Seasonality of the demand for nontreponemal test in a private laboratory in the city of Niterói (RJ)

Sazonalidade da demanda de teste não treponêmico em um laboratório privado do município de Niterói (RJ)

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ABSTRACT

Introduction: Syphilis is a systemic, chronic, curable, and unique bacterial infection in humans, transmitted sexually, mainly. When untreated, it evolves to stages that range in severity and can affect different body organs and systems. **Objective:** To delineate whether or not there are significant changes in the demand and positivity of the nontreponemal test, after Carnival or at other times in the analyzed years, from January 2014 to December 2019, in a laboratory in the private health network of Niteroi. **Methods:** A retrospective, quantitative and descriptive study was carried out aiming at defining the profiles of the population that seeks a particular laboratory to undergo the nontreponemal test from 2014 to 2019. Data collection was carried out through documental analysis of the results, with an authorization from the laboratory, preserving the confidentiality of patients. The seasonal decomposition, which is a monthly time series, was performed to assess the trend and exponential trend using the additive model. **Results:** A total of 34,817 tests were performed, with 1,637 positivity of the nontreponemal test results in the analyzed years, using the SPSS program. There was an increase in the number of exams in 2019 (6,488), maintaining the distribution during this year. **Conclusion:** Both the demand and the positivity of the nontreponemal tests have increased significantly over the years, finding no seasonality in relation to reactive of the nontreponemal tests.

Keywords: STD. Syphilis. Seasonality. Brazil.

RESUMO

Introdução: A sífilis é uma infecção bacteriana sistêmica, crônica, curável e exclusiva do ser humano, transmitida principalmente pela via sexual. Quando não tratada, evolui para estágios de gravidade variada, podendo acometer diversos órgãos e sistemas do corpo. **Objetivo:** Delinear se ocorrem alterações significativas na demanda e positividade de teste não treponêmico após o carnaval ou em outras épocas dos anos estudados, no período de janeiro de 2014 até dezembro de 2019, em um laboratório da rede privada do município de Niterói. **Métodos:** Realizou-se um estudo descritivo retrospectivo, de caráter quantitativo, no qual se buscou definir os perfis da população que procurou determinado laboratório para a realização do teste não treponêmico no período de 2014 a 2019. A coleta de dados foi feita por meio de pesquisa documental dos resultados, fornecidos mediante autorização do laboratório, preservando o sigilo dos pacientes. Foi feita a decomposição sazonal, que é série temporal mensal, com vistas a avaliar a tendência e a tendência exponencial pelo modelo aditivo. **Resultados:** Realizaram-se 34.817 exames, com 1.637 testes não treponêmicos reagentes nos anos estudados, analisados por meio do programa SPSS. Houve um aumento do número de exames em 2019 (6.488), mantendo a distribuição durante esse ano. **Conclusão:** Tanto a demanda quanto a positividade de exames não treponêmicos aumentaram significativamente de forma equiparada no decorrer dos anos, não encontrando sazonalidade em relação a testes não treponêmicos reagentes.

Palavras-chave: DST. Sífilis. Sazonalidade. Brasil.

INTRODUCTION

Syphilis is a chronic and systemic sexually transmitted disease (STD)[1], also known as lues (plague, scourge). It is caused by *Treponema pallidum*, subspecies *pallidum*, spirochete bacterium that is not stained by the Gram technique nor does it grow in artificial culture medium. It alternates exuberant and mild clinical manifestations, with periods of clinical silence called latency.

Its main and most important transmission route is sexual (genital, oral, and anal). The infection through blood transfusion (which is rare nowadays) or through accidentally or voluntarily contaminated perforating material is feasible. It can also be transmitted by intrauterine infection or by the contact of the fetus with maternal peripartum infections, in these cases representing a failure in the public health system, since this is a condition that is easy to diagnose and has low laboratory costs[1].

In May, 2016, the World Health Assembly established the 2016–2021 strategy of the global health sector for STDs[2], which includes the expansion of interventions and services based on evidence to control the STDs and to reduce their impact as a public health problem until 2030, thus defining goals for the reduction in the incidence of gonorrhea and syphilis in adults and recommending the performance of surveys of STD global incidence rates until 2018[2].

Based on the prevalence data from 2009 to 2016, the World Health Organization (WHO) estimated the total incident cases of curable STDs in 376.4 million, among which 6.3 million (95%CI 5.5–7.1 million) were cases of syphilis. The estimated global prevalence of syphilis, among men and women, was 0.5% (95%CI 0.4–0.6, with regional values ranging from 0.1 to 1.6%[2].

The situation of syphilis in Brazil is not different than that in other countries. The number of cases of infection are a matter of concern

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and needs to be controlled. In the 2020 epidemiological journal, it was observed that acquired syphilis, whose notification became compulsory in 2010, showed increasing detection. In 2019, 152,915 cases of acquired syphilis were notified in the Notifiable Diseases Information System (SINAN) (detection rate of 72.8 cases/100,000 residents); 61,127 cases of syphilis among pregnant women (detection rate of 20.8/1,000 live births); 24,130 cases of congenital syphilis (incidence rate of 8.2/1,000 live births); and 173 deaths caused by congenital syphilis (mortality rate of 5.9/100,000 live births). Despite the increased number of notified cases, no federation unit presented a higher incidence of congenital syphilis than the detection rate of syphilis among pregnant women, which may mean an improvement in the notification of cases of syphilis among pregnant women in the country[2].

In the last decade, in Brazil, between 2015 and 2019, there was an increasing number of notifications of acquired syphilis, syphilis in pregnant women and congenital syphilis, which can be partly attributed to the improvement in the surveillance system and the increased use of fast tests[2].

In 2019, in comparison to 2018, there was a 3.3% reduction in the detection rate among pregnant women, and 8.7% in the incidence rate of congenital syphilis. There was a reduction of 4.6% in the detection rate of acquired syphilis, which can be related to the identification of problems involving the transfer of data between the SUS management spheres, and that can also be a result of the delayed notification and entry in SINAN's databases[2].

Niterói is a mid-sized city, with 515,317 residents in 2020 and excellent socioeconomic indicators. It has the best literacy rates in the state of Rio de Janeiro. It also has the richest population in Brazil; 30.7% are in class A2[3]. The portion of the population inserted in supplementary health is expressive: 55.5% in 2020[4]. It is worth to mention there were not many studies about the prevalence of STD infections in its population.

Celebrated in Portugal since the XV century[5], Carnival was brought by the Portuguese to the Brazilian colony by the carnival of Madeira Island, in Portugal, in the XVI century. The connection between the Madeira Island and the slaves as a port of passage for assets and people, along with the expansion of the international sugar trade in the Atlantic, influenced the carnival traditions in Brazil. The celebration took place in a period prior to lent and it mean freedom, which remains until nowadays[5].

It is believed that the strong and permissive sexual appeal in these times of Carnival exposes people to a risk behavior that favors the development of STDs and the acquired immunodeficiency syndrome (AIDS). Therefore, the Ministry of Health has been using strategies, such as media campaigns and distribution of male condoms in party locations, aiming at preventing the increasing number of cases in these times of celebration.

STDs have motivated people to look for health services, in order to obtain proper diagnosis and treatment for a problem that affects, indistinctively, people of all classes. The nontreponemal test (VDRL) is not expensive, accessible and has great value for the diagnosis of syphilis, especially in latent periods. Therefore, even users of the Unified Health System (SUS) may use it in the private network to guarantee fast results.

It is important to emphasize that even though the fast test for syphilis and VDRL are available in SUS, the patients go to the private service for comfort and practicality, and not in business hours. The hypothesis of this study is that there is a seasonal increase in the number of acquired syphilis cases after carnival.

It is worth to mention that the presence of an STD, such as syphilis or gonorrhea, increases the risk of acquiring of transmitting the human immunodeficiency vírus (HIV) in up to 18 times[6-8].

OBJECTIVE

To design the seasonality of the demand and positivity of VDRL, after carnival or at other times of the studied years, from January 2014 to December 2019, in a laboratory of the private network of the city of Niterói.

METHODS

A cross-sectional, descriptive, retrospective and quantitative study was performed aiming at assessing the number of tests and positive results of VDRL in a specific laboratory of the private network (Bittar Laboratory), from January 2014 to December 2019.

Bittar is one of the most respected medical companies in the cities of Niterói and São Gonçalo (supplementary/private medicine, not related to SUS). It was founded 57 years ago by the pathologist physician Elimar BIttar. It has been part of the Quality Control programs of ControlLab (number 17) and the National Program of Quality Control (PNCQ – number 5,414) for over 30 years, with excellent evaluation and six units in Niteroi and two in São Gonçalo[9].

The study was sent to the Research Ethics Committee of Hospital Universitário Antônio Pedro, Universidade Federal Fluminense (UFF), and was approved in 2019, CAAE 23832819.2.0000.5243.

The bibliographic review was carried out with searches in the main databases (Lilacs, SciELO, MedLine and PubMed), with publications in the past forty years.

Data was collected through a documental analysis of the test results, provided with the laboratory's authorization, previously protecting the patients' anonymity. The laboratory provided the tests and positive results, and first excluded repeated positive results with minor titles, probably for being related to a serological scar. It was not possible to assess if there was a single request for the test or if it was part of routine tests, given the anonymity. The VDRL kits used in the studied period were from Labtest, Minas Gerais, and Omega, from Biosys/Kovalent, German-Brazilian brand.

The listed variables are: number of working days in each studied year, number of tests collected per studied day, month and year, the period of carnival in the studied years and the number of positive tests in each month of the analyzed years, using the SPSS software, version 1.0.0.1439, and the R *software*, version 4.1.2. The data were organized in Excel sheets, separated month by month in each studied year.

The methods of time series descriptive analyses were: sequence charts, boxplot, frequency histogram, and classical decomposition of the series described in Moretti and Toloi[10]. Additionally, we used the cross-correlation coefficient, which is a method that can quantify the long-range cross-correlation between two time series as a power law, in a non-stationary regime; besides, it can identify seasonal or periodical components. All hypotheses were tested with the establishment of a 5% significance level, that is, p equal to 0.05[10-13].

Classical decomposition of the demand and positivity series

According to Moretti[10], the decomposition model (additive) of the time series can be decomposed in three non-observable components:

T(t), S(t) and a(t). These components represent: trend, seasonality and random variation, respectively. Therefore, an observation of a time series can be described as:

Z(t) = T(t) + S(t) + a(t), in case these components interact in an additive manner or;

Z(t) = T(t) x S(t) x a(t), if the relationship between them is multiplicative.

In this study, we used the additive model to verify the magnitude of the trend (T(t)) and seasonality (S(t)) components and look for interpretation.

RESULTS

Between January 2014 and December 2019, 34,817 tests were performed and presented 1,637 reactive VCRL tests (4.70%) in the studied years, anlayzed using the SPSS software, being 15.18% in 2014 (5,288 tests); 16.06% in 2015 (5,591 tests); 16.39% in 2016 (5,708 tests); 16.18% in 2017 (5,636 tests); 17.53% in 2018 (6,106 tests); and 18.63% in 2019 (6,488 tests). The incomplete data were excluded. There was an increase in the number of tests in 2019 (6,488), maintaining the distribution during that year (**Table 1**).

The working days per month were, in annual means: 25.00 in 2014; 24.92 in 2015; 25.08 in 2016; 25.00 in 2017; 24.66 in 2018; and 25.08 in 2019. The monthly mean of working days in the six studied years was: 25.50 in January; 22.33 in February; 25.00 in March; 24.00 in April; 25.50 in May; 25.00 in June; 26.50 in July; 26.33 in August; 25.00 in September; 25.67 in October; 23.17 in November; and 25.50 days in December.

The positivity in an annual mean was of: 19.42 in 2014; 21.33 in 2015; 18.33 in 2016; 20.58 in 2017; 23.67 in 2018; and 33.08 in 2019. As to the positivity per month in the six studied years, it was, in average: 21.83 for January; 19.33 for February; 26.17 for March; 20.83 for April; 25.17 for May; 22.50 for June; 24.33 for July; 26.83 for August; 25.17 for September; 24.83 for October; 19.67 for November; and 16.17 for December.

In the studied period, carnival took place in February, in 2015, 2016, 2017 and 2018 on the following days of the month: 16, 9, 28 and 13, respectively. In 2014 and 2019, it happened in March, on the 4th and the 5th, respectively.

Seasonally adjusted values are the data whose seasonal component was removed; it is the difference between observed and seasonal values, in the additive model. If the chart of seasonally adjusted data seems different based on the original data, it is possible to conclude there is a seasonal component in the data. In the case reported in this study, the test line is similar to that demonstrated in **Figure 1A**.

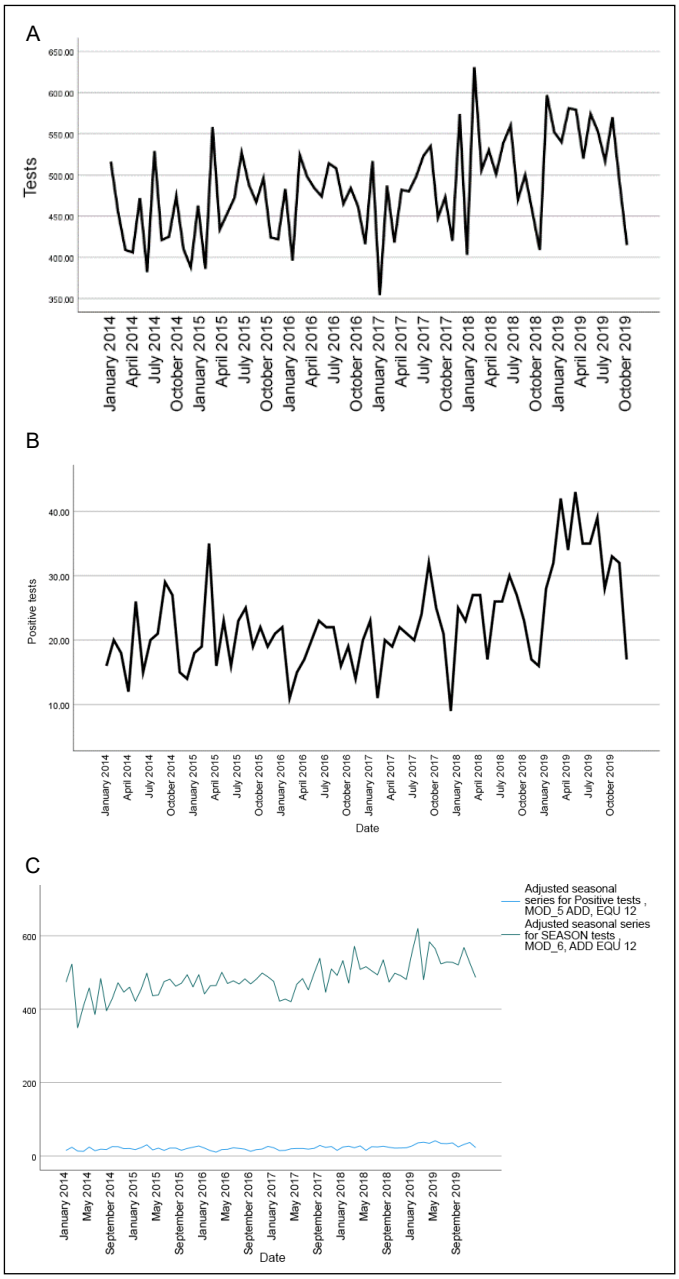

Figure 1. Number of performed tests (A), positive tests (B) and adjusted seasonal series for tests and positive results in 2014–2019 (C).

Table 1. Months with significant data throughout the study years.

VDRL	2014	2015	2016	2017	2018	2019
Minimum demand (absolute)	Apr=406	Feb=386	Feb=386	Feb=354	Feb=403	Dec=415
Maximum demand (absolute)	July=529	Mar=558	Mar=524	Sept=535	Mar=631	Jan=597
Lowest daily demand	Dec=14.92	Dec=16.88	Dec=15.41	Feb=16.09	Dec=16.36	Dec=16.6
Highest daily demand	Jan=19.84	Mar=22.32	July=20.32	Sept=21.4	Mar=25.24	Apr=23.24
Lowest number of working days	Mar=22	Feb=21	Feb=22	Feb=22	Feb=21	Nov=23
Highest number of working days	July/Ouct=27	July=27	Dec=27	Mar/Aug=27	Aug=27	July/Aug=27
Number of positive results – minimum	Apr=12	Apr/June=16	Fev=11	Dec=9	Dec=16	Dec=17
Number of positive results – maximum	Sept=29	Mar=35	June/Aug=22	Sept=32	Aug=30	May=43
Lowest positivity	Apr=2.96%	June=3.9%	Feb=2.76%	Dec=2.4%	May=3.21%	Dec=4.10%
Highest positivity	Sept=6.2%	Mar=6.27%	Dec=4.81%	Sept=5.98%	Sept=5.74%	Mar=7.78%

VDRL: nontreponemal test.

However, even though the line of positive results appears to be different from that in **Figure 1B**, it is important to observe the graph scale, with numerically lower values, corresponding to the line in the marked periods.

In **Figure 2**, the seasonal factors (or seasonal index) correspond to the short-term oscillations that always occur throughout the year, systematically repeating themselves year after year. These change the trend by being added to it.

Since all factors are substantially different, both positive and negative ones, the trend value is changed by them, thus indicating an influence of the seasonal components on the series, softening the trend.

According to the histogram in the chart of **Figure 3A**, it is observed that the concentration of positive tests around the average is above expected (surpassing the normal theoretical curve represented by the continuous dash, whose mean and standard deviation were obtained based on the observations that were made). Besides, extreme values do not seem to be compatible with the normal distribution. In the graph of **Figure 3B**, the boxplot shows that the monthly medians present some distance, with asymmetrical distribution, emphasizing the discrepant value of May and November, with maximum values in March and August; that is, ranging substantially throughout the months, without presenting a seasonal pattern.

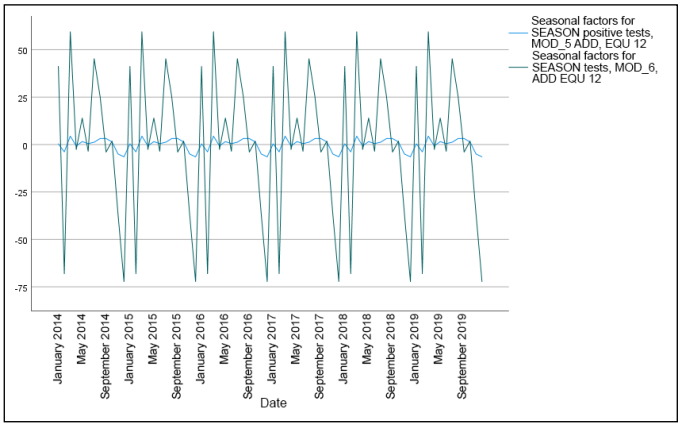

Figure 2. Seasonal factors for tests and positive results.

The chart in **Figure 4A** shows the estimated trend of the demand and positivity series in the period of data observation. In both series, it is possible to see increasing values in 2019, and in the positivity series such an increase is even higher. The chart in Figure 4b illustrates the estimated seasonal effects for each month. For the interpretation of this figure, consider that the horizontal line in red represents the mean behavior of the series. Then, for each month, there is an estimation of the increase or reduction of the associated demand (or positivity) in relation to the global mean.

Among other facts, it is possible to observe, after a visual inspection of the chart in **Figure 4A**, that the demand from December to February is below average, whereas positivity from March to April and from May to November is above average.

The analyses both of the demand and the positivity carried out so far were merely exploratory. After the statistical tests were applied, there was a statistically significant increase both in the demand and in the positivity of the analyzed VDRL tests, and we observed no seasonal influence on the demand and positivity of VDRL in the period between January 2014 and December 2019 in a private laboratory in Niterói.

Cross-correlation analysis between the demand and positivity series

In this case, we observed the hypothesis of correlation between the demand in a specific month and the positive cases in future months. For that end, the cross-autocorrelation function was used.

The measure of cross-autocorrelation requires that both series be stationary, and, due to that fact, the residues of the adjusted models were used to calculate such a measure. By working with residues, the trend components were removed from both series; therefore, it is reasonable to assume that these series are stationary.

The result of the cross-correlation analysis will be summarized by the chart in Figure 5. The dashed limits in the chart of Figure 5 appear as critical values for the cross-correlation numbers. Values that surpass the limits indicate significant correlations between the demand and the positivity in lagged moments. When the lag is at 0, the instantaneous correlation between demand and positivity is

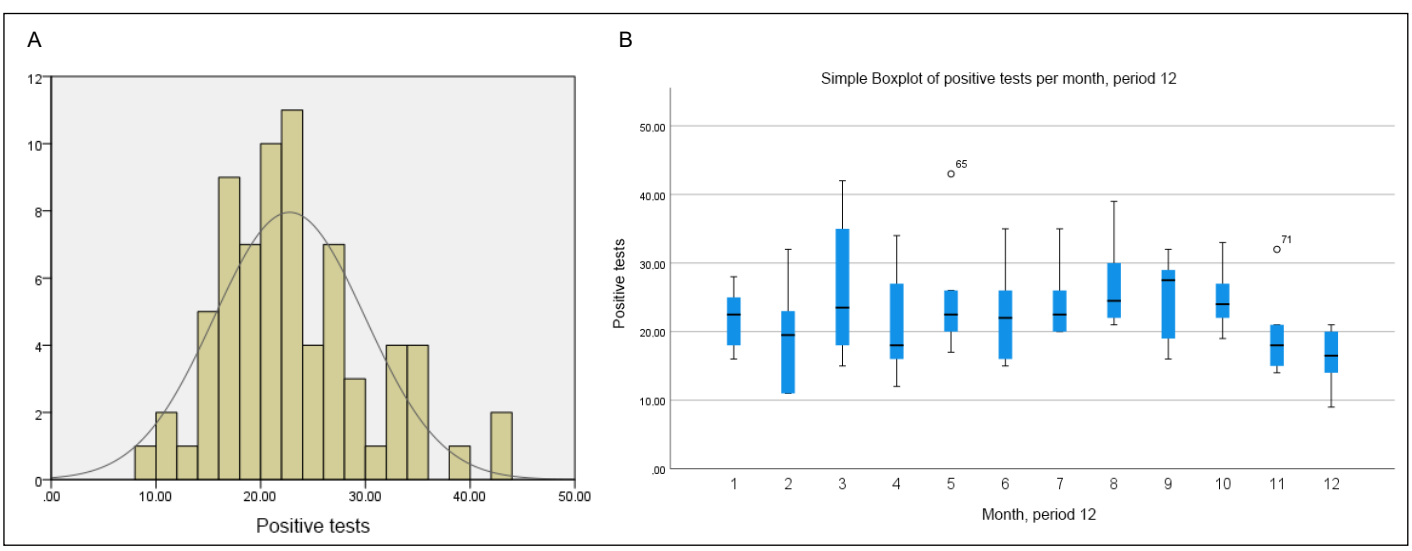

Figure 3. Histogram with mean of positive exams in the months of the year (A) and simple boxplot of positive results per month (B).

being assessed. Since all values are within limits, the conclusion is that there is no evidence of cross-correlation between the demand and positivity series. From the practical point of view, the observed values for the demand in a specific month do not help to predict the positivity in future months.

DISCUSSION

This study intends to deconstruct the public imaginary that the risk sexual practice is related to specific dates of the year, such as carnival. Actually, it is observed that this behavior does not respect specific dates and occurs in a random manner.

It was difficult to find articles that examine the relationship between seasonality, demand, and positivity of VDRL tests during the search in the databases. In fact, there are few publications on the topic, which makes it difficult to visualize the problem, as well as to implement priority interventions and further evaluations about their effectiveness.

Throughout the studied years, it was observed that the number of working days changes month after month, not only because of the absolute number of days, which can range from 28 to 31, but also because of holidays, which occurs mostly in February, March, April, November and December, which could bias this analysis.

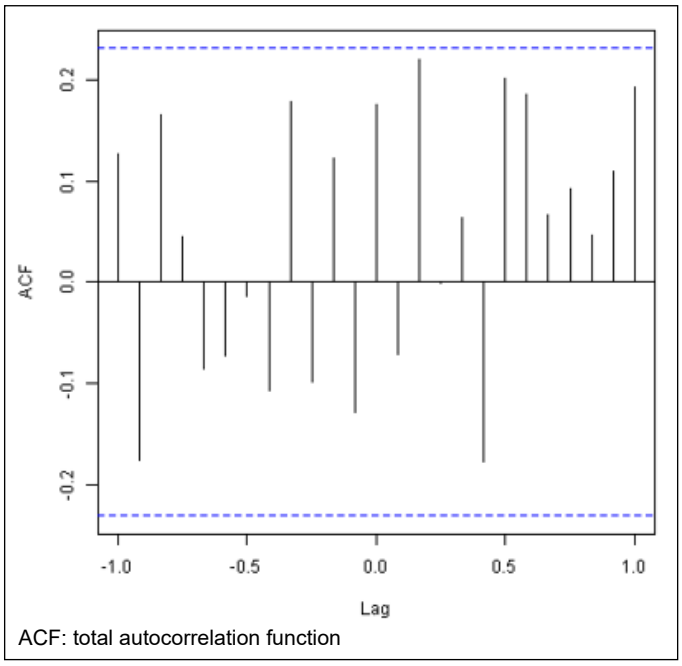

Figure 5. Cross-correlation between the demand and positivity series.

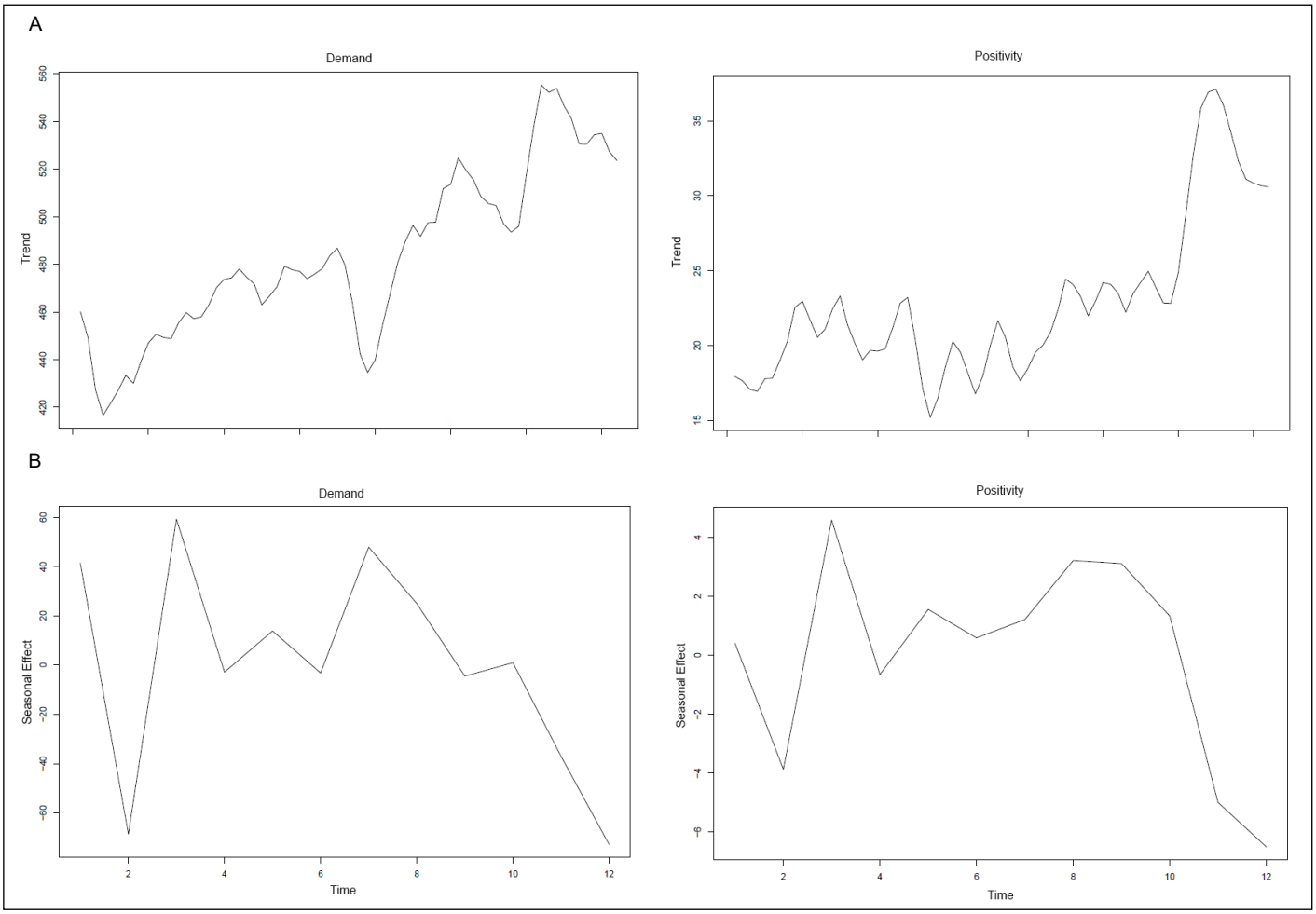

Figure 4. Estimated trend for the demand and positivity series using centered moving average (A) and estimated seasonal effects for the demand and positivity series using centered moving average (B) (decompose function of the R package).

According to Martinez et al.[14], the epidemic calendar is the idea that seasonality is a unifying characteristic of the diseases that tend to become epidemics, and at the absence of control measurements, the local calendar may be marked by their onset. A well-known example of a calendar marked by epidemics is that in the North hemisphere, where outbreaks of influenza occur every winter (the so called "flu season").

According to another article by Martinez, wildlife can be a useful study system for STDs[15]. In some mammal species, there is complete absence of sexual contact (and, therefore, transmission) when it is not reproduction time. Therefore, it is proposed that isolation in time, such as this one, is a much more extreme form of seasonal forcing than that seen in systems of infectious diseases in humans, which can also occur for parasites with other modes of transmission, besides the STDs.

Zhang et al. assessed the methods of decomposition that are usually used to analyze the seasonal and long trend patterns of a disease[16]: seasonal behavior is extracted as a seasonal index, whereas secular trend is expressed in a linear regression model, which is widely used to explore the influence of covariance factors in the infection behavior[16]. However, there are few studies approaching the model of time series of different subtypes of syphilis, as well as its correlation of time series.

Usually, the method of decomposition tries to decompose the two subjacent patterns, long term trend and seasonality, characterizing the infectious behavior in the time series data:

Time series = seasonality + long-term trend + residual.

The seasonality of the incidence of syphilis can be shown by the calculation of seasonal indexes. To calculate them, general incidence rates are calculated first, and, then, the average incidence is divided by the mean incidence of each month. The seasonal index is between 0 and 1 when the incidence is below the average level. Otherwise, the value will be higher than 1. After deriving the seasonal indexes, the series seasonality should be removed by dividing it by the corresponding index. A linear regression model is adjusted to present the long-term trend of the incidence. The linear relationship between the deseasonalized incidence of syphilis (dependent variable) and time t (independent variable) is estimated in the model[17].

Many Chinese people with symptoms of STD do not look for medical care[18]. Surveillance artifacts may occur when there is bias between the trend of surveillance data and the real incidence. When there is an infection, patients may not look for medical care immediately, since there are no symptoms, and even when these symptoms appear, there is no estimation as to how long patients usually wait before going to a care service. Therefore, the increasing incidence of syphilis can be a combination of higher transmission and surveillance artifacts, such as the introduction of a new surveillance system[19], with improvements, and expansion of the system after 2004, as well as the improvement in clinical care for symptomatic patients observed in this study. However, based on the available data, it is not possible to estimate the extension of these artifacts.

The study by Shah et al.[20] analyzed the database from 1999 to 2003 in the Center for Disease Control and Prevention (CDC) for seasonal and long-term trends of STDs in the United States. The linear regression was used to determine time trends, and an autoregressive linear mixed model was applied to establish the statistical significance of the main peaks regarding the average of the annual time series. No clear annual periodicity has been detected in any of the STDs, with clear prominent peaks in March, May, August and November. The March and May peaks can be related to sexual activities of young adults during the spring break in the United States, which start in mid-February and end at the beginning of April, when many sexually active young adults gather in beach resorts. The August peak may represent the summer sexual activity, especially for young people on school vacation. Finally, the autumn peak seems to be an expression of an annual endogenous rhythm in the human reproductive biology, exemplified by the high levels of testosterone in male adolescents and by the sexual activity in this time of the year. These are plausible hypotheses, but require care and further investigations[20].

Another study involving the Chinese population, by Tan et al.[21], presented different findings for syphilis. The May peak in the historical series did not present statistical differences from the other monthly average rates.

Firstly, the ecological causes of the disease transmission can also differ between the rural and urban areas of China, which was not investigated in this study[21]. Secondly, it is possible to only estimate the time of syphilis acquisition, given the lack of associated behavioral data. Besides, pregnant women have a slightly higher risk of acquiring syphilis during the first and second trimesters from a partner who is at the secondary stage of syphilis. Finally, there are no data about the seasonal changes in behaviors involving search for health services, which can also influence the reported cases of STD[21].

The partial immunity to syphilis can be responsible for time oscillation. Besides, the transmission rate of syphilis is higher than that of gonorrhea[22,23]. So, any subjacente periodicity would be more pronounced. In terms of transmission dynamics, it is known that syphilis presents agglomeration in comparison to gonorrhea. This phenomenon can contribute with the pronounced annual oscillation of syphilis. Altogether, the annual oscillation of syphilis and gonorrhea does not support the hypothesis by Grassy et al.[24], which states that the incidence patterns of syphilis can be explained by the immunity in relation to the population, because the incidence of syphilis and gonorrhea oscillate at a similar pattern, with peaks at the same time[25].

In Mexico, the case of seasonality of the epidemic behavior of syphilis has been reported in previous analyses, in which seasonal trends are clearly identified between May and August and July and September[20,25]. These periods correspond to higher annual temperatures in several countries of the North, including Mexico. The study by Ibáñez-Cervantes et al. showed a positive correlation between the mean number of syphilis cases per month and the mean temperature. Even when the relationship between the increasing notification rate and seasonality is not known, the speculation is that this phenomenon can be related to a more active sexual activity in the summer, due to the increased tourist flow[26].

In 2008, Arze et al.[27] analyzed if the highest peaks in diagnosis coincided with the expected peaks of clinical expression of each one of the studied diseases (March/April), in case the contamination had occurred in Carnival (February/March), using the number of services provided in the STD department of Universidade Federal Fluminense (UFF) as an incidence estimation of cases in the population that would potentially use the offered services.

Some issues were discussed to verify the validity of this assumption. Firstly, the number of services reflects the incidence of individuals

with clinical manifestations, and not the number of contaminated people, which makes the number of individuals who look for a health service a good estimation of the number of contaminated individuals. A second factor would be the variation in the offer of appointments in a service. It is known that the demand is related to the need (onset of signs and symptoms) and the offer[27].

Hughes et al.[28], in a study about the risk behavior during carnival, applied a questionnaire among men who percussionists at a samba school in São Paulo, and concluded that the ones who were at risk only in carnival were no different than those who were at risk in other moments. That reinforces the understanding that those who are at risk at a famous festive event, such as carnival, is actually at risk throughout the year.

The idea of major media campaigns about STD/AIDS is based on the hypothesis that there is more exposure to situations of vulnerability (unprotected intercourse and unplanned pregnancies) in the Brazilian population as a whole during carnival, once these campaigns do not happen at other times of the year[29].

To ratify the thesis that the distribution of demand and positivity of VDRL tests do not have a rule, that is, do not present a typical time distribution, but is in fact random, Lima et al.[30], in a publication about massive STD/AIDS campaigns made by the federal government, reinforce that the calendar is fixed, thus contributing only to build the imaginary of STD/ AIDS in the country.

As a way to strengthen the argument of this paper, the number of live births in Niteroi (of mothers who delivered in this city) was analyzed[31]. The result shows that November, nine months after carnivals that took place in February, in the series of 2014-2019, presents the lowest total absolute number of births. The highest numbers are in January, March, May and July. Therefore, it is acceptable to deduce that these data weaken the hypothesis that there are more unprotected sexual intercourses during Carnival.

Most cases of congenital syphilis and syphilis during pregnancy in the study by Souza et al.[17] were notified in February and November, suggesting the seasonality for this STD in the region of Pontal do Paranapanema (SP). The control diagram, based on the information collected from SINAN, did not present an endemic period; however, the month that was more prone to showing an endemic event of syphilis during pregnancy and vertical transmission was February.

Also in the scope of other STDs, there is a major time series study published by Passos et al.[32] in 2010. Throughout 12 years of analysis, they concluded there was no increase in cases of syphilis, gonorrhea and trichomoniasis associated to carnival.

After the analysis of data in **Table 2**, it is clear, at first, that the months of March have higher absolute demands, as well as February have lower absolute demands when compared to other months, except January, 2019. However, these differences do not have statistical significance, which was verified after an analysis made by significance tests.

Despite the increasing demand of VDRL tests in 2019, there was no significant increase in the number and percentage of positivity of the test in relation to the demand. Even though the highest number of cases of syphilis in Brazil is in the Southeast region (52.7%), the incidence rate in this region has been increasing throughout the years and can be a reflex of a prevention campaign concerning the transmission of STDs, and the provision of fast tests in reference centers and basic health units, which, in the case of syphilis, need to be complemented by the VDRL. This study can also assume that the increasing demand and positivity of VDRL suggests an increase of other STDs after carnival.

This study shows that the initial hypothesis was not true, and that both the demand and the positivity of VDRL tests increased significantly; there was also no seasonal interference in the entire studied period.

Limitations

One limitation of this study is that it was carried out in a single service located in a single city. However, it is emphasized that Niterói is a mid-sized city, and a hub to several other cities in the metropolitan region of Rio de Janeiro.

Even if the "n" included 34,817 tests, this analysis was only carried out in a private laboratory; even if it is a reference in the city, it cannot be extrapolated to a national level. We suggest the performance of a broader analysis to compare with the obtained results.

Other studies of this nature should be performed in all Brazilian regions, so that it is possible to know the reality of this topic in Brazil, both in the public and in the private sectors.

CONCLUSION

There was no relationship of seasonality with demand and positivity of the VDRL tests carried out in Bittar laboratory, with users of the supplementary/private medical system, basically in the cities of Niterói and São Gonçalo (RJ), Brazil. Even though there was an increasing demand for VDRL tests, mostly in March, this did not reflect on the positivity of VDRL after the Brazilian carnival. There is a significant increase both in the demand and in the positivity of the VDRL tests throughout the studied years from the series of 2014-2019. Therefore, the conclusion is that the main event that dictated the rules for the distribution of variables throughout the years was randomness, and not seasonality, as it would appear according to common sense.

Approval by the Human Research Ethics Committee

The study was approved by the Human Research Ethics Committee University Hospital Antônio Pedro – UFF, com CAAE 23832819.2.0000.5243.

Participation of each author

VMAG: Writing – original draft. JSSM: Writing – review & editing, Visualization. ACL, COSJ, VM: Methodology. CTMB: Resources. MRLP: Writing – original draft, Writing – review & editing. SCAVF, AEM, RSC: Writing – original draft; Writing – review & editing.

Conflict of interest

The authors declare no conflicts of interest.

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