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Higher education students' perceptions of issues related to Covid-19: A study on three Portuguese-speaking countries

Laurinda Leite[1*], Luís Dourado[2], Maria Verónica Mapatse[3], José Arão[4], Jerusa Moraes[5] and Sônia Castellar[6]

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*Corresponding author: Laurinda Leite, University of Minho, Campus de Gualtar, Braga, Portugal
E-mail: lleite@ie.uminho.pt

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Abstract: In early 2020, a pandemic caused by the new coronavirus SARS-CoV-2 affected the world and all countries had to adopt important measures to face a disease named COVID-19. This paper aims at investigating the perceptions about key issues related to COVID-19 held by students attending the third year of three different areas of undergraduate studies at higher education institutions of three Portuguese-speaking countries: Brazil, Mozambique and Portugal. Four hundred and forty university students participated in the study by answering to a questionnaire. They were attending undergraduate programs in the areas of education/pedagogy, natural sciences, and social sciences. Differences emerged among participants of different nationalities and areas of study. Brazilians and education undergraduates showed perceptions that are more consistent with the knowledge base available so far. Health related policies and local culture seem to influence participants' perceptions regarding COVID-19 issues, which are not directly related to the extent of the science component of participants' study programs. The latter relationship should be further studied, in order to uncover what needs to be improved in

ABOUT THE AUTHOR

The elements of this international research team have a long cooperation history in the areas of science and geography education. The team is composed of six researchers, including three experts in science education (José Arão, Laurinda Leite, and Luís Dourado) and three experts in geography education (Jerusa de Moraes, Sônia Castellar, and Verónica Mapatse) who act as primary and secondary school teacher educators in their areas of expertise, in three Portuguese-speaking countries: Brazil, Mozambique and Portugal. During the pandemic, they decided to develop a joint research project on "Perceptions of higher education students on the COVID-19 pandemic and its effects on teaching and learning: an international study". The research reported in this paper focuses on the first part of the project that is, on university students' perceptions of COVID-19. Other papers will deal with perceptions of vaccines against COVID-19 and teaching and learning during pandemic times.

PUBLIC INTEREST STATEMENT

The study compares university students' perceptions of COVID-119 in three Portuguese-speaking countries with different pandemic histories whose most outstanding characteristic are: political denial of the disease in Brazil; shortage of health care resources in Mozambique; and oscillation between exemplary control and almost lack of control in Portugal. Those perceptions differ from one country to the other, and are influenced by health related policies and local culture. In addition, they are not directly related to the extent of the science background of their holders, as science students performed lower than education students (with a weaker science background) did. The research results provide a ground for discussing and improving undergraduates' education to ensure that they develop a good awareness of socio-scientific issues that are relevant for their personal and societal lives and may help politicians and educators to identify appropriate actions in the course of a pandemic or another emergency health situation.

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Subjects: Education - Social Sciences; Health & Development; Higher Education

Keywords: COVID-19; Portuguese-speaking countries; university students; knowledge of COVID-19; perceptions of COVID-19

1. Introduction

At the end of December 2019, a new disease appeared in Wuhan, China. It was identified as a novel beta coronavirus caused disease (Mackenzie & Smith, 2020) and named COVID-19. In March 2020, the World Health Organization (WHO) classified COVID-19 as a pandemic because the disease lead to a substantial number of cases in all parts of the world simultaneously (Byers, 2022).

All countries needed to adopt measures to face COVID-19, but different countries dealt differently with the pandemic (Roth & Roth, 2021). This is true for Portuguese-speaking countries, in different continents. Portugal was one of the first European countries to go into lockdown, and had diverse performances (ranging from a very good control to an almost uncontrolled number of new cases a day) in different phases of the pandemic, despite the high rate of vaccination reached early on time. The way Brazilian authorities dealt with COVID-19 changed over time and differed from one government level to the other. Federal government denied COVID-19, suggested treatments without scientific foundations and acted against WHO recommendations while most state governors tried to put WHO recommendations into practice (Soares & Menezes, 2021). This mismatch resulted in confusing guidelines for Brazilian citizens, and led to large numbers of infections and deaths, as well as to a delay in reaching a good level of vaccination (Fujita et al., 2022). The Mozambican government acknowledged lockdown, and hygiene and social distancing preventive measures as suggested by WHO, and the country had a quite constant performance in terms of new cases per day. This performance occurred in spite of several potentially disturbing factors. These include: the reinterpretation of governmental determinations based on personal experiences, which led some people to reject the disease or to disrespect the government health protective measures (Posse & Chaimite, 2020); the slow rate of vaccination; and the neighbourhood of South Africa that seems to be the country where the Omicron variant has developed first (Ferre et al., 2022). Whatever the country, higher education students suffered with universities lockdown (Oloyede et al., 2022), for two years or more, as both students and citizens.

Different political ways of facing the pandemic may have led citizens to develop different knowledge and perceptions of COVID-19. Considering undergraduates' levels of knowledge and analytical competences, they would be expected to act according to science-based information rather than to politicians or media popular messages. However, the fulfilment of this expectation cannot be taken for granted, as previous studies show that even health professionals may be influenced by non-science arguments (Ali et al., 2021; Wake, 2020).

This paper aims at investigating the perceptions of COVID-19 related issues held by undergraduates that were attending three university study areas since the beginning of the pandemic, in three Portuguese-speaking countries: Brazil, Mozambique, and Portugal. The study adds to the knowledge available, as it compares three Portuguese-speaking countries with different COVID-19 pandemic histories whose most outstanding characteristic are: political denial of the disease in Brazil; shortage of health care resources in Mozambique; and oscillation between exemplary control and almost lack of control in Portugal. It also adds to the knowledge available because it compares three areas of study, with different natural sciences knowledge bases and future professional responsibilities. In addition, the research results will provide a ground for discussing students' ideas in relation to the health policies of their countries, as well as for improving

undergraduates' education to ensure that they develop a good awareness of socio-scientific issues that are relevant for their personal and societal lives. Another contribution is the policy or practical implications derived from this study, which may help politicians and educators to identify appropriate and required actions in the course of a pandemic or another emergency health situation.

2. Framework of the study

Even though this is a paper on education, a brief overview of the state of the art on COVID-19 will be included because it will enable a discussion on the participants' perceptions on the issues that are at stake. Besides, a revision of relevant literature on conceptions, behaviours, attitudes, and perspectives on COVID-19 and related issues will be done as it is relevant to put the research reported in context.

2.1. An overview of COVID-19 features

Coronaviruses (CoVs) are a family of bat-born mRNA viruses (Menasria & Aguilera, 2022) that may jump from animals to humans (Edwards et al., 2022). The novel coronavirus found in Wuhan belongs to the SARS-CoV family, and was addressed as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It is responsible for a coronavirus disease, which was named after its cause and the year it appeared, that is COVID-19 (Tran et al., 2022).

Even though the COVID-19 outbreak clearly began epidemiologically at the Wuhan market, current evidence does not fully support the argument that it has emerged in the market (Mackenzie & Smith, 2020). In addition, the way in which the virus moved from animals to humans is yet to be determined (Mackenzie & Smith, 2020). On the contrary, human-to-human transmission of SARS-CoV-2 is widely documented. The dominant modes of transmission are directly, through the respiratory tract via droplets, or indirectly, via fomites (Mackenzie & Smith, 2020). Transmission might occur not only from severe infected people but also during part of the incubation period, as well as from asymptomatic or very mild infections (Mackenzie & Smith, 2020; Siordia, 2020). However, there is not enough empirical data to rule out the possibility of indirect transmission of SARS-CoV-2 (Ijaz et al., 2022).

SARS-CoV-2 infects cells via its spike protein, which binds to the surface receptor on target cells (Theoharides, 2022). Infection results in COVID-19-related illness that spans from asymptomatic to mild respiratory symptoms and to acute symptoms (Tran et al., 2022). In the latter case, patients usually need hospitalization and even admission to intensive care units. COVID-19 starts in the upper respiratory tract and lungs but in severe cases it can reach heart, blood vessels, brain, liver, kidneys, and intestine (Tran et al., 2022).

Although severe illness and death are more likely to occur in older individuals, with pre-existing clinical illness and malignancies (Mackenzie & Smith, 2020), COVID-19 has been affecting people in all age ranges, including very young children (Crawford, 2022). Protective measures and vaccination are key elements to counter the spread of new variants of the virus, and to prevent new waves of severe COVID-19 cases and deaths (Ferre et al., 2022).

Based on a diversity of types of previous knowledge, the scientific community was able to characterize the immune response to the virus and to develop vaccines against COVID-19 in record time (Dopico et al., 2022). Vaccines have helped change the course of the pandemic by reducing serious illness, hospital admission and death, but they do not necessarily prevent transmission and reinfection (Dopico et al., 2022). In addition, immunity (whether infection-induced, vaccine-elicited or hybrid immunity) tends to wan (Misra et al., 2022) with people taking the risk of being infected sometime after vaccination or re-infected after a former infection, even if they are vaccinated. Besides, new changes and variants of SARS-CoV-2 constantly emerge and circulate around the world (Menasria & Aguilera, 2022) which reinforce the need to develop broad-spectrum coronavirus vaccines active against any new, antigenically distinct SARS-CoV-2 variants (Edwards et al., 2022).

There is empirical evidence that former COVID-19 patients, adults (Arslan et al., 2022) or children (Crawford, 2022), may be re-infected at different time intervals after vaccination, with the same or with a different variant of the virus (Ren et al., 2022). Moreover, former infected people can develop the so-called long COVID that is a chronic condition characterized by a variety of symptoms, which include fatigue and neuropsychiatric, and have neurotoxic effects as well as detrimental effects to the brain (Theoharides, 2022). These effects are not yet fully identified but they should not be neglected for the sake of the patients' quality of life. Trusting science and scientists, one can expect the development of vaccines that may have more of an effect on transmission (Stokel-Walker, 2022), thus reducing the risk of infection, and physical and emotional health-problems for individuals, as well as social and economic losses for societies.

2.2. An overview of people's perceptions on the origin, features and feeling towards COVID-19

At an early stage of the pandemic, the nonexistence of a cure called for preventive measures to be put into place, with the ultimate objective of avoiding deaths. Nowadays, the pandemic is not over, the virus has been changing, a cure does not exist, vaccines have a short lifetime, and people continue in need of good and accurate information on what to do and not to do for their wellbeing and for preventing a new COVID-19 wave.

Research suggests that throughout the pandemic period a few people evidenced a good knowledge of COVID-19 (Rothmund et al., 2022) while the majority showed a variety of conceptual understandings that are alternative to the scientifically accepted ones (Strydhorst & Landrum, 2022). As with other science issues (Allen, 2019), those alternative conceptions may have emerged from the attempts to make sense of the origin of COVID-19 made by people that were unaware of the cause of the disease, the way it affects humans, and how humans can prevent themselves from infection. However, national policies and media also play a role in alternative conceptions development due to incorrect understandings and procedures they acknowledge and disseminate.

As far as the origin of the disease is concerned, some people believe that COVID-19 has a divine origin, and is a punishment from God (Bakebillah et al., 2021) for the sins of humanity, while others think that a virus causes COVID-19. However, while some of the latter think that the virus is not dangerous (Bakebillah et al., 2021), others believe that it is deadly (Okunlola et al., 2020), and others even argue that it is the result of technological advances like 5 G (Mutanga & Abayomi, 2022) or a part of a virus war (Bakebillah et al., 2021; Tariq et al., 2020). Concerning the latter idea, some people believe that the virus is a bioweapon engineered by international agencies (S. Islam et al., 2020) against China whereas others (Lin, 2021) believe that China created it to fight other countries. In addition, some people seem to believe that the virus was imported from China to their own countries. This idea has a risk of stigmatization of those that travel to and from that Asian country (Schmidt et al., 2020), as they are considered guilty of infecting other people.

Both the general public and university students held good knowledge of the main symptoms of COVID-19 (high temperature, new and persistent cough, and anosmia) but had low confidence on their ability to differentiate them from symptoms of other illnesses (Mowbray et al., 2021). In addition, the attribution of symptoms to COVID-19 is more likely to occur when the symptoms are severe, many symptoms are present, symptoms last for some time, and the perceived risk of exposure to infection (due to previous contact with others) is high. Besides, some people seem to acknowledge the benefits of regular testing for family, friends and society, as they believe that a positive or negative result guides them on how to act (Wanat et al., 2021). However, others believe that there is no need to test for COVID-19 unless one has been exposed to an infected person (Smith et al., 2022).

A diversity of threatening feelings towards COVID-19 have emerged since the beginning of the pandemic. Some adults (Bakebillah et al., 2021) as well as children (Folino et al., 2021) felt scared, and some people felt fear and stress (Alimoradi et al., 2022; Berhe et al., 2022; Utz et al., 2022) or anxiety (Alimoradi et al., 2022; Cohen, 2020) towards the pandemic. Nevertheless, other people

simply refused to acknowledge COVID-19 as a disease (Bakebillah et al., 2021; Rothmund et al., 2022; Schmidt et al., 2020).

Bad feelings, restrictions, and uncertainty caused by COVID-19 may have severe implications for people mental health (Alimoradi et al., 2022; Alsubaie et al., 2021), particularly for those in low-paid or precarious employment (Williams et al., 2020) and in healthcare related professions (Alimoradi et al., 2022). These feelings seem to be partly related to education (Bakebillah et al., 2021), as the more educated people are, the less they show them. However, denial of and fear from COVID-19 cannot be linked to a single factor or pattern of psychological dispositions, but rather they may be related to conspiracy beliefs, political alignments and motivation, low beliefs in epistemic complexity, and media use (Rothmund et al., 2022). Citizens should be supported in the expression of their feelings, opinions and beliefs on the pandemic for the sake of their wellbeing (Wicke & Bolognesi, 2020), and programs should be settled in order to help people to stay mentally healthy (Alimoradi et al., 2022) during and after the pandemic.

2.3. An overview of people's perceptions of infection, transmission and treatment of COVID-19

There is a variety of conceptions about who is prone to be infected by SARS-CoV-2 and get COVID-19. Some people believe that COVID-19 is a disease typical of poor countries (Posse & Chaimite, 2020) and others believe that it only affects white people and or rich people that can travel (Aminu, 2020; Kasozi et al., 2020; Schmidt et al., 2020). A consequence of perceiving COVID-19 as a disease of white and reach people is that people categorized as "black" may perceive themselves not to be at risk of catching Covid-19 (Ibrahim & Ekundayo, 2020). On the other hand, some people are aware that elderly people and those with immunocompromised conditions are more vulnerable to catching Covid-19 (Schmidt et al., 2020), whereas others believe that it affects only elderly people (Okunlola et al., 2020), and some young people believe that they are immune to catching this disease (Schmidt et al., 2020). A consequence of this is that young people may not adhere to preventive measures, and, in doing so, they put their own lives and others' lives at risk (Schmidt et al., 2020).

Access to information reduces the belief that infection cases are more prevalent among certain marginalized social and economic groups (e.g., Muslims, low caste, rural-poor population) than among the rest of the population (A. Islam et al., 2021). In addition, information is a key tool that governments can use for increasing public compliance with safety measures in force in the country (Thanh & Tung, 2022) and preventing the dissemination of the infection. Nevertheless, one should expect sceptics of science arguing that information on the COVID-19 pandemic is manipulated and using this idea to support their own unfounded beliefs, a consequence of this being the strengthening of citizens' alternative conceptions on the disease.

As far as ways of avoiding the infection are concerned, research shows that some people believe that testing prevents from the infection and therefore argue that everyone should be tested for COVID-19 (Ali et al., 2021). Other people showed motivation to self-test regularly, but they do it because they would like to know whether, or not, they are infected with SARS-CoV-2 (Wanat et al., 2021). For them, testing is a transmission preventive measure, as they would use the test result to make decisions relative to participation in events (e.g., about visiting other people) that could lead to dissemination of the disease in case of being infected.

People that experienced strong COVID-19 symptoms (e.g., high temperature, a new and continuous cough, a loss or change of the sense of smell or taste) tend to take more tests and see mass asymptomatic testing as giving access to a more normal life (Mowbray et al., 2021). Even though regular testing is important to help identifying asymptomatic cases (Wanat et al., 2021) and may prevent dissemination if a behaviour consistent with the result of the test is adopted, it can be argued that mass asymptomatic testing would mean a waste of resources, as testing alone cannot prevent the transmission of the disease (Mowbray et al., 2021).

Key self-prevention behaviours are hand hygiene, physical distancing, and avoiding contact with infected people (Ali et al., 2021; Thomas et al., 2021). The use of facemasks is important to prevent transmission of the virus to others rather than to protect the facemask user from being infected (Ali et al., 2021), as self-infection may occur for example, by touching infected objects. These facts about the effectiveness of facemasks are different from alternative conceptions saying that wearing facemasks is not necessary (Aminu, 2020), is highly protective of the infection (Ali et al., 2021) or offers no kind of protection against the virus (Okunlola et al., 2020).

As far as recommendations for using facemasks as protective devices are concerned, Tso and Cowling (2020) identified two main groups of countries. One group includes countries that promoted the use of facemasks and argued that they are good protective devices but also explained the importance of their proper use along with other hygiene measures. The other group includes countries whose authorities issued recommendations against the use of masks due to either shortage of supplies or belief in people's inadequate skills to wear them or fear from possible reduction of compliance with other important self-protective behaviours. Hence, citizens' conceptions regarding the use of facemasks may be partly due to governments' policies towards this protective device (Tso & Cowling, 2020) and a symptom of people's tendency to follow authorities' recommendations in times of crises, rather than their ideas alone (Mede & Schäfer, 2022).

As far as maintaining physical distancing is concerned, some people think that it is an unnecessary measure (Aminu, 2020). However, this is not the case. Physical distancing is a way of preventing the reception of droplets of saliva released, not only by infected people that may be aware that they transport the virus (Mackenzie & Smith, 2020), but also by asymptomatic people and people in the incubation period (Mackenzie & Smith, 2020) who are unaware of their ongoing infection. This is especially important because temperature measurement is not an accurate method of knowing if someone is infected, or not (WHO n.d.). The ways individuals and communities behave with regard to physical distancing are influenced by their alternative conceptions regarding who can transmit COVID-19 (Majid et al., 2022). Hence, as vaccines only protect from severe forms of the disease, vaccinated people (Dopico et al., 2022) as well as children (Crawford, 2022), either vaccinated or not, can be infected and re-infected (namely by infected asymptomatic people) and transmit the virus. Therefore, physical distancing continues making sense as a preventive measure.

WHO (n.d.) and countries health authorities recommended washing hands with alcohol gel regularly as alcohol gel might kill the virus. However, some people believe that drying the hands with hand dryers helps to prevent the virus (Okunlola et al., 2020) probably because they also think that the virus does not resist to dryness and high temperatures (Ali et al., 2021). In addition, and opposite to what people think, in summer the virus does not die (Tariq et al., 2020) and the transmission rate is not null, even though it may be lower than it is in winter (Carlson et al., 2020). The persistence of SARS-CoV-2 on surfaces or in the air is sensitive to temperature, humidity, and ultraviolet light (Carlson et al., 2020) but not at a scale to outweigh other protective measures, even in summer. Besides, contrary to what some people think (WHO n.d.), exposure to sun light or to ultraviolet light should not be used as SARS-CoV-2 protection for people, as they are not effective and, moreover, both of them may cause severe damage to the human skin (Pourang et al., 2022).

Opposite to what one might think by analogy with other diseases (e.g., malaria), there is no evidence that SARS-CoV-2 can be transmitted through mosquitoes (WHO n.d.). In addition, transmission through hard surfaces and aerosols seems to be reduced (Mackenzie & Smith, 2020). However, disinfection of hard surfaces and application of other measures (namely effective ventilation) to indoor spaces are recommended in order to reduce, as much as possible, transmission rate (Peng et al., 2022).

Even though food can be a potential carrier of the virus due to environmental (including contact with contaminated surfaces) or human contamination (Abbasi et al. 202; Paparella et al., 2022), there are no proven cases of infection from food so far (Paparella et al., 2022). Appropriate food management, cooking and food processing technologies are good means to control viral food safety (Abbasi et al., 2022). This means that the adoption of correct hygiene practices, by both food workers and common people, makes the risk of contamination by food very low (Paparella et al., 2022).

People reacted differently towards protective measures and even some of those that acknowledge the need to adopt some protective measures decided to use their own, often based on myths, instead of using the official ones. Some of them are based on ingestion of substances and others are centred on sanitary measures and testing. One of the former, probably influenced by media and social media advertisements, has to do with the pseudoscientific belief that Vitamin C (Ascorbic acid) supplements are enough to prevent COVID-19 (Ali et al., 2021; S. Islam et al., 2020). Others have to do with eating garlic or spicy food (S. Islam et al., 2020; WHO n.d.), drinking bleach (S. Islam et al., 2020) or alcohol (WHO n.d.), rinsing the nose regularly with saline water or spraying alcohol or chlorine over the body (WHO n.d.) to kill the virus inside.

As far as treatments for COVID-119 are concerned, beliefs are a twofold sword. On one hand, beliefs in a potential cure may impede individuals from adopting appropriate and effective protective behaviours (Thomas et al., 2021). This is so because those beliefs may decrease risk perception by lowering the relevance of the infection in the community or by strengthening biased ideas on the origins and transmission of the disease (Majid et al., 2022). On the other hand, individuals who believe that effective treatments do not exist may be more inclined to pursue treatments from faith healers (Majid et al., 2022) which have not proved efficient. Besides, some people believe that antibiotics and other medicines are effective in treating COVID-19 (Thomas et al., 2021) while others think that taking local herbs (Aminu, 2020) or homemade remedies (Okunlola et al., 2020) will destroy de virus and stop the disease.

Majid et al. (2022) noted that alternative conceptions of COVID issues do not differ across a few different pandemics and countries. However, people's behaviours towards the pandemic may have evolved for better or for worse, depending on the infection of a particular person that citizens respect (Tanase et al., 2022) or admire (Cohen, 2020), the sources of information they use and the way information is interpreted (Huang & Yang, 2020; Sun, 2022). Social media have demonstrated to be misleading (S. Islam et al., 2020; Mutanga & Abayomi, 2022; Schmidt et al., 2020; Zhou et al., 2020) while scientists, especially virologists, have given a positive contribute for citizens' behaviour change (Leidecker-Sandmann et al., 2022; Utz et al., 2022), which seems to be a valuable information for fighting the pandemic.

3. Methodology

3.1. Research site and time

This research was carried out in three Portuguese-speaking countries, which are located in three different continents: Brazil (in South America), Mozambique (in Africa) and Portugal (in Europe). Normally, these countries have non-coincident academic years. In Brazil and Mozambique, it is the same as the civil year, whereas in Portugal it starts in mid-September.

In order to control as far as possible participants' higher education experience and training, and taking into consideration the differences among the academic year of the three countries, the period settled for data collection was end of 2021 and beginning of 2022. This would ensure that participants were in their third year of undergraduate studies, after living for two years under the COVID-19 pandemic. Two of the participants' academic years were affected by the pandemic, which may have been the subject of discussion in classes.

3.2. Research sample

The participants in the study were third year university students from three Portuguese-speaking countries, attending five different universities. Convenience sample was adopted but, as suggested by McMillan and Schumacher (2014), some actions were taken to minimize the shortcomings of this kind of sampling process and to have a heterogeneous and informative sample consistent with the requirements of the objectives of the study. Three different non-health related areas of study were considered of interest. They differ from each other in terms of the science background they convey and the professional responsibilities of their prospective graduates. The areas of study are education/pedagogy, natural sciences (addressed thereafter as science), and social sciences. This set of areas gears a heterogeneous group with regard to students' background, which is important as the study area is expected to affect students' perceptions of COVID-19 related issues. In the three countries, authors invited undergraduate students of their own university programs within the scope of these areas to participate in the study. Within each area of study, similar programs (e.g., Pedagogy, in Brazil, Basic Teaching, in Mozambique, and Education and Basic Education, in Portugal) were selected in the three countries. Consistently with the requirements of good research practices, invited students were free to decide whether they would participate in the study or not. Non-acceptance cases were rare, and they were due to other students' commitments that would collide with data collection schedules.

Four hundred and forty students, almost equally representing the three countries (Brazil: 130, i.e., 29,5%; Mozambique: 171, i.e., 38,9%; Portugal: 139, i.e., 31,6%), participated in the study. Most of them (61,6%) are female. The majority (71,1%) is below 25 years old, 15,5% are between 25 and 30 years old, 10.9 % are between 30 and 40 years old and the remaining 2,5% are 40 years old or above. The areas of the participants' undergraduate programs are: education, including education, basic education and pedagogy: 43,2%; science, including chemistry, physics, biology, geology, and mathematics: 34,1%; and social sciences, mainly geography but also a few history, sociology, and philosophy undergraduates: 22,7%.

3.3. Data collection materials and methods

Data were collected by means of an online opinion questionnaire including five Likert type questions, with different numbers of items. The questions and their items focus on the origin of the disease, agents of transmission, forms of transmission, forms of prevention, and cure of COVID-19 patients. Participants in the study were asked to agree or disagree with the items, using a four-point scale: agree, partly agree, disagree, it is nonsense.

Using the same questionnaire in different countries facilitates data comparisons but poses some challenges (e.g., cultural or linguistic differences may lead to unwanted interpretations) and requires appropriate actions to minimize them. A first version of the questionnaire was developed by two of the authors. Afterwards, it was reviewed by the other authors, not only for its content (e.g., to ensure that the popular ideas in their country were considered) but also for the improvement of country language adequacy, as there are some language differences among the three countries that need to be considered to minimize respondents' difficulties and increase the reliability of the results. An example of this is bleach that in Portugal and Mozambique is named *lixívia* while in Brazil is named *água sanitária*. In cases like this, to make the items fully understandable in the three countries, the two names were used (i.e., *lixívia/água sanitária*). Then, as suggested by McMillan and Schumacher (2014), the questionnaire was validated for its adequacy to the respondents of the three countries, using higher education students not belonging to the invited sample. The analysis of their answers showed no need to rephrase or replace the questions or their items.

The questionnaire was designed to be answered online, through a computer or a mobile device with internet connection, under face-to-face supervision of one of the researchers, during a period previously agreed for each group of students. This procedure, which required collaboration of some teaching staff members, prevents contamination of the answers from colleagues, books, internet, etc.

As suggested by Cohen et al. (2018), for research based on online questionnaires, the first page of the questionnaire introduces the study to the participants and asks for their informed consent. After approval by the Ethics Board of the University of Minho, data were collected through technological devices with internet connection, like personal computers, tablets or smartphones. Each co-author supervised face-to-face data collection in his/her university.

3.4. Variables used for empirical analysis

To attain the objectives of the research, two independent variables were used: country and area of study. In the former case, the variable encompasses three categories that are the three countries referred to above (Brazil, Mozambique, and Portugal); in the latter case, the variable has also three categories that have to do with the overarching scientific areas of the programs students are enrolled in: education/pedagogy (thereafter, education), physical and natural sciences (thereafter, science) and social sciences.

As far as dependent variables are concerned, the issue underlying each item was taken as an independent variable that will be studied against each one of the two independent variables.

3.5. Data analysis

To attain the objectives of the study, comparisons among countries and among participants' areas of study need to be performed aiming at finding out whether the perceptions of the different groups of each independent variable are statistically different or not. There has been a lot of discussion on what kind of statistical tests (parametric or non-parametric) to perform when Likert type items and large samples (over 30) are at stake and no definite consensus was reached so far. Reviews of papers using different statistical approaches show that both types of tests lead to similar results (Harpe, 2015; Winter & Dodou, 2010). Besides, South et al. (2022) concluded that many papers are inconsistent in their interpretations of Likert data as discrete or continuous and sacrifice statistical power (which is greater for the parametric tests) by applying nonparametric tests unnecessarily. Therefore, following other authors (e.g., Huang & Yang, 2020; Rothmund et al., 2022), in this paper it was assumed that an interval scale was used. Then, the one-way analysis of variance (ANOVA), together with the F test (Fisher test), was the method selected to uncover statistically significant differences among the three groups of each one of the two independent variables. Statistical significance will be acknowledged for $p < \alpha$, for $\alpha = 0{,}05$. It should be highlighted that with 440 participants and three groups, the number of degrees of freedom (df) between groups is 2, the df within groups is 437, and the F test (Fisher test) critical value is 3,0164.

In a few cases, the appropriate answer would be the lowest extreme of the item (the most negative, showing less knowledge, awareness, perception, etc.). For calculation purposes, it was given 0 points, and the highest one (the most positive, showing the opposite) was given three points. Thus, whatever the item, the midpoint (which is 1,5) separates a prevailing correct perception (mean scores above 1,5) from a prevailing incorrect one (means scores bellow 1,5). Hence, the higher the mean scores, the better the perceptions they show.

4. Findings

4.1. Findings per country

4.1.1. Perceptions on possible origins of COVID-19

Table 1 shows the results for the five items included in the question on possible origins of COVID-19, per country. The differences among countries are statistically significant for all but one item (item 4).

Brazilian undergraduates showed the strongest (correct) perceptions with regard to possible origins dealt with by items 1 to 3; Mozambicans showed the weakest (correct) perception of the origin mentioned in item 5 that is divine punishment. This means that Brazilian undergraduates

Table 1. Participants' opinions on possible origins of COVID-19, per country

Item	Possible origins	Mean			*F*	(N = 440) Statistical significance *(p)*
		BR (n = 130)	MZ (n = 171)	PT (n = 139)		
1	It was purposefully originated by some malicious researchers	2,508	1,456	1,777	69,2512	Yes ($p < 0.05$)
2	It was caused by an unintentional error that occurred in a laboratory	2,077	1,111	1,482	48,2600	Yes ($p < 0.05$)
3	It was caused by technological advances (eg.5 G)	2,454	1,561	2,144	46,5465	Yes ($p < 0.05$)
4	It was caused by bats	1,423	1,573	1,396	1,6037	No $p = 0,2023$
5	It was a divine punishment	2,723	1,801	2,777	85,5486	Yes ($p < 0.05$)

are the surest that malicious researchers, unintended errors or technological advances did not cause COVID-19. The large amount of misinformation that Brazilians had to face during the pandemic (Fujita et al., 2022; Soares & Menezes, 2021) may explain this result, as they may have felt the need to understand what was going on and in doing so they might have developed appropriate knowledge on those issues. Mozambican undergraduates were the ones that (incorrectly) least rejected a divine cause for COVID-19. This result seems consistent with the role many people in the country give to spirits and divinity in explaining diseases (Granjo, 2009; Takeyama et al., 2022). Bats, which were associated with COVID-19 in the early times of the pandemic, deserved a similar (from a statistical point of view) and medium trust (scores near the midpoint) by the three country-based groups of undergraduates even though the Portuguese group is the only one that scored above the midpoint. This means that there is a slight tendency of Portuguese undergraduates to reject the idea that bats are the cause of COVID-19.

4.1.2. Perceptions on the transmission of COVID-19

Participants were asked whether they agree or not with nine possible agents of transmission of COVID-19, as shown by items in Table 2. Agents considered are symptomatic (item1) or asymptomatic (item 4) adults, symptomatic (item2) or asymptomatic (item 5) children, symptomatic (item 3) or asymptomatic (item 6) elderly people, as well as animals. In this case, transmission from mosquitoes (item 7), wild animals (item 8) or domestic animals (item 9) to humans was considered.

There are statistically significant differences among countries for all but one item that is item number 8, which concentrates on transmission from wild animals to humans. In this case, considering the science knowledge available (Mackenzie & Smith, 2020), whatever the country, undergraduates showed a similar and good perception (above 2,0 that is, above the midpoint) that wild animals do not transmit COVID-19 to humans. For items 1 to 6, Brazilian undergraduates showed the best perceptions which are near from the Portuguese's ones and far from those of the

Table 2. ***Participants' opinions on possible agents of transmission of COVID-19, per country*** **(N = 440)**

Item	It is transmitted by …	Mean			*F*	Statistical significance *(p)*
		BR (n = 130)	MZ (n = 171)	PT (n = 139)		
1	infected and symptomatic adults to other humans	2,615	1,789	2,590	62,1820	Yes ($p < 0.05$)
2	infected and symptomatic children to other humans.	2,562	1,661	2,554	67,3762	Yes ($p < 0.05$)
3	infected and symptomatic elderly to other humans	2,600	1,731	2,583	66,3806	Yes ($p < 0.05$)
4	infected and asymptomatic adults to other humans	2,608	1,509	2,439	90,1562	Yes ($p < 0.05$)
5	infected and asymptomatic children to other humans	2,562	1,468	2,403	85,4279	Yes ($p < 0.05$)
6	infected and asymptomatic elderly to other humans	2,592	1,503	2,424	89,8798	Yes ($p < 0.05$)
7	mosquitoes to humans	2,562	2,117	2,281	21,1319	Yes ($p < 0.05$)
8	wild animals to humans	2,123	2,023	2,115	0,8585	No p = 0,42,451
9	domestic animals to humans	2,262	2,058	2,108	3,3467	Yes ($p < 0.05$)

Mozambicans'. Even though the perceptions of the latter group are the least consistent perceptions with the knowledge available so far, they are above the midpoint (that is, above 1,500) for all items except for item 5 which focuses on transmission from infected and asymptomatic children to other humans. This may be because, for a quite long time, people were, wrongly (Crawford, 2022), told that children would not become infected with COVID-19 and asymptomatic children's infection may have gone unnoticed, especially in countries that did not have very intense COVID-19 waves, as it is the case of Mozambique. In the cases of items 7 and 9, Mozambican undergraduates' perceptions reached the highest scores even though these remain lower than, but much close to, the perceptions of their Portuguese counterparts than they are for the previously mentioned items. In any of the items, both Portuguese and Mozambican undergraduates' scores are below the Brazilians' ones. These results mean that Brazilian undergraduates are the ones that showed best perceptions on mosquitoes and domestics animals as possible agents of transmission of COVID-19, as they rejected this possibility more strongly than Portuguese and by Mozambicans undergraduates (in this order) did. This may mean that Brazilian participants and others that rejected mosquitos as agents of COVID-19 transmission distinguished this disease from other mosquito-transmitted diseases (such as malaria or dengue).

Participants were invited to express their (dis)agreement with four possible forms of transmission of COVID-19. The items used for this purpose (Table 3) consider transmission through droplets of saliva (item 1), exhaled air (item 2), hard surfaces (item 3), and food (item 4).

Whatever the group, the scores drop down from item 1 (near the maximum of 3 points for Brazilians and about 2,59 for the others) to item 4 (below the midpoint for the three countries). Differences between countries are statistically significant for item 1 only, meaning that even though the three groups hold the correct perception that COVID-19 is transmitted by contact with droplets of saliva of an infected person (Mackenzie & Smith, 2020), this perception is stronger for the Brazilian group than it is for the other two groups of undergraduate students. The low mean scores obtained for item 4 mean that undergraduates from the three countries believe that food can be infected with SarS-CoV-2 and transmit CoVID-19. This idea was part of a slogan against trade with China (Lin, 2021). However, so far, there is no evidence that the virus can live in food (Paparella et al., 2022). Infected humans who manipulate food may contaminate it. Nevertheless, the industrial approach of food processing, cooking and some food-based bioactive components present in reduce the risk of contamination through food (Abbasi et al., 2022).

4.2. Perceptions on the prevention of COVID-19

Participants in the study were asked to express their opinions on five possible ways of COVID-19 prevention (Table 4). These have to do with ingesting everyday health nonspecific products, like alcohol (item 1), acidic drinks (item 4), bleach (item 5), garlic (item 2) and spices/spicy food (item 3). There are statistically significant differences among countries for the five items. Brazilian undergraduates showed the most appropriate conceptions, which means that they rejected the idea that the products considered prevent COVID-8. This strong rejection may be because Brazil suffered from misinformation on preventive measures (Soares & Menezes, 2021) and this may lead undergraduates to become more aware of effective COVID-19 prevention measures. Mozambican students are the ones that seem to attribute more COVID-19 preventive power to those products, even though their scores are above the midpoint for four of the items. This may be due to the importance that natural medicine and plants have in the Mozambican culture (Takeyama et al., 2022).

Participants were also asked about the possibility of COVID-19 prevention by adopting a range of sanitary measures, most of them recommended by international health authorities, like WHO. These measures (Table 5) include washing hands with salty water (Item 1), soap and water (Item 2), water and ash (item 3), and alcohol gel (Item 4), wearing facemask for self-protection (Item 5) and for others' protection (Item 6), keeping physical distancing (Item 7), avoiding crowded

Table 3. ***Participants' opinions on possible forms of transmission of COVID-19, per country*** **(N = 440)**

Item	It is transmitted through ...	Mean			*F*	Statistical significance *(p)*
		BR (n = 130)	MZ (n = 171)	PT (n = 139)		
1	contact with droplets of saliva from an infected person.	2,908	2,591	2,590	12,3014	Yes ($p < 0.05$)
2	contact with the exhaled air of an infected person.	2,546	2,485	2,540	0,3114	No p = 0,73,257
3	contact with infected hard surfaces	2,492	2,380	2,338	1,3721	No (p = 0,25,467)
4	eating infected food	1,277	1,415	1,295	0,9062	No (p = 0,40,480)

Table 4. ***Participants' opinions on possible forms of prevention of COVID-19, per country*** **(N = 440)**

Item	Possible forms of prevention …	Mean			*F*	Statistical significance *(p)*
		BR (n = 130)	MZ (n = 171)	PT (n = 139)		
1	Drinking alcohol prevents COVID-19	2,715	2,070	2,468	35,3675	Yes ($p < 0.05$)
2	Eating garlic prevents COVID-19	2,685	1,608	2,590	127,3234	Yes ($p < 0.05$)
3	Eating spices/ spicy foods (e. g, with pepper or chili) prevents COVID-19	2,731	1,772	2,604	117,7092	Yes ($p < 0.05$)
4	Drinking acidic substances prevents COVID-19	2,746	1,433	2,583	183,2598	Yes ($p < 0.05$)
5	Drinking bleach prevents COVID-19	2,831	2,012	2,741	89,9531	Yes ($p < 0.05$)

places (Item 8), isolating infected people (Item 9) and isolating those who encountered infected people (Item 10).

There are statistically significant differences for all items, with Brazilian undergraduates scoring higher than their counterparts did for all items but item 5 (wearing facemask for self-protection). In the case of item 5, Portuguese undergraduates scored higher than their counterparts but scores are very low (below 0,5) for the three groups. This means that all of them believe that facemasks protect the person who wears them, which is not completely true (Ali et al., 2021) as discussed above. Brazilians are the group that holds the strongest incorrect belief with regard to such protective measure. For the other items, scores are above the midpoint except for item 3 in the case of Mozambican undergraduates. These seem to believe that washing hands with water and ash prevents the transmission of COVID-19. This result may be related to the fact that ash is known, namely in Mozambique, as an alternative to soap to wash hands. However, there is no reliable evidence showing that it prevents dissemination of SARS-CoV-2 infection (Paludan-Müller et al., 2020). For the majority of the items in this set, especially for those that have to do with WHO recommendations, Portuguese undergraduates scored lower than their Mozambican counterparts did. This may suggest that Portuguese undergraduates took prevention less seriously than Mozambicans, probably because Portugal achieved high rates of vaccination sooner than Mozambique. Those high rates may have led to a false sense of security and a consequent adoption of risky behaviours towards the pandemic. As it was argued above, vaccination against SARS-CoV-2 has proven very protective of severe illness (Edwards et al., 2022), but vaccines do not necessarily prevent transmission and reinfection (Dopico et al., 2022). Besides, immunity tends to wan (Misra et al., 2022) a couple of months after vaccination.

4.3. Findings per Area of Study

4.3.1. Perceptions on possible origins of COVID-19

As far as possible origins of COVID-19 are concerned, Table 6 shows that there are statistically significant differences among the groups, for all but one item (item 4) with Education students performing better than their science and social sciences (Soc.Sc.) counterparts did.

Table 5. ***Participants' opinions on possible sanitary measures for preventing the transmission of COVID-19, per country*****(N = 440)**

Item	Possible sanitary prevention measures	Mean			*F*	Statistical significance *(p)*
		BR (n = 130)	MZ (n = 171)	PT (n = 139)		
1	Rinsing your nose with salt water prevents COVID-19	2,700	1,982	2,367	40,7870	Yes ($p < 0.05$)
2	Washing hands with soap and water prevents COVID-19	2,762	2,708	2,446	9,2499	Yes ($p < 0.05$)
3	Washing hands with water and ash prevents COVID-19	2,515	0,298	2,439	621,2644	Yes ($p < 0.05$)
4	Washing your hands frequently with alcohol gel prevents COVID-19	2,854	2,719	2,576	8,9878	Yes ($p < 0.05$)
5	Wearing a facemask protects the user against COVID-19	0,108	0,427	0,439	14,0183	Yes ($p < 0.05$)
6	Wearing a facemask protects others against COVID-19	2,931	2,620	2,676	13,4748	Yes ($p < 0.05$)
7	Keeping physical distance prevents COVID-19	2,954	2,713	2,676	12,8026	Yes ($p < 0.05$)
8	Avoiding places with lots of people prevents COVID-19	2,938	2,678	2,576	15,9466	Yes ($p < 0.05$)
9	Keeping infected people isolated prevents COVID-19	2,946	2,731	2,705	9,3625	Yes ($p < 0.05$)
10	Isolating people who contacted with infected people prevents the spread of COVID-19	2,862	2,637	2,554	9,9458	Yes ($p < 0.05$)

Table 6. ***Participants' opinions on possible origins of COVID-19, per area of study*****(N = 440)**

Item	Possible origins …	Mean			*F*	Statistical significance *(p)*
		Science (n = 150)	Education (n = 190)	Soc. Sc. (n = 100)		
1	It was purposefully originated by some malicious researchers	1,833	1,989	1,690	3,9514	Yes ($p < 0.05$)
2	It was caused by an unintentional error that occurred in a laboratory	1,327	1,726	1,390	9,1599	Yes ($p < 0.05$)
3	It was caused by technological advances (eg.5 G)	1,993	2,200	1,670	11,9512	Yes ($p < 0.05$)
4	It was caused by bats	1,580	1,447	1,360	1,7450	No $p = 0,17,586$
5	It was a divine punishment	2,307	2,579	2,120	10,2758	Yes ($p < 0.05$)

This means that education students, most of them training to become kindergarten or pre-school or primary school teachers (up to six grade), hold more accurate ideas on the origin of COVID-19 than their science and their social sciences counterparts (in this order) do. In the case of item 4, science students scored a bit above the midpoint and better than their counterparts did but the differences are not statistically significant. The intermediate position of science undergraduates is a bit surprising, as they would be expected to be well informed about a current and relevant socio-scientific issue like this one. However, it should be stressed that health professionals also showed lack of knowledge on COVID-19 (Tariq et al., 2020) which indicates that there may be other factors beyond science knowledge that interfere with one's understanding of this issue.

4.3.2. Perceptions on the transmission of COVID-19

Table 7 shows that there are statistically significant differences between areas of study for all the items considered with regard to possible agents of transmission of COVID-19. Education undergraduates are the group that achieved the best score, meaning that these students are the most knowledgeable on possible agents of COVID-19 transmission. Science students scored in between education and social sciences students even though their scores are closer to those of the education undergraduates than to the scores of the social sciences group. Even though all the groups got scores considerably above the midpoint, these results reinforce the idea that other factors beyond science knowledge may interfere with the understanding of COVID-19 related issues.

As far as forms of transmission of COVID-19 are concerned, the differences between groups are not statistically significant for any of the forms considered (Table 8). However, all the groups scored better for items 1 to 3 than for item 5 that focuses on transmission through food, in which case the means are below the midpoint. As it was mentioned above, contamination through food is not probable, as it seems that the virus cannot live in food (Paparella et al., 2022) and food processing and cooking reduce the possible viral load acquired by the food from infected humans (Abbasi et al., 2022).

Table 7. ***Participants' opinions on possible agents of transmission of COVID-19, per area of study*****(N = 440)**

Item	It is transmitted by …	Mean			*F*	Statistical significance *(p)*
		Science (n = 150)	Education (n = 190)	Soc. Sc. (n = 100)		
1	infected and symptomatic adults to other humans	2,247	2,468	2,000	10,8332	Yes (p < 0.05)
2	infected and symptomatic children to other humans.	2,193	2,379	1,910	9,2331	Yes (p < 0.05)
3	infected and symptomatic elderly to other humans	2,227	2,437	1,960	10,4150	Yes (p < 0.05)
4	infected and asymptomatic adults to other humans	2,040	2,326	1,880	9,0212	Yes (p < 0.05)
5	infected and asymptomatic children to other humans	2,013	2,258	1,870	6,4400	Yes (p < 0.05)
6	infected and asymptomatic elderly to other humans	2,053	2,305	1,850	8,9667	Yes (p < 0.05)
7	mosquitoes to humans	2,247	2,426	2,140	8,1991	Yes (p < 0.05)
8	wild animals to humans	2,113	2,142	1,920	3,1275	Yes (p < 0.05)
9	domestic animals to humans	2,153	2,205	1,970	3,9096	Yes (p < 0.05)

Table 8. ***Participants' opinions on possible forms of transmission of COVID-19, per area of study*** **(N = 440)**

Item	It is transmitted through …	Mean			*F*	Statistical significance *(p)*
		Science (n = 150)	Education (n = 190)	Soc. Sc. (n = 100)		
1	contact with droplets of saliva from an infected person.	2,693	2,742	2,560	2,8028	No (p = 0,06173)
2	contact with the exhaled air of an infected person.	2,587	2,484	2,490	0,8998	No p = 0,40,740
3	contact with infected hard surfaces	2,360	2,463	2,340	1,0898	No (p = 0,33,718)
4	eating infected food	1,307	1,316	1,420	0,4686	No (p = 0,62,616)

4.4. Perceptions on the prevention of COVID-19

With regard to forms of prevention of COVID-19, Table 9 shows that there are statistically significant differences between the groups, with the Education one scoring better than the other two groups of undergraduates. Being a matter of consensus that a virus causes COVID-19 (Tran et al., 2022), the scores of science students were expected to be higher and even closer to the maximum of 3 points for all the items.

As far as possible sanitary measures for preventing the transmission of COVID are concerned, Table 10 shows that there are statistically significant differences among the three groups for five of the 10 items. In three of those items (items 1, 6 and 7) the education group scored slightly higher than the science group and this one scored higher than the social sciences group. In the case of item 3 (washing hands with ash and water), the science group got the highest mean score which is close to the education one. The social sciences group obtained the lowest score, meaning that this group (incorrectly) believes that ash is good to prevent COVID-19, even though there is no evidence of that (Paludan-Müller et al., 2020). The education undergraduates got the lowest score on item 5, which concentrates on self-protection with facemasks, meaning that they showed the worst perception towards this issue. As it was discussed above, facemasks are not effective protectors of the person who wears them (Ali et al., 2021). In the other five items (2, 4, 8, 9 and 10) which concentrate on much publicized sanitary measures, the three groups got similar and quite high mean scores. This means that they have quite good perceptions on the valuable role of sanitary preventive measures that are at stake in those items, namely washing hands with soap or alcohol gel, avoiding places with many people, keeping infected people or people that encountered infected people isolated.

5. Conclusion and implications

The analysis of data collected in three Portuguese-speaking countries showed that, whatever the country, some participants in the study hold alternative conceptions regarding different stages and aspects of the COVID-19 issue. However, some differences were found among the participating

Table 9. ***Participants' opinions on possible forms of prevention of COVID-19, per area of study*** **(N = 440)**

Item	Possible forms of prevention	Mean			*F*	Statistical significance *(p)*
		Science (n = 150)	Education (n = 190)	Soc. Sc. (n = 100)		
1	Drinking alcohol prevents COVID-19	2,327	2,537	2,190	8,5702	Yes ($p < 0.05$)
2	Eating garlic prevents COVID-19	2,160	2,547	1,760	35,3210	Yes ($p < 0.05$)
3	Eating spices/ spicy foods (e. g, with pepper or chili) prevents COVID-19	2,193	2,574	2,020	23,7064	Yes ($p < 0.05$)
4	Drinking acidic substances prevents COVID-19	1,993	2,542	1,790	32,5098	Yes ($p < 0.05$)
5	Drinking bleach prevents COVID-19	2,287	2,726	2,320	21,9243	Yes ($p < 0.05$)

Table 10. ***Participants' opinions on possible sanitary measures for preventing the transmission of COVID-19, per area of study*** **(N = 440)**

Item	Possible sanitary prevention measures	Mean			*F*	Statistical significance *(p)*
		Science (n = 150)	Education (n = 190)	Soc. Sc. (n = 100)		
1	Rinsing your nose with salt water prevents COVID-19	2,247	2,468	2,130	7,9408	Yes ($p < 0.05$)
2	Washing hands with soap and water prevents COVID-19	2,687	2,626	2,600	0,5856	No (p = 0,55,724)
3	Washing hands with water and ash prevents COVID-19	1,247	2,216	1,090	45,8908	Yes ($p < 0.05$)
4	Washing your hands frequently with alcohol gel prevents COVID-19	2,740	2,732	2,670	0,6196	No (p = 0,53,866)
5	Wearing a facemask protects the user against COVID-19	0,400	0,247	0,410	3,6811	Yes ($p < 0.05$)
6	Wearing a facemask protects others against COVID-19	2,740	2,805	2,600	5,1761	Yes ($p < 0.05$)
7	Keeping physical distance prevents COVID-19	2,800	2,832	2,630	5,8966	Yes ($p < 0.05$)
8	Avoiding places with lots of people prevents COVID-19	2,733	2,779	2,640	2,3217	No (p = 0,09931)
9	Keeping infected people isolated prevents COVID-19	2,767	2,842	2,740	1,8178	No (p = 0,16,361)
10	Isolating people who contacted with infected people prevents the spread of COVID-19	2,673	2,721	2,640	0,7413	No (p = 0,47,707)

countries, with the Brazilian participants showing better perceptions on some items than the Mozambicans or the Portugueses. This difference may probably be because the Brazilian President at that time was a denier of the pandemic, a defender of non-validated treatments, and a disseminator of the idea that media and science walk in opposite directions with regard to economic growth (Soares & Menezes, 2021). Brazilian respondents may associate this with too many deaths that occurred in the country and feel like expressing their strong disagreement with (scientifically inconsistent) ideas that the President argued for as well as with other issues that they see as similar in their nature.

Surprisingly, science undergraduates seem to be less knowledgeable on the COVID-19 origin, transmission and prevention than education students do. This may mean that science students are too much focused on their own issues and did not pay enough attention to the pandemic issues albeit these are social issues that are strongly related to science knowledge. It may also mean that these undergraduates did not perceive a relationship between COVID-19 and science or were not aware of what was happening in the world around them. Fortunately, education students, most of them preparing to become preschool or primary school teachers, seem to be reasonably aware of COVID-19 related issues. This may indicate that they see their role as encompassing not only the teaching of school subjects but also the education of pupils with regard to every day relevant issues that may cause concern to them.

A limitation of this research has to do with the fact that participants from different countries had different experiences with regard to answering to digital questionnaires and this may have interfered with their performance as well as with the successful submission rate. In addition, the academic histories of the participants from diverse countries and study programs are different and these differences were not considered. It may happen that the COVID-19 issue was an extra curriculum topic in some programs and not in others, and, if this is the case, results based on the participants' area of study may be a bit biased.

Science students seem to lack more knowledge than it would be expected, given their science background. Social sciences students, a group that should be expected to be concerned with social matters, showed an even lower performance in this study. In the future, it would be interesting to analyse data by country and area of study in order to find out whether students of a given area of study perform similarly or differently in different countries. Besides, in this article, broad areas of study were considered. Future research should also consider and compare narrower and more focused groups. For instance, it would be interesting to find out whether life sciences students (whose curriculum addresses issues like viruses' nature and behaviour) perform differently, or not, form the physical sciences or the mathematics or the geography ones. This would require a much larger sample but would provide specific data on what needs to be improved in diverse undergraduate programs to ensure that students enrolled in them develop a good awareness of socio-scientific-issues that are relevant for their personal and societal lives. In addition, it would be worth investigating how education students see their role in the future as educators/teachers, namely with regard to every day relevant issues that may cause concern to their pupils and to find out whether university programs prepare prospective educators/teachers to deals with such kind of issues.

The COVID-19 pandemic is not over (some countries are having new waves) and the infection rate continues oscillating in different parts of the world. By the time this article was being written, health authorities were fearing for what could happen in the coming winter, namely in Europe, because of both people tend to be inside and other seasonal diseases (like flu) may come and foster COVID-19 transmission (through coughing, sneezing, etc.) by infected people.

Continuing the work on the identification of the clinical characteristics of COVID-19, the development and identification of pertinent diagnostic criteria, and the search for effective treatment and care are vital for overcoming the pandemic (Siordia, 2020). However, citizens' alternative

conceptions on COVID origin, transmission and cure may have a negative effect on the fight against the pandemic (Okunlola et al., 2020; Schmidt et al., 2020). The same can be said about the foolish of some politicians and the inconsistency of some governmental measures (Soares & Menezes, 2021) as well as about fake news that circulate in several media (Ali et al., 2021; Schmidt et al., 2020), either traditional media or social media (Ali et al., 2021; Zhou et al., 2020).

Education seems to reduce the frequency of alternative conceptions on COVID-19 (Bakebillah et al., 2021; Kreps et al., 2021) but the results of the present study suggest that science background may not be enough to face a pandemic appropriately. Science undergraduates may have trusted and feel comfortable with the information released by the media and therefore did not feel the need to deepen knowledge on issues related to the pandemic. Higher education institutions need to promote bridges between science, technology and society by enriching their undergraduate programs with socio-scientific issues that are relevant from a societal point of view, as it is the case of COVID-19. They need also to develop a culture of acknowledging the students' own environments as a valuable resource to teach about, in order to provide meaningful learning situations and to promote science and non-science students' literacy (Leite, 2017) as well as sensitiveness to public health and other socially relevant daily life issues. This would equip undergraduates with informed and responsive attitudes, which would be especially important when politicians do not pay appropriate attention to socio-scientific issues.

This paper concentrates on COVID-19 but other public health or socially relevant issues might appear in the future. If it is the case, governments need to prioritize mass media and social media to disseminate evidence-based information in order to inform and educate people about those issues (Bakebillah et al., 2021). When preparing such communication, they should select and engage science experts well recognized by the public (Utz et al., 2022), to ensure scientific accuracy and to develop public trust (Thanh & Tung, 2022) and build a closer connection with the audience, as this is a condition that Xu et al. (2021) consider of utmost importance.

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Author details
Laurinda Leite[1]
E-mail: lleite@ie.uminho.pt
ORCID ID: http://orcid.org/0000-0003-4713-3815
Luís Dourado[2]
Maria Verónica Mapatse[3]
José Arão[4]
Jerusa Moraes[5]
Sônia Castellar[6]
[1] Institute of Education, University of Minho, Campus de Gualtar, 4710057 Braga, Portugal.
[2] Institute of Education, University of Minho, Braga Portugal.
[3] Faculty of Educational Sciences and Psychology, University Save, Mozambique.
[4] Faculty of Science and Technology, University Licungo, Mozambique.
[5] School of Philosophy, Language and Human Sciences, The UNIFESP University, Brazil.
[6] Faculty of Education, University of São Paulo, Brazil.

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References

Abbasi, A., Kafil, H. S., Ozma, M. A., Sangtarash, N., & Sabahi, S. (2022). Can Food matrices be considered as a potential carrier for COVID-19? *Le Infezioni in Medicina*, *1*, 59–72. https://doi.org/10.53854/liim-3001-7

Ali, R., Jawed, S., Baig, M., Azam Malik, A., Syed, F., & Rehman, R. (2021). General public perception of social media, impact of COVID-19 Pandemic, and Related Misconceptions. *Disaster Medicine and Public Health*, *229*, 1–8. https://doi.org/10.1017/dmp.2021.229

Alimoradi, Z., Ohayon, M. M., Griffiths, M. D., Lin, C.-Y., & Pakpour, A. H. (2022). Fear of COVID-19 and its association with mental health-related factors: systematic review and meta-analysis. *British Journal of Psychiatry Open*, *8*(2), 1–26. https://doi.org/10.1192/bjo.2022.26

Allen, M. (2019). *Misconceptions in Primary Science* (3rd) ed.). McGraw-Hill Education.

Alsubaie, S., Alshahrani, H., Alshahrani, A., Asiri, A., Alfaifi, A., Al Ibrahim, R., & Alqahtan, W. (2021). Denial Attitude towards COVID-19 among General Population in Saudi Arabia. *European Psychiatry*, *64*(S1), S296–S297. https://doi.org/10.1192/j.eurpsy.2021.795

Aminu, J. A. (2020). The Implications of Misconceptions about Coronavirus Disease (COVID-19) pandemic in relation to its daily increases from Nigerian perspective. *Journal of Infectious Diseases and*

Epidemiology, *6*(156), 1–14. https://doi.org/10.23937/2474-3658/1510156

Arslan, Y., Akgul, F., Sevimet, B., Varol, Z. S., & Tekin, S. (2022). Re-infection in COVID-19: Do we exaggerate our worries? *European Journal of Clinical Investigation*, *52*(6), 1–10. https://doi.org/10.1111/eci.13767

Bakebillah, M., Billah, A., Wubishet, B. L., & Khan, N. (2021). Community's misconception about COVID-19 and its associated factors in Satkhira, Bangladesh: A cross-sectional study. *Public Library of Science - PLoS ONE*, *16*(9), 1–13. https://doi.org/10.1371/journal.pone.0257410

Berhe, N. M., de Velde, S. V., Rabiee-Khan, F., van der Heijde, C., Vonk, P., Buffel, V., Wouters, E., & Van Hal, G. (2022). Knowledge deficit and fear of COVID-19 among higher education students during the first wave of the pandemic and implications for public health: A multi-country cross-sectional survey. *BMC Public Health*, *22*(1144), 1–11. https://doi.org/10.1186/s12889-022-13511-3

Byers, P. (2022). SARS-CoV-2 pandemic to endemic: When will we know and what will it look like? *Journal of the Mississippi State Medical Association*, *63*(6), 1–6. https://jmsma.scholasticahq.com/article/35673-sars-cov-2-pandemic-to-endemic-when-will-we-know-and-what-will-it-look-like

Carlson, C. J., Gomez, A. C. R., Bansal, S., & Ryan, S. J. (2020). Misconceptions about weather and seasonality must not misguide COVID-19 Response. *Nature Communications*, *11*(4312), 1–4. https://doi.org/10.1038/s41467-020-18150-z

Cohen, E. (2020). Stars - they're sick like us! The effects of a celebrity exemplar on COVID-19-related risk cognitions, emotions, and preventative behavioral intentions. *Science Communication*, *42*(5), 724–741. https://doi.org/10.1177/1075547020960465

Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods in Education* (8th) ed.). Routledge.

Crawford, N. W. (2022). Importance of Understanding the Reinfection Risk of COVID-19 in Children. *The Lancet Child & Adolescent Health*, *6*(June), 355–357. https://doi.org/10.1016/S2352-4642(22)00093-1

Dopico, X. C., Ols, S., Loré, K., & Hedestam, G. B. K. (2022). Immunity to SARS-CoV-2 Induced by Infection or Vaccination (Review). *Journal of Internal Medicine*, *291*(1), 32–50. https://doi.org/10.1111/joim.13372

Edwards, A. M., Baric, R. S., Saphire, E. O., & Ulmer, J. B. (2022). Stopping Pandemics before They Start: Lessons Learned from SARS-CoV-2. *Science*, *375*(6585), 1–7. https://doi.org/10.1126/science.abn1900

Ferre, V. M., Peiffer-Smadja, N., Visseaux, B., Descamps, D., Ghosn, J., & Charpentier, C. (2022). "Omicron SARS-CoV-2 Variant: What We Know and What We Don't.". *Anaesthesia Critical Care & Pain Medicine*, *41*(1), 1–3. https://doi.org/10.1016/j.accpm.2021.100998

Folino, C. H., Alvaro, M. V., Massarani, L., & Chagas, C. (2021). A Percepção de Crianças Cariocas sobre a Pandemia de COVID-19, SARS-CoV-2 e os Vírus em Geral. *Cadernos de Saúde Pública*, *37*(4), 1–13. https://doi.org/10.1590/0102-311x00304320

Fujita, D. M., Nali, L. H. S., Sartori, G. P., Galisteo, A. J., Andrade Jr, H. F., & Luna, E. J. A. (2022). Fake News and Covid-19: A Concern Due to the Low Vaccine Coverage in Brazil. *Saúde e Sociedade (São Paulo)*, *31*(1), 1–11. https://doi.org/10.1590/S0104-12902022210298

Granjo, P. (2009). Saúde e Doença em Moçambique. *Saúde e Sociedade (São Paulo)*, *18*(4), 567–581. https://doi.org/10.1590/S0104-12902009000400002

Harpe, S. (2015). How to Analyze Likert and other Rating Scale Data. *Currents in Pharmacy Teaching and Learning*, *7*(6), 836–850. https://doi.org/10.1016/j.cptl.2015.08.001

Huang, Y., & Yang, C. (2020). A Metacognitive Approach to Reconsidering Risk Perceptions and Uncertainty: Understand Information Seeking during COVID-19. *Science Communication*, *42*(5), 616–642. https://doi.org/10.1177/1075547020959818

Ibrahim, O. M., & Ekundayo, D. D. (2020). COVID-19 Pandemic in Nigeria: Misconception among Individuals, Impact on Animals, and the Role of Mathematical Epidemiologists. *Innovative Journal of Medical Sciences*, *4*(4), 1–6. https://doi.org/10.20944/preprints202004.0492.v1

Ijaz, M. K., Nims, R. W., & McKinney, J. (2022). Indirect Transmission of Severe Acute Respiratory Syndrome Coronavirus Virus 2 (SARS-CoV-2): What Do We Know and What Do We not Know? *Infection Control & Hospital Epidemiology*, *43*(5), 676–678. https://doi.org/10.1017/ice.2021.57

Islam, A., Pakrashib, D., Vlassopoulos, M., & Wang, L. C. (2021). Stigma and Misconceptions in the Time of the COVID-19 Pandemic: A Field Experiment in India. *Social Science & Medicine*, *278*, 1–9. https://doi.org/10.1016/j.socscimed.2021.113966

Islam, S., Sarkar, T., Khan, S. H., Kamal, A.-H. M., Hasan, S. M. M., Kabir, A., Yeasmin, D., Islam, M. A., Amin Chowdhury, K. I., Anwar, K. S., Chughtai, A. A., & Seale, H. (2020). COVID-19-Related Infodemic and Its Impact on Public Health: A Global Social Media Analysis. *The American Journal of Tropical Medicine and Hygiene*, *103*(4), 1621–1629. https://doi.org/10.4269/ajtmh.20-0812

Kasozi, K. I., MacLeod, E., Ssempijja, F., Mahero, M. W., Matama, K., Musoke, G. H., Bardosh, K., Ssebuufu, R., Wakoko-Studstil, F., Echoru, I., Ayikobua, E. T., Mujinya, R., Nambuya, G., Onohuean, H., Zirintunda, G., Ekou, J., & Welburn, S. C. (2020). Misconceptions on COVID-19 Risk among Ugandan Men: Results from a Rapid Exploratory Survey. *Frontiers in Public Health*, *8*(416), 1–10. https://doi.org/10.3389/fpubh.2020.00416

Kreps, S. E., Goldfarb, J. L., Brownstein, J. S., & Kriner, D. L. (2021). The Relationship between US Adults' Misconceptions about COVID-19 Vaccines and Vaccination Preferences. *Vaccines*, *9*(901), 1–8. https://doi.org/10.3390/vaccines9080901

Leidecker-Sandmann, M., Attar, P., Schütz, A., & Lehmkuhl, M. (2022). Selected by Expertise? Scientific Experts in German News Coverage of COVID-19 Compared to other Pandemics. *Public Understanding of Science*, *31*(1), 1–20. https://doi.org/10.1177/09636625221095740

Leite, L. (2017). Introduction: Why Should Contextualized Teaching be a Matter for Educational Concern? In L. Leite, L. Dourado, A. S. Afonso, & S. Morgado (Eds.), *Contextualizing Teaching to Improve Learning* (pp. ix–xxv). Nova Science.

Lin, H.-S. (2021). COVID-19 and American Attitudes toward U.S.-China Disputes. *Journal of Chinese Political Science*, *26*(1), 139–168. https://doi.org/10.1007/s11366-020-09718-z

Mackenzie, J. S., & Smith, D. W. (2020). COVID-19: A Novel Zoonotic Disease Caused by a Coronavirus from China: What We Know and What We Don't. *Microbiology Australia March*, *17*(1), 45–50. https://doi.org/10.1071/MA20013

Majid, U., Wasim, A., Bakshi, S., & Truong, J. (2022). Knowledge, (Mis-)Conceptions, Risk Perception, and Behavior Change during Pandemics: A Scoping

Review of 149 Studies. *Public Understanding of Science*, *29*(8), 777–799. https://doi.org/10.1177/0963662520963365

McMillan, J., & Schumacher, S. (2014). *Research in Education: Evidence-Based Inquiry* (7th ed.). Pearson Education.

Mede, N. G., & Schäfer, M. S. (2022). Science-Related Populism Declining during the COVID-19. A Panel Survey of the Swiss Population before and after the Coronavirus Outbreak. *Public Understanding of Science*, *31*(2), 211–222. https://doi.org/10.1177/09636625211056871

Menasria, T., & Aguilera, M. (2022). Genomic Diversity of SARS-CoV-2 in Algeria and North African Countries: What We Know so far and What We Expect? *Microorganisms*, *10*(467), 1–19. https://doi.org/10.3390/microorganisms10020467

Misra, A., Theela, E. S., & Humphries, R. M. (2022). Immunity to SARS-CoV-2: What Do We Know and Should We Be Testing for It? *Journal of Clinical Microbiology*, *60*(6), 1–11. https://doi.org/10.1128/jcm.00482-21

Mowbray, F., Woodland, L., Smith, L. E., Amlôt, R., & Rubin, G. J. (2021). Is my cough a cold or COVID? A Qualitative Study of COVID-19 Symptom Recognition and Attitudes toward Testing in the UK. *Frontiers in Public Health*, *9*, 1–9. https://doi.org/10.3389/fpubh.2021.716421

Mutanga, M., & Abayomi, A. (2022). Tweeting on COVID-19 Pandemic in South Africa: LDA-Based Topic Modelling Approach. *African Journal of Science, Technology, Innovation and Development*, *14*(1), 163–172. https://doi.org/10.1080/20421338.2020.1817262

Okunlola, M. A., Lamptey, E., Senkyire, E. K., Dorcas, S., & Dooshima, B. A. (2020). "Perceived Myths and Misconceptions about the Novel COVID-19 Outbreak.". *Science Medicine Journal*, *2*(3), 108–117. https://www.scimedjournal.org/index.php/SMJ/article/view/120

Oloyede, A. A., Faruk, N., & Raji, W. O. (2022). COVID-19 Lockdown and Remote Attendance Teaching in Developing Countries: A Review of some Online Pedagogical Resources. *African Journal of Science, Technology, Innovation and Development*, *14*(3), 678–696. https://doi.org/10.1080/20421338.2021.1889768

Paludan-Müller, A. S., Boesen, K., Klerings, I., Jørgensen, K. J., & Munkholm, K. (2020). Hand Cleaning with Ash for Reducing the Spread of Viral and Bacterial Infections: A Rapid Review. *Cochrane Database of Systematic Reviews*, *CD013597*, 1–55. https://doi.org/10.1002/14651858.CD013597

Paparella, A., Purgatorio, C., Chaves-López, C., Rossi, C., & Serio, A. (2022). The Multifaceted Relationship between the COVID-19 Pandemic and the Food System. *Foods*, *11*(18), 1–24. https://doi.org/10.3390/foods11182816

Peng, Z., Rojas, A. L. P., Kropff, E., Bahnfleth, W., Buonanno, G., Dancer, S. J., Kurnitski, J., Li, Y., Loomans, M. G. L. C., Marr, L. C., Morawska, L., Nazaroff, W., Noakes, C., Querol, X., Sekhar, C., Tellier, R., Greenhalgh, T., Bourouiba, L., Boerstra, A., … Jimenez, J. L. (2022). Practical Indicators for Risk of Airborne Transmission in Shared Indoor Environments and Their Application to COVID-19 Outbreaks. *Environmental Science and Technology*, *56*(2), 1125–1137. https://doi.org/10.1021/acs.est.1c06531

Posse, L., & Chaimite, E. (2020). Os Imaginários dos 'Intermediários' à volta da COVID-19 em Moçambique. *Ideias*, *133*, 1–2. https://www.iese.ac.mz/wp-content/uploads/2020/07/ideias_133-LPEC.pdf

Pourang, A., Tisack, A., Ezekwe, N., Torres, A. E., Kohli, I., Hamzavi, I. H., & Lim, H. W. (2022). Effects of Visible Light on Mechanisms of Skin Photoaging. *Photodermatol Photoimmunol Photomed*, *38*(3), 191–196. https://doi.org/10.1111/phpp.12736

Ren, X., Zhou, J., Guo, J., Hao, C., Zheng, M., Zhang, R., Huang, Q., Yao, X., Li, R., & Jin, Y. (2022). Reinfection in Patients with COVID-19: A Systematic Review. *Global Health Research and Policy*, *7*(12), 1–20. https://doi.org/10.1186/s41256-022-00245-3

Rothmund, T., Farkhari, F., Ziemer, C.-T., & Azevedo, F. (2022). Psychological Underpinnings of Pandemic Denial - Patterns of Disagreement with Scientific Experts in the German Public during the COVID-19 Pandemic. *Public Understanding of Science*, *31*(4), 437–457. https://doi.org/10.1177/09636625211068131

Roth, D., & Roth, D. (2021). From the Editors: Research in Times of COVID. *The Journal of Legal Pluralism and Unofficial Law*, *53*(2), 159–160. https://doi.org/10.1080/07329113.2021.1957432

Schmidt, T., Cloete, A., Davids, A., Makola, L., Zondi, N., & Jantjies, M. (2020). Myths, Misconceptions, Othering and Stigmatizing Responses to COVID-19 in South Africa: A Rapid Qualitative Assessment. *Public Library of Science – PloS ONE*, *15*(12), 1–20. https://doi.org/10.1371/journal.pone.0244420

Siordia, J. A. (2020). Epidemiology and Clinical Features of COVID-19: A Review of Current Literature. *Journal of Clinical Virology*, *127*, 1–7. https://doi.org/10.1016/j.jcv.2020.104357

Smith, L. E., Potts, H. W., Amlôt, R., Fear, N. H., Michie, S., & Rubin, G. J. (2022). Who Is Engaging with Lateral Flow Testing for COVID-19 in the UK? The COVID-19 Rapid Survey of Adherence to Interventions and Responses (CORSAIR) Study. *BMJ Open*, *12*(2), 1–12. https://doi.org/10.1136/bmjopen-2021-058060

Soares, A., & Menezes, R. F. (2021). Coronavirus in Brazil: The March of Folly. *Saúde e Sociedade (São Paulo)*, *30*(2), 1–17. https://doi.org/10.1590/S0104-12902021200653

South, L., Saffo, D., Vitek, O., Dunne, C., & Borkin, M. A. (2022). Effective Use of Likert Scales in Visualization Evaluations: A Systematic Review. *Computer Graphics Forum*, *21*(3), 43–55. https://doi.org/10.1111/cgf.14521

Stokel-Walker, C. (2022). What Do We Know about COVID Vaccines and Preventing Transmission? *BMJ*, *376*, 1–2. https://doi.org/10.1136/bmj.o298

Strydhorst, N. A., & Landrum, A. R. (2022). Charting Cognition: Mapping Public Understanding of COVID-19. *Public Understanding of Science*, *31*(5), 534–552. https://doi.org/10.1177/09636625221078462

Sun, Y. (2022). Verification upon Exposure to COVID-19 Misinformation: Predictors, Outcomes, and the Mediating Role of Verification. *Science Communication*, *44*(3), 261–291. https://doi.org/10.1177/10755470221088927

Takeyama, N., Muzembo, B. A., Jahan, Y., & Moriyama, M. (2022). Health-Seeking Behaviors in Mozambique: A Mini-Study of Ethnonursing. *International Journal of Environmental Research and Public Health*, *19*(4), 1–12. https://doi.org/10.3390/ijerph19042462

Tanase, L.-M., Kerr, J., Freeman, A. L. J., & Schneider, C. R. (2022). COVID-19 Risk Perception and Hoax Beliefs in the US Immediately Before and after the Announcement of President Trump's Diagnosis. *Royal*

Society Open Science, *9*(8), 1–11. https://doi.org/10.1098/rsos.212013

Tariq, R., Hamid, H., Mashood, S., Tariq, Y., Tariq, S., Ibrahim, A., Faris, Y., & Khurshid, Z. (2020). Common Misconceptions Regarding COVID-19 among Health Care Professionals: An Online Global Cross-Sectional Survey. *Journal of Oral ResearchCovid-19*, *S2*(1), 36–45. https://doi.org/10.17126/joralres.2020.049

Thanh, P. T., & Tung, L. T. (2022). Do government activities increase public compliance in the Covid-19 pandemic? Evidence from Vietnam. *Global Knowledge, Memory and Communication*. https://doi.org/10.1108/GKMC-08-2021-0137

Theoharides, T. C. (2022). Could SARS-CoV-2 Spike Protein Be Responsible for Long-COVID Syndrome? *Molecular Neurobiology*, *59*(3), 1850–1861. https://doi.org/10.1007/s12035-021-02696-0

Thomas, R., Greenwood, H., Michaleff, Z. A., Abukmail, E., Hoffmann, T. C., McCaffery, K., Hardiman, L., & Glasziou, P. (2021). Examining Australian's Beliefs, Misconceptions and Sources of Information for COVID-19: A National Online Survey. *BMJ Open*, *11*(2), 1–10. https://doi.org/10.1136/bmjopen-2020-043421

Tran, B. M., Deliyannis, G., Hachani, A., Earnest, L., Torresi, J., & Vincan, E. (2022). "Organoid Models of SARS-CoV-2 Infection: What Have We Learned about COVID-19?". *Organoids*, *1*(1), 2–27. https://doi.org/10.3390/organoids1010002

Tso, R. V., & Cowling, B. J. (2020). Importance of Face Masks for COVID-19: A Call for Effective Public Education. *Clinical Infectious Diseases*, *71*(16), 2195–2198. https://doi.org/10.1093/cid/ciaa593

Utz, S., Gaiser, F., & Wolfers, L. N. (2022). "Guidance in the Chaos: Effects of Science Communication by Virologists during the COVID-19 Crisis in Germany and the Role of Parasocial Phenomena.". *Public Understanding of Science*, *31*(6), 799–817. https://doi.org/10.1177/09636625221093194

Wake, A. D. (2020). Knowledge, Attitude, Practice, and Associated Factors Regarding the Novel Coronavirus Disease 2019 (COVID-19) Pandemic. *Infection and Drug Resistance*, *13*, 3817–3832. https://doi.org/10.2147/IDR.S275689

Wanat, M., Logan, M., Hirst, J. A., Vicary, C., Lee, J. J., Perera, R., Tracey, I., Duff, G., Tufano, P., Fanshawe, T., Mwandigha, L., Nicholson, B. D., Tonkin-Crine, S., & Hobbs, R. (2021). Perceptions on Undertaking Regular Asymptomatic Self-Testing for COVID-19 Using Lateral Flow Tests: A Qualitative Study of University Students and Staff. *Public Health*, *11*, 1–8. https://doi.org/10.1136/bmjopen-2021-053850

WHO (World Health Organization). (n d). "*12 Myths about COVID-19*." https://www.who.int/docs/default-source/searo/thailand/12myths-final099bfbf976c54d5fa3407a65b6d9fa9d.pdf

Wicke, P., & Bolognesi, M. M. (2020). Framing COVID-19: How We Conceptualize and Discuss the Pandemic on Twitter. *Public Library of Science – ONE*, *15*(9), 1–24. https://doi.org/10.1371/journal.pone.0240010

Williams, S. N., Armitage, C. J., Tampe, T., & Dienes, K. (2020). Public Perceptions and Experiences of Social Distancing and Social Isolation during the COVID-19 Pandemic: A UK-Based Focus Group Study. *BMJ Open*, *10*(7), 1–8. https://doi.org/10.1136/bmjopen-2020-039334

Winter, J. F. C., & Dodou, D. (2010). "Five-Point Likert Items: T test versus Mann-Whitney-Wilcoxon (Addendum added October 2012).". *Practical Assessment, Research, and Evaluation*, *15*, 1–17. https://doi.org/10.7275/bj1p-ts64

Xu, H., Yuan, S., & Liu, S. (2021). Call them COVIDiots: Exploring the Effects of Aggressive Communication Style and Psychological Distance in the Communication of COVID-19. *Public Understanding of Science*, *30*(3), 240–257. https://doi.org/10.1177/0963662521989191

Zhou, J., Ghose, B., Wang, R., Wu, R., Li, Z., Feng, R. H. D., Tang, S., Tang, S., & Tang, S. (2020). "Health Perceptions and Misconceptions Regarding COVID-19 in China: Online Survey Study.". *Journal of Medical Internet Research*, *22*(11), 1–14. https://doi.org/10.2196/21099

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