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## Fear of Covid-19 and health-related outcomes: results from two Brazilian population-based studies

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### ABSTRACT

Fear is a reaction that can influence multiple aspects of health and life. During the Covid-19 pandemic, there have been serious pathophysiological, social, behavioral and mental consequences that can be related to fear. This study aimed to assess the fear of Covid-19 and its association with sociodemographic, behavioral and health variables. Data were gathered from two cross-sectional population-based studies conducted in 2020 with adults from two cities from Southern Brazil. The Fear of Covid-19 scale was used to evaluate fear of Covid. Exposure variables were socioeconomic, demographic, health and pandemic-related factors. Adjusted Poisson regression was performed to assess the association between fear of Covid-19 and the exposure variables. A total of 2,152 subjects were assessed. Higher fear of Covid-19 was found among women and in individuals with symptoms of Covid-19. Living alone, being richer, and testing positive for Covid-19 were associated with lower prevalence of fear. Higher prevalence of fear of Covid-19 was related to worse sleep quality, worse health perception, sadness, higher stress, depressive symptoms, and suicidal ideation. There was a linear association between fear of Covid-19 and health outcomes. The results provide evidence that fear of Covid-19 seems to be associated with socio-economic, demographic, health and pandemic-related factors.

### 1. Introduction

Since its discovery, the new coronavirus has rapidly spread around the world, becoming an international health problem. The virus easily spreads by respiratory droplets, and aerosols led to intense and fast progression of the Covid-19 disease, resulting not only in serious pathophysiological consequences, but also in social, behavior and mental negative outcomes (Holmes et al., 2020; Wu et al., 2020).

The Covid-19 outbreak scenario highlights the concept of

vulnerability and inequalities in health, demonstrating how social determinants have been affecting the morbidity and mortality of diseases (Abrams and Szefer, 2020). It is well known that the elderly, males, people with non-communicable diseases, unhealthy behaviors and those who live in areas with socioeconomic inequality are more susceptible to the severity and/or mortality of the disease (Demenech et al., 2020; Li et al., 2021; Zheng et al., 2020).

Fear is an expected behavior during respiratory outbreaks, as occurs with the new coronavirus, which seems to be influenced especially by

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easy transmission and imminent risk (Ahorsu et al., 2020; Pappas et al., 2009). It can lead to social and mental health damage, discrimination and stigmatization, influencing behaviors that people develop in such situations (Baldassarre et al., 2020; Pappas et al., 2009).

Ahorsu et al. (2020) created a psychometric instrument to analyze fear of Covid-19 in populations, which is a short and helpful screening tool not only to measure levels of anxiety and preoccupation regarding Covid-19, but also to assess multiple factors associated with this construct during the pandemic. In Israel, Bangladesh, Japan, Brazil and Australia, higher levels of fear of Covid-19 have been reported among females, individuals in lower socioeconomic groups, those with risk factors associated with worse cases of the disease (and/or with family members with these conditions), individuals that had contact with an infected person, who presented symptoms of depression, suicidal ideation, psychological distress, and increased alcohol consumption. Wearing a mask and practicing hand hygiene during the novel coronavirus outbreak were also associated with higher fear of Covid-19 (Bitan et al., 2020; Giordani et al., 2020; Mamun et al., 2021; Midorikawa et al., 2021; Rahman et al., 2020).

Especially in Brazil, the fight against the pandemic has been complicated. The country is one of the nations with the highest impact of Covid-19, with more than twenty million cases and five hundred and sixty thousand deaths until the beginning of August 2021 (Boschiero et al., 2021; Johns Hopkins University of Medicine, 2021). The existing social inequalities, the current political, educational and health care fragilities, along with the spread of fake news, weak lockdown measures, delays in vaccination and scientific denial, have contributed for this scenario in Brazil (Boschiero et al., 2021). Therefore, considering this panorama, the possible impact of fear on health and the need to develop public health initiatives to cope with the situation, we aimed to assess the association between fear of Covid-19 and sociodemographic, behavioral and health aspects using data from population-based studies carried out in two cities from Southern Brazil.

## 2. Methods

### 2.1. Setting, study sample and data collection

This cross-sectional study used data from two population-based studies conducted in two cities from Southern Brazil: Criciúma (Santa Catarina state), and Rio Grande (Rio Grande do Sul state). Criciúma has approximately 217,311 inhabitants, a Human Development Index (HDI) of 0.788, and population density of around 815.87 inhabitants per km<sup>2</sup> (IBGE, 2020). Rio Grande has 211,965 inhabitants, HDI of 0.744, and population density of 72.79 inhabitants per km<sup>2</sup> (IBGE, 2020).

The study "Mental Covid: impact of Covid-19 on the mental health of the population" was conducted amid the Covid-19 outbreak between October 2020 and January 2021. Individuals aged 18 years or older who were living in the urban area of both cities were included in the study. Subjects who were physically or cognitively unable to complete the survey were excluded.

The sampling process was conducted in two stages, based on data from the 2010 Brazilian Demographic Census (IBGE, 2011). First, primary units (census tracts) were randomly selected. Second, secondary units (households) were randomly chosen from the previously selected census tracts. The total number of households was sampled proportionally to sector size. In Criciúma, 60 census tracts were sampled, resulting in 15,765 households; 607 of them were included in this study. In Rio Grande, 90 census tracts were sampled, resulting in 29,734 households, 900 of which were included. All adults living in the selected households were invited to participate, resulting in roughly 2,800 individuals eligible for the investigation.

Face-to-face interviews were conducted by trained personnel who worn personal protective equipment during the fieldwork in order to avoid SARS-CoV-2 infection. A single, precoded, and standardized questionnaire was used. It included information regarding mental health

disorders, behaviors amid pandemic, nutrition, physical activity, and chronic diseases. Data collection was performed using tablets and the RedCap® software; each interview lasted for 30 minutes on average.

### 2.2. Fear of Covid-19

The Fear of Covid-19 scale was used to assess negative feelings regarding Covid-19. It consists of a screening tool developed by Ahorsu et al. (2020), validated for use in Brazil (Medeiros et al., 2021). It contains seven items (e.g., "I am afraid of losing my life because of coronavirus") using a five-point Likert-scale (ranging from 1 = "strongly disagree," 3 = "neither agree nor disagree," and 5 = "strongly agree"). The cumulative score ranged from 7 to 35 (the higher the score, the higher the participant's fear of Covid-19). This score was divided into quintiles and those individuals in the highest quintile were classified as having higher fear of Covid-19.

### 2.3. Sociodemographic characteristics, pandemic and health-related behaviors

The following socioeconomic and demographic variables were considered in this study: sex (male, female), age group (collected in completed years and categorized as 18-39, 40-59, 60 or more), skin color (collected as white, black, brown, yellow, indigenous and dichotomized into white and others), marital status (single, married/separated/widow/widower), schooling (elementary school, high school, university education), wealth index (categorized in tertiles), living alone (no, yes). Pandemic-related behavioral variables were: got unemployed (no, yes), started working at home (no, yes), wearing a mask when going out (no, yes), adherence to social distance (no, yes), infodemic (no, yes), contact with someone infected (no, yes), presence of Covid-19 symptoms (no, yes), and tested positive for Covid-19 (no, yes). To evaluate adherence to social distancing, the following question was used: "During the period of social distancing, when only essential services were open, did you leave home?" considering the answers options: no and yes. Infodemic was assessed using the question: "How many times a day do you search for or receive information about Covid-19?"; the answers options were: many times a day, a few times a day, few times a day, only once a day, and a few times a week. Infodemic was considered to occur when an individual searched for or received information about Covid-19 many times a day (Pulido et al., 2020).

Health-related variables were: sleep quality (very good, good, regular, poor, very poor), and health perception (very good, good, regular, poor, very poor), which were further categorized as very good/good/regular, and poor/very poor; self-reported sadness (assessed through the faces scale) (Andrews and Withey, 2012); perceived stress (assessed using the Perceived Stress Scale (PSS-14) (Reis et al., 2010), which was categorized in quintiles and those individuals classified as fourth or fifth quintile were considered stressed; depressive symptoms, and suicidal ideation (both assessed through Patient Health Questionnaire-9 (PHQ-9) (Santos et al., 2013).

### 2.4. Statistical analyses

Descriptive analysis was used for absolute and relative frequencies. Crude analyses of the association between fear of Covid-19 and socio-economic, demographic, pandemic and health-related variables were performed using the Fisher's exact test. The significance level was set to 5% for two-tailed tests.

Adjusted analyses were performed to check whether significant associations were independent of possible confounders. For these analyses Poisson regression with robust variance was used, and the results were reported as prevalence ratio (PR) and its respective 95% confidence intervals (95% CI). To define potential confounders, a hierarchical model of analysis was designed (Victora et al., 1997), and the variables were selected using the backward method, taking each hierarchical level

into account. Those variables associated with both exposure and outcome at a 20% significance level (p-value <0.20) were considered to be confounders and remained in the final model.

2.5. Ethical aspects

All participants who agreed to participate in the study provided informed verbal consent. The Mental Covid study was approved by the Research Ethics Committee of the Federal University of Rio Grande, protocol number 4.055.737.

The authors declare that the dataset, containing the variables analyzed in this study, was shared in a file of Stata software, version 17.0. Individual de-identified participant data (including data dictionaries) is not available. The variables are clearly labelled, with missing data coded as point (“.”). This dataset will be available in Figshare and as a supplementary material on the SAGE journal platform.

3. Results

A total of 2,152 individuals participated in the studies (76.9% response rate). Most participants were female (59.8%), had white skin (83.8%), and did not live alone (89.4%). One-third of them were aged 40 to 59 years old (35.0%) and 42.6% were less educated (Table 1). The mean score of fear on the Covid-19 scale was 17.9 points (SD: 6.1; median: 18), ranging from 7 to 35 points. The last quintile score ranged from 23 to 35 points, with an average score of 26 points. The scale’s

**Table 1**  
Distribution of characteristics of individuals and fear of Covid-19 according to demographic and socioeconomic variables. Rio Grande-RS and Criciúma-SC, 2021 (n=2,152).

Variables	N	%	Fear of Covid-19 (%)	p-value *	Adjusted PR** (CI95%)
Sex				<0.001	
Male	866	40.2	14.5		1.00
Female	1,286	59.8	22.2		1.50 (1.19; 1.88)
Age (years)				0.002	
18 to 39	723	33.6	16.5		1.00
40 to 59	753	35.0	17.8		1.08 (0.81; 1.42)
≥60	676	31.4	23.5		1.26 (0.94; 1.68)
Skin color				0.455	
White	1,797	83.8	18.7		1.00
Others	347	16.2	20.5		1.02 (0.79; 1.30)
Marital status				0.328	
Single	745	34.6	18.0		1.00
Married/separated/widow(er)	1,407	65.4	19.8		0.97 (0.78; 1.20)
Schooling				<0.001	
Elementary school	917	42.6	24.0		1.00
High school	685	31.9	14.5		0.70 (0.55; 0.87)
University education	548	25.5	17.0		0.90 (0.67; 1.21)
Wealth index (tertile)				<0.001	
First (poor)	706	34.3	25.8		1.00
Second	669	32.6	16.9		0.68 (0.52; 0.86)
Third (richer)	679	33.1	15.8		0.62 (0.46; 0.83)
Live alone				0.107	
No	1,863	89.4	20.0		1.00
Yes	221	10.6	15.4		0.57 (0.41; 0.81)

PR: Prevalence ratio. \* Fisher’s exact test. \*\* Poisson regression.

alpha coefficient of Cronbach was 0.86. The highest level of fear of Covid-19 was found among female, elderly, poorer and less educated individuals. After adjustment for socioeconomic and demographic variables, the highest level of fear of Covid-19 was found among females (PR: 1.50, 95%CI: 1.19; 1.88), while richer individuals (PR: 0.62, 95% CI: 0.46; 0.83) and those living alone (PR: 0.57, 95%CI: 0.41; 0.81) presented lower prevalence of fear of Covid (Table 1).

For pandemic-related variables, the majority of participants did not get unemployed during the pandemic (92.6%), and did not work remotely (92.3%). Almost all individuals reported wearing a mask when leaving home (96.6%), and more than 80% did not adhere to social distancing. Infodemic was observed in one out of four participants, approximately (22.2%). Moreover, about 23% of them referred Covid-19 symptoms and 6.2% had a positive diagnosis for the disease. Those individuals who did not work remotely, did not wear a mask when leaving home, adhered to social distancing, had Covid-19 symptoms, and those who did not have a positive diagnosis of Covid-19 presented the highest level of fear of Covid-19. In the adjusted analysis, having Covid-19 symptoms and not having a positive diagnosis of Covid-19 remained associated with fear of Covid-19. Individuals with Covid-19 symptoms were 73% more likely to report fear of Covid-19 when compared to those without symptoms (PR: 1.73, 95%CI: 1.38; 2.15). In addition, the participants who tested positive for Covid-19 were 50% less likely to be afraid of Covid-19 (PR: 0.50, 95%CI: 0.29; 0.85) (Table 2).

**Table 2**  
Distribution of fear of Covid-19 according to pandemic-related variables. Rio Grande-RS and Criciúma-SC, 2021 (n=2,152).

Variables	N	%	Fear of Covid-19 (%)	p-value *	Adjusted PR ** (CI95%)
Got unemployed				0.346	
No	1,993	92.6	18.9		1.00
Yes	159	7.4	22.0		1.09 (0.80; 1.48)
Started working from home				0.004	
No	1,987	92.3	19.8		1.00
Yes	165	7.7	10.9		0.68 (0.42; 1.08)
Wearing a mask when going out				0.045	
No	95	4.4	27.4		1.00
Yes	2,057	96.6	18.8		0.76 (0.53; 1.08)
Adherence to social distancing				0.002	
No	1,751	81.4	17.8		1.00
Yes	401	18.6	24.9		1.09 (0.85; 1.40)
Infodemic				0.114	
No	1,674	77.8	19.9		1.00
Yes	478	22.2	16.5		0.80 (0.70; 1.13)
Contact with someone infected				0.256	
No	1,611	74.9	19.7		1.00
Yes	541	25.1	17.4		1.00 (0.81; 1.25)
Presence of Covid symptoms				<0.001	
No	1,662	77.3	17.1		1.00
Yes	487	22.7	25.9		1.73 (1.38; 2.15)
Positive test for Covid				0.054	
No	2,018	93.8	19.6		1.00
Yes	134	6.2	12.7		0.50 (0.29; 0.85)

PR: Prevalence ratio. \* Fisher’s exact test. \*\* Poisson regression. Adjustment for variables from this Table and Table 1, which showed p-value <0.20.

Table 3 shows fear of Covid-19 and its association with health outcomes. After the adjusted analysis for socioeconomic, demographic and behavioral variables, fear of Covid-19 was more prevalent among the individuals with worse sleep quality (PR: 1.38, 95%CI: 1.01; 1.88), worse health perception (PR: 1.25, 95%CI: 1.08; 1.45), who felt sadness (PR: 1.39, 95%CI: 1.07; 1.82), stressed (PR: 2.10, 95%CI: 1.69; 2.60), depressed (PR: 1.78, 95%CI: 1.39; 2.27), and had suicidal ideation (PR: 2.35, 95%CI: 1.54; 3.58) when compared to their peers. When the variable fear of Covid-19 was assessed into quintiles, there was a linear association with all the study health outcomes ( $p < 0.001$ ) (Fig. 1).

#### 4. Discussion

Important results were found in the present study, which aimed to analyze the association between sociodemographic, behavioral and health factors and fear of Covid-19 in population-based studies in two cities from Southern Brazil. Being female and having symptoms of Covid-19 were associated with higher level of fear, while those who lived alone, were richer and had already tested positive for Covid-19 referred lower level of fear. Moreover, those who had higher prevalence of fear of Covid-19 reported worse sleep quality, worse health perception, sad feelings, higher levels of stress, depressive symptoms and suicidal ideation.

Fear is a biological reaction for a potential danger that involves physical and mental responses, and it is a consequence of respiratory outbreaks (Pappas et al., 2009). In a pandemic, the fact that a person could be sick and transmit the virus at the same time, as well as the need to face losses and denial, are some of the worries - other than the disease and the fear of dying of it - that may trigger this emotional and biological reaction (Baldassarre et al., 2020; Pappas et al., 2009; Schimmenti and Starcevic, 2020).

In the present study, the mean score of fear of Covid-19 was 17.9 points, similar to that of other population-based cross-sectional research studies carried out in Bangladesh, Japan, Poland and Australia, which demonstrated means score of fear ranging from 15.81 to 21.30 points (Chodkiewicz et al., 2021; Giordani et al., 2020; Hossain et al., 2020; Mamun et al., 2021; Midorikawa et al., 2021; Mistry et al., 2021; Rahman et al., 2020). In another Brazilian study, the mean score of fear of Covid-19 was 19.8 (SD: 5.3), which was quite similar to the present results (Giordani et al., 2020).

Some factors may be associated with fear of Covid-19. In the Southern Brazilian population in our study, being a woman and having Covid-19 symptoms were related to higher fear, while being richer, living alone and testing positive for the disease were associated with

**Table 3**  
Health outcomes and their association with fear of Covid-19. Rio Grande-RS and Criciúma-SC, 2021 (n=2,152).

Outcomes	N (%)	Less fear (%)	More fear (%)	Absolute difference (p.p.)	Adjusted PR ** (CI95%)
Very poor or poor sleep quality	207 (9.6)	8.4	12.9	4.5	1.38 (1.01; 1.88)
Regular or poor health perception	544 (25.3)	20.4	34.7	14.3	1.25 (1.08; 1.45)
Feeling of sadness	348 (16.2)	13.1	22.3	9.2	1.39 (1.07; 1.82)
Higher stress level	383 (17.9)	11.4	33.8	22.4	2.10 (1.69; 2.60)
Depressive symptoms	279 (13.0)	11.3	20.8	9.5	1.78 (1.39; 2.27)
Suicidal ideation	82 (3.8)	3.9	8.3	4.4	2.35 (1.54; 3.58)

PR: Prevalence ratio. p.p: percentage points. \* Poisson regression with adjustment for variables from Tables 1 and 2 with p-value <0.20.

lower fear of Covid-19. Similar results were found in other studies (Bitan et al., 2020; Giordani et al., 2020; Hossain et al., 2020; Midorikawa et al., 2021; Rahman et al., 2020).

Regarding gender differences and fear of Covid-19, the World Health Organization (WHO) (World Health Organization, 2020) highlights that most women play the role of caregivers either inside their own home with their family members or on the frontline of workers at outbreak. Further, fear may be related to the impacts of stay-at-home restrictions. During outbreak, spending more time with a violent partner increases the chance of violence against women who were already suffering from this type of abuse. In several countries, there was an increase in domestic violence in the first months of the pandemic (World Health Organization, 2020). A study conducted in Pakistan also found greater fear and concern about Covid-19 among women (Rana et al., 2021). According to Rana et al. (2021), women have a better perception of risk and tend to adhere more closely to health recommendations than men during a pandemic (Rana et al., 2021), which may also explain higher fear scores among women.

In addition, the presence of symptoms of Covid-19 may be a consequence of fear triggered by excessive concern about the pandemic. This assumption supports the idea that any physical symptom could be related to an infection. Also, the prediction of the worst outcomes may be due to the unpredictable behavior of the virus, in case of a positive infection (Arora et al., 2020).

The relationship between socioeconomic variables and fear of Covid-19 does not have a pattern. Covid-19 outbreak brought to surface innumerable socioeconomic inequalities. Jobs and businesses were lost, access to education became more difficult, productivity was reduced, and the global economy has been affected (Carethers, 2021). In the present study, most participants still had a job; however, it was found that individuals with less education and the poorest were more afraid of Covid-19. People in lower socioeconomic levels have been the most affected owing to higher difficulties in accessing health promotion, healthy eating, physical activity and mental health care. Most disadvantaged individuals often reside in the most affected neighborhood, which can contribute to a worse health status and a greater possibility of developing a severe case of Covid-19 (Carethers, 2021). Brazil is going through socioeconomic instability that can lead to difficulty in access to health, fast diagnosis and treatment during a Covid-19 infection, contributing to higher scores of fear of Covid-19 in the lower socioeconomic subgroup (Boschiero et al., 2021).

The low score of fear of Covid-19 in those who lived alone may be related to the fear of infecting a family member and/or being infected by it, when observed from the point of view of concern for others. This fear makes the population feel responsible for the well-being and health of their love ones, in addition to providing a new vision about those living in the same house as a possible threat to life since they can be vectors for coronavirus (Cori et al., 2021; Schimmenti and Starcevic, 2020). A study carried out in Italy demonstrated that people had more fear of infecting a family member (65.8%) than themselves (35.6%) (Cori et al., 2021), and a systematic review and meta-analysis showed that the risk of infection by Covid-19 is higher with cases of household contacts than with cases of contacts outside home. This finding indicates that households are locations with easy transmissibility (Madewell et al., 2020). These facts can explain the evidence in the present study that living alone was associated with lower fear, because it offers social distance and, consequently, protection to family members. Moreover, it makes individuals solely responsible for their health, without relying on healthcare, and reduces their fear of being infected by household members.

Participants who tested positive for Covid-19 were 50% less likely to develop fear of Covid-19. Having had contact with the virus and not having a negative outcome may have contributed to the reduction of fear. It is known that common and mild symptoms, such as cough, fever and fatigue, are the most frequently found in a Covid-19 infection, and that the risk for disease severity is about 18% (CI95% 12.6-23.5) while for disease mortality, it is 3.2% (CI95% 2.0-4.4), i.e., lower risks than in



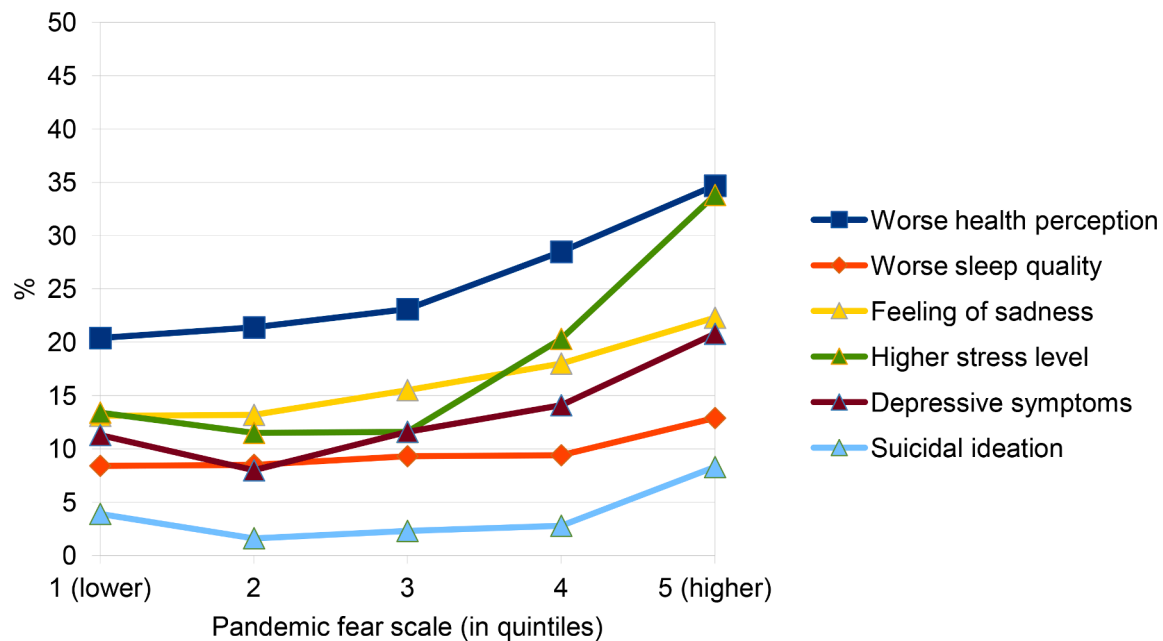


Fig. 1. Association between fear of Covid-19 and health outcomes. Rio Grande-RS and Criciúma-SC, 2021 (n=2,152).

other respiratory syndromes (Hu et al., 2020). From an individual point of view, once infected, the usual thought is that the chance of contracting the virus again decreases because of the concept of widespread immunity, although it is more complex and influenced by population and transmission differences and post-infection immunity duration (Randolph and Barreiro, 2020). Moreover, at the time of data collection, participants were healthy as far as Covid-19 was concerned, because those who had had the disease were not hospitalized (i.e., they recovered). Therefore, it is possible to think that uncertainty could lead to more fear than the exposure already experienced by individuals who have not had serious or major consequences by the Covid-19 infection. Those participants can present a feeling of security and optimistic about the pandemic, different from individuals who have not been infected and still do not know how your health would react and how the consequences would be (Bavel et al., 2020).

It has also been found that being more afraid of Covid-19 was related to the presence of depressive symptoms, stress, sadness and suicidal ideation, worse sleep quality, and worse health perception. Similar results have already been found in other populations, in which higher scores of fear were associated with depression, anxiety, negative emotions, and poor health perception (Chodkiewicz et al., 2021; Cori et al., 2021; Mamun et al., 2021; Rahman et al., 2020; Sit et al., 2021). However, this is a cross-sectional study and causal inference cannot be made between fear and mental health. Lastly, another study with nursing students from the Philippines showed that fear of Covid-19 negatively affected sleep quality ( $\beta = -0.04$ ; CI95% -0.085; -0.001) (De Los Santos et al., 2021) and having fear of Covid-19 infection was associated with suicidal risk behaviors in Bangladesh (OR=1.31; CI95% 1.05-1.64) (Rahman et al., 2021).

During the new coronavirus pandemic, sleep is directly influenced by events that have been affecting people's life on a daily basis. Sleep problems are especially favored by social isolation that took people out of their routine and changed their work and social schedule, acting as stressors by affecting the sleep-wake cycles and resulting in poor health outcomes (Morin et al., 2020). In this context, a recent systematic review and meta-analysis reported higher frequency of sleep problems during the Covid-19 pandemic and its association with psychological distress (depression and anxiety) (Alimoradi et al., 2021).

Thus, it can be argued that the combination of depressive symptoms, sadness, stress and poor sleep quality can lead to poorer health

perception. Constant search for health services, excessive use of social media and the amplification of negative thoughts are common characteristics of a person with fear of Covid-19 that can harm their social life and mental health (Ahorsu et al., 2020; Arora et al., 2020). The increase in social media use to search for information about Covid-19 has been termed as "infodemic" (Pulido et al., 2020). The circulation of information about the Covid-19 outbreak is growing rapidly, but a large amount of available information is false. WHO declared that infodemic threatens the mental health of the population, since most of them still have difficulty in recognizing false information (World Health Organization, 2020a). Studies have been showing that amid the Covid-19 pandemic, higher frequency of social media exposure was associated with depression and anxiety (Gao et al., 2020) and that stress, anxiety and depression were associated with worse sleep quality (Franceschini et al., 2020). In addition, economic loss, living in areas with higher risk of infection, and having lost someone close to Covid-19 were associated with risk of suicide (Rahman et al., 2021), and worse health perception was associated with stress, anxiety, depression and higher psychological impact (Wang et al., 2020). These findings demonstrating that fear affects daily life and rational thinking during the pandemic (Ahorsu et al., 2020; Arora et al., 2020).

Furthermore, there was a linear and worrying association between fear of Covid-19 and health outcomes; in other words, according to the increase of quintiles of fear of Covid-19, the prevalence of health outcomes has also increased. Being exposed to excessive updates about the pandemic, having to leave home, going to work and feeling sick are triggers to fear of Covid-19 and may induce reactions that can be physiological (troubled sleep and Covid-19 symptoms), emotional (sadness, stress and fear), and behavioral (wearing masks, not touching surfaces and respecting social isolation) (Arora et al., 2020). These factors corroborate the results from the present study, and although they do not are statistically significant, the majority of the population with higher level of fear was not unemployed, did not work from home either, and adopted protective behaviors (wearing masks and social isolation). All these triggers or consequences of fear of Covid-19 illustrate how the constant and continuous exposure to trigger factors that enhance fear can negatively affect the population's health on the same proportion.

The limitations of the present study need to be mentioned. The cross-sectional design does not allow to establish causality in the associations; therefore, the results should be carefully interpreted. Furthermore, sleep

quality and health perception were self-reported; nonetheless, it has been shown that the validation of self-reported health has increased over time and its measure is important for the evaluation of individuals' own perception of health, while self-reported sleep quality was strongly associated with physical and mental health evaluation (Cori et al., 2021; Muzni et al., 2021; Schnittker and Bacak, 2014). Moreover, PHQ-9, PSS-14 and the faces scale are tools to screen depression, stress and sadness, respectively, but they cannot be considered as diagnostic tools; however, they are easy instruments to apply and have already been used in other studies and showed good validity and sensitivity (Andrews and Withey, 2012; Chodkiewicz et al., 2021; Mamun et al., 2021; Reis et al., 2010; Santos et al., 2013).

On the other hand, some factors may be considered as strengths of this study. Unlike most studies carried out during the pandemic, face-to-face interviews were conducted in participants' households. In addition, the sampling process was developed in two-stages, with a representative sample of two cities from Southern Brazil. Moreover, this is one of the only population-based studies developed in Brazil to evaluated groups at risk for fear of Covid-19 and its association with health outcomes. It can be considered as an important contribution to understand the fear of Covid-19 during the pandemic.

In conclusion, this study has evidenced that women and individuals with Covid-19 symptoms presented higher scores of fear, while richer ones and those who already had Covid-19 showed less fear. Fear of Covid-19 may even be positive for engagement and adherence to guidelines that increase self-care; however, when fear is exaggerated and irrational, it can intensify dysfunctional behaviors and harm mental health. In this study, we identified important health outcomes: greater fear was associated with an increased prevalence of depression, stress and sadness, poor sleep quality, poorer perceived health, and suicidal ideation. These findings highlight the multiple impact of the Covid-19 pandemic on society and individual's health, indicating the need for intersectoral actions to help the population to cope with this public health emergency.

#### CRedit authorship contribution statement

**Fernanda Oliveira Meller:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing. **Antônio Augusto Schäfer:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing. **Micaela Rabelo Quadra:** Writing – original draft, Writing – review & editing. **Lauro Miranda Demenech:** Conceptualization, Methodology, Writing – review & editing. **Simone dos Santos Paludo:** Conceptualization, Methodology, Writing – review & editing. **Priscila Arruda da Silva:** Conceptualization, Methodology, Writing – review & editing. **Lucas Neiva-Silva:** Conceptualization, Methodology, Writing – review & editing. **Samuel C. Dumith:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – review & editing.

#### Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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