

Georeferencing in Health: Strategic Tool for the Implementation of Public Policies in Primary Care and Chronic Multimorbidity Management

Georreferenciación en Salud: Herramienta Estratégica para la Implementación de Políticas Públicas en la Atención Primaria y la Gestión de Multimorbilidad Crónica

Mba'erekochauka tesãigua: tembipuru oñemoingeva'erã sãmbyhyreko opavaveguápe ñeñangareko'ypy ha mba'asyeta hypy'üva ñemongu'erã

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ABSTRACT

Georeferencing in health is fundamental in the current era of medicine, since, through the assignment of geographic coordinates, it offers a powerful tool to better understand the distribution of diseases and identification of vulnerable population, being able to predict high-risk areas in the territory. The objective of this review article is to analyze the implementation of risk typification process in primary health care policy, being especially the georeferencing a contribution in chronicity studies under multimorbidity context. The methodology used is a survey of information resulting from paper analysis under MESH criteria in search engines, mainly Pubmed. The results show that georeferencing in health is a valid instrument to know and deepen public health policies, especially in primary health care, to intervene in territorial and community processes, as long as it is supported by community assets.

One of the relevant conclusions is that this geoprocessing of data generates great impact, since it allows not only to locate events in a territory, but also, by means of probabilistic processes, to estimate evaluations of combined effects of spatial variables that are of special analysis for clusters, around sources of exposure of some specific epidemiological situation. At the same time, this geolocation makes it possible to subsidize

Consequently, it allows optimal planning of health services in their delivery of productive factors, facing epidemiological inequalities, developing territorial impact work.

KEYWORDS: health georeferencing; public policy; chronicity; primary care; multimorbidity

RESUMEN

La georreferenciación en salud es fundamental en la era actual de la medicina, ya que, por medio de la asignación de coordenadas geográficas, ofrece una poderosa herramienta

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para comprender mejor la distribución de enfermedades e identificación de población vulnerable, pudiendo predecir áreas de alto riesgo en el territorio. El objetivo de este artículo de revisión es analizar la implementación de proceso de tipificación de riesgo en la política de atención primaria, siendo en especial la georreferenciación un aporte en estudios de cronicidad bajo contexto de multimorbilidad. Metodología: revisión sistemática de 65 papers alcance (scoping review) según metodología rigurosa por medio de análisis PRISMA. Resultados muestran que la georreferenciación en salud es un instrumento muy importante para conocer y profundizar las políticas públicas de salud y que estas estén concordantes al cuidado del ambiente, en especial de la atención primaria, para intervenir en los procesos territoriales y comunitarios. Esta metodología se apoya en los activos comunitarios, en el concepto de la salutogénesis y entrega una priorización espacial para intervenir en ciertas poblaciones, más aún cuando se debe trabajar en apoyo a usuarios con multimorbilidad crónica. Sería relevante a futuro analizar las implicaciones prácticas de la georreferenciación aplicada en políticas públicas de salud.

PALABRAS CLAVE: georreferenciación en salud; política pública; cronicidad; atención primaria; multimorbilidad.

HAIPAVY

Mba'erekohachauka tesãi rehegua tuicha mba'e pohãreko agãguápe, péicha, peteĩtekohachauka ñembohéra rupive, oñekuave'ẽ peteĩ tembipuru mbarete oñeikũmbyporãve hagũa mba'asykuéra renda ha ojehechakuaa mávapa umi tapicha hekokangyvéva, ikatuhápe ojeporavóma tenda'i hi'ãngave'ỹvéva tekohápe. Ko haipy'i jehecha jehupytyvoirãhína oñehesa'ỹijóta mba'éichapa oñembohape ãngave'ỹ reko ñeñangareko ypy sãmbhyhyrekópe, ojehechávo poravopyréramo tekohachuka peteĩ mba'eme'ẽ mba'asypuku kuaapyhyrã mba'asyeta apytépe. Taperekokuaaty: jehechajey ohupytyva 65 kuatia hekópe (jehchajey ohupytyva) he'iháicha taperekokuaaty mbarete PRISMA ñehesa'ỹijo rupive. Ha'arõmby: ohechauka pe tekohachauka tesãi rekópe ha'eha peteĩ tembipuru tuichamba'éva ojekuaa ha ojepyguara hagũa sãmbhyhyreko opavavegua tesãi rekópe ha kóva toĩ tekoha ñeñangareko ndive, poravopyréramo ñeñangareko ypy, oñemba'apo hagũa mba'e'apo tenda ha atekohaguápe. Ko taperekokuaaty ojeko tekoha mba'aitakuéra rehe, pe tesãi'ypy (salutogénesis) he'iséva ha ome'ẽ peteĩ ñemotenonde pa'ũgua oñemba'apóvo tavaygua aty'íre, umi tenda oñemba'apoveva'erãha pytyvõme tapicha imba'asyetávare. Iporãva'erã tenonderãvo oñehesa'ỹijo mba'éichapa tekohachauka jepuru oíke sãmbhyhyreko tesãi opavavegua apytépe.

ÑE'Ë YTA: tekohachauka tesãi rekópe; sãmbhyhyreko opavavegua; mba'asypuku; ñeñangareko ypy; mba'asyeta

INTRODUCTION

As stated by researcher Macinko et al, "the purpose of the PHC renewal process is to revitalize the capacity of countries to articulate a coordinated, effective and sustainable strategy that allows them to improve equity and face present and future health problems" (Macinko, Montenegro, Nebot Adell & Etienne 2017), a situation ratified in the Declaration of Montevideo, where it was commented that "a health system based on Primary Health Care orients its structures and functions towards the values of equity and social solidarity, and the right of every human being to enjoy the highest attainable degree of health without distinction of race, religion, political ideology or economic or social condition. The principles required to maintain such a system are the capacity to respond equitably and efficiently to the health needs of citizens, including the ability to monitor progress for continuous improvement and renewal" (World Health Organization, 2015).

But, knowing that public policies should aim to solve problems, it is understood that, in order to

do so, they should propose territorial solutions, responses to complex health situations that are nurtured by the social history of a community.

63% of deaths since 2010 in the world are due to non-communicable health diseases (World Health Organization, 2019) and under this situation, primary health care must implement rapid actions to reduce this situation.

What has happened in recent years is that these pathologies have become a true universal pandemic, therefore "social intervention in health must have a territorial view and awaken in the neighborhoods a sense of linkage to intervene in these indicators" (Llobera, 2019).

One of the activities to be carried out and which is the proposal of Deleuze et al. is the creation of a "dynamic of social situations, where a permanent mapping is required that diachronically accompanies the territory, which is not static, as it is permanently reconfigured" (Chilean Ministry of Health, 2021).

In Chile, "the main cause of death by major disease groups are those of the circulatory system, reporting a mortality rate of 142.6 per 100,000 inhabitants in 2010-2011 (approximately 30% of all deaths in the country). Of this group of diseases, ischemic heart disease and cerebrovascular disease account for 69% of cases, reporting a rate of 49.9 and 48.9 per 100,000 respectively" (Hosseinpour et al, 2012).

In the case of diabetes mellitus 2, "the epidemiological situation in Chile regarding this pathology is of great concern. Compared to 2003, the 2010 ENS recorded an increase in prevalence of more than double (Chilean Ministry of Health, 2020). The increase was from 4.2% to 9.4% in the adult population. If we also take into account the high burden that diabetes mellitus 2 generates to the country, an estimated 72,230 years of life lost due to disability (Pontificia Universidad Católica de Chile, 2017), it is extremely urgent to consider effective, integrated and comprehensive public health measures to control this epidemic. If we take into account the exponential growth of diabetes mellitus 2 and the burden it generates for the country, it is extremely urgent that different public health measures be taken to reduce non-communicable diseases (from now on NCDs)".

Regarding cerebrovascular pathologies in Chile, it can be said that "ischemic stroke represents approximately 65% of the cases of cardiovascular diseases. Ischemic stroke occurs mainly in middle-aged and elderly adults and is the main cause of morbidity and mortality in the elderly. This pathology has a high prevalence, 2.2% in the general population and 8% in those over 65 years of age, and is the leading cause of death in the Chilean population" (Ministry of Health of Chile, 2023).

According to a study by Lavados et al, "in Chile and worldwide, the pandemic of potentially modifiable individual lifestyles continues to be a major challenge because the prevalence of NCDs is increasing steadily over time. The country must reflect on how to make public health policies that effectively achieve the required behavioral change, not only at the individual level as has been proposed so far, but also at the sociocultural and structural roots of these health problems. Not innovating with respect to public policies regarding NCDs today in Chile will inexorably imply an increase in NCDs and associated health spending" (Lavados et al, 2015).

Under this scenario, the Ministry of Health of Chile, defined the ECICEP policy (Deleuze & Guattari, 1998), mentioned above, which, unlike others, has a recognition of the territory, in that, it requests Primary Care Health Centers, to develop a view of chronicity and multimorbidity. The challenge of this new public policy is to review the population

density in sectors of users with these pathologies and to be able to develop new strategies, leaving each establishment free to carry out this action.

Geoprocessing techniques have shown to obtain good results for the development and analysis of epidemiologically relevant areas, to achieve "monitoring, planning, validation of health actions, becoming a tool for analysis of event relationships, identifying sectors with more vulnerable population classifying different population risks" (Camara & Monteiro 2019).

METHODOLOGY

A scoping review was carried out according to a rigorous methodology using PRISMA analysis.

Two literature searches were performed. The first in Pubmed in English (August 2024), with the following search equation: (georeferencing and health and the application policies) obtaining 65 papers.

The second search was carried out in Google Scholar (August 2024), with the following search equation: (georeferencing in health) and (policies in primary care), obtaining 6950 papers.

Subsequently, the articles were evaluated according to their date of creation (last 12 years), resulting in 6100 papers, then the documents that were complete were established, resulting in 600 papers. Then, a complete study of these papers was carried out, leaving only those that met the following inclusion criteria:

Articles based on aspects of public policy implementation.

Articles that used georeferencing techniques in health with defined results.

Articles that used territorial analysis

Articles that carried out data treatment methodologies with georeferencing based on primary health care issues.

Articles that carried out data treatment methodologies on multimorbidity and chronicity in patients treated at the primary health care level.

Articles with full access

Therefore, we excluded papers that did not comply with the above, or, as previously expressed, had a publication date of 12 years or more.

Thus, 59 research studies were obtained, which were used for this review (Figure 1).

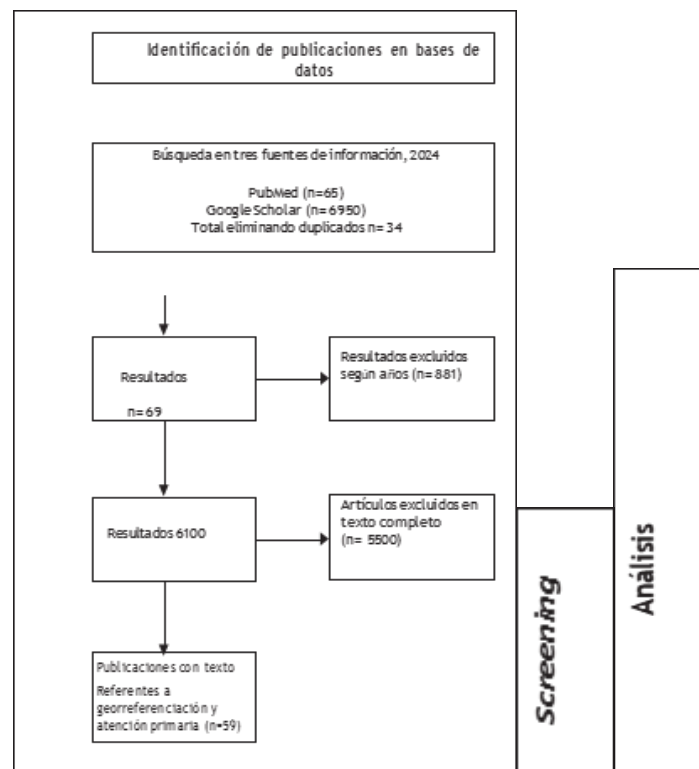


Figure 1. PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses. WOS: Web of Science.

RESULTS AND DISCUSSION

Georeferencing systems allow a quick analysis of the conditions of a territory, but they are also capable of projecting a situation into the future, with the expertise of the health professionals and technicians who attend to the needs of these populations. We will enhance this last sentence, subdividing the results obtained for a better understanding of the findings.

1.0 Benefits in spatial planning

In the study “spatial analysis in epidemiology” by the researchers Ana María Valbuena and Laura Rodríguez, both from the Industrial University of Santander, Spain, it is specified that “spatial analysis is a set of techniques that uses as inputs the geographical location of events that could be important for an epidemiological study and that allows to quickly perform spatial variability analysis” (Valbuena-Garcia et al, 2018).

In this work cited, the researchers conducted a review of spatial analysis methods that could be applied to epidemiology with the purpose of encouraging the study of these systems and promoting the incorporation of this technique in future researchers since, “they recognize that the

place where an individual or a population belongs are determinants for the health and disease relationship, however, they clarify that in most public health research an analysis of personal characteristics and in a given time predominates” (Valbuena-Garcia et al, 2018).

Spatial analysis uses a series of techniques and inputs that allow the spatial or geographic location of some events, but can also establish a series of attributes to those objects as established by the researcher (Goodchild et al, 1992).

As mentioned, the geo-referencing prediction model not only allows us to locate events in a territory, but, by means of probabilistic processes we can estimate evaluations of combined effects of spatial variables that are of special analysis for clusters around sources of exposure of some specific epidemiological situation (Goodchild et al., 1992).

How researchers Valbuena and Rodriguez (Valbuena-Garcia et al, 2018) establish it, this last form of analysis is a poisson distribution that establishes distance or proximity analysis study relationships, in studies of effects of environmental exposures incorporating spatial correlation analysis of data, a technique also

presented by Lawson et al, in a 2016 study. Among the conclusions of this research, it is established "that the georeferencing system in health, like epidemiological studies, analyzes the triad of time, place and host, thus being a powerful analysis tool that provides a current view on health, but also a perspective of future occurrence of health and disease events" (Lawson et al., 2016).

2.0 Impact on primary care

The research entitled "experiences, benefits and challenges of the use of geoprocessing for the development of Primary Health Care", by researchers Elizabeth Salinas, Francisco Chiaravalloti and Leandro Giatti, who conducted a systematic investigation of primary studies published in Spanish, English and Portuguese for seventeen years, identified one hundred and thirty-four articles demonstrating that the use of geoprocessing generates benefits that go beyond the technical benefits, with feasible limitations to be overcome. The authors state that "there has been a great deal of publicity about georeferencing in health, but there are very few studies in the world that have evaluated its implementation in a practical way, and those that have been able to do so have shown that its continuous use can increase the capacity to respond to the goals of Primary Health Care and even lead to good results in meeting the goals of sustainable development".

They explain that "the current 2030 agenda for sustainable development raises the need to implement integrative actions between different sectors to achieve the goals of promoting physical, mental health and social well-being, contributing with the principles of Primary Health Care and with the search for intersectoral and multidisciplinary actions, given the diversity of connections between health determinants" (Salinas et al, 2018).

They report that the use of geoprocessing can be an important tool for the process of self-evaluation of the actions of Primary Health Care itself, as also commented by Andrade et al, and its specific contribution "lies in the possibility of subsidizing derived measures towards smaller areas than in traditional approaches, with priority for local communities, where the possibilities of public policy intervention are greater" (Andrade et al, 2013), in the same tone the researcher Nascimento et al. comment that "despite the high growth in the acceptance and implementation of these geographic systems in the public health environment, there are still major Health Centers in the world that have not used them sufficiently in an experimental and practical way in the population" (Nascimento, Berto & Matias, 2007).

The concept of territorialization is reduced in the

practical, to a physical space and are not used creatively, thus wasting the potential of this tool that is also of local management, as presented by Carvalho and Ritter (Carvalho et al, 2005), (Ritter, Rosa & Flores, 2013).

Being of great importance for the development of Primary Health Care, georeferencing also complies with the sustainable development objectives of the United Nations development program, since its intersectoral nature, the need to exchange best practices and the virtues in the use of geoprocessing in public health, should allow the practical development of all these management projects that would undoubtedly deliver more benefits than limitations. Likewise, this work used the analysis of these tools specifying the challenges that still need to be overcome in their implementation and in the contribution of a better Primary Health Care (Carvalho et al, 2005), (Ritter, Rosa & Flores, 2013).

The work of the researchers Salinas, Chiaravalloti and Giatti (Salinas et al. 2018), establish as benefits of the use of georeferencing for Primary Care, the following aspects:

1. Allows the entry, updating and analysis of epidemiological and program data, to present results in a graphical and quickly understandable form.
2. It helps in making consistent decisions to plan health services, analyze inequities and adjust distributions of both physical and human resources, this is also observed as a conclusion in the works of Bazemore (Bazemore, Phillips & Miyoshi 2010), (Silberman et al., 2013), (Lofters & et al. 2013).
3. Professionals optimize their work time, since the information provided is processed data, useful and with significant value, as also proposed by Ritter (Ritter et al 2013).
4. Location data and data for filling out forms can be collected through the use of mobile devices that can be securely transferred to a web server, this methodology is especially novel and quick to use, as explained by Sá et al. in their research (Sá et al. 2012).
5. It has also been observed that the use of technology generates enthusiasm in professionals and a high motivation to include new events, as reported by researchers Bazemore and Silberman.
6. It is also established that georeferencing in health allows for an interactive control panel, in real time, for monitoring actions and population studies, as pointed out by Silberman.

7. It allows to evaluate the comprehensiveness of health programs, as well as of public policies, especially those that are being implemented recently, and that allow local surveillance, as pointed out by the researchers Carncross (Cairncross et al. 2002).

8. It enables intersectoral and intrasectoral work, which includes visions and experiences of different actors for a situational analysis of health, as established by Bazemore and Carncross' research.

9. Prevalence and trends can be interpreted quickly, a situation that a table or a graph often fails to understand, according to research by Hardt et al. 2013).

Georeferencing in health and in particular for Primary Care, allows a complete analysis of a health situation, allowing not only to locate some epidemiological incidents, but also to relate them to each other, allowing a local surveillance analysis, in relation to social determinants, all this under a dynamic modality of studies that allows to enhance public policies that a region or a country decides for its Primary Care.

In the study "health and incidence and differences in territorial vulnerabilities in the City of Madrid" the researchers María Mercedes Esteban, Elena Fernández, Rodrigo Jiménez, Valentín Hernández and Isaac Fernández analyze territoriality and how this is configured under an important axis of inequality. "The objective of this study was to determine the level of association between territory and vulnerability, specifying proposals for territorial intervention through key socio-health indicators" (Esteban and Peña et al. 2020). In the aforementioned research, it refers to vulnerable people as those who "have poorer health, but also a group of key morbidity indicators as fundamental axes of physical, psychological, social and functional health, including what they call the big four or four major health problems such as tobacco, alcohol consumption, diet and exercise, which are constantly used and addressed under different spheres and theoretical frameworks" (Esteban and Peña et al. 2020).

They emphasize the need to develop the concept of territoriality, analyzing that these are complex and composite concepts, not only under a geographical aspect, but also under a conception of migratory, cultural, political and economic diversities, as proposed by researchers Macintyre and Kearns, where they comment that "the individual does not always have what the collective brings, since where one lives and within that experience, there is a set of diversities that can explain health through causal, cultural, economic or migratory pathways" (Macintyre et al

2002), (Kearns & Moon, 2002).

The objective of the study was to analyze the City of Madrid, in order to justify on scientific grounds, the pragmatism of public policy interventions specifically in Primary Care, from a close administrative notion, under a planning design and, therefore, under real problem solutions in certain geographical areas, to intervene from the collective, as studied by the researcher Rose in 2001 (Esteban and Peña et al. 2020).

In this study, a series of vulnerability indicators were designed, carrying out eight thousand eight hundred and forty-five interviews in around four hundred surveys per district with a sampling error of 1%, using age, sex and immigration as sociodemographic variables that make up the vulnerability indicator from secondary sources of municipal statistics of the Madrid City Council. The districts analyzed included Retiro, Salamanca, Puente de Vallecas, Ciudad Lineal, Villa de Vallecas, Barajas and others.

They also included a series of health variables from the health survey of the City of Madrid conducted in 2017. They conclude that "territorial differences were significant between more and less vulnerable districts to assess the self-conception of health, with no difference between both sexes. There was no significant difference between vulnerable populations before the self-perception of a poor state of health, referencing as the first measure major problems of mental illness.

Under concepts of habits, in the case of men there was a greater presence of complex situations, while the pattern of obesity and sedentary lifestyle was higher in the vulnerable territories and in them, in the case of women. The levels of association between variables were significant in both sexes, particularly in the vulnerable population, not being so specific in populations that did not have this characteristic" (Esteban and Peña et al. 2020).

In order to develop all of the above, the researchers in this study gathered information through surveys, using a sociodemographic and health mapping methodology with the use of geographic maps (Rose, 2001).

The research called "georeferencing at the service of health, an experience from community assets", by the researchers (Betancurth, Vélez and Sánchez, 2023), analyzed the use of physical and digital georeferencing technologies at the service of a health system based on direct experiences with community assets.

Before proceeding further, it is necessary to define what a community asset is, a concept that has become increasingly important in aspects of

public policy in primary health care.

Community assets, according to the researchers, "are becoming increasingly interesting because they place an activity or a public policy under a direct population-based perspective, which many government policies lack. Strictly speaking, a community asset is the people and their civil organizations, both as state and private organizations that become priority actors in the development of a specific area, such as health, and build bridges with the rest of the people who develop in that territory" (Betancurth, Vélez and Sánchez, 2023).

Therefore, empowering these people and organizations is a desire for Primary Health Care and georeferencing in health introduces information and allows the study of social phenomena, where health is part of, under intersectoral strategic actions and management to improve the life of the population.

In this context, geographic information systems have been highlighted by the World Health Organization for their contribution to public health since they allow the spatiotemporal location of events and their analysis in the population and the resources that communities and the state have in order to opt for an effective solution as provided by researchers (Carvalho, 2006) and (Buzai, 2011).

As we have been able to review previously, georeferencing systems have been used to identify risks in communities and, eventually prioritize vulnerable populations from some type of variables or conditioning factors and even analyze the access of health systems, according to Aguirre (2016) and Ramasco et al. (2017), but currently georeferencing could also help in the salutogenic perspective, which highlights the identification of population willing to work in health.

As Cubillo - Llanes says, "the concept focuses on describing those material and human resources that can improve the capacity of communities to preserve health and well-being, those involved in the territorial space, adding value and facilitating the improvement in the lifestyles of the population" (Cubillo-Llanes et al. 2018). In this study, an exploratory activity has been carried out with mixed methods and recurrent transformative design, analyzed under social georeferencing including physical and digital analysis for the identification of community assets.

As important results of this research it was evidenced that "georeferencing is a fundamental complement for the analysis of epidemiological

events in a population, the exploration of a mapping related to a participatory dialogue of these community assets, make it increasingly powerful and allows better decision making by focusing the governmental institutional offer in a vulnerable population" (Cubillo-Llanes et al. 2018).

3.0 Applicationd for chronic morbidity

Among the benefits of digital georeferencing in this work, it was specified that "the visual schemes allowed decision makers to interpret and locate concrete situations, likewise the empirical advance in the use of geoprocessing as a positive technology for the management of Primary Health Care services was evidenced and to conclude it was contributed that this tool also allows the analysis of health data under a territorial analysis allowing dynamic implementation as part of the epidemiological activities and control of social determinants of health that ends up being a challenge for the future. It was also observed that the time performance in terms of data analysis was decreasing once the health professionals themselves were understanding better and better the geoprocessing software, in turn the platforms equipped with GPS satellite data, allows the analysis of accurate and updated territories achieving a better health management and ensuring specific actions for the development of needs of vulnerable populations. In this way, georeferencing in health is definitively established as a dynamic, agile methodology, easy to enter and available at all times" (Cubillo-Llanes et al. 2018).

In a study called "Geospatial distribution of health in Jalisco: analysis of the millennium development goals", researchers Ramos, Portugal, Gonzalez and Robles, state that "today it is possible to analyze the development of these indicators by means of a georeferencing analysis. They comment that, through a geographic approach with a spatial focus, it is possible to apply a methodology that allows defining the development of the millennium goals in Mexico based on indicators proposed by the united nations, especially to combat mortality in children under five years of age, improve aspects of maternal health and combat HIV/AIDS.

Using a geographic approach with a focus on spatial analysis, the researchers applied a methodology proposed by the specialized technical committee of the information system of the millennium development goals in Mexico, to analyze and map the objectives indicated. The three previously mentioned objectives are identified in five goals and nine indicators which were analyzed under the defined geoprocessing.

As a result, it was established that goal four of the SDG, which deals with the reduction of under-five mortality, was easily mapped, thus defining ranges, minimum values, important indicators, and aspects of child survival. The data were related to the social, economic, environmental and health care conditions in which they live. In turn, goal five of the SDG, which deals with improving maternal health, where the objective is to reduce these indicators by three quarters, was also easy to geolocate, showing areas with higher morbidity and mortality, accident rates, and different types of incidents during labor, delivery and postpartum.

Regarding objective number six, which deals with combating HIV/AIDS, malaria, tuberculosis and other communicable diseases, it is again evident that georeferencing is a good method for the analysis of areas of great importance, establishing places with higher mortality and morbidity rates and particularly of states where the prevention of sexually transmitted infections is of future importance for the health services involved" (Ramos-Herrera et al. 2019).

Consequently, a territorial perspective was presented for the analysis of compliance with the Millennium Development Goals using georeferenced information that gives an absolute account, with great precision, of the current states of the population.

As we have observed, georeferencing allows to better implement the actions to be carried out by health workers, in relation to community assets and under this aspect will allow, to be a contribution to the deepening of this new public policy.

In the research "evaluation of the health situation by Primary Health Care professionals based on georeferencing in information systems" headed by Fernando Ritter and Roger Dos Santos from the Federal University of Rio Grande do Sul, Porto Alegre, Brazil, "an information system based on Primary Health Care is analyzed under the importance of observing in practice some analysis of indicators that were accessible to the health teams of the districts belonging to the City of Porto Alegre. Eight teams were established which answered a questionnaire in three different moments, the first one before reading the reports, the second one after this reading and the third one after using georeferencing" (Ritter et al. 2013).

The results according to the researchers indicated that there is a significant difference in the understanding and classification of important territorial aspects in health after the third reading, which correspond to georeferencing in health directly. In other words, when health professionals work without knowing the results that are

obtained in Primary Health Care, they exercise a less important action in territorial aspects, when professionals know this information they improve their knowledge and perform actions with greater impact, but when this same information is presented with a mapping methodology, professionals not only understand better the information provided but also quickly propose new territorial actions (Ritter et al. 2013).

The researchers report that "territorialization is a fundamental step for the characterization of the population, as well as for the evaluation of the impact of services. Hence, it can be considered as a fundamental activity for the consolidation of health actions of Primary Health Care, such as the realization of diagnoses and situational health analyses, as well as the definition of strategies necessary to overcome the problems of the collective and of the people who are part of each health unit. They indicate that in order to operationalize a situational diagnosis it is necessary to optimize the georeferencing systems, allowing managers, workers and the population itself to know them, act and project some interventions" (Ritter et al. 2013).

As researchers Mishima and Moraes comment, the data provided by georeferencing can be converted into indicators that support interdisciplinary planning, programming and team decision making (Mishima et al. 1999), (Moraes et al. 2001).

The researchers Faria, Oliveira and Silva indicate that, unfortunately, in actual practice in health care, the priorities of the services give minimal power to the workers themselves to carry out new activities, since those who define the actions to be developed are generally restricted groups that occupy higher levels in the institutional hierarchies (Faria et al. 2009), (Oliveira et al. 2011).

Therefore, it is necessary for health teams to master information technologies that allow the development of community diagnoses more appropriate to the reality of the territory.

In the research "an experience of using georeferencing for mapping the process of territory realization for Primary Health Care", the researchers Melina Alves and Fátima Correa, state that "georeferencing is an absolutely valid instrument for visualizing actions for health services", they use the free software Google Maps, since it is an absolutely validated instrument already updated not only in Brazil but worldwide (Alves de Caramargo et al. 2019).

Important health data from one hundred and nine services were inserted into this system, where they were able to create a documentation tool with a guide that aims to provide specific information for

the knowledge and applicability of the system for the entire health team. This guide, which is part of the georeferencing process, "will be used in the meetings of the Brazilian single health system in order to subsequently manage new health actions and activities that the teams define as priorities to obtain better results" (Alves de Caramargo et al. 2019).

According to the researchers, the health teams were able to analyze and subsequently prioritize the information provided by this tool, thus establishing proposals for future actions and active intervention methodologies in the territory.

Once again, it is absolutely clear that georeferencing in health for the creation of maps according to characteristics or variables, are very positive not only for the population but also for the health professionals themselves to understand in a fast and clear way the needs or demands, relating them with the offers that are delivered.

In the research "Current situation of geoprocessing and spatial data analysis in health in Brazil", the authors Barcellos and Ramalho, analyze under a growing concept, the demand for the incorporation of geoprocessing techniques for public health in Brazil, where they stipulate that "in order to achieve this new movement, actions will depend on access to information, programs and training so that spatial analysis techniques can be developed". They comment that, in order to achieve successful results, it is necessary to have reliable sources of information and generate technological solutions for the health sector with greater interoperability in cartographic bases, for the development of user-friendly programs and, at the same time, to provide analytical tools for health teams (Barcellos et al. 2002).

From the point of view of research methodology, the studies are related to the analysis and calculation of the density of cases, understood as the number of events per area, produced in a surface with probability characteristics where the areas with the closest cases present greater risk, whose denominator used for this rate is the density of people or inhabitants per area, understood as a continuous surface.

In the article "Spatial analysis of arterial hypertension in Peruvian adults in 2022", the researchers Hernández, Carrillo, Azurín, Turpo and Azañedo, conducted "a spatial analysis of arterial hypertension in the Peruvian adult population, to identify geographical patterns with a greater analysis of the concentration of cases" (Hernández-Vásquez, 2023); (Brouwers et al. 2021).

Within their study, it is analyzed that hypertension

is a chronic disease of multifactorial nature and high disease burden affecting 1.28 billion people worldwide according to information from the World Health Organization and Brouwers et al.

According to the World Health Organization report (2023), "about 22% of the world population presented arterial hypertension and the prevalence in six Latin American countries (Argentina, Brazil, Chile, Colombia, Peru and Uruguay) reached 32.3%". According to Camafort (Camafort and cils. 2021), "68% and 32% were located in urban and rural areas of these countries, respectively".

Continuing with the methodology in this research, a spatial analysis of georeferenced data from the Peruvian Demographic and Family Health Survey, which is conducted by the National Institute of Statistics and Informatics year after year, was carried out, collecting data on households, women of reproductive age and children under five years of age. The sampling for this research was probabilistic, two-stage, stratified and independent. The sampling frame was based on statistical and cartographic information (Kang et al. 2016); (Elliot et al. 2000); (Lee, 2011).

The method used for data collection was direct interviews in the selected dwellings, conducted by trained personnel. The main study variable was the presence of arterial hypertension (Bernardo & Smith, 2009).

The variables used for the spatial analysis were the longitude and latitude of the cluster in which the respondent's home was located. These variables were collected by means of global positioning systems included in a Tablet placed one meter from the main door of the dwelling. They also used some variables to characterize the population such as sex, age group, educational level, ethnic self-identification, marital status, nutritional status, previous diagnosis of diabetes, presence of smoking habit, wealth index, residential region of Lima and finally area of residence either urban or rural (Johnson, 2004).

The research called "making the most of spatial information in health under Bayesian disease mapping methods" written by Shen, states that "disease maps are effective tools to explain and predict disease outcome patterns in any geographical space, identifying areas of potentially elevated risk and allowing the formulation and validation of hypotheses for a disease" (Shen & Louis, 2000).

One of the most important methodologies to be able to comply with the above mentioned, relates to georeferencing analysis in health and Bayesian models, which have become a standard with approaches that can be developed for disease

mapping that could provide a basic understanding of key concepts involved that provides assistance in the interpretation of maps and provides a useful starting point for anyone involved in the execution of primary health care.

As explained above, this study again reflects on georeferencing as an excellent guide for disease mapping, as exemplified by Elliot in 2000.

The aforementioned researchers ratify that, "recent advances in spatial epidemiology are based on Bayesian statistical methods and also for the analysis of the geographical distribution of diseases" (Best et al. 2005)

"Methodologically a disease mapping model is essentially a regression model that links the outcome of a disease to a set of risk factors, an important concept in this type of disease model is the use of random effects. In this context random effects provide a way to estimate variation in disease risk between areas that might not otherwise be captured and easily recognizable" (Ancelet, Abellan, Vilas, Birch & Richardson. 2012).

Bernardo and Smith in 2009, comment that, "work based on Thomas Bayes and his contemporary Laplace, has allowed an approach to data analysis that focuses on observed and unknown quantities using conditional probabilities that are probability measures of a given event and another that has not occurred" (Johnson, 2004).

From the point of view of georeferencing "the Bayesian model allows an analysis of an unknown parameter and a known parameter under a location estimated by a point, and which allows the analysis of distributions and probabilities into the future. These distributions are known as priors. What is interesting today is that these new distributions represent a kind of uncertainty about our knowledge and an almost improbable way of understanding it if we do not handle territorial concepts" (Gurrín et al, 2000); (Ghosh, Natarajan, Walker & Kim. 1999), (Wakerfield. 2007).

As commented by Ancelet et al, 2012; "Bayesian methods are very useful for the framework of studies based on geo-referential mapping of diseases since they produce a robust and reliable estimation of health outcomes of interest in small areas, even when based on small sample sizes. Within these areas then, Bayesian methods produce accurate and reliable estimates and Bayesian smoothing techniques can also be performed that even improve estimates from neighboring areas.

Bayesian methods also, under disease mapping models, help to strengthen inferences about the true value of the parameter guaranteeing

It is also interesting to mention the possible estimation of the resulting standardized incidence of disease relative risk (SIR) depends on each area as a function of population size.

Having said all the above, we conclude once again that the process of georeferencing in health is a clear methodology, easy to understand for health professionals and particularly a valid tool for the authorities mainly in Primary Health Care so that they can make the best decisions in the field of management that adequately impact the health goals presented by each country.

In conclusion, georeferencing plays an essential role in modern health by providing a unique spatial perspective that improves the understanding and management of diseases, the planning of health services and informed decision making.

4.0 Identified limitations and discussion

One of the limitations of georeferential analysis, and the most common, does not stem from the system itself, but from the skills of the administrative teams to clean the data in health or other areas where the study is carried out, in order to obtain the correct results.

The study of computational systems related to geoprocessing requires a certain expertise to be able to manipulate them and, as in all research, the analysis of ethical principles is important, especially in these cases, where a wide range of information can be obtained from the community. An important aspect that our region of America should promote is the current lack of technological infrastructure in urban areas, but especially in rural areas, as well as the economic development and training gap in aspects of technology for the health of the teams.

This work aims to highlight georeferencing as a technical contribution to territorial health, and not only that, but also as a contribution to institutional management, since, if we do not delve deeper into these issues, local decision-making processes become inefficient again in the management of personal, material, financial, equipment, medicines and technology resources in general terms.

CONCLUSIONS

As technology continues to advance, georeferencing will continue to be an invaluable tool for addressing global and regional health challenges.

In turn, one of the valuable contributions that georeferencing provides is to continue integrating

georeferenced data into health care systems, allowing an immediate updating process in the integrated geographic system, therefore, the methodology we will use goes hand in hand with the need to streamline public policies of Primary Health Care in Chile and in the world.

Potentially, georeferencing improves the management of resources, therefore, it generates a positive process for the efficiency and effectiveness of health services, constituting also as a new health technology. There is a space for research on this topic of georeferencing in health, since, in Chile, the use of this technology to typify the population risk of users with chronicity under multimorbidity context has not been studied.

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