# EXPECTATIONS OF REDUCING THE PUBLIC HEALTH PROBLEMS CAUSED BY THE COVID-19 PANDEMIC AND ITS CORRELATION WITH WEATHER CONDITIONS[1]

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**Expectations of reducing the public health problems caused by the Covid-19 pandemic and its correlation with weather conditions**

## ABSTRACT

**Introduction**: Warmer climatic conditions caused some optimism in the population about reducing new records of COVID-19, resulting in a population behavior of relaxing the prevention measures against the SARS-CoV-2 outbreak. **Objective**: The present study aims to investigate the relationship among climatic and sociodemographic elements over the pandemic data in a subtropical countryside municipality. **Methods**: Data about confirmed cases of COVID-19 were obtained in the daily bulletins from the Municipal Health Secretariat and climatic data were obtained from the local meteorological station. Spearman correlation analyses were performed. **Results**: Most of infected people (41.8%) live in the downtown, which is the main trade area and presents high movement of people in the municipality, being it classified as a super spread region of SAR-CoV-2. The statistical correlations were revealed as not significant. **Conclusion**: climatic conditions are not able to flatten the pandemic curve as waited for many people.

**KEYWORDS:** Coronavirus; climatic correlation; SARS-CoV-2

**Expectativas de redução dos problemas de saúde pública causados pela pandemia de Covid-19 e sua correlação com as condições climáticas**

## RESUMO

**Introdução**: As condições climáticas mais quentes geraram certo otimismo na população quanto à redução de novos registros de COVID-19, resultando em um comportamento

da população de relaxamento das medidas de prevenção ao surto de SARS-CoV-2. **Objetivos**: O presente estudo tem como objetivo investigar a relação entre elementos climáticos e sociodemográficos e dados pandêmicos em um município do interior subtropical. **Métodos**: Os dados dos casos confirmados de COVID-19 foram obtidos nos boletins diários da Secretaria Municipal de Saúde e os dados climáticos foram obtidos na estação meteorológica local. Análises de correlação de Spearman foram realizadas. **Resultados**: A maioria dos infectados (41,8%) mora no centro da cidade, principal área de comércio e com grande movimentação de pessoas no município, sendo classificado como região de super dispersão do SAR-CoV-2. As correlações estatísticas revelaram-se não significativas. **Conclusão**: as condições climáticas não são capazes de achatar a curva pandêmica como esperado por muitas pessoas.

**PALAVRAS-CHAVE:** Coronavírus; correlação climática; SARS-CoV-2

**Expectativas de reducir los problemas de salud pública provocados por la pandemia Covid-19 y su correlación con las condiciones climáticas**

## RESUMEN

**Introducción**: Las condiciones climáticas más cálidas provocaron cierto optimismo en la población sobre la reducción de nuevos registros de COVID-19, resultando en un comportamiento poblacional de relajar las medidas de prevención frente al brote de SARS-CoV-2. **Objetivo**: El presente estudio tiene como objetivo investigar la relación entre los elementos climáticos y sociodemográficos sobre los datos pandémicos en un municipio rural subtropical. **Métodos**: Los datos sobre los casos confirmados de COVID-19 se obtuvieron en los boletines diarios de la Secretaría Municipal de Salud y los datos climáticos se obtuvieron de la estación meteorológica local. Se realizaron análisis de correlación de Spearman. **Resultados**: La mayoría de las personas infectadas (41,8%) vive en el centro de la ciudad, que es la principal zona comercial y presenta un alto movimiento de personas en el municipio, por lo que se clasifica como una región de superdifusión de SAR-CoV-2. Las correlaciones estadísticas se revelaron como no significativas. **Conclusión**: Las condiciones climáticas no logran aplanar la curva pandémica como esperaban muchas personas.

**PALABRAS CLAVE**: Coronavirus; correlación climática; SARS-CoV-2

## INTRODUCTION

The probable origin of SARS-CoV-2 is from the wild fauna negotiated in the Huanan market in Wuhan, southeast of China, where the first cases of COVID-19 were recorded in

November of 2019 (ZHOU et al., 2020; ZHANG et al., 2020), since then the virus has been spread worldwide (LESCURE et al., 2020).

International efforts have been promoted for investigating the biological characteristics of the SARS-CoV-2 and the influence of social and environmental traits on its spread (ZHENG, 2020). Many researchers have investigated the influence of gender (WENHAM et al., 2020), climate conditions (CHEN et al., 2020; AULER et al., 2020), people agglomeration rates and social classes (GUPTA et al., 2020; SURYAWANSHI et al., 2020) over the COVID-19 pandemic, thus social and environmental investigations about the pandemic in different localities contribute for evaluating the previous results about it and presenting how they can be applied in other regions with particular sociodemographic and climatic traits.

The non-pharmacological interventions, such as the use of facemasks, the right sanitation of hands and surfaces and the compliance with distance and social isolation measures seems to be the best manner for avoiding the virus dissemination and prevent the pandemic of COVID-19 (ALVI et al., 2020). However, the summer climatic conditions in the south hemisphere caused some optimism in the population about the flattening in the curve of new cases of COVID-19, resulting in a population behavior of relaxing the prevention measures against the SARS-CoV-2 outbreak. Thus, there is the need of investigating the relationship among climatic and sociodemographic elements over the pandemic data in a subtropical countryside municipality where the temperatures were becoming high by the proximity of the summer. Here are presented the local pattern of geographic distribution of confirmed cases of COVID-19 and data about the correlation between climatic variables (temperature, relative air humidity and wind speed) and daily records of COVID-19 in a subtropical Brazilian municipality in a period of 168 days, since the first record of a local patient infected by SARS-CoV-2.

## MATERIAL AND METHOD

### Study locality

The study was performed in São Luiz Gonzaga (28º24'30"S, 54º57'39"W), south of Brazil. The city presents the Human Development Index of 0.741, around 35,000 habitants, 15% of them are more than 60 years old (IBGE, 2020; SEBRAE, 2019). According to Köppen classification, the region climatic characteristics are *cfa*: hot and dry summers and cold and wet winters. The downtown area is where the biggest supermarkets and churches are located, as well as the banks, stores, drugstores, hospital and schools, which are pointed as super spreading places (MEHL-MADRONA et al., 2020).

### Data collection

Data about the numbers of confirmed cases of COVID-19 in the municipality were obtained in the daily bulletins from the Municipal Health Secretariat and climatic data were obtained from the local meteorological station.

**Statistical analysis**

Statistical analysis were performed in the software Past v. 3.14 (HAMMER et al., 2001). Spearman correlation analyses were performed for verifying the relationship between average values of temperature, relative air humidity and wind speed (independent variables) with daily cases of COVID-19 recorded in the municipality (dependent variables). For the climatic data employed in the statistical analyses were considered the daily averages of the seventh day before each recorded case of COVID-19 due to viral incubation period (HUANG et al., 2020), which can delay the diagnose. Weekly average values of temperature were also calculated and correlated with the total number of COVID-19 cases recorded in the period. It was considerate a confidence level of 95% ($p<0.05$).

**RESULTS**

The first case of COVID-19 in the municipality was recorded in May 4$^{th}$, since then there was a daily average of three new cases, totalizing 331 in October 19$^{th}$. However, in three moments 13 or more patients were daily diagnosed with COVID-19, at those moments the average temperatures were between 19.5 and 29.5°C, air relative humidity levels between 45 and 64.5% and the wind speed between 15.8 and 19.8 km/h. The most of infected people (41.8%) live in downtown, which is the main trade and crowded area in the municipality where dozens of people walk around every day. The remaining 58.2% of COVID-19 cases were homogeneously recorded in 23 other municipal districts.

The statistical correlations between daily cases of COVID-19 and the average values of temperature, relative air humidity and wind speed (FIG. 1a-c) were revealed as not significant, as noticed for the weekly values measured (FIG. 2).

FIGURE 1: Spearman correlation analyses between average values of temperature (a), air relative humidity (b) and wind speed (c) – grey area – with daily cases of COVID-19 – black line. *: 27 cases of COVID-19 daily recorded. Data recorded for 168 consecutive days.

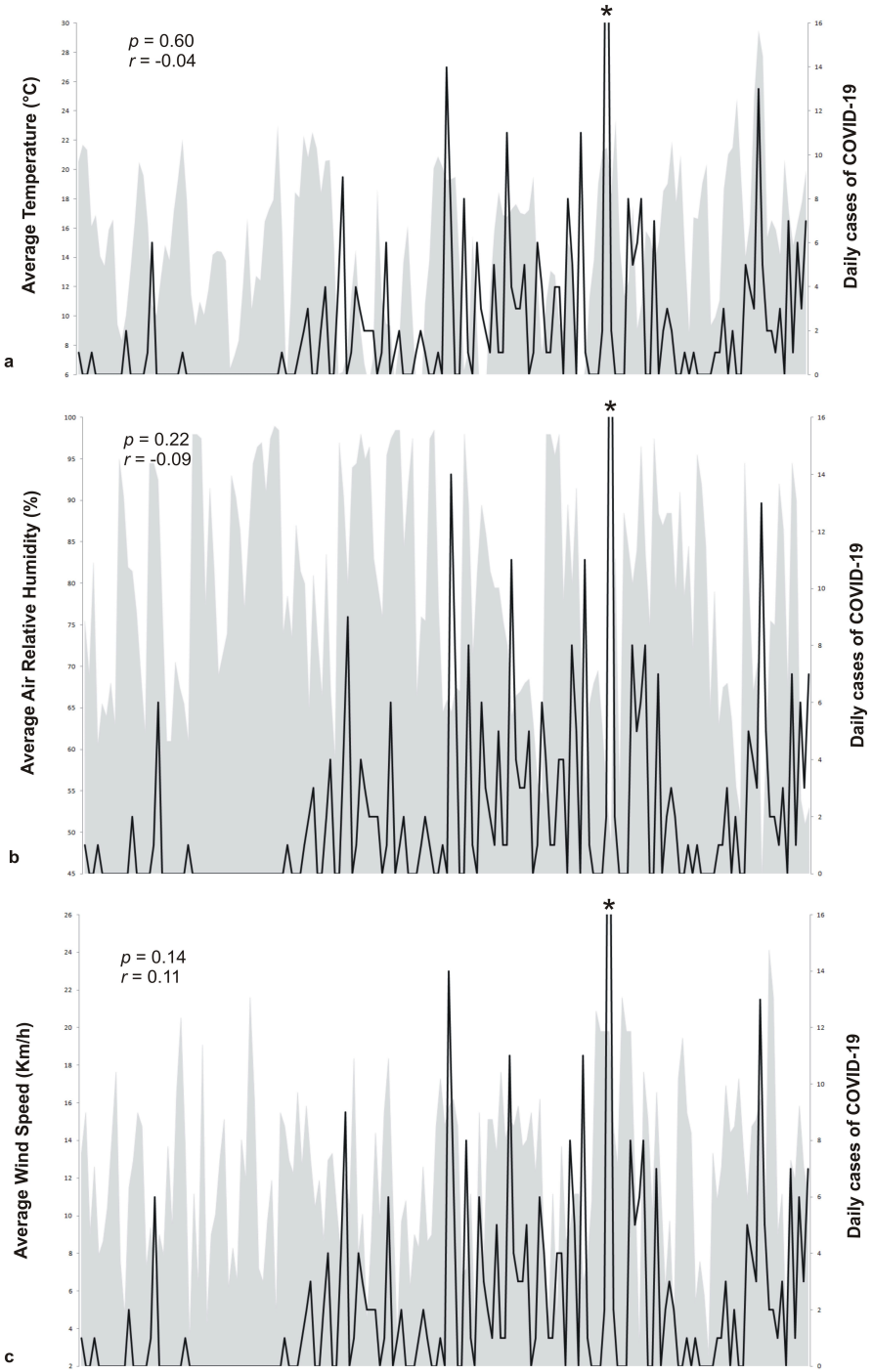
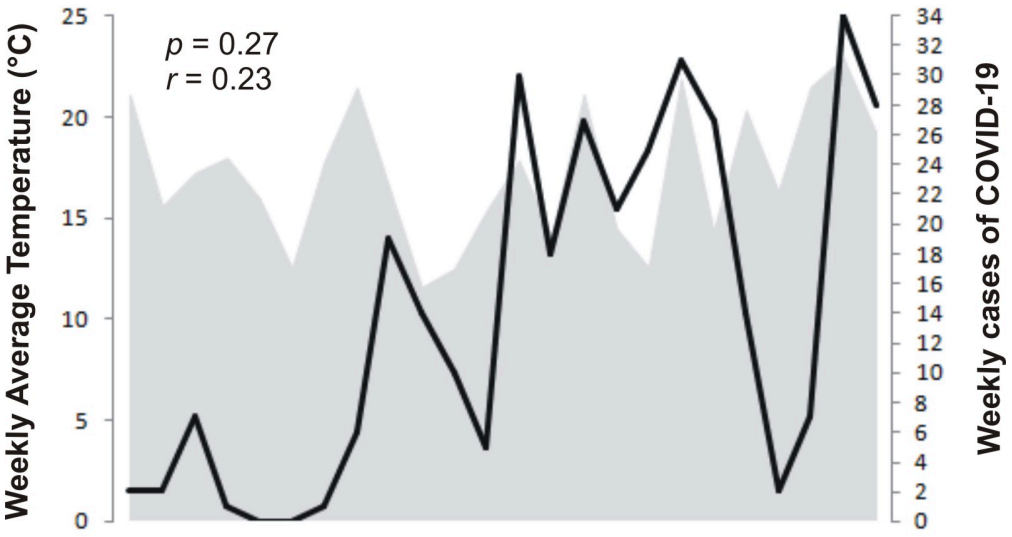



FIGURE 2: Spearman correlation analyses between weekly average values of temperature (grey area) with the total number of COVID-19 cases recorded in the period (black line).




## DISCUSSION

The influence of climatic variables such as temperature and air relative humidity is widely known over the respiratory viruses (WATSON et al., 2006; MORIYAMA et al., 2020). Nevertheless, it is almost impossible to standardize the influence level of different variables, such as climate and people behavior, over the SARS-CoV-2 spread, once the process health-disease is a complex interaction among many factors (BATISTELLA, 2007), that is, the number of recorded daily cases of COVID-19 is a multifactorial interaction among individual and collective traits including environmental, economical, behavioral, physiological and immunological aspects (AZIZI et al., 2020a; AZIZI et al., 2020b; LIPPI et al., 2020), which makes hard to standardize the data about COVID-19 pandemic for comparisons among localities worldwide (MEHL-MADRONA et al., 2020).

Social agglomerations and climatic conditions are among the factors that can contribute for spreading the SARS-CoV-2 and increasing the number of infected people (CHEN et al., 2020; AULER et al., 2020; YUAN et al.; 2006). However, the compliance of non-pharmacological interventions seems to be the main factor contributing for flattening the epidemic curve and mitigating the viral impacts on public health (ANDERSON et al., 2020). Considering that SARS-CoV-2 is transmitted by air along with aerosol particles (WANG, DU, 2020), agglomeration in closed and poorly ventilated places increases the contamination indexes in some localities (MORAWSKA et al., 2020), as in trading areas similar to the downtown region in the investigated municipality. In countries like China where the populational isolating was strictly adopted, the viral spread rates have been significantly reduced (HUANG et al., 2020).

Some authors indicate a relationship between climatic variables, especially low temperatures, and the increase in the number of people infected by coronavirus (TOSEPU et al., 2020; YUAN et al., 2006; LIU et al., 2020). On the other hand, climatic conditions also can affect the social behavior, that is, while the high temperatures favor crowds at fairs and pubs, the low temperatures can keep people in close and sometimes also poorly ventilated spaces, as it has been noticed in several Brazilian cities. In some Brazilian northern warm cities the population contamination rates were also high (DE SOUZA et al., 2020; LIMA et al., 2020; GUERRA-SHINOHARA et al., 2020), which may reflect social behavior, such as agglomeration or other sociodemographic indicators in the SARS-Cov-2 outbreak. However, the incubation period of coronavirus can hide the climatic variables influence on the pandemic data, since the symptoms of COVID-19 have been revealed as diverse and some people can also be asymptomatic (HUANG et al., 2020), which can cause some delay for updating the local statistics of COVID-19, consequently it is able to cause some interference in the results about association between the climate conditions and the spread levels of SAR-CoV-2, furthermore, some results just can be noticed in datasets larger than one employed in the present study.

## CONCLUSIONS

The summer high temperatures, as well as the air relative humidity levels and the wind speed, were not able to flatten the curve of COVID-19 cases as many people were waiting for, since the correlations among climatic variables and the numbers of recorded cases of COVID-19 were not significant. Highlighting the influence of people agglomeration over the pandemic results, as well as the importance of non-pharmacological interventions being maintained by people, such as the use of face masks, the right sanitation of hands and surfaces and the social distance measures, once the majority of COVID-19 cases were recorded in the downtown area where there are most people daily walking and working, being it identified as a super spreading region of SARS-CoV-2 in the investigated municipality.

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