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ORIGINAL ARTICLE

SPATIAL-TEMPORAL PATTERN OF TUBERCULOSIS IN ADOLESCENTS
PADRÃO ESPAÇO-TEMPORAL DA TUBERCULOSE EM ADOLESCENTES
PATRÓN ESPACIO-TEMPORAL DE TUBERCULOSIS EN ADOLESCENTES

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ABSTRACT

Objective: to analyze the spatial-temporal pattern of notified cases of tuberculosis in adolescents. ***Method:*** this is an ecological study developed from tuberculosis cases in adolescents. The temporal correlation between the crude tuberculosis incidence rates and the year of occurrence was obtained according to Pearson's linear correlation coefficient and the spatial autocorrelation by the Moran index. The analysis was performed using the TerraView program, version 4.2.2. ***Results:*** it is revealed that the Moran Index showed a spatial association. A moderate and low negative linear correlation was found between the variables represented by the gross rates and year of occurrence, according to age groups, from 10 to 14 and from 15 to 19 years, respectively. ***Conclusion:*** the existence of priority municipalities for nursing intervention planning and actions is indicated by spatial autocorrelation.***Descriptors***: Tuberculosis; Health Education; Spatial Analysis; Adolescent; Nursing; Neglected Diseases.

RESUMO

Objetivo: analisar o padrão espaço-temporal dos casos notificados de tuberculose em adolescentes. ***Método***: trata-se de um estudo ecológico desenvolvido a partir dos casos de tuberculose em adolescentes. Obtiveram-se a correlação temporal entre as taxas brutas de incidência da tuberculose e o ano de ocorrência segundo o coeficiente de correlação linear de *Pearson* e a autocorrelação espacial pelo índice de *Moran*. Realizou-se a análise no programa *TerraView*, versão 4.2.2. ***Resultados***: revela-se que o Índice de *Moran* apresentou associação espacial. Levantaram-se correlação linear negativa moderada e baixa entre as variáveis representadas pelas taxas brutas e ano de ocorrência, segundo faixas etárias, dos dez aos 14 e dos 15 aos 19 anos, respectivamente. ***Conclusão***: indica-se, pela autocorrelação espacial, a existência de municípios prioritários para intervenção e planejamento de ações da Enfermagem. ***Descritores***: Tuberculose; Educação em Saúde; Análise Espacial; Adolescente; Enfermagem; Doenças Negligenciadas.

RESUMEN

Objetivo: analizar el patrón espacio-temporal de casos notificados de tuberculosis en adolescentes. ***Método:*** estudio ecológico, desarrollado a partir de casos de tuberculosis en adolescentes. La correlación temporal entre las tasas brutas de incidencia de tuberculosis y el año de ocurrencia se obtuvo de acuerdo con el coeficiente de correlación lineal de *Pearson* y la autocorrelación espacial utilizando el índice de *Moran*. El análisis se realizó con el programa *TerraView*, versión 4.2.2. ***Resultados:*** el Índice de *Moran* mostró una asociación espacial. Se obtuvo una correlación lineal negativa moderada y baja entre las variables representadas por las tasas brutas y el año de ocurrencia, según los grupos de edad, 10 a 14 y 15 a 19 años, respectivamente. ***Conclusión:*** la autocorrelación espacial indica la existencia de municipios prioritarios para la intervención y la planificación de acciones de enfermería. ***Descriptores***: Tuberculosis; Educación en Salud; Análisis Espacial; Adolescente; Enfermería; Enfermedades Desatendidas.

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INTRODUCTION

Tuberculosis (TB) appears in adolescents with a specification deficit in epidemiological manuals of the World Health Organization (WHO), however, the involvement is related to the risks and vulnerabilities associated with difficulties in diagnosis[1] (shows positivity of the sputum exam commonly lower)[2], the characteristics specific to the age group (from 10 to 19 years old) related to the immunological status and vaccination situation, to the formation of the concept of self-care, with possible neglect of the diagnosis / treatment and to the stigma related to the disease, in addition to the social and contextual factors of access to health, education and living conditions. [1,3]

It is observed that, although several countries have presented information on the reduction of the incidence of TB, control and elimination are still a challenge for the population, as they are influenced by socioeconomic factors, migratory flows and by the increase in immunosuppressed people.[4-5] In Brazil, in 2018, 72,788 new TB cases were diagnosed, which corresponds to the incidence coefficient of 34.8 cases / 100 thousand inhabitants,[6] and the confirmed cases corresponded to 1,061 in adolescents aged 10 to 14 years and 5,138 from 15 to 19 years of age.[7]

It is related to the vulnerability to tuberculosis, in the juvenile period, to the incipience of social protection schemes for nutritional support, improvement of the domestic economy, training and routine screening of tuberculosis for orphans and young people in socio-educational measures with deprivation of freedom, combat to stigma and discrimination, in addition to greater attention to indigenous populations, those living with HIV / AIDS and those who are on the street or who live in precarious living conditions. It is understood that measures for the eradication of TB, especially in groups in situations of social vulnerability, involve the participation of affected individuals, specialists and civil society in the construction of strategies in the fields of health supported by health law and human rights.[8]

The eradication of TB is inserted in the challenges of sustainable development of the third millennium proposed by the United Nations (UN), which aim: to ensure a healthy life and to promote well-being for all, at all ages, with the goal of eliminating it until 2030.[9]

TB prevention is required from the decentralization of control actions for Primary Health Care (PHC), based on health education strategies that consider the specificities of adolescents for prevention, active search, early diagnosis and chain break transmissibility. For the performance of the multi-professional health team in the territory, the involvement of the professionals that make up the Family Health Strategy (FHS) and the recognition of the epidemiological aspects that involve the disease in this range are required.[1] It is known that the territory is an important space for health action to combat tuberculosis in the juvenile period, since its appropriation goes beyond the idea of geographical boundaries, but it includes power relations, policies, culture, economy and the appropriation of space by adolescents.

In the adoption of spatial analysis, geoprocessing and Geographic Information Systems (GIS) are used as a strategic tool for mapping the disease in a given territory, which allows recognizing the dynamics of transmissibility and the identification of the situation health of the population due to the risk of becoming ill.[10] In view of the above, this study seeks to analyze the spatial-temporal pattern of notified cases of tuberculosis in adolescents.

METHOD

This is an ecological study with a temporal trend, constituted in the State of Pernambuco (PE), Northeast region of Brazil, based on secondary data referring to cases of compulsory TB notification in the years 2001 to 2015, since it is configured as period that followed the creation of the Millennium Development Goals, eight objectives to fight poverty in the year 2000 to be achieved by the end of 2015, among them, the investment to fight tuberculosis, relevant for the collection of the variables age group of the teenager and municipality of residence.[2]

Secondary publicly available data available in the Notifiable Diseases Information System (SINAN) were used to carry out this study[7] and the Brazilian Institute of Geography and Statistics (IBGE).[11] According to the National Health Council, Resolution 510, of April 7, 2016, submission to the Research Ethics Committee was waived because it is a study based on secondary and public domain databases.

The population was composed of 5,208 notified cases of TB in adolescents aged 10 to 19 years. All data reported from 2001 to 2015, provided by the Informatics Department of the Unified Health System (DATASUS)[12], through electronic access to SINAN.[7]

The first step was taken with obtaining the vector files of the digital cartographic bases by municipal meshes of the State of Pernambuco (PE) transmitted to the census information. Then, two worksheets were made that corresponded to the two phases of adolescence (from 10 to 14 years old and from 15 to 19 years old) with the general quantitative population of the State, in the period from 2001 to 2015, provided by the IBGE.[11] The second stage continued with the survey and preparation of spreadsheets of registered TB cases

in adolescents, living in Pernambuco (PE), obtained from SINAN.[7] In the third stage, the formatting and calculation of gross rates was carried out.

The analysis of the study was supported in the calculation of the gross incidence rates of TB cases in adolescents by municipality of residence and by year of occurrence in the period from 2001 to 2015. These data were tabulated by territorial expression and temporal progression. In the territorial analysis, the spatial association was evaluated by means of the global and local Moran Indexes based on the calculation of gross rates.

In this phase of the analysis, the Bayesian tool was used in order to smooth the rates values according to empirical statistical criteria related to the possible influences exerted by territorial proximity. In the analysis of temporal progression, the linear correlation of the dependent variable represented by the crude rates and the independent variable of the year of occurrence were evaluated.

The spatial statistical analysis was performed with the aid of the TerraView program, version 4.2.2, for the construction of the Thematic Maps from the rates smoothed by the Bayes empirical technique and by spatial association through the Moran Index (LisaMap).[13] The variable dependent on TB rates per 100 thousand inhabitants was calculated with Baysean smoothing. Through this type of analysis, it was possible to mitigate instability and random fluctuations, which could result in biases if they were identified by obtaining the gross rates, since the estimates in less populous municipalities, with the occurrence of events by mere chance, tend to have high sensitivity.[14]

The first stage of analysis was supported in the elaboration of thematic maps based on the global empirical Bayes estimator. This analysis is performed by calculating the weighted average between the locality's gross rate and the region's global rate. Thematic maps were then constructed for the expression of local Bayesian rates. The local estimate is portrayed by this analysis, being established from the rates of the geographical neighborhood of the area to be estimated.[14] Therefore, the significance of the Moran LisaMap Index - Local Indicator for Spatial Autocorrelation was determined. By this indicator, the correlation of the values of a municipality in relation to its territorial neighborhood is analyzed, as it qualifies and quantifies the association in relation to sociodemographic aspects between the municipalities.

This type of analysis also reveals statistical significance by comparing local values through random permutations between the attributes of the municipalities. It is detailed that the p-value greater than 0.05 indicates low significance of the index provided and, when less than this value, the correlation is significant, thus, the areas are classified into five different levels of significance: without significance; significance of 0.05 (95% confidence); 0.01 (99% confidence); 0.001 (99.9% confidence) and 0.0001 (99.99% confidence).[15]

Through the analysis of the local Moran Index, it is possible to visualize territorial clusters with values of similar or anomalous attributes for the characterization of areas at risk for a given disease or condition, with the identification of clusters in relation to the neighborhood being more significant.[15]

For the rates of TB cases, the Equal Steps grouping mode, classified by color scale, was used to subdivide the minimum and maximum values into five classes with equal intervals. [16]

The exploratory analysis of the data continued with the identification of the temporal progression of TB cases, which allows obtaining implicit information, in addition to presenting atypical behaviors from the calculation of the correlation coefficient.

The zero correlation coefficient means that there is no correlation between the two variables, and the module of the correlation coefficient equal to one indicates the perfect linear correlation. It is prescribed, for that value squared (ρ^2), the coefficient of determination, that expresses the strength of linear association, classified in: ρ^2(0.1 – 0.3) weak; ρ^2 (0.4 – 0.6) moderate; ρ^2 (0.7 – 1) strong.[17]

RESULTS

In this study, the linear correlation and spatialization of TB cases in adolescents living in the State of Pernambuco (PE), Northeastern Brazil are analyzed, with the universe of data composed of 5,208 reported cases.

In relation to the linear correlation between TB rates and years, there is a statistically negative correlation for the occurrence of this phenomenon, classified as the strength of association as moderate (ρ = 0.002) 10 to 14 years old and weak (ρ = 0.001) for those aged 15 to 19 years, which makes it possible to advance in forecasting the evolution of rates by the year 2017 for the two phases that comprise adolescence (Figure 1).

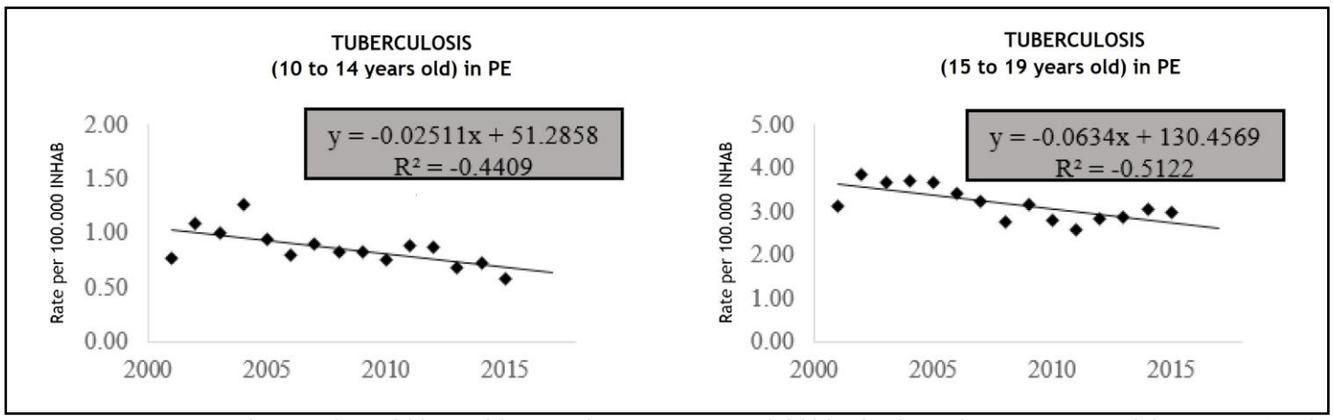

Figure 1. Linear correlation, from 2001 to 2015, and projection until 2020 of tuberculosis cases in adolescents. Recife (PE), Brazil, 2018.

Thematic maps referring to rates are presented in figure 2, with the smoothing of TB cases in adolescents obtained according to the Bayes Empirical Global estimator, for the period from 2001 to 2015, showing, in darker tones, the municipalities that present higher global baysean rates, with emphasis, in the first phase of adolescence, from 10 to 14 years old for the mesoregions and municipalities: Metropolitan - Abreu e Lima (1.46), Recife (1.53) and Olinda (1.34); Zona da Mata - Barreiros (1.28) and Sertão - Bodocó (1.39); in the second phase of adolescence, from 15 to 19 years old, the municipality of Itapissuma (11.52), which belongs to the Metropolitan mesoregion, was identified with the highest overall rate.

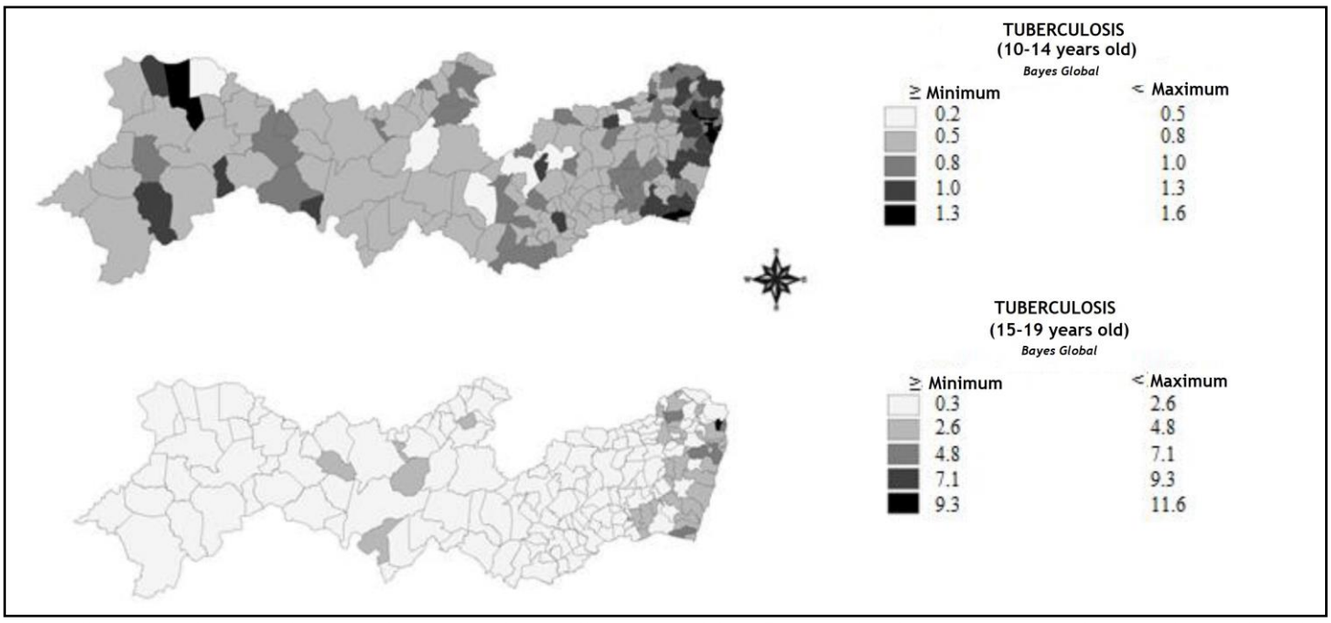

Figure 2. Thematic map of rates with smoothing by Global Empirical Bayes referring to tuberculosis cases from 10 to 14 years old and from 15 to 19 years old, per 100 thousand inhabitants, in the municipalities of the State of Pernambuco. Recife (PE), Brazil, 2018.

Figure 3 shows the local Bayesian rates, which showed the mesoregions and municipalities: Metropolitan - Recife (1.52), Olinda (1.41), Abreu e Lima (1.26) and Araçoiaba (1.48); Zona da Mata - Tracunhaém (1.27); São Francisco - Itacuruba (1.49) and Sertão - Bodocó (1.55), aged 10 to 14 years old; in the second phase of adolescence, only the municipality of Itapissuma (12.47), located in the metropolitan mesoregion, had a more significant rate.

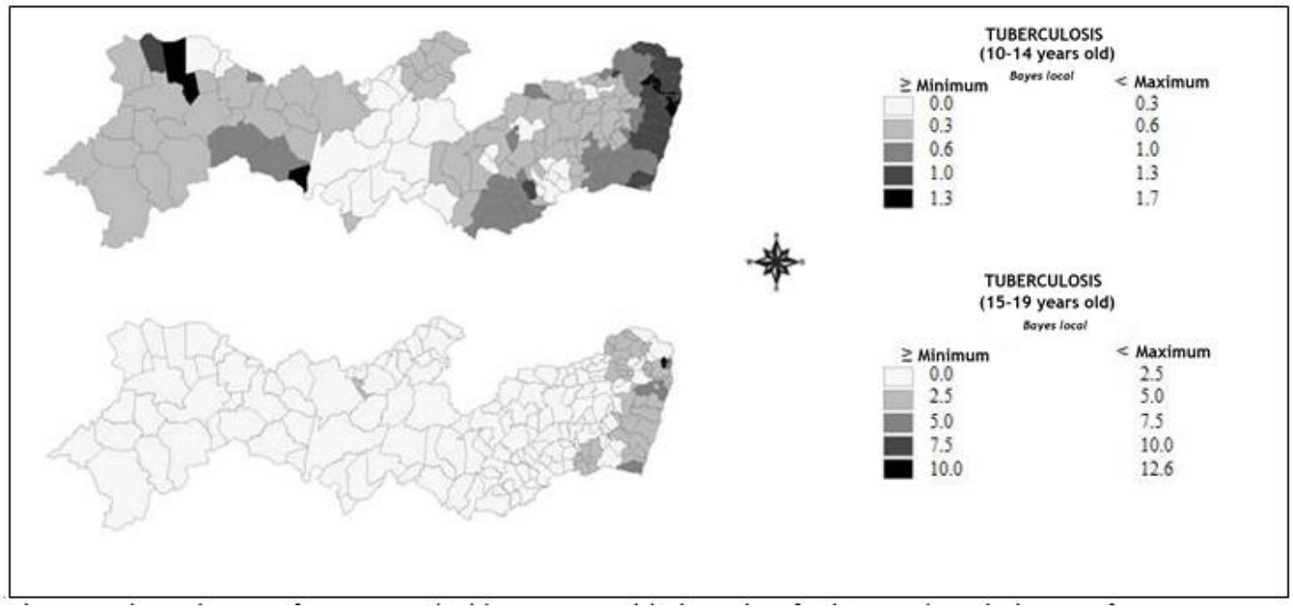

Figure 3. Thematic map of rates smoothed by Bayes Empirical Local, referring to tuberculosis cases from 10 to 14 years old and from 15 to 19 years old, per 100 thousand inhabitants, in the municipalities of the State of Pernambuco. Recife (PE), Brazil, 2018.

The Moran Index showed a spatial association for both age groups when expressing an index value equal to 0.184171 and a p-value equal to 0.002 (ten to 14 years of age) and an index value equal to 0.41345 and a p-value equal to 0.001 (15 to 19 years old). Figure 4 shows the dynamics of transmissibility over five years. More significant rates were presented, in the period from 2001 to 2005, for the municipalities Recife (8.49) and Itapissuma (7.91), located in the Metropolitan Region, and Barreiros (9.09) and Sirinhaém (8.10), in the Zona da Mata; in the period between 2006 and 2010 and in the last five years, the municipality Itapissuma presented a high overall rate, 11.03 and 11.73, respectively.

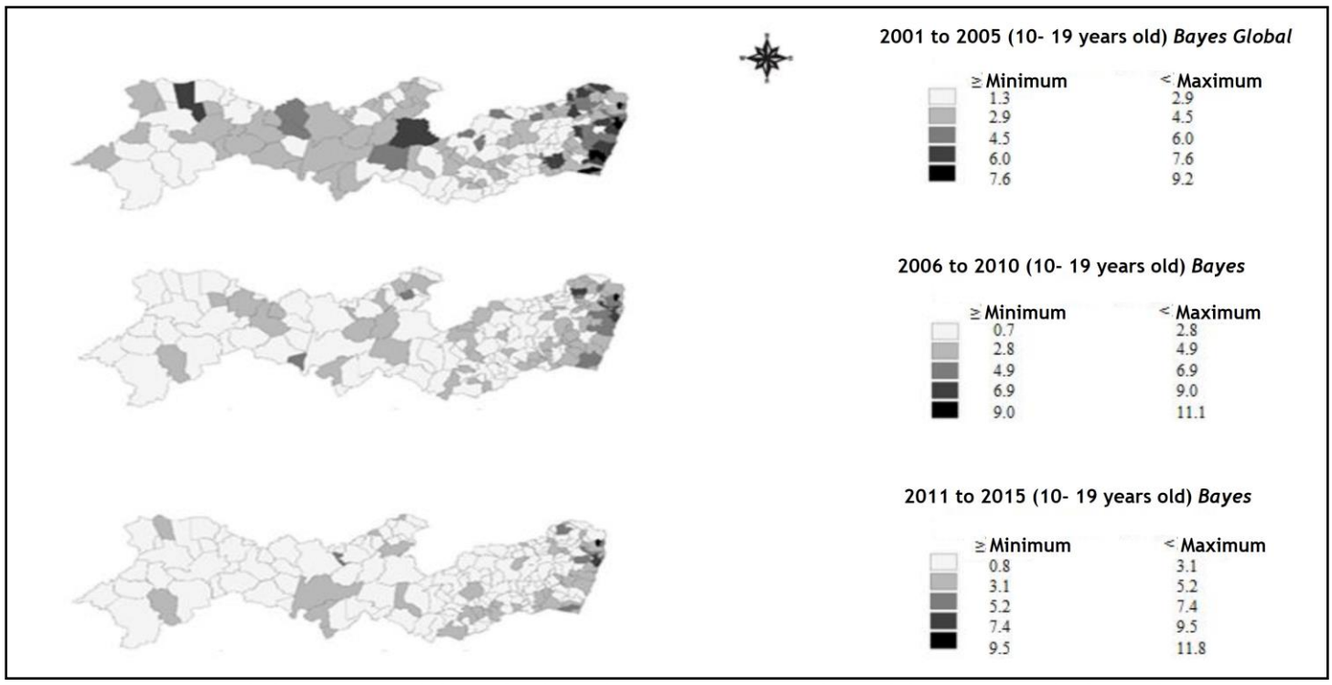

Figure 4. Dynamics of the transmissibility of tuberculosis cases reported in adolescents aged 10 to 19 years, in the municipalities of the State of Pernambuco: a priori, the rates for the period from 2001 to 2005; in the center, the rates for the period from 2006 to 2010 and, therefore, the rates corresponding to the period from 2011 to 2015. Recife, PE, Brazil, 2018.

DISCUSSION

The spatial association and the occurrence of TB in the adolescent population of Pernambuco are suggested by the results of the analysis, according to the Moran index. It was possible to visualize the areas with the highest occurrence of TB through the thematic maps constituted by a global and local empirical bayes estimator for the period from 2001 to 2015. It is detailed that the areas neighboring the municipalities with varying gross TB rates in adolescents have a spatial association for both the age groups of the first and second phases of adolescence. The highest index in the second phase of adolescence can be related

to greater autonomy and mobility among the regions with the highest rates.

Through the temporal analysis of the epidemic in the State of Pernambuco (PE), divided by five-year periods, it was possible to identify the dynamics of the transmissibility of TB cases reported in the adolescent population. It is revealed that, in the last years (2011-2015), this phenomenon was more expressive in the metropolitan mesoregion of the State and this finding can be justified because it is a region composed of an accelerated urbanization process resulting from the migratory flow.

There was a negative linear correlation for the occurrence of TB in adolescents living in the State of Pernambuco (PE), and the number of cases over the years (2001 to 2015) indicated a decreasing linear trend for contamination, however, the number of cases TB remains high and poses a threat to the population.

It should be noted that, despite the decrease, the negative correlations, classified as moderate or weak, may indicate that, despite this behavior, there was a decrease in TB rates over the study period (2001 to 2015) and that they did not reach global targets for 90% reduction in TB deaths and 80% reduction in TB incidence (new cases per year) by 2030.[2]

In a similar study carried out with cases of TB / HIV coinfection in adolescents living in Pernambuco, the relationship of conglomerates in leisure activities with the increase in exposure to HIV infection, in addition to the low adherence to treatment that results in HIV/TB coinfection, stood out. It is added that the cases were more frequent in male adolescents, in the second phase of adolescence, with low education, 91% of who were residents in the metropolitan region of the state. Regarding the evolution of cases, there was a low follow-up of treatment, hospitalization and unfavorable outcomes.[18]

The social context of adolescents living in Pernambuco must be considered through the dynamics of transmissibility, health situation and vulnerability context, since social inequities are directly related to the process of falling ill. It is believed that the fight against TB demands social restructuring in order to achieve social protection, not in a perspective of mitigating poverty, but for the construction of an equitable society. It is observed, therefore, that adherence to TB treatment requires social incentives, for example, the Family Welfare Program, in addition to the provision of basic food basket and transportation voucher for people in extreme vulnerability, associated with the offer to Directly Observed Treatment and the bond established between the professional and the patient for treatment adherence.[19]

It was found that, over the years, the urbanization process has generated, on the periphery of the metropolitan regions of the Brazilian states, irregular construction of subdivisions and housing developments that make the ideal sanitary conditions impossible to maintain health, making it difficult, among other aspects, the prevention of infectious diseases.[20]

They are propitiated, by the disorderly growth of marginal populations in the Metropolitan Mesoregion of Pernambuco, as a result of migrations in search of better quality of life and job opportunities, conditions favorable to contamination by the Koch bacillus.

In a study carried out in the Northeast of Brazil, the spatial distribution of new TB cases by residence was analyzed to determine areas of greater occurrence, and the results revealed that the capitals of the Northeastern states and metropolitan areas are important focuses for the spread of TB.[21]

The epidemiological portrait that is characterized in the Northeast, the region of the country with the highest spatial distribution and the highest incidence rates of the disease, showed the incipience of health services, such as difficulty of access, which leads to late diagnosis and underreporting.[22]

It is similar to the concentration of reported cases in the municipalities with the highest indexes to the concentration of the surrounding municipalities, and this fact can be justified by the hypothesis of the presence of similar sociodemographic characteristics, which indicates greater vulnerability to the incidence of TB in the adolescent population.

The spatial analysis of TB cases in the municipalities represents the dynamics of transmissibility in the areas covered by Pernambuco (PE), presented in this study with a flow directed to the metropolitan regions of the State.

It is known that socioeconomic variables and endogenous factors age, sex, race and presence of the human immunodeficiency virus (HIV) have the potential to increase vulnerability to TB related to individual and unequal access to information. The expansion of the health / disease process allows the resources of consumer goods and health services to be used in order to contribute to health promotion, becoming a means of preventing infection by the bacillus of Koch.[23]

They are checked, in Pernambuco (PE), by the socioeconomic factors referring to the levels of income and education, possible causes for the appearance of new cases and increase of the TB rates. The State of Pernambuco (PE) is responsible for 16.73% of illiterate Brazilians, a higher rate when compared to the States of the North Region

with lower GDP.[24] The nominal monthly household income, up to two minimum wages, is equivalent to 54.29%; permanent private households with a sewage collection network reach 46.8% of households; the density of residents per household, greater than one resident, comprises 67.97% of households.[11]

It is mentioned, as important, that, in Pernambuco (PE), 78.9% of the cases reported in adolescents belong to the second phase of adolescence (from 15 to 19 years old). It is noteworthy that the greater autonomy acquired in adolescence corroborates changes in common behaviors in this age group, such as sleep time and irregular eating, excessive physical activity and emotional lability, which can compromise immune resistance. Added to these factors is the expansion of the universe of conviviality and leisure in environments with large conglomerates.[25] It is warned that adolescents are more susceptible to TB due to physiological changes intrinsic to the developmental process characteristic of this phase, such as: hormonal changes and calcium metabolism.[26]

In a study conducted at a Children's Hospital of the State Health Secretariat of São Paulo, SP, Brazil, the most reported clinical symptoms in pulmonary forms of TB in childhood and adolescence were: cough (38%); fever (31%); dyspnoea (8%); adynamia and asthenia (6%); sweating (5%); weight loss (4%); chest pain and hemoptysis (1%). It is added that, in non-pulmonary forms of tuberculosis, the most common symptoms were: fever (30%); cough (20%); weight loss (20%). Other symptoms, such as strabismus, asthenia, dyspnoea, seizure, chest pain and adenomegaly, were reported in 5% of cases. All patients in this study were vaccinated with a dose of Bacillus Calmette-Guérin (BCG) vaccine. TB in childhood and adolescence was evidenced as a neglected aspect, as these are evaluated only when considered communicants of bacilliferous pulmonary TB and with symptoms already installed.[25]

Historically, in public health in Brazil, the very frequent practice of reductionist educational actions, focused on specific events and little able to mobilize community participation, is observed.[27]

It is pointed out that the school is a space that should be used for the prevention of new TB cases, including among adolescents, as well as the effective treatment by nurses. In recognition of the importance of the school environment, the Health in School Program (HSP) was implemented by the Ministry of Health as an articulation strategy of the Family Health Strategy (FHS) with the basic public education network to promote health actions schoolchildren and allow them to be multipliers of health knowledge.[28]

CONCLUSION

Through the creation of thematic maps by a global and local empirical bayes estimator, for the period from 2001 to 2015, in adolescents living in Pernambuco (PE), the identification of risk areas and their neighborhoods, emphasizing the importance of using integrated methods that consider the territorial space for understanding the health situation of the population.

They are guided, by geoprocessing, by planning and decision-making, by nurses, since it constitutes an important epidemiological tool for the construction of health education actions aimed at the prevention, active search and control of TB transmissibility. The role of Nursing in the fight against TB is endorsed in the commitment to recognize the social epidemiological context and the social determination of the health-disease process through the context of vulnerability of adolescents.

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REFERENCES

1. Pinto JTJM, Freitas CHSM. Pathways of children and adolescents with tuberculosis in Health services. Texto contexto-enferm. 2018 Mar; 27(1): e3880016. DOI: 10.1590/0104-070720180003880016

2. Ishikawa CS, Matsuo OM, Sarno F. Latent tuberculosis infection and tuberculosis in children and adolescentes. Einstein, 2018;16(3):1-6. Doi: 10.1590/S1679-45082018AO4090

3. Junges JR, Burille A, Tedesco J. Directly Observed Therapy for treating tuberculosis: critical analysis of decentralization. Interface. 2019 Oct;24:e190160. DOI: 10.1590/interface.190160

4. Rowińska-zakrzewska E, Korzeniewska-koseła M, Augustynowicz-kopeć E, Szturmowicz M. What factors may influence epidemiological situation of tuberculosis in Poland and in the world? Pneumonol Alergol Pol. 2016;84(2)126–33. DOI: 10.5603/PiAP.2016.0013

5. Silveira C, Goldberg A, Silva TB, Gomes MHA, Martin D. Health workers' place in studies on international migratory processes and health. Cad Saúde Pública. 2016 Oct;32(10):e00063916. DOI: 10.1590/0102-311X00063916

6. Ministério da Saúde (BR), Secretária de Vigilância em Saúde. Brasil Livre da Tuberculose: evolução dos cenários epidemiológicos e operacionais da doença [Internet]. Brasília: Ministério da Saúde; 2019 [cited 2019 Aug 10]. Available from:

http://portalarquivos2.saude.gov.br/images/pdf/2019/marco/22/2019-009.pdf

7. Ministério da Saúde (BR), Sistema de Informação de Agravos de Notificação. O Sinan [Internet]. Brasília: Ministério da Saúde; 2016 [cited 2019 Aug 10]. Available from: http://portalsinan.saude.gov.br/o-sinan

8. World Health Organization. Global Tuberculosis Report [Internet]. Geneva: WHO; 2017 [cited 2019 Aug 10]. Available from: : http://www.who.int/tb/publications/global_report/en/.

9. Nações Unidas Brasil. Objetivos de Desenvolvimento Sustentável [Internet]. Brasília: Nações Unidas Brasil; 2017 [cited 2018 July 04]. Available from: https://nacoesunidas.org/pos2015

10. Muller EPL, Cubas MR, Bastos LC. Geoprocessing of data as a management tool in a family health unit. Rev Bras Enferm. 2010 Nov/Dec;63(6):978-82. DOI: 10.1590/S0034-71672010000600017

11. Ministério do Planejamento, Orçamento e Gestão (BR), Instituto Brasileiro de Geografia e Estatística. Estimativa populacional 2016 – Pernambuco [Internet]. Rio de Janeiro; 2016 [cited 2018 Nov 15]. Available from: https://www.ibge.gov.br/cidades-e-estados/pe.html

12. Ministério da Saúde (BR), Sistema de Informação de Agravos de Notificação. Violência Interpessoal/Autoprovocada [Internet]. Brasília: Ministério da Saúde; 2016 [cited 2019 Aug 15]. Available from: http://www.portalsinan.saude.gov.br/violencia-interpessoal-autoprovocada

13. Minas Gerais (Estado), Secretaria de Estado de Saúde. Portal da Vigilância em Saúde. TERRAVIEW 4.2.2. [Internet]. Belo Horizonte: SES; 2010 [cited 2019 Dec 28]. Available from: http://vigilancia.saude.mg.gov.br/index.php/download/instalador-terraview-windows-v-4-2-2/

14. Honorato T, Lapa PPA, Sales CMM, Reis-Santos B, Tristão-Sá R, Bertolde AI, et al. Spatial analysis of distribution of dengue cases in Espírito Santo, Brazil, in 2010: use of Bayesian model. Rev Bras Epidemiol. 2014 [cited 2019 Aug 10];17(Suppl 2):150-9. DOI: 10.1590/1809-4503201400060013

15. Nunes FG. Spatial exploratory analysis of indicators of the socio-environmentaldevelopment of north and northeast planning areas in goiás. Ateliê Geográfico. 2013 Apr;7(1):237-59. DOI: 10.5216/ag.v7i1.19809

16. Francisco CN. Conceitos de Geoprocessamento: Sistemas de Informações Geográficas [Internet]. Rio de Janeiro; Universidade Federal Fluminense; 2014 [cited 2019 Aug 10]. Available from: http://www.capacidades.gov.br/blog/download/id/38/post/410/midia/9901

17. Mukaka MM. Statistics Corner: a guide to appropriate use of correlation coeficiente in medical research. Malawi Med J [Internet]. 2012 Sept [cited 2019 Aug 10];24(3):69-71. Available from: https://www.ajol.info/index.php/mmj/article/view/81576/71739

18. Black TLP, Cardoso MD. TB/ HIV coinfection in adolescents resident in pernambuco, notified in the period 2001 to 2016. Braz J Hea Rev [Internet]. 2019 Jan/Feb [cited 2019 Aug 10]; 02(1):321-24. Available from: http://www.brjd.com.br/index.php/BJHR/article/view/947/821

19. Orlandi GM, Pereira EG, Biagolin REM, França FOS, Bertolozzi MR. Social incentives for adherence to tuberculosis treatment. Rev Bras Enferm. 2018 Sept;72(5):1182-8. DOI: 10.1590/0034-7167-2017-0654

20. Nardi SMT, Paschoal JAA, Pedro HSP, Paschoal VD, Sichieri EP. Use of geo-processing system in Public Health : principles and applications. Rev Inst Adolfo Lutz [Internet]. 2013 [cited 2019 Aug 10];72(3):185–91. Available from: http://www.ial.sp.gov.br/resources/insituto-adolfo-lutz/publicacoes/rial/10/rial72_3_completa/arquivos-separados/1562.pdf

21. Barbosa IR, Pereira LMS, Medeiros PFM, Valentim RS, Brito JM, Costa ÍCC. Spatial distribution analysis of tuberculosis in Northeastern Brazil, 2005-2010. Epidemiol Serv Saúde. 2013 Dec;22(4):687–95. DOI: 10.5123/S1679-49742013000400015

22. Yamamura H, Freitas IM, Santo Neto M, Chiaravalloti Neto F, Popolin MAP, Arroyo LH, et al. Spatial analysis of avoidable hospitalizations due to tuberculosis in Ribeirao Preto, SP, Brazil (2006-2012). Rev Saúde Pública. 2016 May;50:20. DOI: 10.1590/S1518-8787.2016050006049

23. San Pedro A, Oliveira RM. Tuberculosis and socioeconomic indicators: systematic review of the literature. Rev Panam Salud Publica [Internet]. 2013 [cited 2019 Dec 12];33(4):294–301. Doi: 10.1590/S1020-49892013000400009

24. Sindicato dos Trabalhadores em Educação de Pernambuco. Pernambuco entre os dez piores no índice de analfabetismo [Internet]. Recife: SINTEPE; 2010 [cited 2018 Dec 15]. Available from: https://www.sintepe.org.br/site/v1/index.php/component/content/article/40-noticias/1394-analfabetismo.

25. Zombini EV, de Almeida CHD, Silva FPCV, Yamada ES, Komatsu NK, Figueiredo SM. Clinical and epidemiological profile of tuberculosis in Childhood and adolescence. Rev bras crescimento desenvolv hum [Internet]. 2013 [cited 2019 Aug 10];23(1):52-7. Available from:

http://pepsic.bvsalud.org/pdf/rbcdh/v23n1/pt_08.pdf

26. Pelissari DM, Diaz-Quijano FA. Household crowding as a potential mediator of socioeconomic determinants of tuberculosis incidence in Brazil. Plos ONE. 2017 Apr;12(4):e0176116. Doi: 10.1371/journal.pone.0176116

27. Sá LD, Gomes ALC, Carmo JB, Souza KMJ, Palha PF, Alves RS, et al. Health education in tuberculosis control: the perspective of Family Health strategy professionals. Rev eletrônica enferm. 2013 Jan/Mar;15(1):103-11. DOI: 10.5216/ree.v15i1.15246

28. Ministério da Educação (BR), Secretaria de Atenção à Saúde, Departamento de Atenção Básica. Programa Saúde nas Escolas [Internet]. Brasília: Ministério da Educação; 2016 [cited 2019 Aug 10]. Available from: http://portal.mec.gov.br/expansao-da-rede-federal/194-secretarias-112877938/secad-educacao-continuada-223369541/14578-programa-saude-nas-escolas

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