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DYNAMICS OF MEDICAL GEOGRAPHY DEVELOPMENT IN INDIA: EXPLORING THE INTERACTION BETWEEN GEOGRAPHICAL FACTORS AND PUBLIC HEALTH

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Abstract

Medical Geography is an interdisciplinary branch of geography that examines the spatial and temporal dimensions of health, disease, health-care services, and their relationships with physical, environmental, social, economic, and cultural factors. In India, the development of Medical Geography has gradually shifted from descriptive studies of disease distribution towards systematic spatial analysis, epidemiological mapping, health-care accessibility assessment, and the application of Geographic Information Systems (GIS) and remote sensing. The present study, titled "Dynamics of the Development of Medical Geography in India: Exploring the Interaction between Geographical Factors and Public Health," attempts to examine the evolution of Medical Geography in India and analyse the interaction between geographical factors and public health. The study focuses on major geographical determinants such as climate, temperature, rainfall, water availability and quality, topography, land use, population density, urbanisation, environmental pollution, socio-economic conditions, and accessibility to health-care facilities. These factors play an important role in determining the spatial distribution, intensity, and seasonal variation of various communicable and non-communicable diseases. Water-borne diseases are strongly associated with water quality and sanitation, while vector-borne diseases such as malaria and dengue are influenced by climatic and environmental conditions.

Keywords: *Medical Geography, Public Health. Disease Distribution, Health Care Accessibility, GIS, Spatial Analysis, Solapur District, Public Health, Health Infrastructure*

Introduction

Understanding the relationship between geographical factors and human health has become an important area of study in medical and global health research. Medical geography is a branch of geography that studies how different geographical factors influence human health. These factors include the physical environment, social conditions, and economic conditions of a particular area. For example, climate, water availability, sanitation, living conditions, income, and health-care facilities can affect the health of people and the spread of diseases. Therefore, studying the relationship between geographical conditions and human health is very important for improving public health (Ruffini, 2022). Medical geography is an important interdisciplinary field that studies the relationship between geographical factors and human health. It helps us understand how climate, environment, location, population, and availability of health services influence the occurrence and spread of diseases (Martin, 2022). India has great geographical diversity, including mountains, plateaus, plains, coastal areas, deserts, and different climatic regions. These geographical differences can influence the distribution of diseases and the health status of people. For example, diseases such as malaria and dengue are strongly influenced by climate, temperature, rainfall, and environmental conditions. Similarly, air pollution in highly urbanized areas can increase the risk of respiratory diseases. In recent decades, urbanization, population growth, environmental changes, and changes in lifestyle have created new health problems. Large cities may experience increasing cases of diseases such as tuberculosis, diabetes, heart disease, and other lifestyle-related diseases. Therefore, understanding the geographical distribution of diseases is important for effective public health planning.

In simple terms, medical geography helps us answer three important questions:

1. Where are diseases occurring?
2. Why are they more common in some areas than others?
3. How easily can people in those areas access health-care services?
4. Thus, medical geography provides an important geographical approach to understanding and improving public health in India.

METHODS

This research uses a descriptive qualitative approach. Qualitative research is a research procedure with descriptive data results in the form of written or spoken words (Hamilton and Finley2019). Qualitative research aims to analyze the quality of a study. The type of research used is aliterature study which is research that has been done before by collecting books, journals, magazines, and scientific papers that are interrelated with the research problems and objectives. Literature study is a data collection technique carried out by conducting a study of books or literature related to the problem being solved (Roller 2019). The literature review database used is by searching on Google Scholar, Scopus, and Google Book. The search was conducted using keywords related to the development of medical geography in Indonesia and case studies of the utilization of geographic information systems in the health sector.

Results and Discussions

Introduction to Medical Geography

Medical Geography is a branch of geography that studies the relationship between geographical factors and human health. It helps us understand how the physical, social, Economic, and cultural conditions of a place can affect the health of people and communities (DeVerteuil, 2015; Vishlenkova & Renner, 2019). Medical Geography studies several important factors, such as the distribution of diseases, availability and accessibility of health services, climate, topography, pollution, population conditions, and socio-economic differences. It helps explain why a particular disease is more common in one area than another. It also helps in planning health services and controlling disease outbreaks (Hazen & Anthamatten, 2019). Understanding the relationship between the environment and human health is very important. Factors such as temperature, rainfall, climate, landforms, water resources, pollution, and living conditions can influence the occurrence and spread of diseases. This knowledge can help identify high-risk areas, develop disease-prevention programmes, respond to natural disasters, and reduce inequalities in access to health services (Martin, 2022).

Development of Medical Geography

The development of Medical Geography in India began in the early twentieth century. During this period, researchers started to recognize the relationship between geographical conditions and human health, particularly in relation to infectious diseases such as malaria and dengue. However, Medical Geography was not yet a major area of health research (Rahmanti et al., 2012). During the 1960s and 1970s, interest in Medical Geography increased. Government agencies and researchers began to understand that environmental conditions were important in explaining health problems. Studies examined diseases such as malaria, diarrhoea, and other infectious diseases and considered factors such as rainfall, temperature, and water conditions (Indriasih, 2008; Ismail et al., 2020). During the 1980s and 1990s, Medical Geography received more attention in India. Universities and research institutions started developing education and research in this field (Yani, 2018). The focus gradually expanded beyond infectious diseases to include non-communicable diseases, lifestyle-related diseases, and mental health problems. With the development of GIS, remote sensing, GPS, and other information technologies, Medical Geography has become more useful. Modern mapping and spatial analysis allow researchers to identify disease patterns and health-risk areas more accurately and quickly. At the same time, issues such as air pollution, climate change, urbanization, and environmental degradation have become important areas of research.

Geographical Factors and Infectious Diseases in India.

Geographical factors play an important role in the spread of infectious diseases in India, a country with wide environmental diversity. One of the main factors is the tropical climate that favors the spread of many infectious diseases (Sambodo et al. 2021). The Aedes aegypti mosquito, a vector of dengue fever and Zika virus, thrives in tropical areas with warm temperatures and sufficient rainfall (Rejeki et al. 2022). This causes Indonesia to experience frequent dengue fever outbreaks and Zika virus cases (Dhewantara et al. 2021). Topography also plays a role in the spread of disease. Hilly and mountainous areas can provide shelter for disease vectors such as the Anopheles mosquito, which is responsible for malaria transmission. In low-lying areas prone to waterlogging, the Aedes aegypti mosquito can breed rapidly, increasing the risk of dengue fever transmission (Ishak et al. 2021). Human mobility also affects the spread of infectious diseases in Indonesia. Improved transportation infrastructure has increased connectivity between regions, facilitating the spread of disease agents from one area to another (Irawan et al. 2019). For example, cases of malaria or leptospirosis can be transported by humans from endemic areas to areas previously free of the disease (Rejeki et al. 2022).

Climate

Climate is one of the most important geographical factors affecting infectious diseases. Temperature and humidity influence the growth of pathogens and the breeding of disease vectors. Malaria and dengue are strongly influenced by warm and humid conditions.High temperatures can increase the activity of mosquitoes.Seasonal changes can influence the timing and intensity of disease outbreaks.

Rainfall

Rainfall has a major effect on water availability and mosquito breeding.Heavy rainfall can create stagnant water, providing breeding places for mosquitoes.Flooding can contaminate drinking-water sources.Diseases such as dengue, malaria, diarrhoea and cholera may increase under favourable environmental conditions.

Temperature

Temperature affects the survival and reproduction of many disease-causing organisms and vectors.Warm conditions favour mosquito-borne diseases.Very high or changing temperatures may alter the geographical range of some vectors.Seasonal temperature variations contribute to differences in disease occurrence between regions.

Relief and Topography

India includes mountains, plateaus, plains, deserts and coastal regions. These landforms influence climate, drainage, settlement and accessibility to health services.For example, mountainous and remote areas may have limited accessibility to

hospitals and health centres, while densely populated plains may experience greater transmission of some infectious diseases.

Water Resources

The availability and quality of water are directly related to human health.Contaminated water can contribute to cholera, diarrhoea, typhoid and hepatitis A/E. Areas with inadequate sanitation and unsafe drinking water are particularly vulnerable to water-borne diseases.

Vegetation and Land Use

Vegetation provides suitable habitats for insects and other disease vectors.Changes in forests, agriculture and land use can influence the habitats of mosquitoes and other vectors.

Deforestation and human encroachment into forest areas can also increase contact between humans, animals and disease vectors.

Population Density

Population density is an important social-geographical factor.Highly populated areas can facilitate the transmission of infectious diseases through:close human contact,overcrowding,poor sanitation,inadequate waste disposal, andpressure on health-care facilities.

Urbanization

Rapid urbanization has changed the geographical pattern of many diseases.Unplanned settlements, construction sites, stagnant water and inadequate drainage can create favourable conditions for dengue and other mosquito-borne diseases. Crowded urban environments can also facilitate the spread of respiratory infections.

Migration and Mobility

Movement of people between villages, towns and cities can contribute to the geographical spread of infectious diseases. Migration may connect areas with different disease environments and health conditions.

Environmental Change and Public Health Challenges-

Environmental changes occurring globally have brought various new challenges in the field of public health (Xu et al. 2020). One significant change is climate change caused by global warming (Nuraini et al. 2021). The increase in the earth's average temperature has resulted in unstable weather patterns, such as floods, droughts, and more intense storms (Rakuasa 2022). The impacts of climate change can have both direct and indirect effects on public health. For example, extreme temperature increases can cause health problems such as heatstroke and dehydration (Kjellstrom et al. 2016). In addition, changes in weather patterns can also affect the spread of vector-borne diseases such as malaria and dengue fever. In addition to climate change, rapid urbanization also has a significant impact on public health (Misslin et al. 2016). The increase in urban populations has led to lifestyle changes, including unhealthy diets and physical inactivity, contributing to increased rates of obesity, diabetes and cardiovascular disease. In addition, urbanization also has an impact on air quality and the environment in cities. Air pollution from vehicle and industrial emissions can cause respiratory problems such as asthma and chronic lung diseases (Wang et al., 2022).Another challenge is related to changes in disease patterns and epidemics. Once-dominant diseases such as upper respiratory infections have given way to non-communicable diseases such as diabetes, cancer and mental disorders (Nuraini et al. 2021). This requires health systems to adapt and develop new strategies in prevention, diagnosis and treatment. In addition, heightened global mobility also increases the risk of infectious diseases spreading in a shorter time (Planey et al. 2022). To address these challenges, collaboration between various sectors such as health, environment and government is crucial (Hazen and Anthamatten 2019). Measures such as public education on the impact of environmental change on health, promotion of healthy lifestyles, development of green infrastructure in cities, and effective disaster management can help reduce the negative impact of environmental change on public health. In addition, scientific research and technological innovation also need to continue to develop better solutions to the growing health challenges posed by environmental change.

Utilization of Geospatial Technology in the Health Sector

Geospatial technology, which involves mapping, analyzing, and interpreting location-based data, has brought about major changes in the health field (Rakuasa et al., 2021). One of the main benefits of this technology is in better understanding the distribution of diseases and their causative factors (Surendra et al. 2023). Using geographic information systems (GIS), health data such as disease cases, disease vectors, and environmental factors can be integrated with spatial information such as area maps and satellite images (Ishak et al. 2021). This allows researchers and health experts to identify disease patterns that may be related to specific geographical conditions, assisting in the planning of disease prevention and control strategies (Muin & Rakuasa 2023). In addition, geospatial technology also plays a role in public health monitoring. For example, in the handling of disease outbreaks, GIS can help in tracking and visualizing the movement of the disease in real-time (Ishak et al., 2021). By monitoring the progress of these diseases, authorities can take quick measures to controltheir spread. This technology also helps in the development of outbreak prediction models based on factors such as population, environment, and population mobility, which can enable more effective preventive measures (Puspandari et al. 2021). The use of geospatial technology can also support disease vector monitoring and control programs. In efforts to fight vector-borne diseases such as malaria, dengue fever, and other infectious diseases, mappingthe location of vector distribution and environmental factors can help identify high-risk areas (Juhairiyah et al. 2021). Thus, vector control programs can be implemented more precisely and efficiently. Finally, geospatial technologies can improve responses to natural disasters and health crises. In emergency situations such as earthquakes, floods, or pandemics, geospatial information can help in mapping the affected areas and planning the distribution of health resources such as field hospitals or aid posts (Giofandi et al. 2023). With a better understanding of the geography of affected areas, aid can be distributed in a more effective and Nusantara Journal of Behavioral and Social Science, 2(3), 2023, –84UKInstitutetimely manner. Overall, the utilization of geospatial technologies in health has helped in improving the understanding, monitoring and response to various aspects of public health. With the integration of

location-based data, prevention measures, disease management, and response to emergency situations can be directed more carefully and efficiently, contributing to the overall improvement of people's well-being (Planey et al. 2022).

Awareness-raising and Decision-Making

Increasing awareness and decision-making in medical geography is a crucial step in understanding, preventing and addressing geographically-based health problems (Hazen and 2019). Awareness of the importance of geography in public health is increasing due to advances in information technology and easy access to information. People are now better able to understand how environmental, geographic and social factors canaffect individual and population health. This increased awareness is reinforced by the role of education and information campaigns on medical geography. People are taught how to analyze health information based on geographic location, understand disease distribution maps, and recognize region-specific risk factors. This awareness also plays a role in driving active participation in public health programs that focus on geographic mapping, such as mass vaccination or disease prevention campaigns (Fadjarajani 2020). This increased awareness then leads to better decision-making in terms of health.Individuals and communities that have a better understanding of disease distribution and risk factors can take preventive actions more effectively. For example, communities can take steps to protect hemselves from disease outbreaks that may spread in their area (Yani 2018). Decision-making based on an understanding of medical geography can also help individuals better manage chronic diseases, based on the environment in which they live (Frost et al. 2019). In addition, medical geography mapping also supports decision-making by governments and health agencies. The visual information presented in maps can help policymakers identify areas that require more intensive health interventions, allocation of medical resources, or improvement of health infrastructure. A deeper understanding of the relationship between geographic location and health problems can also help design more specific and effective prevention strategies (Martin 2022).Overall, increased awareness and decision-making in the context of medical geography provides great benefits in the effort to improve the quality of public health. With a better understanding of the impact of environmental and geographical factors on health, individuals and communities can be better prepared for the health challenges unique to their region. This awareness also encourages collaboration between communities, medical personnel and policy makers in formulating more effective and responsive solutions to health issues related to medical geography.

Conclusion And Recommendationa

literature rivew shows that the development of medical geography in Indonesia has an increasingly important role in understanding the complex relationship between geographical factors and public health. Through an in-depth interaction between geospatial data and health information, this article reveals how the geography of an area can have a significant impact on the spread of disease, health risk factors, and access to medical services. The importance of medical geography in the Indonesian context is reflected in its ability to identify disease clusters, formulate prevention strategies, and design more informed and responsive health policies. This research underscores how geographic mapping helps to plan health resource allocation more effectively, and helps to map the distribution of medical facilities to make them accessible to all communities, regardless of geographic location. In the face of increasingly complex health challenges, the development of medical geography in Indonesia shows a continuous effort in applying information technology and mapping innovations to formulate evidence-based solutions. The results of this study provide a deeper understanding of how medical geography in Indonesia has evolved over time and have an important role in shaping a holistic view of public health. As a vast and diverse archipelago, the application of medical geography principles in Indonesia can make a significant contribution in improving the planning, decision-making, and implementation of more effective and inclusive health programs.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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