implying that environmental health had a direct impact on their quality of life (World Bank, 2006).

Environmental health concerns must be addressed immediately in any development plan or strategy that aims to reduce poverty. Issues including air pollution, inadequate vector management, unsanitary conditions, poor hygiene, and contaminated water mostly influence the global disease burden. However, new problems like

climate change will make reducing poverty more difficult. Extreme weather events (heat waves, torrential rains, and droughts) can have a significant influence on public health, particularly for the impoverished and indigenous communities. They can also aggravate water scarcity in certain countries.

Recent research suggests that, contrary to popular belief, malnutrition is not simply caused by inadequate food intake, but rather by poor sanitation and repeated infections (Morales et al. 2024). Environmental health risks such as inadequate water, poor sanitation, and poor hygiene practices can affect children's health through diarrheal disease and (indirectly) malnutrition, which in turn affects their future cognitive learning and productivity. The purpose of this review study is to identify environmental health risks that have an impact on the diseases of the indigenous group (the Orang Asli) in Peninsular Malaysia. The following are the review's main themes:

A decade ago, there were a few documented outbreaks of Hepatitis A infection in Malaysia since 2010. In 2011, three villages in Hulu Terengganu, Terengganu, experienced an outbreak of HAV infection when their water source was contaminated, affecting the Orang Asli community and two additional villages (Zolkepli, 2011). Subsequently, research on water access, sanitation, and hygiene (WASH) data for indigenous communities in Peninsular Malaysia were investigated and explored in order to assess the Orang Asli well-being.

Anuar et al. (2012) investigated the behavioural hazards associated with Entamoeba infection, such as food consumption and personal cleanliness, as well as environmental sanitation and housing situations. Current WASH practices indicate that the native Orang Asli may have contracted Entamoeba from polluted water sources, even though none of the three papers have precisely examined water samples. Thus, in order to enhance their understanding, perspective, and behaviour regarding the prevention of Entamoeba infections and the responsible use of water, educational intervention is necessary. Since nematodes live in aquatic environments and bodies of water, it is also unclear whether environmental elements like weather, climate, and environment have an impact on the nematode's ability to survive.

Soil-transmitted helminth (STH) prevalence varies across Malaysia, mostly impacting the aboriginal Orang Asli tribes of Perak, Kelantan, and Pahang. Nasr et al. (2013a, b) conducted a two-part cross-sectional study on 484 Orang Asli children aged < 15 years from 215 households across 13 villages in Lipis district, Pahang, Malaysia. The study found a significant frequency of STH in these youngsters, with key variables including contaminated drinking water, no toilet in the house, big family size (≥ 7 individuals), and not washing hands before eating or after defecation (Nasr et al., 2013a). Other contributing factors are poor sanitation systems, absence of de-worming programs, preventive health education, and in some cases inadequate personal hygiene practices.

Another cross-sectional survey was conducted from May 2016 to April 2017 in eight villages in Peninsular Malaysia's northern states, including all six Negrito indigenous sub-tribes (Muslim et al., 2019). Soil-transmitted helminth (STH) infections are primarily caused by three species: Ascaris lumbricoides, Trichuris trichuria, and hookworms (Ancylostoma duodenale, Necator americanus). As these worms feed on host tissues, the host suffers from protein-energy malnutrition, iron-deficiency anaemia, and vitamin A deficiency (American International Medical University, 2017), resulting in symptoms such as abdominal pain, nausea, diarrhoea, bloody stools, worms in stools, and weight loss.

As one of the Neglected Tropical Diseases (NTDs), STH had infected roughly 2 billion people worldwide by 2012 (World Health Organisation, 2012), resulting in approximately 135,000 fatalities per year (Pasaribu et al., 2019), and was primarily widespread in low-income developing nations. Their data demonstrated that the prevalence of STH was substantially higher in interior forest areas. Remote forest locations also had a greater prevalence of moderate to severe hookworm infections as well as other intestinal parasite illnesses (such as Entamoeba sp., Blastocystis sp., and flukes).

A decade later, diseases caused by environmental health risks persist, with an emphasis on parasitic infections, primarily in Orang Asli villages in remote forest areas of Selangor, Perak, and Pahang, which are isolated from public facilities and thus more vulnerable to parasite infestations. Although effective interventions, such as the health education learning package (HELP), have been implemented to eliminate STH among Orang Asli, the disease remains prevalent a decade later due to a serious lack of personal hygiene, an unimproved source of drinking water, and inadequate WASH facilities in schools and homes (Al-Delaimy et al., 2014).

More than 70% of STH infestation prevalence was noted in the majority of STH investigations (Muslim et al., 2021; Nasr et al., 2020; Nisha et al., 2020; Nisha and Davamani, 2021). The frequency of blastocystosis varied from 18.5% to 40.7%. The study that found the lowest prevalence was conducted among 58 Temiar Orang Asli who had been transferred to Gua Musang, whereas the study that found the highest frequency was conducted in Sungai Lembing, Pahang. In research conducted among schoolchildren in Kuala Kubu, Selangor, the highest documented incidence for amoebiasis was 51.1% (Adli and Ghani, 2020).

Stunting is present in up to 45.8 percent of Orang Asli children, which is significantly greater than the overall population (21.8 percent) (Muslim et al., 2021). This frequency was much greater than in 2019 Orang Asli research, which discovered that 19.2% of Orang Asli children aged 6 to 19 were stunted. The discrepancy in prevalence could be explained by the location of the analysed area, as the Muslim et al. investigation was conducted in a distant area. Stunting is also associated with untreated water, poor sanitation, and a high prevalence of STH among Orang Asli due to nutritional malabsorption induced by acute and chronic enteric illness (Muslim et al., 2021; Wong et al., 2021). Another source of concern is that the Orang Asli community is primarily a poor and low-income group with limited purchasing power. They face challenges in farming and food searching, as well as a depleted food supply in their surroundings, which exacerbates food insecurity and increases the risk of stunting (Gan, 2020).

Despite the strength of industry, government, and other factors, many Orang Asli continue to live predominantly traditional lifestyles, albeit on grounds that are endangered or degraded in comparison to those occupied by previous generations. Semang communities (such as the Batek and Jahai) that traditionally live a hunter-gatherer lifestyle have been the most resistant to change. Because of their traditionally nomadic, egalitarian, and autonomous nature, most of these communities have opposed sedentarism and the authority of industry, government, and other entities (Venkataraman et al., 2017). As a result, remote rural communities continue to rely significantly on natural resources. These Batek communities, particularly those living in forest settings, were highly associated with another parasite disease, malaria. These indigenous people, who traditionally lived as hunter-gatherers in a tropical jungle environment, are also regularly exposed to malaria. Malaria cases in Orang Asli totalled 550 (3.3%) out of 16,500 between 2013 and 2017 (Hussin et al., 2020). Similarly, in the state of Amazonas, malaria is a disease that mostly affects rural populations and reflects social and economic issues that are exacerbated in indigenous communities (Recht et al., 2017).

Conclusion

Human health and well-being are greatly influenced by a healthy environment. By safeguarding the natural environment, we can conserve ecosystems that support biodiversity, prevent the emergence and spread of diseases at the animal-human-plant interface (such as the dilution effect), enhance well-being, and advance health. Human-caused environmental deterioration poses a number of health risks, all of which are intricate and have their roots in how people interact with and use the environment. Unsafe water, inadequate sanitation, and hygiene are major causes of mortality and morbidity from a variety of diseases, particularly among vulnerable groups living in isolated forest settings like the Orang Asli of Peninsular Malaysia. Unintentional poisonings, primarily caused by overexposure and inappropriate use of harmful substances, such as agricultural pesticides that contaminate river basin habitats, have a substantial influence on indigenous human health. Waterborne infections are another source of worry for human health.

In order to achieve sustainable environmental health, food and water security, safety, and the well-being of the Orang Asli people, there needs to be a cooperative collaboration between indigenous communities and Malaysian mainstream society. As such, the strategy aids in the realisation of the Sustainable Development Goals, which cover issues such as hunger, poverty, inequality, health and wellbeing, clean water and sanitation, partnerships, and sustainable and responsible consumption and production. Furthermore, remedial procedures should be given great importance in remote indigenous communities. This may include water treatment systems or additional facilities to provide adequate water supply and quality in these communities, as well as more effective housing/community design or housing interventions to reduce overcrowded homes. These solutions can be expensive to deploy, especially in rural areas, and their effectiveness must be evaluated. It is critical that this research be translated into policy and practice in order to address modifiable factors and improve the health and well-being of indigenous population in Peninsular Malaysia.

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