Screen use and mental health: the need to strengthen the information ecosystem

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Abstract

Despite the long-claimed harm associated with the intensive use of screen-based technologies, the measures to curb the COVID-19 pandemic in early 2020 promoted increased screen time. We investigated this behavior at two junctures: during lockdowns and post-lockdowns. Our overarching goal was to deepen the understanding of how intensive screen use correlates with negative and positive mental health outcomes, considering different purposes and circumstances of use. Furthermore, building on infodemic research, we explored the use of trusted sources of information and information sharing, alongside certainty of knowledge and context-related distress. We aimed to determine whether perceived trustworthy sources help individuals cope with uncertainty, notwithstanding possible misinformation. An online survey conducted in June 2020 (T1, $n = 327$) and repeated in June 2021 (T2, $n = 300$) with Brazilian adults (18+ years) revealed significant correlations: individuals who perceived increased screen time showed higher anxiety, and those who reported greater information sharing showed higher distress; using screens for novel activities correlated with higher well-being; and despite the awareness of the spread of unreliable content, seeking information ranked as the top purpose for using screens. Surprisingly, individuals who relied on official health channels revealed lower certainty and more distress than those who prioritized other sources. Our findings emphasize the importance of understanding the diverse purposes and circumstances for using screens and the significant role of trusted information sources in coping with uncertainty. Moreover, this study underscores the urgent need for an approach to health communications that can effectively help build a healthy information ecosystem.

Keywords: *mental health, information ecosystem, health communication, information technology, COVID-19 pandemic, infodemic*

1. Introduction

The lockdowns implemented in early 2020 to curb the spread of COVID-19 resulted in screen-based technologies becoming primary tools for daily activities, socializing, and staying informed [1, 2]. Without diminishing the severity of the pandemic, the intensified use of screens on a global scale favored new insights for a deepened understanding of how this behavior correlates with both negative and positive mental health outcomes.

Recent studies suggest that screen use played a pivotal role during the restrictive circumstances of the pandemic given that it made the continuation of everyday life possible, including connecting with family and friends, which is a strong predictor of well-being [3, 4]. This assertion corroborates the notion that to determine whether screen time harms mental health, it is necessary to assess the context and the purposes of use [5, 6].

Notably, the COVID-19 pandemic scenario was marked by great uncertainty reinforced by a far-reaching information epidemic, or an "infodemic" [3]. The term refers to vast amounts of facts and falsehoods that rapidly spread through digital technologies, making it difficult for people to discern what is accurate from inaccurate content [7]. In the context of the pandemic, the intensified use of screens coupled with disproportionate media coverage of a disease that experts knew little about promoted an infodemic of unprecedented reach [8, 9]. Consequently, seeking information was associated with confusion, stress, and other adverse mental health outcomes [3, 10].

Even though infodemics are often linked to the use of social media, the phenomenon is fueled by the interaction of social media, mainstream media, and specialized media [8]. Moreover, it extends into the political arena [7, 11] and involves social influences on behaviors and individuals' coping with uncertainty [12]. Among the theoretical models employed in understanding information processing under uncertainty, the psychological entropy model posits that individuals tend to seek information in an attempt to manage uncertainty-related anxiety, even though this coping strategy may present the opposite outcome when one finds inaccurate information, too much information, or both [13, 14]. Alternatively, the heuristic-systematic model posits that individuals tend to use source credibility as a cue to cope with information overload and process conflicting information [15, 16].

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While declines in mental health during a crisis are to be expected [17], infodemics exacerbate these effects and trigger noncompliance with public health guidance, endangering individuals and society [10]. To counter this risk, besides leading the global response to the spread of COVID-19, the World Health Organization (WHO) took efforts into working with social media platforms and Google©. They aimed to make sure that whenever people searched for information related to the pandemic, they were directed to the WHO's website, or other official channels presenting information supplied by the organization [11]. Given the reputation of the WHO, using these channels should help individuals cope with false or misleading information and adverse mental health outcomes [18–20].

At the same time, as stated by Escandón et al. [8], the pandemic-related infodemic was highly polarized, ultimately because critical issues were often framed as if there were only two opposing sides to the matter (e.g., must stay home vs. save the economy, indefinite lockdown vs. unlimited reopening, masks for all vs. no masking). This dynamic promoted a vicious circle of polarized discussions and all-or-nothing guidance, which was reinforced by algorithms and by the sharing of content that was convergent with the preexisting views of like-minded people. Using source credibility as a cue to assess information has been extensively investigated in different disciplines [21]. Thus, it is well known that polarized sources and echo chambers favor the dissemination of false and misleading content.

In addition, prior to the pandemic, polarized narratives on varied subjects raised attention to the online spread of "fake news" [12]. This term gained popularity once it became frequently applied to any content that political parties and individuals did not like or endorse [21]. In addressing the resulting rapid proliferation of falsehoods and out-of-context facts online, two terms were broadly adopted by the scientific community: "disinformation," to refer to content fabricated with the intent to cause harm, and "misinformation," to refer to false or misleading content disseminated by individuals inadvertently [8, 22].

As argued by Wang et al. [21], ascertaining such intent has become ever more complex; thus, unless stated otherwise, the benefit of the doubt makes it reasonable to address inaccurate or misleading content as misinformation. In accordance, when the COVID-19 outbreak was classified as a pandemic in March 2020, polarized debates with oversimplified narratives reinforced opposing views of the situation [8]. Based on the heuristic-systematic model, using the WHO as a trusted source of information may have helped individuals process conflicting content, just as using sources other than WHO's channels may have similarly helped other individuals—regardless of whether the content was accurate, therefore, despite the risk of misinformation.

Nevertheless, a new element was introduced into the scenario: a shared goal of gathering knowledge and acting upon a common threat [12], which impacted the information ecosystem. Based on the ecological systems theory [23], "information ecosystem" is defined as an interconnected network of structures, entities, and agents engaged in generating, sharing, transmitting, and utilizing information. This complex system influences how people understand themselves and the world around them, shaping physical and digital interactions and behaviors. In this sense, a "healthy information ecosystem" enables creating, sharing, and utilizing information in balanced and diverse ways. It provides access to accurate content and fosters positive interactions and resilience,

ultimately promoting mental health individually and societally [24]. During the pandemic, people turned to screens to stay informed about the virus, its spread, and preventive measures, contributing to disseminating crucial information. However, this collective behavior also posed challenges related to misinformation and mental health at a global scale [3].

Given the above, in the present study, we investigated how screen use for diverse purposes correlates with mental health outcomes in different circumstances. Specifically, we conducted an online survey at two junctures: (1) when the number of cases and deaths due to COVID-19 escalated and physical distancing measures were broadly implemented, and (2) one year later, when the number of cases and deaths had decreased, vaccines had become available, and the physical distancing measures had been eased. Despite the intensified screen use, we expected mental health indicators to vary according to the different purposes and circumstances of use.

Furthermore, building on infodemic research, we explored the use of perceived trustworthy sources and the sharing of information alongside certainty of knowledge and context-related distress. Our goal was to analyze whether prioritizing a trusted information source helps individuals cope with uncertainty when navigating today's information ecosystem, notwithstanding the risk of misinformation. In this sense, it is worth noting that among the countermeasures in battling infodemics, building trust has been considered a central strategy for improving the efficacy of health communications [19, 21].

Overall, the literature suggests that the pandemic has affected individuals' mental health to varying degrees, with screen use playing a significant role in enabling the continuance of daily life and much-needed social interactions while fueling a polarized infodemic beyond the pandemic scenario [3, 20]. A deepened understanding of the intensified use of screens is critical, considering that this behavior interferes with mental health at both the individual and societal levels, with potential harms and benefits [5, 25]. This topic becomes ever more critical given the increased spread of multimedia content produced through artificial intelligence [26–28], potentially generating more confusion [22].

In this study, we aimed to understand how the use of screens for varied purposes in everyday life is associated with both negative and positive mental health outcomes and specifically explore individuals' use of trusted sources to cope with uncertainty and distress amid the ever-growing spread of misinformation and inaccurate narratives and beliefs.

2. Materials and methods

2.1. Procedure and participants

We conducted a cross-sectional online survey through snowball sampling using a self-report questionnaire targeted at Brazilian adults (aged 18+). We collected data at two time points: (1) in June 2020 (T1), when the number of cases and deaths due to COVID-19 had escalated and lockdowns were enforced, and (2) in June 2021 (T2), when the number of cases and deaths had decreased, and physical distancing measures had been eased. The data before the pandemic is also considered (Tb). Notably, different individuals participated in each data collection.

We followed the same procedure at both time points: we posted an online invitation through WhatsApp®, Facebook®, and

Instagram® and encouraged the recipients to share it online. The participants were considered as valid based on the following criteria: respondents had to be Brazilian, 18+ years old, and provide informed and voluntary consent to participate, which could be accessed through a link on that invitation. The link led to the Qualtrics® online platform, where potential respondents found further information about the research project and the consenting term to be reviewed. Those who indicated they fully understood and voluntarily agreed to participate had access to the survey questionnaire. Individuals who did not accept the informed consent were taken to the end of the survey and not accounted as participants.

Before the data collection, the study was approved by the PUCRS Research Ethics Committee (certificate #31234720.0.0000. 5336, ethical review #4.078.008), and we performed a pilot study to double-check the clarity of all instructions. The same questionnaire was presented to the participants at both time points, T1 and T2, except for the measures of COVID-19-related experience and context-related distress, added at T2. We inserted all measures into the online platform, which resulted in the questionnaire presented to the participants. The complete questionnaire was formatted in Brazilian Portuguese through the Qualtrics® online platform. For the present report, we prepared an English version of the measures adapted for this study as Supplementary materials.

2.2. Measures
The following sections describe the measures used in this study.

2.2.1. Sociodemographic characteristics
The respondents were asked to indicate their age, gender, educational level, marital status, and nationality.

2.2.2. Screen use
We assessed screen use (referring to perceived screen time, purpose of use, and related beliefs) through four questions adapted from Fortes et al. [5]: (1) "On a scale ranging from 0 (not at all) to 10 (intensively), indicate how much have you used technologies *[i.e., smartphone, computer, internet, and related resources]*, for each of the following purposes: To search for information before the pandemic, *[and]* in the past two weeks; to watch movies/series before the pandemic, *[and]* in the past two weeks..." to a total of 20 purposes (as listed on **Table 1**); (2) "How intensive is your current use of technologies, in terms of hours per day? Less/same/more than before the pandemic"; (3) "For each statement, indicate your level of agreement ranging from 0 (strongly disagree) to 5 (strongly agree): The use of technologies for long hours is detrimental to individuals' health; the use of technologies for long hours is more detrimental in routine circumstances than in a restrictive context; people should make use of technologies for novel activities, such as learning a foreign language, a musical instrument, or trying other interesting experiences; thinking of my current use of technologies and what others are doing, I am probably below average"; and (4) "Among the available information related to the pandemic: There is a lot/some/no fake news/not sure."

2.2.3. Infodemic-related screen use
We assessed infodemic-related screen use (referring to sources of information used with confidence, sharing of information about COVID-19, and certainty regarding self-knowledge about COVID-

19) through six questions adapted from Chadwick and Vaccari [29]: (1) "In recent years, it has become common for people to share information on social media. How often have you shared information related to the COVID-19 pandemic in the past two weeks? Less/same/more than before the pandemic/not applicable"; (2) "When you share information online, how important do you find each of the following reasons, on a scale ranging from 0 (not important at all) to 10 (extremely important): To inform others, to demonstrate my knowledge, to express my opinions, to find out other people's opinions, to keep in touch with people, to fuel positive discussions, to express my feelings, to persuade others, to tease and entertain others, not applicable"; (3) "Indicate how certain you feel about each of the assertions about COVID-19 [*related to masks, vaccine, and medications*]: I am sure the information is correct, I am sure the information is incorrect, I am pretty sure the information is correct, I am pretty sure the information is incorrect, I am not sure whether the information is correct or incorrect"; (4) "In the past two weeks, how much have you used with confidence the following sources of information regarding the COVID-19 pandemic, on a scale ranging from 0 to 10: Mainstream media *[established television, radio, and news media channels]*, family and friends, health organizations [e.g., WHO], government channels"; (5) "Sometimes people share news on social media that turn out not to be fully accurate. Amid the pandemic, do you recall sharing any information that (you can select more than one option): You thought was made up when you shared it; was exaggerated, and you were not aware of this; was exaggerated, and you were aware of this; seemed accurate at the time, but later you found out it was made up; not applicable"; and (6) "You decided not to share information when (you can select more than one option): You were not sure the information was accurate; you thought the content could be false and did not want to look like someone who passes on unreliable information; you realized it was best to avoid conflict; you considered that the information could harm someone."

2.2.4. Anxiety
We used the generalized anxiety disorder (GAD-7) scale [30] to assess the levels of generalized anxiety. The good internal consistency previously identified in Brazil ($\alpha = 0.91$) [31] was also present in this study (αT1 = 0.89; αT2 = 0.92).

2.2.5. Well-being
We used the Warwick-Edinburgh mental well-being scale (WEMWBS) [32] to assess the levels of mental well-being. The good internal consistency previously identified in Brazil ($\alpha = 0.89$) [33] was also verified in this study (αT1 = 0.88; αT2 = 0.91).

2.2.6. Context-related distress
We assessed the levels of distress related to the circumstantial context using a measure adapted from Magson et al. [34]: "On a scale ranging from 0 (not at all distressed) to 10 (extremely distressed), indicate how distressed have you been about: Having to wear a mask, the global economic situation, the risk of contracting COVID-19 and becoming severely ill, the risk of dying from COVID-19...", to a total of 18 items, with higher scores reflecting higher levels of distress. The good internal consistency of the original measure ($\alpha = 0.91$) was confirmed in this study (αT2 = 0.86).

Table 1 • Purposes for screen use: before the pandemic versus June 2020 versus June 2021

Purposes for screen use	Tb	T1	*p* Tb vs. T1	T2	*p* T1 vs. T2	*p* Tb vs. T2
To search for information	7.50	8.68	0.00**	8.96	0.23	0.00**
To watch movies/series	6.18	7.67	0.00**	6.13	0.00**	0.10
To watch TV news	4.35	4.78	0.04*	3.30	0.04*	0.00**
To watch soap operas/soccer matches	3.22	2.85	0.19	4.78	0.00**	0.00**
To watch short-form videos	5.47	6.90	0.00**	6.78	0.10	0.24
To speak with family/close friends	6.11	8.49	0.00**	8.38	0.10	0.00**
To speak with work/school colleagues	5.00	7.44	0.00**	8.14	0.00**	0.00**
To gather with family/close friends	2.15	6.88	0.00**	4.64	0.00**	0.00**
To meet with work/school colleagues	1.99	6.41	0.00**	6.68	0.10	0.00**
To produce work-/school-related content	3.84	5.54	0.00**	3.43	0.00**	0.46
To produce digital content for fun	3.15	4.28	0.00**	3.63	0.00**	0.91
To improve health (e.g., physical activities)	3.28	4.70	0.00**	3.01	0.00**	0.10
To play games alone	1.91	2.73	0.00**	2.24	0.17	0.62
To play games with other people	0.78	1.28	0.00**	1.11	0.02*	0.27
To view posts on social media	6.33	7.77	0.00**	7.34	0.23	0.00**
To post content on social media	4.37	4.93	0.00**	4.34	0.11	0.10
To watch live streams	1.48	5.37	0.00**	4.14	0.00**	0.00**
To shop for products/services	3.77	5.94	0.00**	5.07	0.00**	0.00**
To do extracurricular activities	1.93	3.97	0.00**	4.17	0.10	0.00**
To search for job opportunities	1.63	1.70	0.43	1.14	0.08	0.00**

Tb = before the pandemic; T1 = June 2020; T2 = June 2021. *$p < 0.01$; **$p < 0.05$.

2.2.7. COVID-related experience
We assessed the respondents' experience with COVID-19 (referring to whether the respondent, a family member, or friend, had tested positive, been hospitalized, or lost a loved one to the disease) through two questions adapted from Coninck et al. [35].

2.3. Statistical analysis
All statistical analyses were performed using IBM SPSS Statistics v25. Descriptive statistics, including means, standard deviations (SDs), and percentages for categorical variables, were computed to summarize the demographic characteristics of the participants and other relevant study variables. The analysis of variance (ANOVA) was conducted to compare the means across different groups, and post-hoc comparisons were performed following ANOVA to identify specific group differences. The independent Student's *t*-test was employed to compare the means of the two independent groups and assess significance. In addition, Pearson correlation was used to assess the relationships between continuous variables and Cronbach's Alpha was calculated to assess the reliability of the measures. A significance level of 5% ($p < 0.05$) was used for all statistical tests.

3. Results
As shown in **Table 2**, the survey in June 2020 (T1) included a total of 327 thoroughly answered questionnaires. The mean age of the participants in the group was 43.56 years (SD = 16.01), 70.4% were

female, all were Brazilian, 57.1% were living in the southern region, 47.2% were married, and 45.9% reported holding a bachelor's degree. The survey in June 2021 (T2) included a total of 300 completely answered questionnaires. The mean age of the participants was 42.55 years (SD = 15.88), 65% were female, all were Brazilian, 59% living in the southern region, 46% were married, and 51% reported holding a bachelor's degree. Regarding the direct experience related to COVID-19, 100% of the participants at T2 reported having a family member or friend who tested positive for the disease. In addition, 21% reported having tested positive, and one respondent reported having to be hospitalized; 29% reported having a family member or friend who had to be hospitalized, and 26% had lost a family member or friend to the disease.

Our analysis revealed a significant shift in screen-use patterns compared to pre-pandemic times at T1 and T2. Specifically, 75.9% of participants at T1 and 82.5% at T2 reported using screens for more hours than before the pandemic. Of the participants, 22.3% at T1 and 16.2% at T2 reported using technologies for the same amount of time as before, and 1.8% at T1 and 1.3% at T2 reported using screens for fewer hours than before the pandemic.

As shown in **Table 1**, our study investigated a total of 20 purposes for screen use. Among these, the use for 18 purposes significantly changed at T1 compared to pre-pandemic times. For the remaining two purposes, there were no changes at T1, but changes were observed at T2. Specifically, the use for *watching TV soaps/soccer matches* increased (Tb = 3.22,

T1 = 2.85, T2 = 4.78), while the use for *job searching* decreased (Tb = 1.63, T1 = 1.70, T2 = 1.14).

Table 2 • Participants demographic

Demographic variable	T1 (June 2020)	T2 (June 2021)
Number of participants	327	300
Mean age (SD)	43.56 (16.01)	42.55 (15.88)
Female (%)	70.4	65
Brazilian (%)	100	100
Live in southern Brazil (%)	57,1	59
Married (%)	47.2	46
Bachelor's degree (%)	45.9	51

SD, standard deviation.

In addition, the use for *speaking with work/school colleagues* increased at *T*1 and even more so at T2 (Tb = 5.00, *T*1 = 7.44, T2 = 8.14). In contrast, use for five purposes increased at T1 and remained at the same level at T2: *to search for information* (Tb = 7.50, T1 = 8.68, T2 = 8.96), *to speak with family and friends* (Tb = 6.11, T1 = 8.49, T2 = 8.38), *to meet with work/school colleagues* (Tb = 1.99, T1 = 6.41, T2 = 6.68), *to view posts on social media* (Tb = 6.33, T1 = 7.77, T2 = 7.34), and *to do extracurricular activities* (Tb = 1.93, T1 = 3.97, T2 = 4.17). For three purposes, the use has decreased in T2 compared to T1, but it has increased compared to before the pandemic: *to gather with family and friends* (Tb = 2.15, T1 = 6.88, T2 = 4.64), *to watch live streams* (Tb = 1.48, T1 = 5.37, T2 = 4.14), and *to shop for products/services* (Tb = 3.77, T1 = 5.94, T2 = 5.07).

There were no changes in T2 compared to before the pandemic for eight purposes of screen use; for four of those, the use of screens increased in T1 but returned to the previous levels in T2, and the other four purposes did not significantly change in T2 compared to T1 or before that. Finally, screen use *to watch TV news* increased in T1 but decreased in T2, ending below the levels before the pandemic (Tb = 4.35, T1 = 4.78, T2 = 3.30). In contrast, *to search for information* was rated as the top purpose for using screens before the pandemic, and it remained rated as the number one of the 20 investigated purposes in both T1 and T2.

The reports on screen use–related beliefs showed that, at T1, 61.9% of the respondents agreed that *using technologies for long hours is more detrimental in routine circumstances than in a pandemic context*; at T2, 59.8% reported this belief. In addition, 95.1% of participants at T1 and 92.2% at T2 agreed that *people should use technologies for novel activities such as learning a foreign language, a musical instrument, or trying other interesting experiences*. A substantial percentage of participants in T1 (65.7%) and T2 (64.3%) rated themselves below what they assumed other people had been experimenting with technology in this sense. In addition, the perceived use of screens for novel activities correlated with well-being at T1 ($r = 0.348$, $p < 0.01$) and T2 ($r = 0.431$, $p < 0.05$).

In parallel, one-way ANOVA revealed significant differences in anxiety levels across different perceived intensities of screen use at both T1 (7.28 ± 11.47, $p < 0.01$) and T2 (7.28 ± 7.97, $p < 0.01$). Participants who reported using screens for more hours at T1 than before the pandemic had higher levels of anxiety ($n = 247$, 14.81 ± 2.97, $p < 0.01$) than did those who reported the same intensity as before ($n = 72$, 12.10 ± 3.77, $p < 0.01$). Similarly, participants who

reported using screens for more hours at T2 than before the pandemic had higher levels of anxiety ($n = 245$, 15.59 ± 5.45, $p < 0.01$) than did those who reported using screens with the same intensity as before the pandemic ($n = 48$, 12.29 ± 4.18, $p < 0.01$). The analysis also revealed a positive association between screen use *to search for information*, reported as the most intensive purpose of use, and the level of context-related distress ($r = 0.212$, $p < 0.01$).

The awareness of the spread of fake news through screen-based technologies was expressed by almost all participants in T1 (94.5%) and T2 (98.3%). Among the participants who reported sharing fake news throughout the pandemic (27%), 87.7% reported being unaware that the information was inaccurate, while 12.3% admitted that they knew so. The top reason for sharing digital content was, by far, *to inform others* (7.32 ± 3.24); other reasons were as follows: *expressing my opinion* (3.98 ± 3.60), *expressing my feelings* (3.84 ± 3.44), *keeping in touch with people* (3.30 ± 3.81), *teasing and entertaining others* (2.99 ± 3.53), *fueling positive discussions* (2.89 ± 3.54), *persuading others* (2.72 ± 3.49), *finding other people's opinions* (2.54 ± 3.18), and *demonstrating my knowledge* (2.34 ± 3.18).

While 36% of the participants reported sharing more information on social media than before the pandemic, 42.8% reported sharing it the same way as they used to. However, there were significant differences between the mean distress levels revealed by these groups (9.178 ± 3.07, $p < 0.01$); the group that reported sharing more information than before the pandemic presented higher levels of distress ($n = 101$, 131.19 ± 30.88, $p < 0.01$) than did the group that reported sharing information the same way as before ($n = 122$, 120.56 ± 30.79, $p < 0.01$). Also, participants reported that they decided not to share content on social media when they *were not sure that the information was accurate* (68%), *thought the content could be false and did not want to look like someone who passes on unreliable information* (31.7%), *realized it was best to avoid conflict with other people* (28%), and when they *considered that the information could harm someone* (25.3%).

Further analysis revealed associations between respondents' certainty of their knowledge about COVID-19 (regardless of whether the information was correct) and their use of information sources. The results indicated a negative association between certainty levels and confidently using *mainstream media* as a source of information ($r = -0.073$; $p < 0.01$). A negative association was also found between the former and confidently using *health organizations (e.g., WHO)* as information sources ($r = -0.272$, $p < 0.01$). In contrast, positive associations were found between levels of certainty and trusting *government channels* ($r = 0.133$, $p = 0.023$) or *family and friends* ($r = 0.146$, $p = 0.012$) as information sources. Finally, the analysis revealed statistically significant associations between context-related distress and confidently using these information sources; the former was negatively associated with relying on *government channels* ($r = 0.137$, $p = 0.022$) or *family and friends* ($r = 0.182$, $p = 0.002$) and was positively associated with relying on *mainstream media* ($r = 0.225$, $p = 0.001$) or *health organizations (e.g., WHO)* ($r = 0.201$, $p = 0.001$) as sources of information related to the pandemic.

4. Discussion

The present study aimed to deepen the understanding of how screen use correlates with mental health, considering different

purposes and circumstances of use. Furthermore, we focused our investigation on the use of screens for information seeking, exploring the use of trusted information sources, and information sharing, alongside certainty of knowledge and context-related distress. Our goal was to analyze whether using perceived trustworthy sources helps individuals cope with uncertainty in the contemporary information ecosystem, regardless of whether the information is accurate, therefore, despite the risk of misinformation. Below, we have highlighted our main findings and will discuss each in sequence:

While perceived screen time correlates with anxiety, using screens for novel activities correlates with well-being.

As expected, most participants reported more hours of screen use during the pandemic lockdowns (T1) compared to before the pandemic. This intensified screen time persisted after restrictions were eased (T2). In addition, the reporting on the different purposes of use (**Table 2**) revealed substantial changes in this behavior given the pandemic experience. Not only did the use of technologies for 11 of the 20 investigated purposes increase over the period of the study, but some of those were also practically nonexistent before the pandemic (like *watching live streams*, *doing extracurricular activities*, *gathering with family and friends*, and *meeting with work/school colleagues*).

Interestingly, the notion that *using screens for long hours is detrimental to individuals' health* proved consolidated, while the belief that such behavior is not as harmful amid restrictive circumstances was also substantial at both junctures. The results showed a positive association between screen time and anxiety, which corroborates the enduring health guidance centered on the understanding that individuals should limit their hours of screen use. Since participants were asked to report their perceived hours of screen use, such an association with anxiety may be related to the dissonance between the assumption that screen time should ideally be limited and individuals not following such a recommendation. This is a paradox worth exploring in the improvement of current guidance on screen use.

Notably, overall screen time did not decrease after restrictions were eased. Moreover, in addition to using screens for purposes that were nonexistent before the pandemic, a substantial percentage of participants reported agreeing that *technologies should be used for novel purposes*, and their perception of doing so correlated with well-being. Altogether, these findings indicate a potential openness to using screens in different ways rather than limiting screen time.

Despite the broad awareness of the online spread of false and misleading content, seeking information is a top purpose for using screens.

Using screens *to search for information* was rated as the top purpose of screen use prior to the pandemic; the use of screens for this purpose further increased in T1 and was also rated at the top position in T2. Given that information seeking combines both purposive and nonpurposive information behavior [36], the pandemic-related infodemic, referring to the vast amount of conflicting information that was broadly found, received, and exchanged through multiple online channels [20] helps explain the correlation between using screens for this purpose and distress, also evidenced in the results.

Although the dissemination of false and misleading information through screen-based technologies is not a new phenomenon, the COVID-19 infodemic was characterized as distinctively worrying due to its unprecedented reach [8, 20]. Indeed, almost all participants in T2 reported sharing information through social media at a similar or higher intensity than they used to before the pandemic. Moreover, those who reported sharing more information than before the pandemic revealed higher levels of distress. Also, among the respondents, who admitted having shared inaccurate information related to COVID-19, most indicated not knowing that, at the time, meaning they misinformed others unintentionally. These results suggest that a willful attitude to spreading disinformation may be less concerning than the inadvertent spread of misinformation. Ultimately, information is available 24/7, yet individuals may rely on inaccurate, highly uncertain, or both narratives.

Information sharing is motivated by the duty to inform others, and individuals choose not to share for good reasons too.

Recent studies examining motivations for sharing digital content suggest that such behavior is linked to the notion of civic duty [10, 37]. Accordingly, the top motivation reported by the participants was *to inform others*. In addition, the majority reported deciding not to pass on digital content when they were unsure of its accuracy. While this may reflect a socially acceptable response [29], what stands out are the reports on the additional reasons for not sharing digital content, namely *not risk being perceived as one who passes on unreliable information*, *avoiding conflict with others*, and *not risk harming others*. These are interesting motives to be explored in developing preventive campaigns aimed at managing infodemics.

Sharing false and misleading information, intentionally or not, contributes to amplifying infodemics, as illustrated in studies about the COVID-19 infodemic that were developed in parallel to this one. For example, Coninck et al. [35] found associations between greater beliefs in disinformation and misinformation narratives and higher feelings of depression, while Leung et al. [10] observed that the spread of conflicting information during the pandemic promoted confusion and jeopardized social support among family and friends. This study has identified a consolidated awareness of the spread of false and misleading content alongside the increased use of screens, although no associations were found between this notion and the levels of anxiety or well-being reported by the participants.

Building trust is not enough.

While examining the role of trusted sources of information, we were surprised to find that individuals who relied on official health channels revealed lower certainty levels and more distress than those who prioritized other information sources. The results showed compelling associations between the sources used with confidence by the participants and their perceived certainty of knowledge about COVID-19, which was linked to context-related distress. Specifically, higher levels of certainty were associated with confidently using *government channels* or *family and friends* as information sources, in contrast to confidently using *mainstream media* or *health organizations (e.g., WHO)* as sources of information. Furthermore, relying on *government channels* or *family and friends* was associated with lower levels of distress compared to relying on *mainstream media* or *health organizations (e.g., WHO)*.

These results contrast with those of Leung et al. [10] and Coninck et al. [35]. The study developed by Coninck et al. [35] found the use of mainstream media (established television, radio, and news media channels) associated with lower beliefs in false narratives; according to the authors, this would reflect a trend back to more traditional media as opposed to social media due to infodemics. Similarly, the study developed by Leung et al. [10] found the use of perceived trustworthy sources associated with lower levels of emotional distress; the authors referred to official health channels as an example of such sources. In fact, ensuring access to accurate information is part of the standard guidelines in humanitarian emergencies [17]; hence, the announcement of the pandemic status by the WHO and the organization's positioning as the official source of information about COVID-19 [18, 38]. However, in this study, the perceived reliability of *health organizations (e.g., WHO)* did not show associations with higher certainty or lower levels of distress; relying on *mainstream media* did not show these associations either.

A possible explanation is the different political, economic, and media climates surrounding the respondents of the studies [8, 35]. In Brazil, health channels and mainstream media repeatedly broadcasted the risks of contamination, death rates, and long-term effects of the disease based on the WHO's reports, thus reinforcing that people should stay home; in contrast, government representatives highlighted the economic burdens of the restrictive measures in the short and long term, therefore often questioning the former guidance [39]. These conflicting approaches might explain the finding that screen use for *watching TV news* (mainstream media) increased significantly in T1 but decreased in T2, ending up rated below the levels of before the pandemic. Ultimately, this finding resembles the proposition by Su et al. [40] about the risks of worry fatigue, referring to feelings of burden due to too much worry unsolved.

As mentioned earlier, the intensified use of screens was coupled with disproportioned media coverage, which promoted polarized discussions and all-or-nothing guidance [8]. Among the several factors that influence individuals to take sides, the effects of algorithms are undoubtedly relevant, for it reinforces like-minded thinking [29]. In addition, the tangible and intangible costs of behavior change are another possible explanation worth exploring. As asserted by Koyuncu [41], if risks are downplayed in conveying health guidance, the likelihood of change is reduced; if fear is the outtake, chances of panic or denial are increased. Although clear information from credible sources helps reduce the chances of recipients filling in any gaps, mandatory changes in behavior involving high costs increase the chances of recipients questioning such an imposition, and more so when others question such information [41].

In this study, we asked the participants about the information sources they *used with confidence*; therefore, the perceived credibility of *mainstream media* and *health channels (e.g., WHO)* by those who prioritized these sources was not an issue. However, guidance demanding substantial changes in behavior, conveyed through oversimplified rather than nuanced narratives [8], might as well have reinforced polarization rather than engaged all into fighting the same fight. Our findings suggest that perceived trusted sources can help individuals cope with uncertainty and reduce context-related distress; however, these benefits might involve misinformation and inaccurate narratives, potentially affecting decision-making and hindering healthy behaviors. Therefore, it is essential that international organizations like the WHO and their regional partners implement communication strategies to help build a healthy information ecosystem—one where people are more resistant to confirmation bias, open to nuanced views, and most of all, prompted to make better choices in a highly connected world.

4.1. Limitations

Apart from the study's contributions, it is imperative to consider its limitations. Adding to the latest research about screen use developed in different countries [10, 35], we conducted this study in Brazil. Our findings corroborate the notion that political and media climate is an important variable to consider when addressing information seeking and information sharing. Nonetheless, exploring other cultural contexts can enrich the current findings. The same input applies to the methodology. Although we originally planned for a longitudinal study, the unforeseen endurance of the pandemic resulted in different groups of individuals participating in the two data collections. Longitudinal studies would be recommended for further research, and expanding sample sizes would be interesting as well. Also, it is worth noting that the extant literature about screen use and mental health focuses on problematic digital behaviors [42, 43]. In contrast, we focused on the use of screens for daily activities; more specifically, we were interested in further understanding the growing use of screens for diverse purposes in everyday life. However, addictive screen use and other problematic behaviors related to the ever-more rapid technological innovations permeating this scenario should be considered in future research.

In addition, although we investigated 20 different purposes for using screens, information seeking was rated as the top purpose for using screens before, during, and after the pandemic lockdowns, and it correlated with distress. Therefore, exploring the different types of information individuals seek online and correlations with mental health indicators would be a relevant topic for further investigation. Similarly, given the correlation between using screens for novel purposes and well-being, further exploring screen use focusing on other specific purposes is another interesting venue for future research.

Also, our findings indicate that health communications related to the COVID-19 pandemic did not help diminish uncertainty and distress, but quite the opposite. We argued that this may also apply to guidance regarding screen use, but such an assertion demands proper investigation. In this sense, exploring gray messaging in health communication rather than all-or-nothing perspectives (e.g., whether smartphones should be banned from schools) might be a fruitful path for future research and practice. This study indicates that individuals are not making the best use of technological solutions—but would welcome the proper guidance to do so.

5. Conclusions

Since the pandemic experience, technological innovations emerging seemingly overnight have gained global attention. We are currently witnessing the arising of a new generation of technologies that offers transformative potential while posing critical challenges. There are no signs that individuals will diminish screen use, but quite the opposite. One of the challenges evidenced by our discussion is the need to curb the vicious circle

of polarization to effectively promote healthy screen use and vice versa. Ultimately, positive mental health outcomes must prevail over negative ones as people continue using screens in everyday life. Given what we learned from this study, we should reevaluate our health communications to reach the humans operating within the contemporary information ecosystem, rather than demonizing technologies and waiting for political regulations and literacy programs.

In conclusion, understanding users' beliefs and motivations should be the basis for developing effective interventions and preventive actions aimed at promoting individual and social mental health. Our findings suggest that there is a demand for better ways to create, consume, and share information at the individual and societal levels. Proper guidance could lead screen users—meaning everyone—into taking responsibility for what the available and new technologies become. This study suggests that we should start by rethinking the undergoing health communication strategies concerning screen use. The ongoing efforts do not seem to achieve this purpose.

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Author contributions

Conceptualization, P.L.B. and A.B.F.; methodology, P.L.B. and A.B.F.; validation, P.L.B., A.B.F. and C.S.M.L.; data collection, P.L.B. and A.B.F.; data curation and analysis, A.B.F.; technical support, C.S.M.L.; writing—original draft preparation, P.L.B.; writing—review and editing, P.L.B., A.B.F. and C.S.M.L. All authors participated in all stages of the study and approved the final version of the research manuscript.

Conflict of interest

The authors declare no conflict of interest.

Data availability statement

Data supporting these findings are available within the article, at https://doi.org/10.20935/MHealthWellB7332, or upon request.

Institutional review board statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee of the Pontifical Catholic University of Rio Grande do Sul (CAAE 31234720.0.0000.5336 approved on 06/09/2020).

Informed consent statement

Informed consent was obtained from all participants involved in the study.

Sample availability

The authors declare no physical samples were used in the study.

Supplementary materials

The supplementary materials are available at https://doi.org/10.20935/MHealthWellB7332.

Additional information

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