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IDENTIFICATION DETERMINANT DISEASE THROUGH EPIDEMIOLOGY SPATIAL: LITERATURE REVIEW UTILIZATION ANALYSIS REGRESSION WEIGHTY GEOGRAPHICAL

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Abstract

Introduction: Epidemiology spatial is one of the branch from epidemiology that takes into account characteristics place (spatial) of occurrence something problem health . Use analysis *Geographically Weighted Regression* in epidemiology spatial used For reduce risk of bias due to heterogeneity of data from variation spatial.Various study earlier on the issue health has done through approach epidemiology spatial and GWR analysis .

Method: Literature review research using the PubMed database for 159 articles . Based on ... a number of the established criteria , obtained as many as 30 articles research conducted study comprehensive .

Results: Based on results literature review obtained that use GWR analysis becomes proper analysis in study field health public especially in epidemiology spatial research previously show that GWR analysis can give mapping and related data point risk high / vulnerable (*hotspot*) and points risk low (*coldspot*) problem health in an area based on character geographically . GWR analysis can also identify variables significant predictors influential to problem health in each region. Various implications results GWR research field health public intended For recommendation development policy health that focuses on a specific area in accordance character spatial .

Conclusion and Suggestions: GWR analysis in health public effective used For increase quality study with reduce risk of research bias from factor heterogeneity spatial research area . GWR analysis can used as material For recommendation policy health focused on at-risk areas tall problem health and variables significant predictors in each region . Required development study more carry on use GWR analysis in epidemiology spatial For help map problem health based on location geographical .

Keywords: Disease Determinants, Spatial Epidemiology, GWR Analysis

INTRODUCTION

Epidemiology is the study of the distribution and determinants of disease in human populations. Epidemiological studies aim to describe the frequency of disease in a given population by identifying individuals at risk, the time of occurrence, and the place of occurrence. Traditional epidemiology generally focuses on the person and time components, but less on the place (Cuadros et al., 2021) . Traditional epidemiology provides etiological information for disease control. However, traditional epidemiology has limitations, such as the lack of information on spatial distribution and visualization of the temporal distribution of disease (Li et al., 2022) .

Currently , research field health public through approach epidemiology spatial Already start used . There are a number of factor driver use epidemiology spatial among them improvement use system global positioning in survey prevalence problem health , mapping facility health . Epidemiology spatial is also increasingly develop with existence health data mapping with involving availability relevant variables in a way epidemiological as well as development analysis statistics . Development technology that makes things easier access data availability is also an issue factor supporters in epidemiology spatial . Through epidemiology spatial , obtained

information trend For mapping and understanding pattern as well as dynamics problem health on a scale spatial and temporal conditions the make emergence term new " health" precision society ” (Tatem, 2018) .

Epidemiology spatial is description and analysis pattern geographic , variation determinant disease , mortality and morbidity in connection with distribution related factor demographic , social , economic , environmental , behavioral health , factors risk genetics along with changes that occur over time (Liu et al., 2022) . Quantitative methods in spatial epidemiology can be used to estimate geographic hotspots . Geographic *hotspots* are defined as areas with a disproportionate disease burden. Identification of areas in spatial epidemiology can provide information on the location of high-risk populations and predictive or determinant factors that facilitate disease persistence and spread ADDIN CSL_CITATION {"citationItems":[{"id":"ITEM-1","itemData":{"DOI":"10.4239/wjd.v12.i7.1042","ISBN":"0000000170604","ISSN":"1948-9358","abstract":"Diabetes mellitus (DM) is a growing epidemic with global proportions. It is estimated that in 2019, 463 million adults aged 20-79 years were living with DM. The latest evidence shows that DM continues to be a significant global health challenge and is likely to continue to grow …","author":[{"dropping-particle":"","family":"Cuadros","given":"Diego F","non-dropping-particle":"","parse-names":false,"suffix":""},{"dropping-particle":"","family":"Li","given":"Jingjing","non-dropping-particle":"","parse-names":false,"suffix":""},{"dropping-particle":"","family":"Musuka","given":"Godfrey","non-dropping-particle":"","parse-names":false,"suffix":""},{"dropping-particle":"","family":"Awad","given":"Susanne F","non-dropping-particle":"","parse-names":false,"suffix":""}],"container-title":"World Journal of Diabetes","id":"ITEM-1","issue":"7","issued":{"date-parts":[["2021"]]},"page":"1042-1056","title":"Spatial epidemiology of diabetes: Methods and insights","type":"article-journal","volume":"12"},"uris":["http://www.mendeley.com/documents/?uuid=738d6941-169a-4788-a2d5-9e1cc810837c"]}],"mendeley":{"formattedCitation":"(Cuadros et al., 2021)","plainTextFormattedCitation":"(Cuadros et al., 2021)","previouslyFormattedCitation":"(Cuadros et al., 2021)"},"properties":{"noteIndex":0},"schema":"https://github.com/citation-style-language/schema/raw/master/csl-citation.json"}(Cuadros et al., 2021 *)* .

Through studies epidemiology spatial will obtained that through understanding , mapping and development good analysis with highlight point hot spots and points cold (*coldspot*) a problem health . Epidemiology spatial can help highlight lagging groups , measuring magnitude possible risks happen as well as do mapping in a way efficient , effective as well as economical normal so that make it easier in focus target intervention health with source limited power . Approach epidemiology spatial can used as method new in development information field health as well as as instruments and insights For overcome various problem health (Tatem, 2018) .

With existence epidemiology spatial , mapping problem health from scale national to subnational can done in a way fast with accuracy specific to the resolution distance certain specified conditions . In the process , the tendency existence substantial heterogeneity possibility found in the data used (Tatem, 2018) . For example , in the research about HIV prevalence in Zimbabwe, found that there is heterogeneity spatial in HIV incidence and various factor the trigger (Birri Makota & Musenge, 2023) . The results of a spatial epidemiology approach and the use of geospatial analysis have the potential to significantly increase the effectiveness of implemented programs. Through spatial epidemiology, a specific implementation of spatial analysis is to investigate preventive interventions across different populations and geographic locations for more effective and efficient budget utilization (Cuadros et al., 2021) .

Currently, there has been rapid development in geographic information systems (GIS) and spatial analysis. Therefore, it will be easier to access information involving environmental components, sociodemographics, and big data regarding a health issue (Li et al., 2022) . Spatial epidemiology has been widely used in the field of infectious diseases and is currently being expanded to study non-communicable diseases (Cuadros et al., 2021) . Epidemiology spatial play a role important in develop understanding about distribution geographical diseases and factors the risks that are significant contribute to prevention and control programs problem diseases in society (Liu et al., 2022). The use of spatial epidemiology in the health sector is generally combined with spatial statistical analysis. One such analysis currently under development is Geographic Weighted Regression (GWR). GWR analysis is used as method sophisticated calculating average association local between indicator (variable predictor) and perform regression parameter estimates for each district /region. GWR is used as capable instruments detect variation spatial (Muhammad et al., 2024) . Analysis regression spatial and geographical weighted (GWR) can used by the makers policy and program planning for design intervention health in a way spatial . Intervention health community focused to hotspot area (point vulnerable) effective done For reduce prevalence anemia (Tesema et al., 2021) . Regression weighted in a way geographic (GWR) can give estimate parametric local from variables model predictors that vary across the study area. The resulting GWR model can used For identification distribution spatial problem health as well as availability information map point vulnerable problem health in the research area. Research output using GWR can used For intervention problem better health effective and efficient (Tessema et al., 2020) .

Description on become background behind importance study with focus study literature about use Analysis *Geographically Weighted Regression* in study field epidemiology spatial in health public .

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METHOD

Study This is study with design literature review. Articles used as study data own a number of criteria including (1) articles with title and content in accordance objectives , (2) full text , (3) published in the period 2020 – 2025, (4) in English English and (5) focus use analysis *Geographically Weighted Regression* (GWR) fields health community . Data obtained from electronic databases that is *PubMed* between 2020-2025 . Keywords used in search article is " **Geographically Weighted Regression ".** Search results obtained as many as 159 articles . Based on a number of stages selection process based on the criteria set , obtained as many as 30 articles were done assessment .

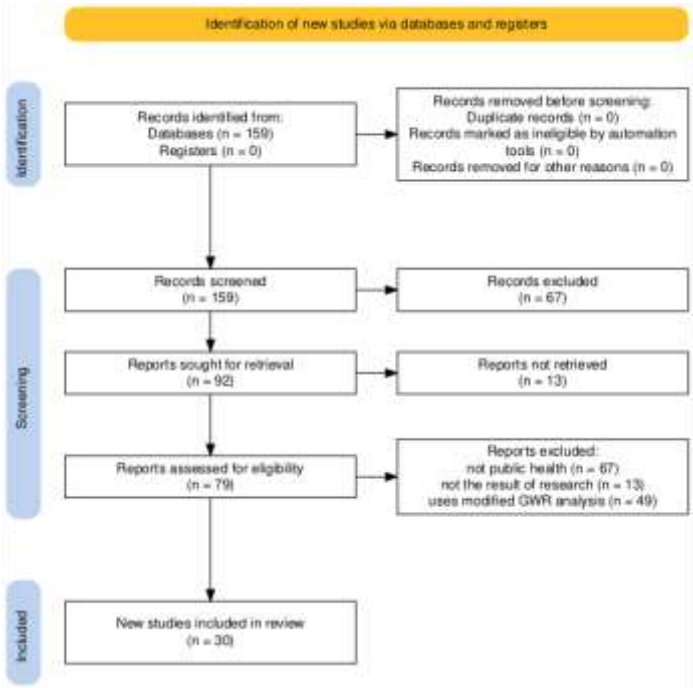

Figure 1. Literature Review Stages

RESULTS

Based on results study of 30 articles with focus main is study field health people who use analysis *Geographical Weighted Regression* (without modification) in the field health public . Study results throughout study related served in table following .

Table 1. List of Articles " Research The Public Health Sector uses Analysis *Geographically Weighted Regression* (GWR)"

No	Writer	Title	Software	Geographical Area	Results
1	Xiaodie Chena, Mawlanjan Emamb , Li Zhangc , Ramziya Rifhatd , Liping Zhang, Yanling Zheng	Analysis of spatial characteristics and geographic weighted regression of tuberculosis prevalence in Kashgar , China	ArcGIS 10.4.1	Kashgar , China	Research result show that a number of variables characteristics spatial like amount facility health per capita and number resident own correlation positive with TB (Chen et al., 2023)
2	Getayeneh Antehunegn Tesema, Zemenu Tadesse Tessema, Dessie Abebaw Angaw , Koku Sisay Tamirat, Achamyeleh Birhanu Teshale	Geographic weighted regression analysis of hot spots of anemia and its associated factors among children aged 6–59 months in Ethiopia: A geographic weighted regression analysis and multilevel robust Poisson regression analysis	ArGIS 10.7 and SaTScan 9.6	Ethiopia	Research result show that prevalence anemia identified experience variation significant spatial distribution across Ethiopia . Some areas are considered anemia hotspots . are Central, West and East Afar, Somalia, Dire Dawa, Harari and northwest Gambella . Mother with anemia , possession child age 6-59 months , age mothers aged 15-19 years as well as poverty is variables significant predictors to variation spatial anemia (Tesema et al., 2021)

No	Writer	Title	Software	Geographical Area	Results
3	Zemenu Tadesse Tessema , Melkalem Mamuye Azanaw , Yeaynmarnesh Asmare Bukayaw and Kassahun Alemu Gelaye	Geographical variation in determinants of high-risk fertility behavior among reproductive-aged women in Ethiopia using the 2016 demographic and health survey: a geographically weighted regression analysis	ArcGIS 10.7 and MGWR 2.0	Ethiopia	Research result show that in the analysis spatial identified cluster main is in the Southeast Oromia region and throughout Somalia. The GWR analysis found that that formal education , use contraception type pills / injections / implants is factor the predictor (Tessema et al., 2020)
4	Beminate Lemma SeifuI , Getayeneh Antehunegn Tesema, Bezawit Melak Fentie, Tirualem Zeleke Yehuala , Abdulkerim Hassen Moloro , Kusse Urmale Mare	Geographical variation in hotspots of stunting among under-five children in Ethiopia: A geographically weighted regression and multilevel robust Poisson regression analysis	ArcGIS 10.7	Ethiopia	Research result show that prevalence of stunting is widespread with pattern geographically clustered . Obtained a number of significant stunting hotspot areas are in the western and southern Afar regions , Tigray, Amhara and eastern SNNPR . Some factor like level education , income , distance birth and age child become factor determinant variation spatial Stunting (Seifu et al., 2024)
5	Daniel Gashaneh BelayI , Shumet Mebrat Adane, Oshe Lemita Ferede, Ayenew Molla Lakew	Geographically weighted regression analysis of anemia and its associated factors among reproductive aged women in Ethiopia using 2016 demographic and health survey	SaTscan and ArcGIS 10.7	Ethiopia	Research result show that in the analysis spatial identified cluster main is in the Southeast Oromia region and throughout Somalia. The GWR analysis found that that formal education , use contraception type pills / injections / implants reduce anemia . Risk anemia occurs in women with child more from One in 5 years as well as to women who have Marry with ownership member family > 5 (Belay et al., 2022)
6	Tsion Mulat Tebeje , Kassahun Alemu Gelaye , Yazachew Moges Chekol , Tigabu Kidie Tesfie , Negalgn Byadgie Gelaw , Kusse Urmale Mare, Beminate Lemma Seifu	Geographically weighted regression analysis to assess hotspots of early sexual initiation and associated factors in Ethiopia	ArcGIS 10.7	Ethiopia	Research result show that there is variation dominant spatial in several regions in Ethiopia . Several regions in Ethiopia are identified as ESI hotspot points . Some significant variables with variation Esi spatial includes single status , rural areas , marital status , and Education level (Tebeje, Gelaye, et al., 2024)
7	Ihsan Abbas Jasim, Moheb Kamil Fileeh , Mustafa A. Ebrahhem , Laheab A. Al - Maliki, Sohaib K. Al - Mamoori , Nadhir Al - Ansari	Geographically weighted regression model for physical, social, and economic factors influencing the COVID - 19 pandemic spreading	Not mentioned	Wasit Governorate, Iraq	GWR analysis explains that there is connection between all over variables independent (physical, social and economic) with spread of COVID 19 (Jasim et al., 2022)
8	Farzana Sher Muhammad, Sharifah Muhairah Shahabudin and Muzalwana Binti Abdul Talib	Measuring spatial inequalities in maternal and child mortality in Pakistan: evidence from geographically weighted regression	GeoDa	Pakistan	The results of the analysis on the ratio inequality For The District Mortality Index (DMI) shows that districts in the decile >16 times more prone to to death compared to with district with decile < 16. In addition , the district of Baluchistan has heterogeneity extreme spatial variability in the DMI. GWR analysis also shows that quintile index wealth own impact spatial in a way significant on DMI (Muhammad et al., 2024)

No	Writer	Title	Software	Geographical Area	Results
9	Samuel HailegebreaII , Yosef Haile, Binyam Tariku SebokaI , Ermias Bekele Enyew , Tamiru Shibiru , Zeleke Abebaw Mekonnen, Shegaw Anagaw Mengiste	Modeling spatial determinants of initiation of breastfeeding in Ethiopia: A geographically weighted regression analysis	ArcGIS 10.7	Ethiopia	Research result show that initiation breast-feed early in a way spatial varies across Ethiopia. Hotspot areas (at risk) high) are the Amhara, Agar and Tigray regions. Some variables predictor variation spatial in a way significant is religion/ belief , index wealth , operations caesarean section , examination post birth baby and size baby moment born (Hailegebreal et al., 2022)
10	Tadesse Tarik Tamir, Berhan Tekeba , Enyew Getaneh Mekonen, Alebachew Ferede Zegeye and Deresse Abebe Gebrehana	Spatial heterogeneity and predictions of stunting among under five children in Mozambique : a geographically weighted regression	ArcGIS 10.7	Mozambique	Research result show that prevalence of stunting in children age < 5 years in Mozambique identified some of the areas including as hotspot area (risk high) stunting. Obtained a number of factor significant predictors with heterogeneity spatial on stunting including is index wealth House ladder as well as age mother (15-19 years) (Tamir et al., 2024)
11	Jaameeta Kurji , Charles Thickstun, Gebeyehu Bulcha , Monica Taljaard, Ziqi Li and Manisha A. Kulkarni	Spatial variability in factors influencing maternal health service use in Jimma Zone, Ethiopia: a geographically-weighted regression analysis	ArcGIS Pro	Jimma Zone, Ethiopia	Research result show that identified existence variability significant spatial relationship all services and factors predictor (Kurji et al., 2021)
12	Jihye Lim and Jong-Ho Park	A Predictive Model of Regional Dementia Prevalence Using Geographic Weighted Regression Analysis	IBM SPSS 27.0 and ArcGIS 10.3	South Korea	GWR analysis shows that level education , habits walking , prevalence hypertension and a low sodium diet as factor predictor dementia (Lim & Park, 2022)
13	Seblewongel Tigabu , Alemneh Mekuriaw Liyew and Bisrat Misganaw Geremew	Modeling spatial determinants of teenage pregnancy in Ethiopia; geographically weighted regression	ArcGIS Pro 2.6.0	Ethiopia	Analysis results exploration explain that area risky tall pregnancy teenager found in the Somali, Afar, Oromia and Hareri regions . Some variables predictor related spatial significant with variation spatial pregnancy teenagers in Ethiopia are education base , index riches poorer , use contraception and methods contraception traditional (Tigabu et al., 2021)
14	Binyam Tariku Seboka , Samuel Hailegebreal , Tizalegn Tesfaye Mamo, Delelegn Emwodew Yehualashet , Girma Gilano , Robel Hussen Kabthymer , Helen Ali Ewune , Reta Kassa, Mary Abera Debisa , Mulugeta Namaro Yawo, Habtamu Endashaw , Abel Desalegn Demeke and Getanew Aschalew Tesfa1	Spatial trends and projections of chronic malnutrition among children under 5 years of age in Ethiopia from 2011 to 2019: a geographically weighted regression analysis	ArcGIS 10.8	Ethiopia	Research result show that group with high prevalence of stunting under 5 years in a way consistent observed in the region of the section Northern Ethiopia includes Tigray, Amhara, Afar and Benishangul-Gumus. Other identified regions is part southern Ethiopia and the Somali region. The results of the analysis regression spatial show that variation geographically observed in stunting in toddlers own correlation significant with poor sanitation , index poor welfare , patterns eat something that is not meet , place residence and level education Mother (Seboka et al., 2022)

No	Writer	Title	Software	Geographical Area	Results
15	Gezachew Gebeyehu Arega, Aweke Abebaw Mitku, Nuru Mohammaed Hussen, Shegaw Mamaru Awoke, Haymanot Berelie Berehan and Kasanhe Jigar Alem	Spatial variation of short birth intervals and their determinant factors among reproductive women in Ethiopia using a geographically weighted regression model	ArcGIS 10.8	Ethiopia	Research result explain that in a way significant there is Clustering of SBI (short birth interval) in administrative zones in Ethiopia. Several areas were identified risky SBI high areas are Jarar, Doolo , Shabelle, Afder , Liben, Korahe , Nogob , West Harerge , Guji , Sidama and Assosa zones (Arega et al., 2024)
16	Huihui Zhang, Yini Liu, Fangyao Chen, Baibing Mi, Lingxia Zeng and Leilei Pei	The effect of sociodemographic factors on COVID-19 incidence of 342 cities in China: a geographically weighted regression model analysis	ArcGIS 10.2	China	Research result explain that there is effect potential from factor sociodemographics to COVID 19 incident . Some variables significant predictors own risk tall against COVID 19 includes city with product domestic high gross domestic product (GDP) , limited source Power health , distance more short to Wuhan (Zhang et al., 2021)
17	Betelhem Abebe Andargie , Emebet Birhanu Lealem , Dessie Abebaw Angaw	Trend, spatial distribution, and factors associated with HIV testing uptake among pregnant women in Ethiopia, based on 2005–2016 Ethiopia demographic and health survey: A multivariate decomposition analysis and geographically weighted regression	ArcGIS 10.7.1	Ethiopia	Study show that there is variation spatial from proportion low and low HIV testing No random . Hotspot cluster (point vulnerable) were identified in several areas. Some predictor to variation significant spatial is low knowledge HIV transmission from Mother to children , low visit antenatal care , low media exposure as well availability facility health (Andargie et al., 2024)
18	Samuel HailegebreaII , Firehiwot Haile, Yosef Haile, Atsedu Endale Simegn , Ermias Bekele Enyew	Using geographically weighted regression analysis to assess predictors of home birth hot spots in Ethiopia	Brittle OrdGi *	Ethiopia	Regression results spatial explain that the Somali, Afar and SNNPR regions are local areas with risk tall For labor at home . Some predictor of areas with birth hotspots At home among them is Woman stay in rural areas , women No educated , index low wealth , Islamic religion as well women who don't do ANC visits (Hailegebreal et al., 2023)
19	Amare Muche, Mequannent Sharew MelakuI , Erkihun Tadesse Amsalu, Metadel Adane	Using geographically weighted regression analysis to cluster under-nutrition and its predictors among under-five children in Ethiopia: Evidence from demographic and health survey	ArcGIS 10.5	Ethiopia	Research result explain that lack nutrition in children show existence variation geographically at the zonal level in Ethiopia. The areas included in hotspots (risk high) are the areas of the Tigray zone and the Benshangul zone . GWR analysis shows that variables predictor varies in Stunting, Wasting and Underweight (Muche et al., 2021)

Table 2. List of Articles " Research Public Health field uses Analysis *Multiscale Geographically Weighted Regression* (MGWR)"

No	Writer	Title	Software	Geographical Area	Results
1	Tsion Mulat TebejeI , Mesfin Abebe, Fantu Mamo Aragaw , Beminate Lemma SeifuI , Kusse Urmale Mare, Ever Siyoum Shewarega , Gizaw Sisay, Binyam Tariku SebokaI	A multiscale geographically weighted regression analysis of teenage pregnancy and associated factors among adolescents aged 15 to 19 in Ethiopia using the 2019 mini-demographic and health survey	ArcGIS 20.7	Ethiopia	Research result show that prevalence pregnancy teenager ages 15-19 years in a way spatial clustered throughout the region. Several areas were identified significant as hotspots are Central and South Afar, North, Central and West Gambella , Central Oromia east and south and eastern Somalia . In the GWR analysis, it was found that that significant predictors from variation spatial pregnancy teenager is blind letters and marriage (Tebeje, Abebe, et al., 2024)
2	Ayodeji Emmanuel Iyandaa , Richard Adelekeb , Yongmei Lua, Tolulope Osayomib , Adeleye Adaralegbec , Mayowa Lasodea , Ngozi J. Chima- Adaralegbec , Adedoyin M. Osundina	A retrospective cross-national examination of COVID-19 outbreak in 175 countries: a multiscale geographically weighted regression analysis (January 11-June 28, 2020)	Not mentioned	175 countries (global)	Research result show that a number of variables factor risk like group aged 15-64 years , percentage smokers and spending in a way significant explain global variations of the COVID-19 outbreak in 175 countries (Okesina et al., 2024)
3	Rutendo Birri Makota, Eustasius Musenge	Spatial heterogeneity in relationship between district patterns of HIV incidence and covariates in Zimbabwe_ a multi-scale geographically weighted regression analysis	Getis -Ord Gi*, ArcGIS Pro	Zimbabwe	Research result obtained dot, dot, dot the HIV epidemic in the southern and western regions of Zimbabwe is different with the eastern and northern regions . In addition , certain areas (districts) in the Matabeleland province south and north show existence clustering of HIV incidents in the periods 2005-2006, 2010-2011 and 2015 (Birri Makota & Musenge, 2023)
4	Xuerui Shi Gabriel Hoh Teck Ling, Pau Chung Leng, Noradila Rusli, Ak Mohd Rafiq Ak Matusin	Associations between institutional-social-ecological factors and COVID -19 case-fatality: Evidence from 134 countries using multiscale geographically weighted regression (MGWR)	Not mentioned	134 countries	Research result show that a number of variables independent in category institutional , social and ecological (SES factors) have heterogeneity spatially which significant to COVID 19 deaths (Shi et al., 2023)
5	Tegene Atamenta Kitaw , Biruk Beletew Abate, Befkad Derese Tilahun, Ribka Nigatu Haile	Geospatial pattern of HIV seropositivity and its predictors among women in Ethiopia. A spatial and multiscale geographically weighted regression analysis	ArcGIS Pro, SatScan 9.6 and Getis -Ord Gi*	Ethiopia	Research result show that HIV seropositivity in women in Ethiopia was identified distributed in a way No random . Several areas were identified significant as HIV seropositive hotspots are Addis Ababa, Harari, Dire Dawa and Gambela . Some variables predictor variation geographical is index wealth , marital status , ownership partner sexual more from one and age First Again connection sexual (Kitaw et al., 2024)
6	Deresse Abebe Gebrehana , Tadesse Tarik Tamir, Gebretsadik Endeshaw Molla, Yishak Kebede, Dejen Tegegne, Solomon Gedlu Nigatu	Spatial variation and predictors of anemia among women of reproductive age in Mozambique, 2022/23 : a multiscale	ArcGIS 10.7	Mozambique	Research result explain that prevalence anemia in women age reproduction in Mozambique identified contain variability geographically . Some areas with number anemia tall are Nampula, Zambezia and Sofala . In addition , each region has variables predictor varies

No	Writer	Title	Software	Geographical Area	Results
	and Araya Mesfin Nigatu	geographically weighted regression			which is significant relate in a way spatial with anemia . The predictive factor in the Tete and Manica regions was drinking water . No worthy . Underweight as predictor in the Niassa region. Meanwhile use contraception and obesity status as effect protection in the Nampula, Zambezia, Niassa and Capo Delgado regions (Gebrehana et al., 2025)
7	Tsion Mulat Tebeje , Beminate Lemma Seifu, Kusse Urmale Mare, Yordanos Sisay Asgedom, Zufan Alamrie Asmare , Hiwot Altaye Asebe , Abdu Hailu Shibeshi , Afework Alemu Lombebo , Kebede Gemeda Sabo, Bezawit Melak Fente and Bizunesh Fantahun Kase	Geospatial determinants and spatio - temporal variation of early initiation of breastfeeding and exclusive breastfeeding in Ethiopia from 2011 to 2019, a multiscale geographically weighted regression analysis	ArcGIS 10.7	Ethiopia	Analysis results spatial show variation significant spatial changes in EIBF and EBF across Ethiopia. Identified some low-lying areas The prevalence of EIBF includes the Tigray and Amhara regions. While the low-lying areas The prevalence of EBF is in the Afar and Somali regions. The variable predictor significant to variation EIBF spatial is religion, parity , no existence visit antenatal and delivery nursing Caesar (Tebeje, Seifu, et al., 2024)
8	Fasika Diress , Yilkal Negesse , Daniel Tarekegn Worede , Daniel Bekele Ketema, Wodaje Geitaneh & Habtamu Temesgen	Multilevel and geographically weighted regression analysis of factors associated with full immunization among children aged 12–23 months in Ethiopia	ArGIS 10.8 and MGWR 2.2	Ethiopia	Research result show that coverage immunization complete in the Ethiopian region identified varies in a way spatial distribution significant spatial impact on immunization complete ages 12-23 months detected in the regions of Northern Tigray, Addis Ababa, Central Oromia and Southeastern Amhara. Several variables the predictor is proportion resident rural , proportion Woman aged 35-44 years , proportion Woman with ANC 4 to on as well as proportion Woman with PNC (Diress et al., 2024)
9	Esmaeil Khedmati Morasae , Daniel W. Derbyshire, Payam Amini, Tahera Ebrahimi	Social determinants of spatial inequalities in COVID-19 outcomes across England: A multiscale geographically weighted regression analysis	Not mentioned	English	Analysis results spatial show that identified existence heterogeneity in effect demographics , health , social and economic against COVID 19 at the level local in England . Concentration main COVID-19 morbidity and mortality are the northwest and southeast regions English . Some variables predictor covering age , type gender , diabetes level and complexity economy (Khedmati Morasae et al., 2024)
10	Shawky Mansour, Abdullah Al Kindi, Alkhattab Al-Said, Adham Al-Said, Peter Atkinson	Sociodemographic determinants of COVID-19 incidence rates in Oman: Geospatial modeling using multiscale geographically weighted regression (MGWR)	ArcGIS 10.6	Oman	Research result explain that connection between covariates and levels the COVID 19 incident has variation in a way geographically identified a number of variables significant predictors among them population elderly age > 65 years , density population , place sleep at home Sick as well as diabetes rate (Mansour et al., 2020)
11	Taylor M. Oshan, Jordan P. Smith and A. Stewart Fotheringham	Targeting the spatial context of obesity determinants via multiscale	Not mentioned	Arizona, United States	Study explain that percentage SNAP recipients and percentage age resident Hispanic as well as prevalence desert

No	Writer	Title	Software	Geographical Area	Results
		geographically weighted regression			food is most influential variables to Obesity (Oshan et al., 2020)

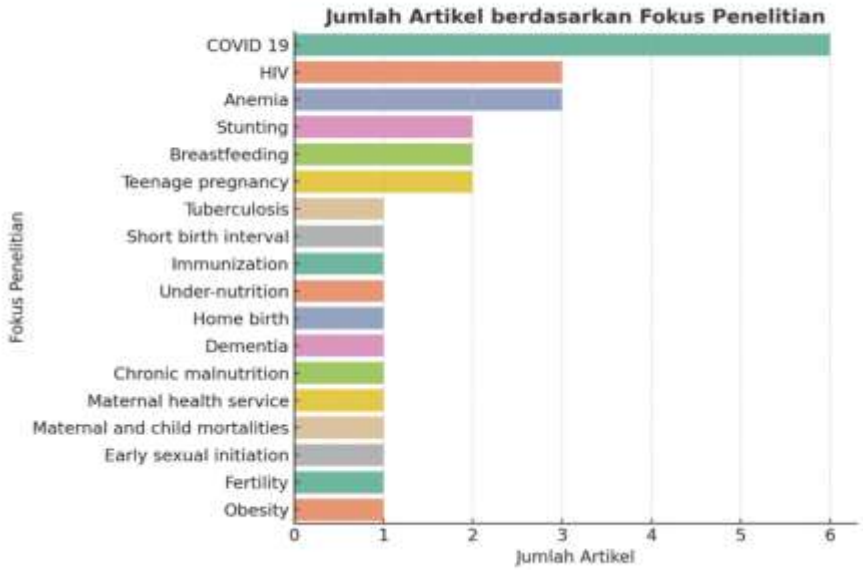

Diagram 1. Distribution Main Research Topics Approach GWR Analysis

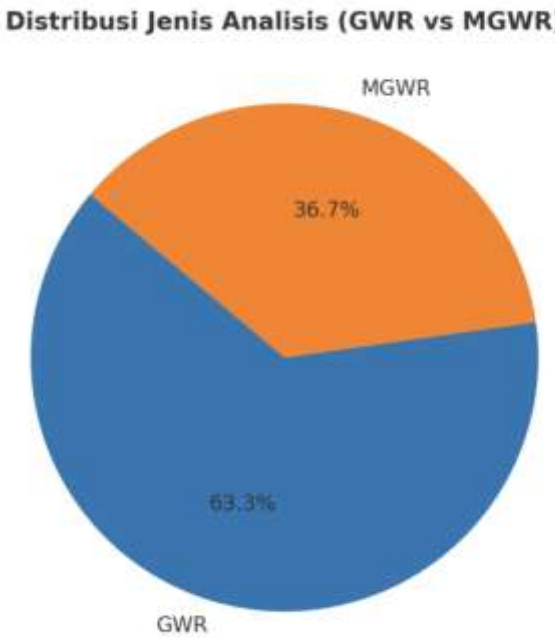

Diagram 2. Distribution Use of GWR Analysis Types

DISCUSSION

1. Approach Epidemiology Spatial in Public Health Research

Recently, the geographic location of disease occurrence has begun to receive special attention as a crucial element that needs to be considered in the dynamics of disease epidemiology. As a result, spatial epidemiology has emerged as a new approach to information gathering and disease control. In spatial epidemiology, place is broadly defined to include the living space or place where individuals within a group live. The components of

place are explored as characteristics beyond the individual related to the social and environmental experiences of individuals and how these interact to influence health (Cuadros et al., 2021) . Spatial epidemiology is a branch of epidemiology. The goal of spatial epidemiology is to describe and analyze the geographic variation of a disease as it relates to demographic, environmental, social, economic, genetic, and other factors using geographic information systems and other spatial techniques (Li et al., 2022) .

Development study field health public For provision of quality data and information Keep going attempted . One of the among them is study based epidemiology spatial with use approach based on character geographical . One of the improvement quality results his research is with use analysis *Geographical Weighted Regression* . Analysis *Geographical Weighted Regression (GWR)* or Regression weighted geographical used as method sophisticated calculating average association local between indicator (variable predictor) and perform regression parameter estimates for each district /region. GWR is used as an instrument that is capable detect variation spatial (Muhammad et al., 2024) .

Effect spatial is very important in the field health . Variations or inequality spatial in health related close with paradigm determinant social Health . Unequal distribution of social, economic, and environmental factors can contribute to differences in health status within a community (Muhammad et al., 2024) . Health research generally uses non-spatial methods, which are limited by the inability to generate spatial information because they do not measure coordinate information in study observations. This results in biased and inconsistent coefficient estimates. To address this bias, the spatial regression (GWR) technique is used. The GWR technique can incorporate coordinate data to generate separate estimated coefficients of predictive factors for health problems for each measurement area and identify public health disparities in each area (Muhammad et al., 2024)

Study spatial motivated by conditions when various intervention health has carried out for prevention anemia in children in the Ethiopian region. But identified that to high spatial heterogeneity (variation) in anemia across different regions in Ethiopia. Therefore that , done study with focus consider characteristics geographically in the Ethiopian region for reduce impact from heterogeneity the (Tesema et al., 2021) . GWR analysis is used For exploration connection spatial between variables dependent and variable the predictor . In the GWR analysis , there are term *Neighborhood* or *bandwidth* namely the distance band or amount neighbors used For every equality regression . *Bandwidth* is the parameter used in regression spatial . Regression can used For control The effectiveness of the resulting model . The complexity of a spatial regression model is not only based on the number of variables in the model, but also depends on the bandwidth. There are three types of bandwidth models that can be used to determine the best model in spatial regression, namely AICc, CV, and *bandwidth parameters.* (Tesema et al., 2021) .

2. *Geographically Weighted Regression* (GWR) as an Analysis Tool Innovative

GWR analysis can give estimate parametric local from variables model predictors that vary across the study area. The resulting GWR model can used For identification distribution spatial problem health as well as availability information map point vulnerable problem health in the research area. Research output using GWR can used For intervention problem better health effective and efficient (Tessema et al., 2020) . Research in Ethiopia on Stunting explains GWR results provide map detailed about Stunting points and factor predictors in each research area . Research This prove that there is implications variation geographical to problem health in various regions. Research results can used For assist program planners to designing steps health community . Prevention problem health need implementation intervention health communities that are focused and targeted at groups risk height and geographic area certain (Seifu et al., 2024) .

Study about behavior fertility risky tall with identify various related factors , one among them is factor from characteristics socio-demographic (place stay , level education , marital status). Study results previously explain that although various study about measurement magnitude and impact from behavior fertility risky tall has done , not yet There is study national that takes into account factor risk variability geographical from behavior fertility risky tall (Tessema et al., 2020) . GWR analysis is used For take into account connection between possible variables own variation depending on location Geographical . GWR analyzes the relationships between variables in different regression models based on space/region. The GWR modeling results obtained take into account the spatial influence of the data sample and assign different regression parameters to each observation in the study area (Tebeje, Gelaye, et al., 2024) .

Use analysis spatial in modeling connection spatial use GWR analysis is strength from A study For identification contributing factors to variation spatial problem health (Belay et al., 2022) . Research about identification anemia and factors The predictor was also conducted in Ethiopia. The research This explain that identified that prevalence anemia own cluster in a way spatial especially in the Southeast Oromia region and the entire Somali region. Research This do approach spatial through GWR analysis . The results of the GWR analysis prove that that factor predictor such as formal education, use of contraception type pills / injections / implants can reduce risk anemia . In addition , GWR analysis also identifies a number of variables predictors that become trigger improvement risk anemia among them is Woman with ownership child more from One in 5 - year period . Anemia among Woman age productive proven own variation significant spatial distribution across Ethiopia (Belay et al., 2022) .

3. Case Studies of GWR Implementation in Various Regions of the World

A number of study previously related the use of GWR has conducted . Research identification prevalence anemia in a way spatial along with factor the predictor explain that prevalence anemia in Ethiopia is proven

varies in a way spatial . There is a number of point identified hot spots (*hotspots*) significant These include the Western and Southern Tigray regions, parts of Amhara, Southern, Central and Western Afar, Eastern Gambella , and the Northwest SNNPR. variables significant predictors is single status , place stay rural and not own formal education . Research results use approach spatial can used by stakeholders policy in connection with intervention health the community that will carried out . Intervention health can prioritized in problem hotspot areas health and focused on variables predictors that are significant relate with problem health (Tebeje, Gelaye, et al., 2024) .

GWR can also used as instrument For exploration varying relationships in a way spatial (Jasim et al., 2022) . Research about prevalence of COVID-19 in Iraq done through approach in a way spatial use GWR analysis . GWR analysis is used For exploration influence various factor to distribution spatial of COVID-19 that occurred in the Iraq region . Identification connection between prevalence of COVID-19 and its factors expected can help in the future For restrictions distribution COVID-19 pandemic (Jasim et al., 2022) . Other research to evaluate factor sociodemographics with COVID 19 incident in China using GWR analysis , proving that there is effect potential from factor sociodemographics to COVID-19 incident in China. Research with using GWR is capable produce more models in accordance For investigate impact sociodemographics against COVID 19. Research this also explains that variables sociodemographics such as areas with product domestic gross (GDP), source Power health limited , and distance more short to Wuhan has risk more tall For the occurrence of COVID 19 (Zhang et al., 2021) .

Study about HIV prevalence through approach spatial show that in the period 2005 – 2016 there was improvement trend proportion HIV testing on mothers pregnant . Distribution data obtained spatial low proportion HIV testing among Mother pregnant in a way consistent in the 2005 period in the Tigray and SNNPR regions. Then shifted in 2016 to the Benishangul - Gumuz , Somalia, SNNPR, Gambella and Oromia regions . The low factor knowledge about MTCT of HIV, ANC visits , facility- based deliveries health as well as Still lack of media exposure is predictor significant from the hotspot category area proportion low HIV test in mothers pregnant (Andargie et al., 2024) .

Another study investigated maternal and child mortality rates in Pakistan. This study was based on the significant increase in maternal and child mortality rates and the fact that significant disparities in health outcome data persist across districts in Pakistan. There is a paucity of research examining maternal and child mortality rates in Pakistan, and there is a lack of specific considerations for assessing mortality rates based on spatial differences. These differences in geographic characteristics across regions in Pakistan serve as a basis for researchers and health workers to examine the epidemiology, risk factors, and causes associated with mortality rates in Pakistan (Muhammad et al., 2024) .

Another study using GWR demonstrated the ability of this analysis to predict *hotspot areas* (risk areas) related to home birth activities in Ethiopia. This study identified several areas with a high risk of home births, including Somalia, Afar, and the SNNPR region in Ethiopia. Furthermore, spatial regression also showed that women in rural areas, those with low education, those living in households with a low wealth index, and those who had never attended ANC visits were predictors of home birth hotspots (Hailegebreal et al., 2023) . Research on the use of the GWR approach to breastfeeding behavior in Ethiopia suggests that the results of GWR analysis can be used by policymakers and health planners to design effective health intervention programs in hotspot areas of health problems (Hailegebreal et al., 2022) .

Study about Stunting in Mozambique using GWR explains that results identification heterogeneity spatial on stunting patterns proves that approach use One enforced size For all areas for overcome stunting problem in Mozambique No will effective . On the other hand , the use of tailored strategies in a way specific every location with consider variables predictors of stunting effective can overcome challenge health public (Tamir et al., 2024) . Results of stunting research in the Mozambique region using GWR obtained a number of Stunting *hotspots* include the regions of Nampula, Cabo Delgado, Manica, Zambezia, Niassa, and Tete. In addition , a number of related predictors with heterogeneity spatial stunting in Mozambique covering index riches House stairs and age mother (15-19 years) (Tamir et al., 2024) .

4. Implications and Recommendations Policy Spatial Data Based

Identify risk areas height and predictors main from regional variations can become source information important based proof for the makers policy and practitioners health public in develop targeted strategies (Tamir et al., 2024) . Implications stunting research with approach spatial use GWR analysis provides recommendation for the makers policies in order to be able to prioritize targeted interventions in identified areas as a hotspot in research . The implementation of the strategy is also adjusted For overcome predictor specific stunting that differs in each region (Tamir et al., 2024) .

Study about variation spatial related distance birth prove that there is trend grouping distance birth significant short-term development in the administrative zones of Ethiopia. Several areas were identified risky tall among them are Jarar, Doolo , Shabelle, Afder , Liben, Korahe , Nogob , West Harerge , Guji , Sidama and Assosa . Study This recommend that the results study through approach geographical This can made into material considerations of decision makers decision at level national and area For prioritize service family planning For overcome problem distance birth focused to these hotspot areas (Arega et al., 2024) . In the study In this case , GWR analysis is used For modeling connection varying spatial between problem health and variables predictor . Coefficient from variables significant predictors will mapped For determine predictor with influence the

biggest in proportion problem health that occurs throughout the geographic area in the research area (Arega et al., 2024) .

Research that focuses on factors use service health mother and variability spatial in Jimma, Ethiopia using GWR approach is based on behind by some condition . Research the explain that various characteristics individual like attitude to service childbirth , factors between personal (involvement Woman in taking decision) proven influence use service health mother . However , the relationship between variables the measured through regression models with assumptions as stationary relationship or constant relationship throughout the study area . Estimates from results regression the tend cover variation important things that exist in each research area . Conditions other is there is dependence spatial Where location show similar values with location neighbor / nearest and causes the residuals to be autocorrelated spatial . Condition This will cause occurrence violation assumptions independence and the same error *term* in the regression model general results produced (Kurji et al., 2021) .

Study about nutrition not enough with approach spatial research was also conducted in Ethiopia. This conclude that distribution spatial nutrition not enough form trend group intervention nutrition based geographical important done especially do mobilization source Power additions made For reduce burden lack nutrition in children in identified areas as a hotspot area (Muche et al., 2021) . GWR analysis can help identification dot, dot, dot vulnerable pregnancy significant adolescents in the Ethiopian region . GWR analysis proves that the Afar, Somalia and Hareri regions are hotspot areas (prone) to the occurrence of earthquakes pregnancy teenagers . In general geographical , increase risk pregnancy age teenager occurs in areas with proportion tall woman with No use contraception as well as type contraception traditional . On the other hand , the decline risk pregnancy teenager occurred in the area with proportion Woman educated medium tall (Tigabu et al ., 2021) . Strong geospatial techniques can serve trend time and geospatial problem health , for example in stunting data. Research with approach geospatial can also do exploration predictor spatial from variations in stunting through regression global and local geospatial research with approach geospatial can made into proof comprehensive about stunting trends , inequality based geographical as well as predictor spatial . Research results geospatial stunting in Ethiopia show the need There is policy specifically at the regional and district levels in accordance results study (Seboka et al., 2022) .

Studies on research previously on become proof that study use analysis *Geographically Weighted Regression* (GWR) in fields health public specifically through approach epidemiology spatial has start developed for improvement quality results quality research . The main basis various study with approach epidemiology spatial through use GWR analysis is reduction of research bias from factor heterogeneity of source data variation spatially in various areas at the location research . Each research on own various implications For recommendation policy field health public For increase implementation of intervention programs effective and efficient health and focused on appropriate areas .

CONCLUSION AND SUGGESTIONS

Based on results study literature in as many as 30 articles with focus use Analysis *Geographically Weighted Regression* in study field epidemiology spatial in health society , obtained results in a way general that use GWR analysis is quite popular in health public specifically through approach epidemiology spatial . Use GWR analysis was performed For objective improvement quality study For reduce bias in results study Because factor variation spatial . Some study on show GWR analysis can applied to various field good for disease infectious , disease No infectious and problem health others . Final result GWR analysis will provide accurate data about point risk height (*hotspot*) and point risk low (*coldspot*) from problem health in each area studied in a way spatial . The results of the GWR analysis can used as supporting data For recommendation material policy for stakeholders policy field health . Needed development study more carry on use GWR analysis in epidemiology spatial For help map problem health based on location geographical . Research results development the can recommended to stakeholders policy health .

Thank You

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