

## THE EFFECT OF THE HEALTH CLUSTER ON LOCAL HEALTH DEVELOPMENT

<http://dx.doi.org/10.21527/2237-6453.2023.59.12772>

Received: 30/9/2021

Accepted: 12/5/2023

Published: 30/11/2023

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### ABSTRACT

The reorganization of the Brazilian State has transferred numerous responsibilities to the federal entities due to the decentralization of public health actions and services, which were formerly entitled to the federal government. This has challenged states and municipalities to manage scarce public resources more efficiently and effectively. Municipalities have made an extra effort for their development, focusing especially on attracting regional and global organizations, thus fostering the economic activity of production and consumption that induce the generation of employment and income. The cluster formation has been an auxiliary tool for the growth of local and regional economies. Therefore, this study seeks to verify the existence of the health cluster effect on the development of local health, based on the concentration, diversification and specialization of health establishments in municipalities with greater potential for cluster formation. The study is characterized as a quantitative and descriptive research, which uses secondary data from the Annual Social Information List (*Relação Anual de Informações Sociais – Rais*) and the Socioeconomic Development Index (Índice de Desenvolvimento Socioeconômico – Idese), from 2010 to 2017 in the municipalities of Porto Alegre, Caxias do Sul, Passo Fundo, Pelotas and Santa Maria. The results gauge the concentration of establishments in the health sector, the diversification and the specialization of establishments in each segment. In addition, they describe the potential for forming a health cluster in the municipalities, as well as the relationship between the number of health establishments and the development of local health. Thus, based on the results presented, it is concluded that health establishments are grouped, which may characterize the formation of a health cluster, and that any effects on the development of local health may, in fact, contribute to social and economic development of municipalities and its regions. Finally, with this study, we hope to contribute to the literature on the formation of a health cluster, as well as in the management of local and regional health.

**Keywords:** health cluster; concentration; diversification; specialization; local health development.

### O EFEITO DO CLUSTER DE SAÚDE NO DESENVOLVIMENTO DA SAÚDE LOCAL

### RESUMO

A reorganização do Estado brasileiro tem transferido, aos entes federados, inúmeras responsabilidades em virtude da descentralização das tarefas que eram, antes, do governo federal. Isso tem desafiado Estados e municípios a gerirem, de forma mais eficiente e eficaz, os escassos recursos públicos. As cidades buscam o desenvolvimento que passa pela atração de empresas locais e globais, fomentando a atividade econômica de produção e de consumo que induzem à geração de riqueza nessas sociedades. A constituição de *clusters* tem sido ferramenta auxiliar para o crescimento das economias locais. O objetivo do estudo, portanto, é verificar os efeitos de um *cluster* no desenvolvimento da saúde local, a partir da concentração, diversificação e especialização da saúde nos municípios em estudo, os quais possuem os potenciais para a formação de um *cluster*. O estudo caracteriza-se como uma pesquisa quantitativa e descritiva, que utiliza dados da Relação Anual de Informações Sociais (Rais) e do Índice de Desenvolvimento Socioeconômico (Idese) dos anos de 2012 a 2016 dos municípios de Porto Alegre, Caxias do Sul, Passo Fundo, Pelotas e Santa Maria. Os resultados medem a concentração em estabelecimentos do setor de saúde; a especialização de acordo com a quantidade estabelecida destes e a diversificação que identifica os diversos tipos desses estabelecimento; além disso, descrevem a potencialidade de formação de *clusters* de saúde nos locais estudados, e como as atividades de saúde interagem para o desenvolvimento da saúde local. A partir dos resultados apresentados, conclui-se que as empresas aglomeram-se em características que remetem a um *cluster* de saúde, e que os efeitos no desenvolvimento da saúde local podem, de fato, contribuir com o crescimento econômico das regiões estudadas. Dessa forma, com este trabalho, espera-se contribuir com os estudos acadêmicos na construção de *clusters* de saúde, bem como na gestão em saúde.

**Palavras-Chave:** cluster de saúde; Concentração; Diversificação; Especialização; desenvolvimento local da saúde.

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## INTRODUCTION

The global economic scenario, where competition between nations has intensified the dispute for increasingly distant markets, has led public managers to develop efficient and effective strategies, aiming to attract investments in areas that ensure the economic survival of states and municipalities. The offer to allure investors highlights a range of options that materialize both internally in their economies and on the international scene.

In this context, global trade openness accentuates competition between regional and global organizations, posing challenges for municipalities, since economic activities aimed at production and consumption take place within those. Municipalities need to provide an efficient response to this scenario, given the reorganization of the State which, in recent decades, has undergone decentralization processes, transferring numerous responsibilities to federal entities, reinforcing that municipalities become strategic local agents for their own social and economic development.

Investments in local economies urged states and municipalities to insert themselves in the world economy, enabling a local look at new markets, productive resources, more qualified labor and, consequently, a reduction in their operating costs to make their products global. Thus, it is highlighted that the sectoral organization plays a fundamental role in local, regional, national and even international development. Therefore, it is necessary to consider the different formats of local productive systems, which are the inducers of job and income generation.

The cluster has been a type of sectoral organization and a recognized local and regional productive system, representing a form of sectoral geographic concentration, commonly formed by small and medium-sized companies, which establish a systematic relationship, enabling cooperation and competition (Iglioni, 2001). Other important factors to be highlighted are related to the interactions established between companies, universities and/or research institutions and local and regional governments, aiming at a growth that can go beyond municipal borders and raise the level of quality and regional improvement, providing the formation of a cluster as a tool that leverages the region, with strategies that lead to the universalization of knowledge, information and resource sharing.

In this sense, this study seeks to verify the existence of the effect of the health cluster on the development of local health, based on the concentration, diversification and specialization of health establishments in municipalities with greater potential for cluster formation. Therefore, investigating the possible formation of a health cluster is justified as relevant not only because of the social and economic factor it represents, but also to understand whether, in fact, there are characteristics that can configure the formation of a health cluster.

In Brazil, a relevant experience is the health cluster in the city of Florianópolis, which involves regional development, increasing the productivity of organizations in the region, stimulating productivity growth and encouraging the formation of new companies (Suffi, 2002). With this, the cluster becomes a source of employment and income and also of science and technology, which brings together different public and private organizations.

On the other hand, cases such as the Cluster Automotivo Sul Fluminense (Casf) help to understand the dynamics of formation and configuration that emerges in a region, although the initiative may be unilateral from one organization – PSA Peugeot Citroën (Lima; Paiva, 2020).

Likewise, the case of the pulp and paper cluster in Três Lagoas, still in an embryonic stage, based on forest resources, of forests planted for commercial purposes, associated with advanced technological activities, can represent an important example (Tisott; Schmidt; Waquil, 2017).

It is therefore necessary to understand that the cluster enables the development of all organizations involved, promoting and increasing competitiveness through industrial, commercial and service policies, and also promoting innovation and technological development.

Social and economic development, whether local, regional, national or international, has been undergoing transformations that seek stability. Nations advance their discussions in the sense that economic development should no longer be the result of an increase in workers or demands, since its viability is centered on the consecutive growth of knowledge. Thus, over time, the literature has discussed the importance of a cluster for the social and economic development of a region, through processes such as innovation and learning.

## THEORETICAL FRAMEWORK

Economic development is part of the support provided by the cluster, logically, it is not the only one, as the cluster not only provides a basis for it, but also acts as a moderator or inhibitor of the process of creation and transfer of knowledge. It must be considered that knowledge can be transferred more quickly between organizations that work in networks than those that work in isolation; such analysis involves greater complexity (Darr; Argote; Epple, 1995; Powell; Koput; Smith-Doerr, 1996). In addition, studies on the application of cluster or business network development programs have gained prominence in several economies around the world (Silva; Nascimento; Melo, 2021).

As a result, academic debates on clustering have been recurrent since the 1990s, both due to the effect caused on the performance of organizations, as well as on regional economic development, but even on the competitiveness of a country (Porter, 2000; Waits, 2000; Meyer-Stamer, 1998; Delgado; Porter; Stern, 2010). Thus, over the last few decades, the cluster has gained prominence, mainly from the studies of Porter (1990) and Krugman (1991), and has been recognized as one of the ways to overcome the limitations of small and medium-sized companies, in addition to be an important instrument to increase productivity, innovation and, above all, the competitiveness of the regions where these agglomerations exist (Karaev; Lenny Koh; Szamosi, 2007).

According to Zaccarelli *et al.* (2008), although these are not contemporary evidence, networks and clusters can be foundations capable of boosting the differentiated development of a given region. In addition, knowledge is highlighted as a guiding element for the socio-economic development of these regions. Some definitions are focused on the size of the agglomeration, geographic proximity, type of company, sector, cooperation and competitiveness in the agglomeration. Regardless of the approach used, however, what becomes essential is taking advantage of the interactions and synergies generated by the companies in the cluster, which can help to obtain a competitive advantage (Laimer; Fortuna; Laimer, 2020).

A precursor of studies on clusters, Marshall (1920), points out that the agglomeration of firms, in a given region, can provide, to the grouping of producers, competitive advantages that would not be measured if they acted individually. He claims that the root causes such as the

supply of raw materials, energy sources, access to transport and the anticipated presence of demand in the region are capable of attracting other companies that operate in the same sector, industrial segment or in relational and support industries. Ratifying the concept of incidental external economies, in which the location of economic activity and the competitive advantages of producers are evident.

Krugman (1991) comments on the increasing scale returns that clusters generate, highlighting that they are one of the most important forces that attract producers to these regions, which contributes to the adequacy and strengthening of these local clustered producer systems; making a relationship with the industry of Detroit and microelectronics in Silicon Valley, with their concentrated systems of companies, where transitory competitive advantages were generated due to the increasing scale returns and the positive feedback of the developed actions.

According to Krugman (1998), industrial agglomerations are a peculiar combination of invisible manual processes that operate centrifugal and centripetal forces. It should be noted that the predominance of the centripetal force of agglomerations is capable of bringing companies closer together and is based on the possibility of increasing scale returns, which allow the organization to have external economies.

With an overview at local systems, centripetal forces are dominant, generating stimuli to the process of agglomeration of producers, captivated by the probabilities of appropriation of external economies. The existence of centrifugal forces, related to repulsion, also draws attention, as it discourages the concentration of companies and keeps them away from the region. When centrifugal forces outweigh centripetal forces, there is a tendency to crowd out economic activities and industrial enterprises.

Altenburg and Meyer-Stamer (1999, p. 1.694) state that “in its broadest sense, the term cluster only depicts local concentrations of certain economic activities”. Perry (2005, p. 11), while agreeing with the frequent interpretation that clusters are associated with the “concentration of an activity in a specific location”, points out that this concept lacks elaboration, as “it does not allow distinguishing a cluster from inferior forms of grouping”.

These same authors claim that the mere agglomeration of companies does not characterize a cluster, but that this occurs when, when grouping, there is interaction between the participating companies, inducing competitive characteristics, which they describe in their studies and serve as a basis for characterizing a cluster. Therefore, cooperative relationships can provide an increase in the competitiveness of companies and, as a consequence, differentiate the performance of companies in relation to those companies that do not cooperate with others (Centenaro; Laimer, 2017).

It is also worth mentioning that the level of performance of a cluster depends a lot on the stage it is in, because, as already described, the social and cultural aspects of the region are influencing elements, in addition to the relational characteristics, location, level of specialization and importance of the cluster for the region; provides the initial conditions for collective relations between organizations (Tristão, 2013). Interaction based on sharing informal meetings between economic actors (companies, professional organizations, institutions, universities, associations, etc.) enables the formation of cooperation ties (Bertosso; Ebert; Laimer, 2017).

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The basic conditions for the formation of a cluster comprise the concentration, diversification and specialization of economic activities, based on the characteristics described by Zaccarelli *et al.* (2008) existing in a given geographic space. Thus, these three fundamental elements support the creation and emergence of the cluster, complemented by other principles and/or requirements. In the formation of networks between companies, there is the possibility of configuration both as clusters or groupings of companies (Lunedo *et al.*, 2018).

The cluster plays a key role in the social and economic development of a region. In this way, it has been considered an environment that generates competitive advantage and encourages the improvement of companies; determinant in industrial policies aimed at promoting innovation, competitiveness and local development (Malmberg; Maskell, 2002).

The concentration of organizations in the same sector of activities, or linked to it as input suppliers, in the same geographic space – which can be constituted by a neighborhood, city or region – assumes a preponderant role in the formation of clusters. This concentration facilitates access to extremely important resources for the development of activities proposed by the cluster, whether materials, technology, skilled labor, research capacity, among others. It should be taken into account that the greater the geographic concentration of companies and institutions (Zaccarelli, 2006), the greater the effect on the social and economic development of the municipality. Thus, the first research hypothesis is presented as follows:

**Hypothesis 1 (H<sub>1</sub>):** The concentration of economic activities has a positive effect on the development of local health.

Besides, the diversification of activities, in addition to being a great competitive advantage, allows choices of ‘from whom to buy’ and ‘at what price to buy’, also enabling a greater offer of products and services within the region where the cluster is located (Zaccarelli, 2006). The presence of educational and research institutions is also fundamental for the formation, maintenance and development of the cluster, contributing with innovations in products and services, raising the degree of maturity of the cluster and allowing a greater scope of business, benefiting competitiveness. Thus, a second research hypothesis was formulated:

**Hypothesis 2 (H<sub>2</sub>):** The diversification of economic activities has a positive effect on the development of local health.

The literature has indicated that the cluster presents a set of advantages, namely: related to shared infrastructure costs, personnel qualification, transaction efficiency and knowledge diffusion, leading to learning and innovation (Malmberg; Maskell, 2002). Thus, “regions should specialize industrially and promote the dynamics of spatial clustering in order to gain or sustain competitiveness and prosperity” (Malmberg; Maskell, 2002, p. 431).

Besides, the specialization of activities in a cluster does not involve large organizations located in the region, but companies, often small, capable of meeting demands with the efficiency and quality necessary for the execution, or production, with products and supply services. (Zaccarelli, 2006). Some clusters in their chain have the participation of many companies, each one specialized in a part of the task, which is positive for competitiveness (Zaccarelli *et al.*, 2008). Thus, a third research hypothesis was elaborated:

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**Hypothesis 3 (H<sub>3</sub>):** The specialization of economic activities has a positive effect on the development of local health.

These hypotheses favor the verification of potential elements to verify the development of local health, elements that help to characterize a cluster.

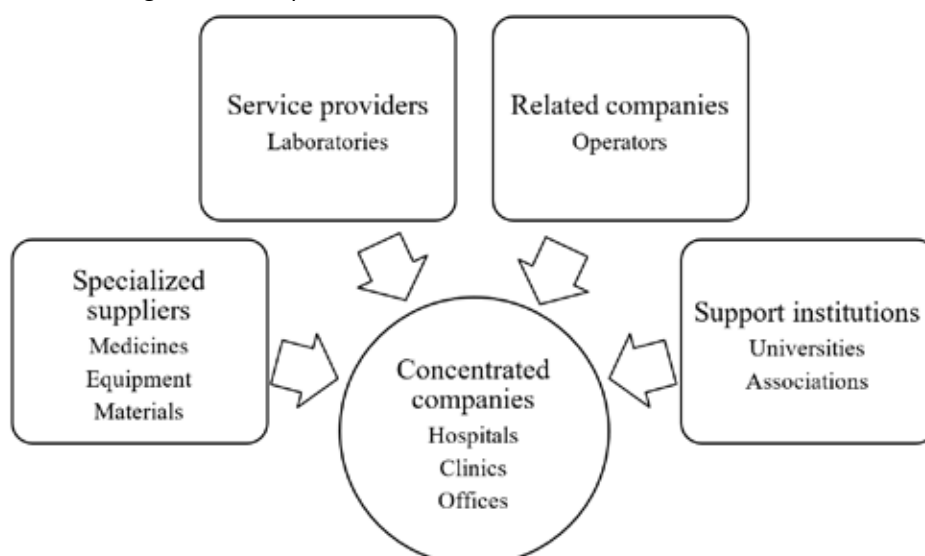
## RESEARCH METHOD

The study is characterized as a quantitative, descriptive research, which seeks to verify the existence of the effect of the health cluster on the development of local health, based on the concentration, diversification and specialization of health establishments in municipalities with greater potential for cluster formation. This study analyzes the five municipalities in the state of Rio Grande do Sul with the largest number of health establishments, based on the Annual Social Information Report (*Rais*) database.

The *Rais* is an annual socioeconomic information report required of legal entities and equivalent persons by the Ministry of Labor and Employment (Ministério do Trabalho e Emprego – MTE). This report has statistical data on public and private establishments (head office and branch) and the respective employment relationships, in order to support government decisions.

The health establishments selected are those that have economic activities linked to the health sector. The economic activities are carried out by the establishment and are compatible with the corporate purpose, being considered the main activity and identified in the National Classification of Economic Activities (*Classificação Nacional de Atividades Econômicas – Cnae*). With this, groups of economic activities in the health sector were defined (Figure 1), which were organized based on the criteria established by Porter (1998): concentrated companies, specialized suppliers, service providers, related companies and support institutions (Appendix).

Figure 1 – Groups of economic activities in the health sector



Source: Prepared by the author (2019).

The five selected municipalities with the highest number of health establishments are located in five different geographic areas, which are (Table 1): Porto Alegre, Caxias do Sul, Passo Fundo, Pelotas and Santa Maria. These five municipalities were chosen for theoretical and methodological reasons: (1) are characterized as a metropolis and/or regional capital and are located in the state of Rio Grande do Sul (IBGE, 2019), which ensures that they have comparable macroeconomic attributes; (2) have a high geographic concentration of health facilities; (3) have different organizational structures, in terms of diversity and specialization (MS, 2019), which allows testing whether the hypotheses are sustained in different territorial and productive conditions; (4) and availability of longitudinal and aggregated data by municipality (MTE, 2019), allowing testing whether the hypotheses are supported based on the basic conditions of formation and their relationship with the development of local health.

Table 1 – Number of health facilities per municipality

Municipality	2010	2011	2012	2013	2014	2015	2016	2017
Porto Alegre	9,574	9,335	9,657	9,834	9,990	9,990	9,946	9,957
Caxias do Sul	1,691	1,794	1,815	1,906	1,953	2,021	2,049	2,132
Passo Fundo	1,052	1,062	1,065	1,114	1,164	1,259	1,257	1,257
Pelotas	1,018	1,079	1,069	1,123	1,157	1,209	1,213	1,206
Santa Maria	1,006	1,033	1,028	1,051	1,044	1,094	1,097	1,116
Total	14,341	14,303	14,634	15,028	15,308	15,573	15,562	15,668
RS total	35,558	36,389	36,699	37,784	38,663	39,756	39,872	40,709

Source: MTE (2019).

The city of Porto Alegre is the capital of the state of Rio Grande do Sul (RS) and is in an advanced stage of formalizing the health cluster. The other municipalities have distinct geographical positions with their own regional characteristics; Caxias do Sul and Passo Fundo are located in the northern half of the state, while the cities of Pelotas and Santa Maria are in the southern half of the state (Ferretto, 2018). In addition, the five municipalities selected for the study are considered references in terms of public and private health actions and services in the state (Figure 2).



Figure 2 – RS map with the five selected municipalities



Source: Prepared based on IBGE (2019).

The five municipalities together have approximately 25% of the population of the state of Rio Grande do Sul (Table 2). In addition, municipalities are characterized as metropolis and/or regional capitals, developing public and private health actions and services for the regional population.

Table 2 – Population of municipalities

Municipality	2010	2011	2012	2013	2014	2015	2016	2017
Porto Alegre	1,409,351	1,413,094	1,416,714	1,467,816	1,472,482	1,476,867	1,481,019	1,484,941
Caxias do Sul	435,564	441,332	446,911	465,304	470,223	474,853	479,236	483,377
Passo Fundo	184,826	186,082	187,298	194,432	195,620	196,739	197,798	198,799
Pelotas	328,275	328,864	329,435	341,180	342,053	342,873	343,651	344,385
Santa Maria	261,031	262,368	263,662	273,489	274,838	276,108	277,309	278,445
Total	2,619,047	2,631,740	2,644,020	2,742,221	2,755,216	2,767,440	2,779,013	2,789,947
RS total	10,693,929	10,732,770	10,770,603	11,164,043	11,207,274	11,247,972	11,286,500	11,322,895

Source: IBGE (2019).

Secondary data collection was carried out in two public databases, the number of health facilities (MTE, 2019) and the socioeconomic development index (FEE, 2019), in order to obtain data for the following research measures:



- a. concentration, which identifies the geographic concentration of companies and institutions, according to the number of establishments in the health sector in each municipality, calculating the Concentration Ratio (CR) index;
- b. diversification, which identifies the diversity of economic activities carried out by companies and institutions within the geographical concentration, which corresponds to the different types of establishments in the health sector in each municipality, calculating the Hirschman-Herfindahl (HH) index;
- c. specialization, which identifies the specialized activities carried out by companies and institutions within the geographical concentration, that is, the so-called division of labor, which corresponds to the number of establishments in each type of specialty in the health sector in each municipality, with the Location Quotient (LQ) being calculated;
- d. Idese Health, which identifies the socioeconomic development index, health block, which is calculated from a set of indicators, which are divided into three parts: maternal and child health (mortality rate of children under 5 years old and number of prenatal consultations per live birth), general health conditions (mortality rate from preventable causes and proportion of deaths from causes) and longevity (standardized crude mortality rate) (FEE, 2019).

The Idese Health can range from 0 (no development) to 1 (total development) and indicates the relative position of the municipality in relation to all municipalities in the state of Rio Grande do Sul. Idese Health can be classified into the following ranges (FEE, 2019):

- a. 0.000 - 0.499 = low index
- b. 0.500 - 0.599 = medium-low index
- c. 0.600 - 0.699 = average index
- d. 0.700 - 0.799 = medium-high index
- e. 0.800 - 1.000 = high index

The collected data were tabulated in an electronic spreadsheet (Excel) and later imported by statistical software (SPSS). In the analysis of the collected data, the normality of the data distribution was verified, based on the asymmetry and kurtosis tests. Asymmetry (ie, skewness  $\leq \pm 3.0$ ) and kurtosis (ie, kurtosis  $\leq \pm 10.0$ ) values are within acceptable limits (Kline, 2016).

Then, a descriptive analysis was employed, which allowed interpretation based on the research objectives and hypotheses (Malhotra, 2012). Afterwards, data analyzes were carried out based on descriptive statistics analysis techniques (mean and standard deviation) for the sample description and inferential statistics (variance analysis test with Tukey post hoc and Pearson correlation test) to test the relations of the research variables.

## RESULTS AND DISCUSSIONS

The results found are based on secondary data collected from the economic activities linked to the health sector of the five municipalities studied. These municipalities were defined as priorities for the possible formation of a health cluster, which could be constituted in their

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respective regions. It is also noteworthy that the chosen activities were selected from the economic activities of the health sector (Figure 1, see previous section), according to Cnae.

In the preliminary analysis, it is possible to verify the availability of health establishments, based on the relationship between the population of the municipality and the number of establishments (Table 3). Thus, it is observed that there is a health establishment available for 149 inhabitants in the municipality of Porto Alegre and 158 inhabitants in the municipality of Passo Fundo, while in the other municipalities the number of establishments is proportionally smaller.

Table 3 – Population ratio and number of health facilities per municipality

Municipality	2010	2011	2012	2013	2014	2015	2016	2017
Porto Alegre	147.21	151.38	146.70	149.26	147.40	147.83	148.91	149.14
Caxias do Sul	257.58	246.00	246.23	244.13	240.77	234.96	233.89	226.72
Passo Fundo	175.69	175.22	175.87	174.54	168.06	156.27	157.36	158.15
Pelotas	322.47	304.79	308.17	303.81	295.64	283.60	283.31	285.56
Santa Maria	259.47	253.99	256.48	260.22	263.25	252.38	252.79	249.50

Source: Prepared by the authors (2019).

The geographic concentration of economic activities in the health sector was measured using the Concentration Ratio (CR) index, considering the five largest municipalities in terms of number of establishments (Table 4). With this, the CR5 was calculated, which represents the participation of the five largest municipalities, based on the number of establishments.

Table 4 – Concentration of economic activities by municipality – 2010/2017

Municipality	2010	2011	2012	2013	2014	2015	2016	2017	Δ%
Porto Alegre	0.2693	0.2565	0.2631	0.2603	0.2584	0.2513	0.2494	0.2446	-9.16%
Caxias do Sul	0.0476	0.0493	0.0495	0.0504	0.0505	0.0508	0.0514	0.0524	10.13%
Passo Fundo	0.0296	0.0292	0.0290	0.0295	0.0301	0.0317	0.0315	0.0309	4.37%
Pelotas	0.0286	0.0297	0.0291	0.0297	0.0299	0.0304	0.0304	0.0296	3.48%
Santa Maria	0.0283	0.0284	0.0280	0.0278	0.0270	0.0275	0.0275	0.0274	-3.10%
CR5	<b>0.4033</b>	<b>0.3931</b>	<b>0.3988</b>	<b>0.3977</b>	<b>0.3959</b>	<b>0.3917</b>	<b>0.3903</b>	<b>0.3849</b>	-4.57%

Source: MTE (2019).

The results indicate that the participation of the five municipalities is approximately 40% of all establishments in the state of Rio Grande do Sul, which has 457 municipalities. The CR variation of each municipality indicates that the municipalities of Caxias do Sul, Passo Fundo and Pelotas had the highest growth in the period between 2010 and 2017, and the municipalities of Porto Alegre and Santa Maria had a reduction in the number of establishments.

In addition, it is noteworthy that the five municipalities have numerous teaching and research institutions, which contribute to the training of manpower and new entrepreneurs in the health area. Thus, the state of Rio Grande do Sul has 20 medical courses, 11 of which exist in the five municipalities investigated – 3 courses in Porto Alegre, 3 courses in Passo Fundo, 2 courses in Pelotas, 2 courses in Santa Maria and 1 course in Caxias do Sul.

Although the municipality of Porto Alegre has a reduction in the number of health establishments, it has been the municipality with the highest participation, with approximately 25% of all establishments in the state of Rio Grande do Sul. Thus, the geographic concentration of health establishments demonstrates that, despite the city of Porto Alegre presenting the highest rates over the years, the analysis shows a reduction in the number of establishments by 9.16%, a fact that may have occurred as a result of economic crises that took place during the period or even migration to other locations. Likewise, the municipality of Santa Maria also presents a negative variation of 3.10% in the number of health establishments.

The municipalities of Porto Alegre and Santa Maria may have registered these variations, considering that other economic sectors presented better performance in the same period, a fact that does not rule out the confirmation of hypothesis 1. The other municipalities present a high concentration of activities economies in the health sector, in particular, the municipalities of Caxias do Sul, Passo Fundo and Pelotas, confirming its vocation as a center specializing in health, which encourages business and new entrepreneurs. The results show that the development of health in these places depends on the concentration of establishments in the sector, confirming that the concentration of economic activities has a positive effect on the development of local health.

As for the diversification of economic activities, in the period between 2010 and 2017 (Table 5), the Hirschman-Herfindahl (HH) index which measures sectoral diversification was calculated, when the index approaches zero. Thus, the municipality of Porto Alegre has the lowest diversification of economic activities in the health sector. The municipality of Caxias do Sul presents the greatest diversification of economic activities during the analyzed period, confirming the theory that in the municipalities there are establishments and products and/or services that allow a greater scope of business, being an important competitive differential in the formation of a cluster.

Table 5 – Diversification of economic activities by municipality – 2010/2017

Municipality	2010	2011	2012	2013	2014	2015	2016	2017	Avg
Porto Alegre	0.0813	0.0704	0.0786	0.0756	0.0743	0.0701	0.0689	0.0655	0.0731
Caxias do Sul	0.0013	0.0023	0.0010	0.0021	0.0017	0.0013	0.0010	0.0011	0.0015
Passo Fundo	0.0094	0.0085	0.0085	0.0084	0.0088	0.0097	0.0091	0.0082	0.0088
Pelotas	0.0045	0.0056	0.0052	0.0053	0.0053	0.0057	0.0060	0.0051	0.0053
Santa Maria	0.0057	0.0062	0.0056	0.0058	0.0055	0.0061	0.0059	0.0060	0.0058

Source: MTE (2019).

Although the municipality of Porto Alegre has the highest diversification index, it appears that there is considerable diversification in the health sector, considering also that the five municipalities account for about 40% of economic health activities in the state of Rio Grande do Sul. The diversification presented in the period confirms  $H_2$ , that the diversification of economic activities has a positive effect on the development of local health.

With regard to the specialization of economic activities, in the period between 2010 and 2017 (Table 6), the Location Quotient (LQ) index was calculated, which measures sectoral specialization in relation to the state of Rio Grande do Sul. Thus, the higher the index, the greater the specialization, and an index greater than 1.0 indicates a high degree of specialization in the sector.

Table 6 – Specialization of economic activities by municipality – 2010/2017

Municipality	2010	2011	2012	2013	2014	2015	2016	2017	Avg
Porto Alegre	1.4325	1.3784	1.4258	1.4095	1.4037	1.3871	1.3813	1.3661	1.3980
Caxias do Sul	1.0287	1.0489	1.0197	1.0425	1.0341	1.0256	1.0194	1.0205	1.0299
Passo Fundo	1.4688	1.4108	1.4139	1.3964	1.4099	1.4403	1.4066	1.3586	1.4132
Pelotas	1.1844	1.2338	1.2162	1.2150	1.2159	1.2305	1.2462	1.2092	1.2189
Santa Maria	1.2538	1.2786	1.2524	1.2610	1.2537	1.2857	1.2739	1.2786	1.2672

Source: MTE (2019).

It is observed that the five municipalities have a high degree of specialization in the economic activities of the health sector. The municipality of Passo Fundo has the highest Locational Quotient (LQ = 1.4132), indicating that it has, on average, the highest degree of specialization among municipalities, which is also reflected in the development of local health.

It should be taken into account that many demands of the health sector involve equipment and qualifications that originate outside their municipalities, due to technological advances and innovations that are not yet present in these regions. This, perhaps, justifies the oscillation of the indices during the analyzed period. Thus, considering the specialization index of the municipalities,  $H_3$  is confirmed, that the specialization of economic activities has a positive effect on the development of local health.

In the analysis of Idese Health (Table 7), which considers the composition of the health index based on three variables that deserve to be highlighted, namely: maternal and child health, general health considerations and longevity. These data demonstrate a certain equity in the rates among municipalities. The municipalities of Caxias do Sul, Porto Alegre and Passo Fundo have socioeconomic development indices, health block, classified as high, which experienced a continuous growth during the analyzed period.

Table 7 – Idese Health by Municipality – 2010/2017

Municipality	2010	2011	2012	2013	2014	2015	2016	2017	Average
Porto Alegre	0.815	0.816	0.819	0.821	0.825	0.829	0.829	0.831	0.823
Caxias do Sul	0.857	0.862	0.868	0.870	0.873	0.875	0.880	0.884	0.871
Passo Fundo	0.805	0.807	0.806	0.807	0.814	0.822	0.827	0.829	0.815
Pelotas	0.790	0.770	0.753	0.738	0.738	0.735	0.728	0.736	0.749
Santa Maria	0.791	0.799	0.807	0.808	0.809	0.822	0.829	0.841	0.813

Source: FEE (2019).

On the other hand, the municipality of Santa Maria showed an increase in the health development index (average = 0.813), which is classified as medium-high at the beginning of the period and upgraded to high at the end of the period of analysis, on the other hand the municipality of Pelotas had a negative variation of -6.84% in its health performance, which may be based on non-compliance with goals in one or more variables described. It is also noteworthy that, over the years analyzed, there were decreasing variations in the index of the municipality of Pelotas.

To verify the existence of differences between the health development indices of the municipalities, the analysis of variance with post hoc Tukey was performed (Table 8). Thus, it was evidenced that there are significant differences between the indices ( $p < 0.05$ ) of the municipalities, even indicating which municipalities have statistically significant differences.

Table 8 – Analysis of variance test (Post hoc Tukey) of Idese Health by municipality

Municipality	Groups of municipalities - Average Idese Health ( $p < 0.05$ )		
	1	2	3
Caxias do Sul	0.871		
Porto Alegre		0.823	
Passo Fundo		0.815	
Santa Maria		0.813	
Pelotas			0.749
Sig.	1.000	0.607	1.000

Source: Prepared by the authors (2019).

The differences found in the period between 2010 and 2017 show that the municipality of Caxias do Sul has presented the highest index of local health development. While the municipalities of Porto Alegre, Passo Fundo and Santa Maria have statistically equal local health development indexes, while the municipality of Pelotas has the lowest local health development index, being significantly different from the other municipalities.

After discussing the existence of the effect of the health cluster on the development of local health, based on the concentration, diversification and specialization of the municipalities' economic activities, it was decided to carry out a Pearson's correlation test to show the relationship between the number of health facilities and the local health development index (Table 9).

Table 9 – Pearson's correlation test between establishment and Idese Health

Municipality	Establishment		IDESE Health		Correlation coefficient	Sig.
	Average	Standard deviation	Average	Standard deviation		
Porto Alegre	9,785.375	240.642	0.823	0.006	0.878	0.004
Caxias do Sul	1,920.125	147.558	0.871	0.009	0.983	0.000
Passo Fundo	1,153.750	93.145	0.815	0.010	0.965	0.000
Pelotas	1,058.625	39.009	0.813	0.016	0.970	0.000
Santa Maria	1,134.250	74.071	0.749	0.021	-0.900	0.002

Source: MTE and FEE (2019).

The results indicate that in the municipalities there is a significant association ( $p < 0.05$ ) between the growth in the number of health establishments and the local health development index, with the exception of the municipality of Santa Maria which presented a negative correlation ( $r = -0.900$ ;  $p = 0.002$ ). The municipalities of Porto Alegre, Caxias do Sul, Passo Fundo and Pelotas show a positive correlation, in which the growth in the number of establishments improves local health development indices.

## CONCLUSION

The formation, maintenance and development of the health cluster can contribute to the development of local health. Therefore, the indicators of the municipalities have indicated that the concentration of health establishments in certain municipalities in the state of Rio Grande do Sul can contribute to public and private health actions and services. This cluster effect on local health may be expanding to the entire region of the host municipality, as neighboring municipalities seek support in the metropolitan region or in regional capitals.

The literature has shown that in several parts of the world, the cluster has influenced the growth and socioeconomic development of the regions where it is located. Therefore, it is necessary to reflect on government actions to stimulate and encourage the formation, maintenance and development of a health cluster.

In the case studied, the probability of cluster formation is evident in the five municipalities that can expand into the region, as they account for approximately 40% of the concentration of health establishments in the state of Rio Grande do Sul. This fact has helped in the generation of jobs and income, in the technological development of companies, in the sharing of information and/or knowledge, among other factors necessary for local and regional development.

The results indicate that the concentration, diversification and specialization of health economic activities have a positive effect on the health development of municipalities, pointing to a growth of health establishments. A significant offer of health actions and services, whether in products or services and, above all, have a high specialization in the health area.

It is necessary to register that other establishments, established outside these municipalities, operate in these regions, but which certainly operate commercially with their products and services. Therefore, it can be inferred that there is a positive effect of the formation of a health cluster on the development of local health.

In a more detailed analysis, the concentration is explained by the average increase in the number of establishments (geographical concentration) from 2010, showing increasing rates until 2017. Diversification considers the presence of manufacturing and marketing of medicines, equipment and materials, as well as health plan operators, insurance brokers and private pension. The existence of support institutions, both business and health professionals, as well as educational and research institutions, professional and technical, and other establishments such as laboratories, X-ray services, radiotherapy, vaccination, dentistry, physiotherapy, chemotherapy, etc.; also confirm the diversification of activities, which contribute as drivers of economic development.

Specialization is present in most regions and is basically confirmed by the reasons described in diversification; however, the metropolises offer qualified products and services, recognized regionally and nationally, as many people converge in these places in search of health services due to the high degree of specialization, both of professionals (doctors and other professionals of different specialties), and of support services for treatments and medications.

Idese makes it possible to analyze the development of health, separately in each municipality, confirming the growth of this indicator in the municipalities studied. The variation of this indicator classifies municipalities between a medium-high and high factor, demonstrating that health actions and services have an effect on local socioeconomic development. This is because



Idese analyzes, in terms of health, maternal and child health actions and services, general health conditions and longevity.

The study is limited by the indicators used, regardless of the number of establishments obtained from the Ministry of Labor and Employment database and the Idese Health obtained from the Foundation (Department) of Economics and Statistics of the state of Rio Grande do Sul but, also, the study is limited to the five municipalities analyzed. As suggestions for future studies, in-depth research could be carried out with other analysis indicators and, especially, research that incorporates a greater number of regional centers (eg, sub-regional capitals, regional capitals and metropolis).

## ACKNOWLEDGEMENT

This study was financed in part by the Fundação Meridional – Brazil.

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## APPENDIX – GROUPS OF ECONOMIC ACTIVITIES IN THE HEALTH SECTOR

Groups of economic activities	CNAE	Description of economic activities (in Portuguese)
<b>Specialized suppliers</b>  Manufacture of medicines, equipment and materials	2110-6/00	Fabricação de produtos farmoquímicos
	2121-1/01	Fabricação de medicamentos alopáticos para uso humano
	2121-1/02	Fabricação de medicamentos homeopáticos para uso humano
	2121-1/03	Fabricação de medicamentos fitoterápicos para uso humano
	2123-8/00	Fabricação de preparações farmacêuticas
	2660-4/00	Fabricação de aparelhos eletro médicos e eletro terapêuticos e equipamentos de irradiação
	3250-7/01	Fabricação de instrumentos não eletrônicos e utensílios para uso médico, cirúrgico, odontológico e de laboratório
	3250-7/02	Fabricação de mobiliário para uso médico, cirúrgico, odontológico e de laboratório
	3250-7/03	Fabricação de aparelhos e utensílios para correção de defeitos físicos e aparelhos ortopédicos em geral sob encomenda
	3250-7/04	Fabricação de aparelhos e utensílios para correção de defeitos físicos e aparelhos ortopédicos em geral, exceto sob encomenda
	3250-7/05	Fabricação de materiais para medicina e odontologia
	3250-7/06	Serviços de prótese dentária
	3250-7/07	Fabricação de artigos ópticos
	3250-7/09	Serviço de laboratório óptico
	3312-1/02	Manutenção e reparação de aparelhos e instrumentos de medida, teste e controle
	3312-1/03	Manutenção e reparação de aparelhos eletro médicos e eletro terapêuticos e equipamentos de irradiação
	3312-1/04	Manutenção e reparação de equipamentos e instrumentos ópticos
3319-8/00	Manutenção e reparação de equipamentos e produtos não especificados anteriormente	

<b>Specialized suppliers</b>  Marketing of medicines, equipment and materials	4644-3/01	Comércio atacadista de medicamentos e drogas de uso humano
	4645-1/01	Comércio atacadista de instrumentos e materiais para uso médico, cirúrgico, hospitalar e de laboratórios
	4645-1/02	Comércio atacadista de próteses e artigos de ortopedia
	4645-1/03	Comércio atacadista de produtos odontológicos
	4664-8/00	Comércio atacadista de máquinas, aparelhos e equipamentos para uso odonto-médico-hospitalar; partes e peças
	4771-7/01	Comércio varejista de produtos farmacêuticos, sem manipulação de fórmulas
	4771-7/02	Comércio varejista de produtos farmacêuticos, com manipulação de fórmulas
	4771-7/03	Comércio varejista de produtos farmacêuticos homeopáticos
	4773-3/00	Comércio varejista de artigos médicos e ortopédicos
	4774-1/00	Comércio varejista de artigos de óptica
<b>Related companies</b>  Operators	6520-1/00	Sociedade seguradora de seguros saúde
	6550-2/00	Planos de saúde
	6622-3/00	Corretores e agentes de seguros, de planos de previdência complementar e de saúde
	6629-1/00	Atividades auxiliares dos seguros, da previdência complementar e dos planos de saúde não especificadas anteriormente
<b>Support institutions</b>  Universities  Associations	8531-7/00	Educação Superior – Graduação
	8532-5/00	Educação Superior – Graduação e Pós-Graduação
	8533-3/00	Educação Superior – Pós-Graduação e Extensão
	8541-4/00	Educação profissional de nível técnico
	8542-2/00	Educação profissional de nível tecnológico
	9411-1/00	Atividades de organizações associativas patronais e empresariais