



RESEARCH ARTICLE

# Dynamics of Medical Geography Development in Indonesia: Exploring the Interaction between Geographical Factors and Public Health

Heinrich Rakuasa

Published online: 3 September 2023

**Abstract:** Understanding the interaction between geographical factors and public health has become an increasingly important subject of research in medicine and global health. By utilizing available geospatial data, we can more deeply understand health patterns and health risks across Indonesia. Therefore, the background of this study underscores the urgency of research in the dynamic development of medical geography in Indonesia. This research uses a descriptive qualitative approach. The type of research used is a literature 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 study 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 geographic information system utilization in the health sector. The results of this study provide a deeper understanding of how medical geography in Indonesia has evolved over time and has 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 to improving planning, decision-making, and implementation of more effective and inclusive health programs.

Keywords: Medical Geography, GIS, Public Health

**Abstrak:** Pemahaman tentang interaksi antara faktor geografis dan kesehatan masyarakat telah menjadi subjek penelitian yang semakin penting dalam bidang kedokteran dan kesehatan global. Dengan memanfaatkan data geospasial yang tersedia, kita dapat lebih mendalam memahami pola kesehatan dan risiko kesehatan di seluruh wilayah Indonesia. Oleh karena itu, latar belakang penelitian ini menggarisbawahi urgensi penelitian dalam dinamika perkembangan geografi medis di Indonesia. Penelitian ini menggunakan pendekatan kualitatif deskriptif. Jenis penelitian yang digunakan adalah studi literatur yang merupakan penelitian yang telah dilakukan sebelumnya dengan mengumpulkan buku-buku, jurnal, majalah, dan karya tulis ilmiah yang saling berkaitan dengan masalah dan tujuan penelitian. Studi literatur merupakan teknik pengumpulan data yang dilakukan dengan cara melakukan studi terhadap buku-buku atau literatur yang berhubungan dengan masalah yang sedang dipecahkan (Roller, 2019). Basis data studi literatur yang digunakan adalah dengan melakukan pencarian di Google Scholar, Scopus, dan Google Book. Pencarian dilakukan dengan menggunakan kata kunci yang berkaitan dengan perkembangan geografi medis di Indonesia dan studi kasus pemanfaatan sistem informasi geografis di bidang kesehatan. Hasil penelitian ini memberikan pemahaman yang lebih mendalam tentang bagaimana geografi medis di Indonesia telah berkembang seiring waktu dan memiliki peran penting dalam membentuk pandangan holistik terhadap kesehatan masyarakat. Sebagai negara kepulauan yang luas dan beragam, pengaplikasian prinsip geografi medis di Indonesia dapat memberikan kontribusi yang signifikan dalam meningkatkan perencanaan, pengambilan keputusan, serta pelaksanaan program-program kesehatan yang lebih efektif dan inklusif.

Kata kunci: Geografi Medis, GIS, Kesehatan Masyarakat

---

University of Indonesia, Indonesia

*\*) corresponding author*

Heinrich Rakuasa

Email: [heinrich.rakuasa@ui.ac.id](mailto:heinrich.rakuasa@ui.ac.id)

## INTRODUCTION

Understanding the interaction between geographical factors and public health has become an increasingly important subject of research in medicine and global health. Medical geography is a branch of science that studies how geographic factors, such as the physical, social and economic environment, affect human health (Ruffini 2022).

The development of medical geography as a research and interdisciplinary field has opened new vistas in understanding the interrelationship between geographical environmental factors and human health (Martin 2022).

Indonesia, as the world's largest archipelago, has a variety of geographical landscapes, including islands spread from Sabang to Merauke and a wide variety of climates that range from tropical rainforests to dry deserts. This diversity has significant implications for disease distribution and public health status. Some examples include malaria being more prevalent in tropical and subtropical regions, and the increased risk of respiratory diseases in areas with high air pollution (Rejeki et al. 2022). In addition, the development of urbanization and environmental changes in recent decades has also had an impact on public health (Puspandari et al. 2021). The development of large cities and changes in the lifestyle of urban communities can affect the transmission of infectious diseases such as tuberculosis and degenerative diseases such as diabetes (Kurniawan et al. 2023)

According to Rusdi et al. (2022), Indonesia as an archipelago with environmental and cultural diversity, the role of geographical factors in public health is becoming increasingly significant. The importance of this study is related to two main aspects: first, the degree of geographic variation in disease incidence and human health indicators. Second, the implications of these distribution patterns for the planning and implementation of effective health programs. An in-depth understanding of the developmental dynamics of medical geography in Indonesia is highly relevant for identifying areas of high health risk and designing appropriate interventions (Sondakh et al. 2022)

The role of geographic factors in determining disease distribution has long been recognized in the field of public health (Planey et al. 2022). Variability in climate, topography, and the physical environment of an area can have a major impact on the spread of infectious diseases, such as malaria, dengue fever, and respiratory infections (Martin 2022). In addition, geographical factors also play an important role in the accessibility and quality of health services, especially in remote or hard-to-reach areas. However, despite the great potential of medical geography in providing valuable insights, the development of this field in Indonesia is still relatively limited and not fully utilized (Eriksson 2011). Increasingly sophisticated information and mapping technologies open up new opportunities to explore the potential of medical geography in the Indonesian context. By utilizing available geospatial data, we can more deeply understand health patterns and health risks across Indonesia. Therefore, the background of this study underscores the urgency of research in the dynamic development of medical geography in Indonesia. Through exploring the interaction between geographical factors and public health, this research aims to fill the knowledge gap and provide a more comprehensive view of how medical geography can contribute to the formulation of more effective and efficacious health policies in Indonesia.

## 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 Finley 2019). Qualitative research aims to analyze the quality of a study. The type of research used is a literature 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 interaction between geographic factors and human health (DeVerteuil 2015). It attempts to understand how the physical, social, economic, and cultural environments can affect the health of individuals and populations as a whole (Vishlenkova & Renner. 2019). In the study of Medical Geography, factors such as patterns of disease spread, accessibility of health services, physical environment (such as climate, topography, and pollution), and social and economic differences are analyzed to understand their impact on human health (Hazen and Anthamatten 2019). Medical Geography has practical implications in public health planning, health policy development, and response to disease outbreaks.

Understanding the interactions between the geographic environment and human health is crucial as it provides insights into how environmental factors such as climate, topography and social environment can affect the health of individuals and populations. This information allows us to design more effective disease prevention strategies, identify high-risk areas, manage the impact of natural disasters, and minimize inequalities in access to health (Martin 2022). By understanding these linkages, communities can take proactive steps to improve overall health and well-being.

The history of Medical Geography development in Indonesia dates back to the early 20th century. At that time, an understanding of the relationship between the geographical environment and human health began to be noticed, especially related to the spread of infectious diseases such as malaria and dengue fever, but this understanding was still limited and had not yet become a major focus in health science (Rahmanti et al., 2012). In the 1960s and 1970s, interest in Medical Geography grew in Indonesia. The government and scientists began to understand the importance of understanding the environment as an important factor in health problems (Indriasih 2008). Research on the spread patterns of diseases such as malaria, diarrhea, and other infectious diseases was conducted by considering environmental factors such as rainfall, temperature, and water flow patterns (Ismail et al., 2020; Juhairiyah et al. 2021) Sari et al., 2023)

Furthermore, in the 1980s and 1990s, Medical Geography received greater attention. Education and research in this field began to be developed in several universities and research institutions in Indonesia (Yani 2018). The focus is not only on infectious diseases, but also on non-communicable diseases such as degenerative diseases and mental health disorders that can be influenced by the environment. In the era of globalization and the development of information technology, the understanding of Medical Geography has expanded. Mapping and spatial analysis technologies are becoming more sophisticated,

enabling more accurate and rapid identification of health and disease risks. In addition, environmental issues such as air pollution, climate change, and urbanization are also increasingly becoming concerns in the context of human health (Mulyanto, Kunst, and Kringos 2019). With these developments, Medical Geography in Indonesia not only contributes to research and understanding of human health, but also in public health policy planning (Surendra et al. 2023). The application of Medical Geography concepts can help reduce the impact of disease and improve people's quality of life through a more holistic and evidence-based approach (Sambodo et al. 2021).

### **Geographical Factors and Infectious Diseases in Indonesia**

Geographical factors play an important role in the spread of infectious diseases in Indonesia, 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). The growth of large cities and the expansion of human settlements can create a favorable environment for the spread of infectious diseases (Haryanto 2020). Deforestation and changes in agricultural patterns can also bring humans closer to the habitats of zoonotic disease reservoir animals, such as rats associated with leptospirosis (Nuraini et al. 2021). An in-depth understanding of these geographical factors is key in designing prevention, control and response strategies to infectious diseases in Indonesia (Hazen and Anthamatten 2019). An approach that considers geographical variables will help the government and health agencies to effectively address health issues in a diverse environment.

### **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 control their 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, mapping the 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

timely 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 Anthamatten 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 can affect 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 themselves 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 RECOMMENDATION

A literature review 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 has 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.

### REFERENCES

- Abdul Muin, & Heinrich Rakuasa. 2023. "Pemanfaatan Sistem Informasi Geografi Untuk Analisis Jarak Jangkauan Pelayanan Fasilitas Kesehatan Di Kota Ambon." *INSOLOGI: Jurnal Sains Dan Teknologi* 2(4): <https://doi.org/10.55123/insologi.v2i4.2235>.
- DeVerteuil, Geoffrey. 2015. "Conceptualizing Violence for Health and Medical Geography." *Social Science & Medicine* 133: 216–22. <https://linkinghub.elsevier.com/retrieve/pii/S027795361500026X>.
- Dhewantara, Pandji Wibawa et al. 2021. "Decline of Notified Dengue Infections in Indonesia in 2017: Discussion of the Possible Determinants." *Narra J* 1(1). <https://narraj.org/main/article/view/23>.
- E. A., Vishlenkova, and Renner A. 2019. "Historical Study of Medical Geography in Russia." *Problems of Social Hygiene Public Health and History of Medicine* 27(5). <https://www.ncbi.nlm.nih.gov/pubmed/31765548>.
- Eriksson, Sören. 2011. "Medical Geography Views on Snakebites in Southeast Asia: A Case Study from Vietnam." *Asian Geographer* 28(2): 123–34. <http://www.tandfonline.com/doi/abs/10.1080/10225706.2011.623415>.
- Fadjarajani, S. 2020. "Peranan Geografi Dalam Analisis Sebaran Covid-19." In *Prosiding Seminar Nasional Hardiknas 1*, 71–78.
- Frost, Isabel et al. 2019. "Global Geographic Trends in Antimicrobial Resistance: The Role of International Travel." *Journal of Travel Medicine* 26(8). <https://academic.oup.com/jtm/article/doi/10.1093/jtm/taz036/5496989>.
- Giofandi, Eggy Arya et al. 2023. "Analisis Aksesibilitas Fasilitas Kesehatan Di Kota Pekanbaru, Indonesia."

- Journal Information System Development (ISD)* 8(1): 1. <https://ejournal-medan.uph.edu/index.php/isd/article/view/581>.
- Hamilton, Alison B., and Erin P. Finley. 2019. "Qualitative Methods in Implementation Research: An Introduction." *Psychiatry Research* 280: 1125-16. <https://linkinghub.elsevier.com/retrieve/pii/S0165178119307917>.
- Haryanto, Budi. 2020. "Indonesia: Country Report on Children's Environmental Health." *Reviews on Environmental Health* 35(1): 41–48. <https://www.degruyter.com/document/doi/10.1515/reveh-2019-0088/html>.
- Hazen, Helen, and Peter Anthamatten. 2019. *An Introduction to the Geography of Health*. Second Edition. | New York : Routledge, 2020. | First edition published in 2011 with Peter Anthamatten as principal author.: Routledge. <https://www.taylorfrancis.com/books/9780429659256>.
- Indriasih, E. 2008. "Sistem Informasi Geografis (SIG) Dalam Bidang Kesehatan Masyarakat." *Buletin Penelitian Sistem Kesehatan* 11(1): 99–104.
- Irawan, Diki Surya et al. 2019. "The Routing of Hazardous and Toxic (B3) Medical Waste Transportation Using Network Analysis (Case Study: Primary Health Care Services, Depok, Indonesia)." *Journal of Physics: Conference Series* 1364(1): 012046. <https://iopscience.iop.org/article/10.1088/1742-6596/1364/1/012046>.
- Ishak, H, A Mallongi, A B Birawida, and Syahribulan. 2021. "Spatial Mapping of Aedes Sp. Densities and Endemicity Level of Dengue in Three Villages in South Sulawesi, Indonesia." *IOP Conference Series: Earth and Environmental Science* 921(1): 012077. <https://iopscience.iop.org/article/10.1088/1755-1315/921/1/012077>.
- Ismail, Arif, Mohammad Dede, and Millary Agung Widiawaty. 2020. "Urbanisasi Dan HIV Di Kota Bandung (Perspektif Geografi Kesehatan)." *Buletin Penelitian Kesehatan* 48(2): 139–46. <https://ejournal2.litbang.kemkes.go.id/index.php/bpk/article/view/2921>.
- Juhairiyah, Juhairiyah et al. 2021. "Spatial Analysis of Malaria in Kotabaru, South Kalimantan, Indonesia: An Evaluation to Guide Elimination Strategies." *Transactions of The Royal Society of Tropical Medicine and Hygiene* 115(5): 500–511. <https://academic.oup.com/trstmh/article/115/5/500/5965378>.
- Kjellstrom, Tord et al. 2016. "Heat, Human Performance, and Occupational Health: A Key Issue for the Assessment of Global Climate Change Impacts." *Annual Review of Public Health* 37(1): 97–112. <https://doi.org/10.1146/annurev-publhealth-032315-021740>.
- Kurniawan, Yogie Indra et al. 2023. "Comparison of Tuberculosis Disease Classification Using Support Vector Machine and Naive Bayes Algorithm." In *AIP Conference Proceedings* 21 February 2023, , 030002. <https://pubs.aip.org/aip/acp/article/2867321>.
- Martin, Alexander. 2022. "Medical Geography and Civil Society in the Russian Empire." *Vestnik of Saint Petersburg University. History* 67(3): 1017–27. <https://history-journal.spbu.ru/article/view/14713>.
- Misslin, Renaud et al. 2016. "Urban Climate versus Global Climate Change-What Makes the Difference for Dengue?" *Annals of the New York Academy of Sciences* 1382(1): 56–72. <https://onlinelibrary.wiley.com/doi/10.1111/nyas.13084>.
- Mulya Sari, Dian, Besral Besral, and Martya Rahmaniati Makful. 2023. "Pemetaan Prioritas Penanganan Diare Pada Balita 12-59 Bulan Provinsi Jawa Barat." *Media Publikasi Promosi Kesehatan Indonesia (MPPKI)* 6(3): 512–22. <https://jurnal.unismuhpalu.ac.id/index.php/MPPKI/article/view/3155>.
- Mulyanto, Joko, Anton E. Kunst, and Dionne S. Kringos. 2019. "Geographical Inequalities in Healthcare Utilisation and the Contribution of Compositional Factors: A Multilevel Analysis of 497 Districts in Indonesia." *Health & Place* 60: 102236. <https://linkinghub.elsevier.com/retrieve/pii/S1353829219309232>.
- Nuraini, Nuning et al. 2021. "Climate-Based Dengue Model in Semarang, Indonesia: Predictions and Descriptive Analysis." *Infectious Disease Modelling* 6: 598–611. <https://linkinghub.elsevier.com/retrieve/pii/S2468042721000269>.
- Planey, Arrianna Marie, Sandy Wong, Donald A. Planey, and Michelle J. Ko. 2022. "(Applied) Geography, Policy, & Time: Whither Health and Medical Geography?" *Space and Polity* 26(2): 115–27. <https://www.tandfonline.com/doi/full/10.1080/13562576.2022.2098649>.
- Puspendari, Diah Ayu, Hermawati Setiyaningsih, Zafria Atsna, and Tri Murti Andayani. 2021. "Pemanfaatan Geospasial Melalui Health and Demographic Surveillance System (HDSS) Pada Pasien Tuberkulosis Dalam Manajemen Obat." *JURNAL MANAJEMEN DAN PELAYANAN FARMASI (Journal of Management and Pharmacy Practice)* 11(4): 262. <https://jurnal.ugm.ac.id/jmpf/article/view/66692>.
- Rahmanti, Annisa Ristya, and Arief Kurniawan Nur Prasetyo. 2012. "Sistem Informasi Geografis: Trend Pemanfaatan Teknologi Informasi Untuk Bidang Terkait Kesehatan." In *In Seminar Nasional Informatika Medis (SNIMed)*, , 6–12.
- Rakuasa, H., Tambunan, M. P., & Tambunan, R. P. 2021. "Analisis Sebaran Spasial Tingkat Kejadian Kasus Covid-19 Dengan Metode Kernel Density Di Kota Ambon." *Jurnal Geografi: Media Informasi Pengembangan dan Profesi Kegeografian* 18(2): 76–82.
- Rakuasa, Heinrich. 2022. "ANALISIS SPASIAL TEMPORAL SUHU PERMUKAAN DARATAN/ LAND SURFACE TEMPERATURE (LST) KOTA AMBON BERBASIS CLOUD

COMPUTING: GOOGLE EARTH ENGINE." *Jurnal Ilmiah Informatika Komputer* 27(3): 194–205.  
<http://ejournal.gunadarma.ac.id/index.php/infokom/article/view/7101>.

Rejeki, Dwi Sarwani Sri et al. 2022. "Clusters of Malaria Cases at Sub-District Level in Endemic Area in Java Island, Indonesia." *Geospatial Health* 17(1).  
<https://geospatialhealth.net/index.php/gh/article/view/1048>.

Roller, M. R. 2019. "A Quality Approach to Qualitative Content Analysis: Similarities and Differences Compared to Other Qualitative Methods." *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* 20(9): 1–21.

Ruffini, Julio L. 2022. *Advances in Medical Social Science*. London: Routledge.  
<https://www.taylorfrancis.com/books/9781315025513>.

Rusdi, Ibnu, Budi Keliat, Rr. Tutik Hariyati, and Yudho Sucahyo. 2022. "Exploration of the Need for Nursing Human Resources Information Systems for Geographical Mapping of Nurses: A Qualitative Study." *Indonesian Journal of Global Health Research* 4(2): 269–80.  
<https://www.jurnal.globalhealthsciencegroup.com/index.php/IJGHR/article/view/1005>.

Sambodo, Novat Pugo, Eddy Van Doorslaer, Menno Pradhan, and Robert Sparrow. 2021. "Does Geographic Spending Variation Exacerbate Healthcare Benefit Inequality? A Benefit Incidence Analysis for Indonesia." *Health Policy and Planning* 36(7): 1129–39.  
<https://academic.oup.com/heapol/article/36/7/1129/6291337>.

Sondakh, Jenny J.S. et al. 2022. "Indonesia Medical Students' Knowledge, Attitudes, and Practices toward COVID-19." *Heliyon* 8(1): e08686.  
<https://linkinghub.elsevier.com/retrieve/pii/S2405844021027894>.

Surendra, Henry et al. 2023. "Geographical Variations and District-Level Factors Associated with COVID-19 Mortality in Indonesia: A Nationwide Ecological Study." *BMC Public Health* 23(1): 103.  
<https://doi.org/10.1186/s12889-023-15015-0>.

Wang, Haikun, Rong Tang, and Yifan Liu. 2022. "Potential Health Benefit of NO<sub>2</sub> Abatement in China's Urban Areas: Inspirations for Source-Specific Pollution Control Strategy." *The Lancet Regional Health - Western Pacific* 24: 100482.  
<https://linkinghub.elsevier.com/retrieve/pii/S2666606522000979>.

Xu, Rongbin et al. 2020. "Wildfires, Global Climate Change, and Human Health." *New England Journal of Medicine* 383(22): 2173–81.  
<http://www.nejm.org/doi/10.1056/NEJMSr2028985>.

Yani, A. 2018. "Pemanfaatan Teknologi Dalam Bidang Kesehatan Masyarakat." *Jurnal Kesehatan Masyarakat (e-Journal)* 8(1): 97–102.