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https://doi.org/10.3390/safety10040094

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Preventive Behaviors Among Higher Education Students in Response to COVID-19: The Role of Risk Perception

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Abstract: In response to the COVID-19 pandemic, higher education institutions adopted a set of measures to ensure safe face-to-face teaching and to control potential outbreaks. However, the effectiveness of the implemented measures is dependent on the behavior of students, who are generally young, often displaced, living with other colleagues, and constantly seeking physical contact, which makes their behavior outside the institution also of particular relevance to controlling the pandemic. An online questionnaire was developed and applied to characterize the behaviors adopted by students inside and outside the higher education institution, as well as risk perception based on the health belief model (HBM) and unrealistic optimism, with the participation of 620 students from three Portuguese higher education institutions. The adoption of safe behaviors is related to a greater perception of the benefits and of the severity of COVID-19. Unrealistic optimism also has a negative impact on preventive behaviors. The behaviors least adopted by students concerning potential exposure to COVID-19 were disinfecting hands and equipment after use, as well as physical distancing from colleagues. With regard to behaviors adopted outside the institution, it was found that students did not avoid physical contact with colleagues and family members. These findings contribute to our understanding of student behavior during the COVID-19 pandemic, help institutions understand if the applied strategies were effective or not, and denote the need to reinforce or improve the implemented strategies.

Keywords: higher education; students; prevention; risk perception; SARS-CoV-2

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Citation: Peralta, C.; Silva, M.V.; Dores, A.R.; Silva, M.A.; Pinto, M.V.; Ramos, D.; Rodrigues, M.A. Preventive Behaviors Among Higher Education Students in Response to COVID-19: The Role of Risk Perception. *Safety* **2024**, *10*, 94. https://doi.org/10.3390/safety10040094

Academic Editor: Raphael Grzebieta

Received: 25 April 2024
Revised: 24 September 2024
Accepted: 28 October 2024
Published: 8 November 2024

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1. Introduction

The COVID-19 pandemic (CO—corona, VI—virus, D—disease) has dramatically affected societies and economies over the last years. According to the World Health Organization (WHO), as of 13 April 2024, 704,753,890 cases of COVID-19 have been confirmed worldwide, including 7,010,681 deaths. In the same period, in Portugal, 5,643,062 cases were confirmed, including 28,126 deaths [1].

To contain the spread of the disease, the Portuguese government, like other countries in the world, decreed several periods of confinement, which entailed restrictions on the daily activities of the population, among others, aimed to control freedom of movement [2]. In addition, there was a need to implement effective measures, namely hand disinfection, compliance with respiratory etiquette, prophylactic isolation, and physical distancing, in order to minimize the risk of coronavirus transmission [2–4]. These restrictions, combined with the fear and uncertainty of becoming infected or being infected, have significantly influenced students in higher education. On 16 March 2020, face-to-face teaching was suspended and digital distance activities were privileged [4–6]. According to the literature, the majority of students had access to a computer and internet during this period. However, according to Iorio et al. [4], 10.0% of students shared a computer with another person and 6.2% shared it with more than one person. This practice of sharing computers was contrary to the recommended principles of social distancing [4,7]. Additionally, it is important to realize that the same authors found that 30.2% of students did not feel comfortable using digital tools and following classes via videoconference.

The return of face-to-face education has been somewhat controversial, as it influences the future of young people and the country, but also favors the spread of the virus [8]. According to a study carried out in Italy, the opening of schools was linked to an increase in the number of cases of COVID-19 infection [8]. Since students have a higher rate of asymptomatic infection, there is a potential for unnoticed contamination over time, which makes people less aware of risk exposure [9–13]. Reducing the transmission of the virus is influenced by the adoption of preventive behaviors; however, according to a study in Bangladesh, students have a greater tendency to neglect these behaviors, especially putting on a mask and physical distancing, which makes it relevant to understand the factors that are associated with these behaviors [3].

1.1. SARS-CoV-2: From the Infection Pathways to Preventive Measures

The first cases of COVID-19 in Portugal were reported on 2 March 2020. Schools closed on 12 March, transitioning to distance learning, which remained in place until the end of the Easter break. The first death occurred on 16 March and a state of emergency was declared on 18 March lasting until 2 May 2020 [14]. The first wave peak occurred on 10 April 2020 with 1516 new cases [15]. Cases decreased in the summer but surged again in October, peaking on 4 November 2020, with 7497 new cases [15]. The third and worst wave peaked on 28 January 2021, with 16,432 new cases [15]. Portugal remained of an emergency from 9 November 2020 to 30 April 2021. High vaccination rates eventually reduced cases, and the state of alert ended in September 2022.

During the return to in-person education, it was crucial to implement risk control measures to prevent new infections and outbreaks within schools. To achieve this, understanding the behavior of the virus was essential. It is well known that SARS-CoV-2 is transmitted through droplets or aerosols released from the nose or mouth of infected individuals when they cough or sneeze. These droplets can directly contaminate the mucous membranes or exposed areas, such as the eyes, of people nearby. Similarly, people can become infected when they come in contact with contaminated surfaces and then touch their mouth, eyes, or nose, with the virus's main target being the lung epithelium [16,17].

The incubation period for the virus, which is the time between exposure and the onset of symptoms, typically averages 5 to 6 days but can extend up to 14 days [16]. Infected people can be contagious even before the onset of their symptoms, being considered as asymptomatic patients [18]. According to Hidalgo et al. [19], around 45% of individuals are

asymptomatic, i.e., they never develop symptoms, and can transmit the virus with the same viral load as symptomatic individuals. The symptomatic phase of this disease manifests itself with fever, dry cough, and fatigue [20]. Other less common symptoms include dysgeusia; anosmia; nasal congestion; conjunctivitis; sore throat; headache; muscle or joint pain; different types of rashes, nausea, or vomiting; diarrhea; and chills or dizziness [20]. Of the population that develops symptoms, around 80% recover from the illness without needing hospital treatment; however, around 15% become seriously ill and need oxygen, and 5% need intensive care [20].

Although anyone can become infected with SARS-CoV-2, certain groups are more vulnerable and at a higher risk of severe illness. These include individuals over the age of 60 and those with underlying conditions such as hypertension, heart and lung disease, diabetes, obesity, and cancer. [20,21].

Given the incidence and mortality of COVID-19, citizens need to adopt the appropriate preventive measures to minimize and mitigate the spread of the virus. These measures include physical distancing; wearing masks; regular hand washing; avoiding touching the eyes, nose, or mouth; coughing or sneezing into the elbow; and ensuring well-ventilated spaces [20].

1.2. Risk Behaviors of Young People and Influencing Factors Related to COVID-19

During a pandemic period, adopting preventive behaviors is essential, but university students tend to neglect some behaviors [22,23]. Despite the guidelines provided by the authorities to the population, namely the use of masks and physical distancing [24], young people have offered some resistance to these preventive behaviors based on optimism resulting from a false sense of security and a low perception of risk [25,26].

Risk perception is a term used to refer to the knowledge and experience associated with risk, including the potential consequences contingent on a situation or a mix of circumstances [27]. It consists in recognizing the risk that the individual may face and is determined by uncertainty and fear, playing a central role in adopting preventive behaviors and preventing the spread of the disease [24]. The influence of risk perception on preventive behavior in the face of pandemics has been particularly interesting among young people. Akan et al. [28], in a study carried out during the H1N1 outbreak, found that higher education students believed that if they contracted the disease, they would have mild symptoms and that healthy people would be unlikely to contract swine flu, even if they did not adopt preventive measures and were not vaccinated. The results of this study identified a low perception of risk on the part of the students, which influences the adoption of preventive behaviors. Students with high levels of unrealistic optimism are more likely to take risks when they are accompanied by others and are more likely to neglect preventive measures [29]. There are also considerations regarding the sources of information and knowledge of the disease, since these influence individuals' anxiety and, in turn, their behavior [30]. In other studies, the opposite was found during the COVID-19 pandemic; students had high-risk perceptions and adopted appropriate health behaviors to mitigate the disease [31,32]. Different contextual realities may explain these findings, as they involve different infectious agents and were conducted in different countries. Additionally, some of the countries studied during COVID-19 had previously been affected by H1N1, which could have influenced the results of the subsequent studies.

Although higher education students do not generally belong to an at-risk group, due to the high incidence and transmission rates of COVID-19 and the low adherence to preventive measures, the spread of the virus was enhanced [33]. However, many expressed a reluctance to get vaccinated, with their hesitation linked to various individual and sociocultural factors. Key reasons include concerns about potential side effects, a low perception of the vaccine's effectiveness, lack of knowledge, misinformation spread online, and negative experiences with vaccination services [34].

1.3. Health Belief Model (HBM)

The health belief model (HBM) was conceived by a team of psychologists led by Godfrey Hochbaum from the United States Public Health Service in the early 1950s to understand the population's resistance to adopting preventive health measures and carrying out tests for the early detection of asymptomatic diseases [35–37].

The HBM has been applied in numerous studies focusing on health behaviors, namely sexual, smoking, alcohol, eating and dental hygiene, and vaccination hesitancy [38]. Indeed, this model encompasses the primary behavioral variations and can be applied to different populations [39]. However, despite its robustness, it has limitations, such as not accounting for physical and cognitive variables and lacking specificity regarding the hierarchy of its dimensions [38].

The main dimensions of this model are adapted from Lewin's general socio-psychological theory and consist of six interrelated dimensions: perceptions of susceptibility, severity, benefit, barriers, stimulus to action, and self-efficacy [39,40].

Perceived risk is a crucial element in an individual's involvement in preventive behavior and usually comprises perceived susceptibility and perceived severity, i.e., people tend to adopt preventive behaviors towards a disease if they consider themselves to be vulnerable to it (perceived susceptibility), if they perceive the existence of serious consequences (perceived severity), if they accept that their behavior can minimize susceptibility and severity (perceived benefits), and if they perceive that the existing barriers to adopting preventive measures (perceived barriers) are outweighed by the benefits [40,41]. The individual must have confidence in their abilities to overcome the perceived barriers (self-efficacy) [42]. Even so, it is not guaranteed that they will carry out the preventive actions, sometimes requiring the presence of stimuli (stimuli for action) [40].

The stimuli that lead people to adopt preventive behaviors can be categorized into three groups: individual perceptions, modifying factors, and probability of action. Individual perception encompasses perceived susceptibility and perceived severity. Modifying factors include demographic variables, risk perception, and triggers for action. The likelihood of action is associated with overcoming the perceived benefits concerning the perceived barriers [43].

There are currently some COVID-19 studies in which the HBM has been applied, particularly in studies on young people's risk perceptions related to preventive behaviors and vaccination [44]. Overall, studies show that a better risk perception contributes to the adoption of preventive behaviors. Regarding the effect of different variables on preventive behavior, previous studies have obtained different results. According to Fathian-Dastgerdi et al. [45], the perception of severity and benefits positively influences preventive behaviors, while the perception of susceptibility and barriers negatively influences them. In another study, it was found that individuals who perform more preventive behaviors have a higher perception of severity and susceptibility, as well as a higher perception of benefits. It was also found that the benefits should outweigh the perceived barriers. In this study, the main barrier was identified as a lack of knowledge about the disease and preventive measures. Participants with less information followed guidelines more closely, whereas vaccination was more acceptable among individuals with more information [46]. Concerning acceptance of the COVID-19 vaccine, Mercadante and Law [47] and Wong et al. [48] found that government recommendations are fundamental and that information on vaccination should be simple and balanced in terms of benefits and risks and more targeted at people under 50 with economic instability in order to motivate vaccination, while hesitation towards vaccination may be associated with the perception of its effectiveness and safety [47,48].

A study in Hong Kong showed that severity and benefits had a positive correlation with vaccine acceptance, although perceived susceptibility had no significant association with acceptance [48]. Another study found that vaccine acceptance depends on negative impacts and not knowing someone who has already been infected [47].

Also, a greater focus on individuals' perceptions of the severity and susceptibility of the disease and how these influence the adoption of behaviors could result in an overall reduction in the transmission of the virus.

1.4. Unrealistic Optimism

Unrealistic optimism refers to the belief that one is less likely than others to experience negative events, such contracting COVID-19 [49]. When people believe they are less likely to contract a disease compared to others, they are often less motivated to take preventive measures [29,41,50]. Weinstein's [51] seminal work highlighted the pervasive nature of unrealistic optimism across a variety of future life events, establishing a foundation for understanding its impact on behavior. The literature supports that unrealistic optimism, while potentially misleading, often leads to beneficial outcomes through increased personal prevention activities. Shepperd et al. [52] provided a comprehensive review discussing the origins and consequences of unrealistic optimism and suggested strategies for mitigating its potential negative effects.

For example, Schwarzer [53] examined how health-related cognitions, including unrealistic optimism, influence behaviors and attitudes toward personal health. His findings indicate that individuals who hold optimistic beliefs about their health are more likely to engage in proactive prevention activities. This aligns with the notion that optimism can be a driving force behind health-promoting behaviors. Aspinwall and Taylor [54] further explored this relationship by investigating how self-regulation and proactive coping are influenced by optimistic beliefs. Their research demonstrated that individuals with higher levels of optimism are more likely to engage in preventive actions to safeguard their health. This proactive coping mechanism is a critical aspect of understanding the benefits and potential drawbacks of unrealistic optimism.

The broader implications of optimism on economic choices have also been investigated, suggesting that optimistic individuals are more inclined to make decisions that the authors believe will lead to positive outcomes [55,56]. While their focus was on economic behavior, the principles can be applied to health behaviors, reinforcing the idea that unrealistic optimism can lead to increased engagement in prevention activities [56].

Unrealistic optimism is a specific form of optimistic bias where individuals believe they are less likely to experience negative events compared to others. Optimistic bias, a more general term, encompasses various degrees of positive expectations, with unrealistic optimism being an extreme manifestation. Jefferson et al. [49] argue that unrealistically optimistic cognitions should be considered beliefs rather than mere desires or hopes.

This assessment of unrealistic optimism is fundamental to understanding individuals' resistance to adopting preventive behaviors when they are at risk of being infected [29,41]. Thus, it is possible to conclude that individuals may not be involved in COVID-19 preventive behaviors because they are optimistic about the risk of the disease [41]. The smaller the gap between the perceived risk and the actual risk of COVID-19, the less likely people are to show optimistic tendencies, thus increasing their involvement in preventive behaviors [29,41].

1.5. Research Objective

Concerning the foregoing, the aim of this study is to analyze preventive behaviors adopted by higher education students during the COVID-19 pandemic and the correlation between those behaviors and risk perception.

2. Methods

2.1. Sample

This cross-sectional observational study included higher education students attending bachelor's and master's programs in health-related fields (e.g., bachelor programs in allied of health technology, medical biotechnology, among others). Three higher education institutions (HEIs) located in different regions of Portugal were selected (North,

Central, and South). The study was conducted during June and July 2021. The sample is a convenience sample.

A total of 620 students took part in the study (about 10% response rate), 86.1% female and 13.9% male, aged between 18 and 59 (M = 22.1, SD = 4.9), and 28.7% displaced from their place of origin (i.e., away from hometown). Of the total number of respondents, 88.9% were studying for a bachelor's degree and 11.1% were studying for a master's degree. A significant number of master's students were already in work activities. Additionally, students over the age of 23 had the option to enroll in undergraduate courses, which results in the institution having students of more advanced ages.

2.2. Instruments

In order to identify the factors associated with COVID-19 behaviors among higher education students, the research team designed a questionnaire, considering their background in environmental health as well as in psychology. The applied questionnaire included different scales/measures to assess the variables under study. All respondents were required to answer every question (mandatory questions). Only part of the information collected has been used in this work.

Appendix A.1. of the questionnaire included questions to characterize the respondents, namely age, gender, the degree corresponding to the course they were attending, the year of the course, whether the student was displaced from their household, whether they had ever been or were diagnosed with COVID-19, if someone they knew had been or was diagnosed with COVID-19, if someone they knew had severe symptoms or other complications associated with COVID-19, if they were part of an at-risk group, if they had been vaccinated against COVID-19, and if they lived with someone who was in the at-risk group.

Appendix A.2. assessed students' perception of the risk of COVID-19. To conduct this, the following dimensions of the HBM model were considered: perception of susceptibility, perception of severity, perception of benefits, and perception of barriers. Items were developed by the research team and the final scale was tested with a sample of 30 students for content validation. All the items were assessed using a 5-point Likert scale, where 1 = strongly disagree and 5 = strongly agree. About the perception of susceptibility, five items were developed that assessed the subjects' perception of the possibility of them and others contracting COVID-19. An example of an item is "I believe I am at risk of contracting COVID-19". Regarding the perception of severity, six items were developed that considered the perception that individuals had of the severity of the disease. An example of one item is "COVID-19 is a serious disease". Concerning the perception of benefits, eight items were included to determine the students' perception of the benefits of preventive behaviors to control the spread of the virus. An example of one item is "Confinement contributes to reducing the transmission of COVID-19". About the perception of barriers, five items were included that determined the perception that individuals had of the barriers to adopting preventive measures. An example of one item is "Wearing a mask is expensive".

Appendix A.3. analyzed unrealistic optimism. The aim was to assess individuals' perception of the likelihood of contracting COVID-19 in relation to others. Unrealistic optimism can be assessed through two dimensions, the "self" dimension and the "others" dimension and is calculated by subtracting the probability of the "self" dimension from the "others" dimension [41]. To perform this, two questions adapted from Dolinski et al. [57] were asked: "How likely are you to be infected with COVID-19?" and "Think about people your age and gender. In your opinion, how likely is an ordinary person of your age and gender to be infected with COVID-19?". A 7-point Likert scale was used for this assessment, with 1 = extremely unlikely and 7 = extremely likely.

In Appendix A.4., the behaviors adopted by students with COVID-19 were considered. To this end, behaviors practiced within and outside of the higher education institution were determined. Regarding behaviors adopted within the higher education institution, nine items were considered. For each item, the student had to indicate how often they practiced

the respective behavior. An example of one item was "Disinfects hands every time they enter the school". With regard to behaviors adopted outside the school, ten items were drawn up for the students to indicate how often they practiced the respective behavior. An example of an item is "Always wear your mask outside the house". All the items were assessed on a 5-point Likert scale, where 1 = never and 5 = always.

In Appendix A.5., clues for action were identified through two questions, the first to identify the sources most used to obtain information about COVID-19 and the second to indicate the sources that the student considered to have the most reliable information. The following sources of information were considered: guidelines from the Directorate-General for Health (DGS), guidelines from the WHO, guidelines from the higher education institution, information published on TV news, TV debates on the subject, opinions from experts, opinions from influencers or other individuals who are not experts in the field, information shared via physical media, and information published in newspapers/magazines and scientific articles.

The questionnaire was distributed online using Google forms and disseminated via institutional channels (institutional email and the higher education institutions' physical networks). Participation was voluntary.

The study was approved by the Ethics Committee of the School of Health, Polytechnic of Porto (Proc. CE0034B) on 21 April 2021, complying with the principles enshrined in the Declaration of Helsinki and the General Data Protection Regulation. It was conducted during June and July 2021, during the COVID-19 pandemic, when students had already resumed their classroom teaching.

2.3. Data Processing

To verify the underlying factor structure of the scale to measure risk perception, an exploratory factor analysis (EFA) using orthogonal Varimax rotation was performed. This analysis aimed to identify the interdependence among items and reduce them to a smaller set of factors or dimensions. The factor analyses, the Kaiser–Meyer–Olkin measure of sampling adequacy (KMO) and Bartlett's test of sphericity, were applied to assess the quality of item correlations. The KMO index, which ranges from 0 to 1, should be above 0.5, and Bartlett's test of sphericity should yield a significant p-value ($p < 0.05$). Items with factor loadings greater than 0.4 were retained and assessed for their relevance to an underlying concept. Constructs formed by the extracted items were further evaluated for internal consistency using Cronbach's alpha coefficient, which can vary between 0 and 1. Between 0.50 and 0.60 it is considered to have moderate reliability, between 0.61 and 0.70 is acceptable, between 0.71 and 0.89 is good, and $\geq$0.90 is excellent [58–60].

A descriptive analysis of the variables was carried out, applying measures of central tendency and dispersion, namely the mean, standard deviation, minimum, and maximum, as well as determining the relative frequency. This was followed by the Student's t-test for independent samples, which is part of the group of hypothesis tests to verify the differences in behaviors adopted inside and outside of the higher education institution, and in relation to gender, level of education, whether or not they were displaced from the household, whether or not they were infected with COVID-19, whether or not they knew someone who had severe symptoms, whether or not they belonged to or lived with someone in the at-risk group, and whether or not someone they knew had been or was diagnosed with COVID-19.

Spearman's correlation coefficient, which is part of non-parametric statistics, was used to analyze the relationship between the variables perceived susceptibility, perceived severity, perceived benefits, perceived barriers, unrealistic optimism, and the behaviors adopted inside and outside the higher education institution. The data were analyzed using the Statistical Package for the Physical Sciences software (SPSS, IBM, NY, USA, version 27), using a significance level of $\alpha = 0.05$.

3. Results

3.1. Factor Analysis

The KMO value was 0.903, which indicates the overall adequacy of the sample for factor analysis and is supported by a significant Bartlett's test of sphericity (χ^2 = 6,340,422, $p < 0.001$). The data matrix demonstrated sufficient correlation for factor analysis.

One item from the perception of barriers dimension was removed because communality was lower than 0.4. For the remaining items, communality values were higher than 0.4. Four factors emerged as expected, explaining 54.7% of the variance. All items exhibited adequate loadings (>0.4). These findings validate the initial assumptions and confirm the defined factors: perceived susceptibility, perceived severity, perceived benefits, and perceived barriers.

3.2. Reliability Analysis of the Risk Perception and Behavior Scales

For the variables perceptions of susceptibility, perceptions of severity, perceptions of benefits, perceptions of barriers, and behaviors adopted in and out of school, internal consistency was determined using Cronbach's alpha separately for each variable. Item-to-item correlations were analyzed to check their validity; if there were none, the item was removed. The results obtained for the final scales are shown in Table 1.

Table 1. Mean, standard deviation, and Cronbach's alpha coefficient.

	Number of Items	Mean	Standard Deviation	Cronbach's Alpha (α)
Perceived susceptibility	5	3.53	0.67	0.73
Perceived severity	6	4.15	0.70	0.85
Perceived benefits	8	4.51	0.58	0.92
Perceived barriers	5	3.11	0.67	0.52
Behaviors inside school	9	4.30	0.47	0.70
Behaviors outside of school	10	4.36	0.59	0.87

According to the data obtained, it can be considered that perceived susceptibility, perceived severity, and out-of-school behaviors have good reliability (0.71–0.89), in-school behaviors have acceptable reliability (0.61–0.70), and perceived benefits have excellent reliability (≥90). However, the reliability of the perception of barriers is moderate (0.50–0.60), which means that some questions may not have been well understood due to the inclusion of barriers with different characteristics. However, similar results have been obtained in other COVID-19 studies in which the scale has been applied [48]. Therefore, as in previous studies, it was decided to keep this dimension.

3.3. Variables Related to COVID-19 Infection and At-Risk Groups

At the beginning of the study, variables related to COVID-19 infection and at-risk groups that could influence students' behavior in response to the virus were identified. The results are summarized in Table 2.

Table 2. Characterization of participants in relation to COVID-19 infection and at-risk groups (n = 620).

Question	Positive Answers	
	Absolute Frequency *n*	Relative Frequency (%)
You have been or are infected with COVID-19.	70	11.3
You know someone who has been or is infected.	565	91.1
You know someone who has had severe symptoms.	241	38.9
You have already been vaccinated.	54	8.70
You belong to an at-risk group.	46	7.40
You live with someone in an at-risk group.	292	47.1

The data revealed that, at the time of collection, the majority of respondents had not been diagnosed with COVID-19 (88.7%), did not know anyone with severe symptoms (61.1%), did not belong to an at-risk group or live with someone who did (92.6% and 52.9%, respectively), and had not been vaccinated against COVID-19 (91.3%). However, around 91.1% knew someone who had been or was infected with COVID-19.

3.4. Preventive Behaviors Adopted Inside and Outside the Higher Education Institution

Tables 3 and 4 describe, in percentage, the behaviors adopted by students inside and outside the three higher education institutions, respectively.

Table 3. Higher education students' preventive behaviors inside the education institute (n = 620).

Behaviors Within the Education Institution	Percentage (%)				
	Never	Rarely	Sometimes	Often	Always
Disinfect your hands every time you enter the school.	0.60	0.60	5.30	18.7	74.7
Disinfects your hands every time they enter the classroom.	3.10	6.50	17.4	25.6	47.4
Complies with the mandatory circuits.	1.00	3.90	16.8	35.3	43.1
Disinfects the table and chair they sit on.	11.8	13.2	18.9	21.8	34.4
Wears a face mask inside the school and classrooms.	0.20	0.50	0.50	4.00	94.8
Wear a mask outside the school.	1.30	2.90	14.8	31.9	49.0
Maintains physical distancing from colleagues (e.g., corridors, smoking, eating lunch, etc.)	2.30	10.3	31.3	37.7	18.4
Avoid contact with sick people.	0.6	1.0	3.7	13.7	81.0
Use their own school materials.	0.3	0.3	2.9	12.9	83.5

Note: Question—"Indicate how often you engage in the described behaviors according to the following scale".

Table 4. Students' behaviors outside the three higher education institutions (n = 620).

Behaviors Within the Education Institution	Percentage (%)				
	Never	Rarely	Sometimes	Often	Always
Wash and disinfect your hands frequently.	0.80	0.80	5.50	26.8	66.1
Wear a mask outside.	0.80	1.50	9.50	23.5	64.7
Limit outdoor activities.	3.90	7.90	20.2	32.6	35.5
Avoid large crowds of people.	0.80	1.60	5.80	30.3	61.5
Avoid attending parties.	1.30	1.60	6.50	19.7	71.0
Avoid physical contact with friends or family.	2.40	8.40	25.6	38.2	25.3
Maintain physical distancing.	0.30	2.40	14.8	45.3	37.1
Avoid contact with sick people.	0.30	0.50	3.50	10.3	85.3
To avoid studying or doing work at colleagues' homes.	1.60	5.30	10.5	21.0	61.6
When eating meals, do not share food or drink with colleagues.	3.20	3.10	5.80	15.8	77.1

Note: Question—"Indicate how often you engage in the described behaviors according to the following scale".

According to the data obtained, students generally tend to engage in preventive behaviors. In fact, most of the students reported that they "Always" or "Often" disinfect their hands upon every school entry (93.4%), wear masks inside the school (98.8%), and always use their own school materials (96.4%). However, only 73% disinfect their hands every time they enter the classroom, and 25% of the students "Never" or "Rarely" disinfect their

equipment. Physical distancing was reported to "Never" or "Rarely" be ensured by 12.6% of respondents, and 31.3% of them reported adopting this behavior only "Sometimes".

Regarding preventive behaviors outside the higher education institution, some actions raise particular concern. About 12% of respondents selected "Never" or "Rarely" to limiting outdoor activities and about 11% participated in get-togethers with friends and family. However, the vast majority reported that they did not share food during meals (often = 15.8%; always = 77.1%), avoided parties (often = 19.7%; always = 71.0%), and avoided contact with sick people (often = 10.3%; always = 85.3%).

The analysis examined whether behaviors differed based on variables such as gender, level of education, displacement from the household, COVID-19 infection status, knowledge of someone with severe symptoms, membership in or association with an at-risk group, and whether someone they knew had been or was diagnosed with COVID-19.

There were significant differences in relation to gender, with female subjects tending to display more safe behaviors within the higher education institution ($t(618) = 2.885$; $p < 0.001$).

3.5. Sources of Information

To determine the sources students most frequently use for COVID-19 information, both the relative and absolute frequencies for each source were analyzed. The results are summarized in Table 5.

Table 5. Sources of information used by students (*nc* = 620).

	Relative Frequency (%)
Portuguese General Directorate of Health guidelines.	93.4
Guidelines from the World Health Organization.	55.1
Guidelines from the higher education institution (website, textbooks, teachers, etc.).	29.2
Information broadcast on TV news.	72.7
Television debates on the subject.	14.4
Experts' opinions via social networking, television, radio, or newspapers.	4.50
Opinions of influencers or other individuals not specialized in the area via physical networks, television, radio, or newspapers.	2.10
Information shared via social networking.	26.8
Information published in newspapers/magazines.	24.9
Scientific articles.	30.1

The results show that the sources most used by students for information on COVID-19 are the DGS (93.4%) and TV news (72.7%).

3.6. Correlation Between Variables

The correlation between behaviors and risk perception and unrealistic optimism was checked, and the results are summarized in Table 6.

Table 6. Spearman correlations between main variables: behaviors, risk perception, and unrealistic optimism.

	1	**2**	**3**	**4**	**5**	**6**
Perceived susceptibility (1)	-					
Perceived severity (2)	0.318 **	-				
Perceived benefits (3)	0.221 **	0.455 **	-			
Perceived barriers (4)	0.227 **	−0.025	−0.082 *	-		
Unrealistic optimism (5)	0.111 **	−0.168 **	−0.103 **	0.114 **	-	
Behaviors inside (6)	0.060	0.243 **	0.231 **	−0.232 **	−0.118 **	-
Behaviors outside (7)	0.081 *	0.358 **	0.384 **	−0.232 **	−0.138 **	0.529 **

* The correlation is significant at the 0.05 level (2 ends). ** The correlation is significant at the 0.01 level (2 ends).

The results indicate a significant positive correlation between the behaviors adopted inside and outside the higher education institution (r = 0.529; $p < 0.01$), showing that the behaviors adopted by the students are independent of the location. Data also showed the important role of risk perception on the adopted behaviors. There was a significant positive correlation between perception of severity and the behaviors adopted inside ($r = 0.243$; $p < 0.01$), as well as the behaviors adopted outside the school ($r = 0.358$; $p < 0.01$). Also, perception of benefits was positively correlated with the behaviors adopted inside the school ($r = 0.231$; $p < 0.01$) and the behaviors adopted outside the school ($r = 0.384$; $p < 0.01$). The correlation results suggest that students who are more aware of the consequences of the disease and the benefits of prevention are more likely to engage in preventive behaviors more frequently. There was also a significant negative correlation between the perception of barriers and behaviors inside the school ($r = -0.232$; $p < 0.01$) and behaviors outside the school ($r = -0.232$; $p < 0.01$). These results indicate that individuals who perceive barriers to adopting preventive behaviors tend to avoid these behaviors both inside and outside the higher education institution.

In addition, there was a significant positive correlation between perceived severity and perceived benefits ($r = 0.455$; $p < 0.01$), indicating that individuals who identify the most serious consequences tend to understand the benefits of adopting preventive behaviors. There was also a significant positive correlation between the perception of susceptibility and the perception of barriers ($r = 0.227$; $p < 0.01$), indicating that those who perceive fewer barriers also feel less susceptible.

Unrealistic optimism was shown to be significant and negatively correlated with the adoption of behaviors inside (r = −0.118; $p < 0.01$) and outside of school ($r = -0.138$; $p < 0.01$), showing that those who believe they are less likely to contract COVID-19 than others tend not to adopt preventive behaviors. There is also a significant negative correlation between unrealistic optimism and perceptions of severity ($r = -0.168$; $p < 0.01$) and perceptions of benefits ($r = -0.103$; $p < 0.01$), i.e., individuals who believe that compared to others they are less likely to contract a disease (unrealistic optimism), have a lower perception of the consequences of the disease as well as the benefits of adopting preventive behaviors. However, the correlation value was very low.

4. Discussion

This study described the preventive behaviors adopted by higher education students during the pandemic and revealed that the least frequently adopted behaviors were disinfecting hands upon entering the classroom and disinfecting classroom equipment. These findings provide new evidence, particularly since no previous research has been conducted with Portuguese students on this topic. Despite the lack of prior studies, the students' inadequate hand hygiene and equipment disinfection may be attributed to the lack or limited availability of disinfectant gel in accessible locations and the short duration of students' presence in schools.

Regarding physical distancing, the results indicated that students tend to adhere to it more consistently than expected. Chen et al. [24] and Imtiaz et al. [3] reported this behavior as one of the least adopted by young people. Additionally, in this research, one of the behaviors most adopted by students was wearing a mask and avoiding contact with sick people, which was not found in previous findings [24]. This behavior may be due to greater control by the authorities in Portugal, including education institutions, but also to the fact that the vast majority of students had not yet been infected or vaccinated against COVID-19 at the time of data collection.

The results obtained in this study revealed that the sources of information most used by students were the officials, namely DGS and WHO, and information broadcast on the news [26,61]. These data are not in line with the results reported by Sherzad et al. [55], which suggested that students were more likely to turn to different media channels, family and friends, and health staff information. This may be because they are students at health institutions and frequently come into contact with scientific articles

and websites. Additionally, the higher education institutions focused on managing the pandemic scenario and developed contingency and action plans, a regulatory requirement of the Ministry of Higher Education, also contributing to more robust information for the academic community [14,62].

It is, therefore, possible to understand the importance of sharing information about COVID-19 in the most varied media so that knowledge reaches the entire population.

Despite extensive education regarding the high transmissibility of COVID-19, students have underestimated preventive behaviors in relation to physical barriers, in line with a study by Mukhtar [63], which indicates that barriers prevent the adoption of preventive measures. Therefore, an attempt should be made to minimize barriers by making masks, disinfectant gels, and other products available, alerting people to their use so that there is greater awareness of the benefits of adopting preventive behaviors.

In addition, it was found that students who adopt preventive behaviors have a better awareness of the consequences of the disease as well as the benefits of adopting these behaviors. The greater the perception of risk, the greater the perception of severity, which consequently favors the adoption of preventive behaviors [63].

According to Park et al. [41] and Imtiaz et al. [3], unrealistic optimism influences the involvement of individuals in preventive behaviors, as well as the devaluation of the severity of the disease and their motivation to prevent it. The results of our study align with previous findings in the literature. However, it is important to note that the correlation value was weak. As Armor and Taylor [64] pointed out, anticipated outcomes do not always materialize. Additionally, other variables, such as risk perception, may play a more significant role in influencing adopted behaviors. Results obtained in this study suggest that students who understand the benefits of adopting preventive behaviors believe that the disease has more serious consequences and that they are more vulnerable to it, i.e., they have a greater perception of risk and consequently tend to adopt more preventive behaviors [28,40,63]. Based on our study's results, we recommend implementing educational campaigns to increase students' awareness of the risks and benefits associated with preventive behaviors and ensuring easy access to disinfectants. Additionally, integrating health education into the curriculum and establishing policies that mandate and monitor compliance with preventive measures can further encourage students to adopt these behaviors.

It also was found that female subjects tend to exhibit safer behaviors. This result is consistent with a study carried out in Hong Kong during the influenza A (H1N1) pandemic in 2009 [26]. However, individuals who have not yet been diagnosed with COVID-19 or do not know people who have been infected with this disease may tend to adopt more preventive behaviors. This can be explained by the false sense of security, that is, young people are currently discouraging preventive behaviors with individuals who have already been infected with COVID-19 since they no longer have the possibility of transmitting the virus because they are "immune".

5. Conclusions

This study revealed that students struggle to adopt preventive behaviors both inside and outside the higher education institution. It also highlighted the rule of risk perception in influencing these behaviors.

This study has contributed to a better understanding of the factors that influence the behavior of higher education students in the face of the pandemic, as well as their involvement in preventive behaviors. These results can help implement and guide control measures for the spread of various diseases, as well as support future studies. Despite the relevance of the results obtained, this study has some limitations. The sample was limited to three higher education institutions, all from allied health sciences, which reduces the possibility of generalizing the results to other realities. Furthermore, the limited sample size was due to the lower-than-expected participation in the study (about 10% response rate). Additionally, the study's focus on students in health-related higher education programs

may introduce bias, as these students are likely to be better informed. Furthermore, since the number of women in health schools is significantly higher than that of men, the results may also be biased by this demographic factor when compared to other realities.

Some items included in the original questionnaire, particularly those related to behavior, were redundant. This was because respondents were asked to evaluate how frequently they adopted certain behaviors, while the items themselves included the word 'always' in the phrasing. Although we do not believe this issue significantly affected the responses, it is important to note that greater care should be taken with such situations in future surveys.

In the future, it is suggested that the sample consider people from other age groups, higher education institutions, and countries. Based on the results obtained, strategies can be designed to mitigate the transmission of the virus in higher education institutions. Effective prevention and control measures should be incorporated into the contingency plans and policies of institutions, particularly regarding the availability of disinfectants in classrooms and the supervision of students' practices within them. Integrating health promotion and disease prevention content into curricula will also help address potential pandemics or new emergencies in the future.

Author Contributions: Conceptualization, M.A.R., A.R.D. and M.V.S.; methodology, M.A.R., A.R.D. and M.V.S.; validation, M.A.R., M.V.S., A.R.D., M.A.S., M.V.P. and D.R.; investigation, C.P., M.A.S. and M.V.P.; data curation, C.P.; writing—original draft preparation, C.P.; writing—review and editing, M.A.R., A.R.D., M.V.S., D.R., M.V.P. and M.A.S.; visualization, A.R.D.; supervision, M.A.R., A.R.D. and M.V.S.; project administration, M.A.R.; funding acquisition, D.R. All authors have read and agreed to the published version of the manuscript.

Funding: A. R. Dores is a researcher of School of Health, Polytechnic Institute of Porto, Porto, Portugal, supported by FCT—Fundação para a Ciência e Tecnologia [Portuguese Foundation for Science and Technology] through R&D units funding [UIDB/05210/2020]. This research received no external funding on 21 April 2021.

Institutional Review Board Statement: This study was approved by the Ethics Committee of the School of Health Sciences on—Polytechnic of Porto (Proc. CE0034B), complying with the principles enshrined in the Declaration of Helsinki and the General Data Protection Regulation.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Dataset available on request from the authors.

Acknowledgments: H&TRC author gratefully acknowledge the FCT/MCTES national support through the UIDB/05608/2020 and UIDP/05608/2020, and IPL for funding the I&DICA- IPL/2021/Vaccin2You_ESTeSL Project.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Este questionário enquadra-se num trabalho de investigação desenvolvido na Escola Superior de Saúde do Porto em parceria com a Escola Superior de Tecnologia da Saúde de Lisboa e com a Escola Superior de Tecnologia da Saúde de Coimbra. Este trabalho tem como objetivo identificar os fatores associados aos comportamentos adotados face à COVID-19 entre os estudantes do ensino superior.
Todas as respostas são anónimas, sendo utilizadas apenas para fins de investigação.
Os resultados do estudo serão posteriormente divulgados no meio científico, garantindo o anonimato.

Appendix A.1. Caracterização do Respondente

1. Idade: ____ anos
2. Género: Masculino ☐ Feminino ☐
3. Frequenta um curso conducente a que grau?: Licenciado ☐ Mestre ☐
4. Ano do curso que frequenta: ____ ano
5. Encontra-se deslocado (a) do seu agregado familiar? Sim ☐ Não ☐
6. Já esteve ou está diagnosticado(a) com a COVID-19? Sim ☐ Não ☐
7. Alguém que conheça já esteve ou está diagnosticado (a) com a COVID-19? Sim ☐ Não ☐

8. Alguém que conheça esteve com sintomas graves ou outras complicações associadas à COVID-19?
9. Sim ☐ Não ☐
10. Faz parte de algum grupo de risco? Sim ☐ Não ☐
11. Se sim, qual? _____
12. Já foi vacinado (a) contra a COVID-19? Sim ☐ Não ☐
13. Coabita com alguém que seja do grupo de risco? Sim ☐ Não ☐

Appendix A.2. Perceção de Risco

Responda às afirmações de acordo com a seguinte escala:

1	2	3	4	5				
Discordo Totalmente	Discordo	Não Concordo nem Discordo	Concordo	Concordo Totalmente				
				1	2	3	4	5
Perceção de suscetibilidade								
É muito provável as pessoas contraírem a COVID-19.								
Acredito que corro o risco de contrair a COVID-19.								
Pessoas como eu provavelmente irão contrair a COVID-19.								
É fácil para pessoas da minha idade contrair a COVID-19.								
É provável que eu fique doente como resultado de uma infeção da COVID-19.								
Perceção de severidade								
A COVID-19 é uma doença grave.								
A COVID-19 é uma doença mais grave do que a gripe.								
A COVID-19 pode originar sintomas graves entre os mais jovens.								
Ter COVID-19 é mais grave do que realmente parece.								
A COVID-19 é uma séria ameaça à minha saúde.								
A COVID-19 é uma doença que pode levar à morte.								
Perceção de benefícios (benefícios dos comportamentos preventivos)								
O confinamento contribui para a redução da transmissão da COVID-19.								
Usar máscara contribui para a redução da transmissão da COVID-19.								
O tipo de máscara contribui para a redução da transmissão da COVID-19.								
Evitar as confraternizações contribui para a redução da transmissão da COVID-19.								
O distanciamento social contribui para a redução da transmissão da COVID-19.								
A correta higienização e desinfeção das mãos contribui para a redução da transmissão da COVID-19.								
A higienização das superfícies contribui para a redução da transmissão da COVID-19.								
Não partilhar equipamentos, nomeadamente telemóveis ou fones, contribui para a redução da transmissão da COVID-19.								
Perceção das barreiras								
É difícil garantir o distanciamento social dos meus colegas.								
É difícil usar máscara durante muito tempo.								
Não tenho sempre acesso a gel desinfetante.								
O uso de máscara é dispendioso.								
Nem sempre é possível manter o distanciamento social (ex. transportes, supermercado, etc.).								

Appendix A.3. Otimismo Irrealista

Responda às seguintes questões recorrendo à escala abaixo descrita.

1	2	3	4	5	6	7
Extremamente improvável						Extremamente provável

	1	2	3	4	5	6	7
Qual a probabilidade de você ser infetado(a) com COVID-19?							
Pense em pessoas da sua idade e género. Na sua opinião, qual é a probabilidade de uma pessoa comum da sua idade e género ser infetada com COVID-19? ”							

Appendix A.4. Comportamentos

Indique com que frequência adota os comportamentos descritos, de acordo com a seguinte escala:

1	2	3	4	5
Nunca	Raramente	Às vezes	Muitas vezes	Sempre

	1	2	3	4	5
Na sua Instituição de Ensino. . .					
Desinfeta as mãos sempre que entra na escola.					
Desinfeta as mãos sempre que entra na sala de aula.					
Cumpre os circuitos obrigatórios.					
Desinfeta a mesa e a cadeira onde se sentou.					
Usa máscara dentro da escola e nas salas de aula.					
Usa sempre máscara nos espaços exteriores da escola.					
Mantém o distanciamento social dos colegas (ex. corredores, fumar, almoçar, etc.)					
Evita o contacto com pessoas doentes.					
Usa sempre o seu material escolar.					
Fora da sua Instituição de Ensino. . .					
Lava e desinfeta as mãos frequentemente.					
Usa sempre a máscara fora de casa.					
Limita as atividades no exterior.					
Evita grandes aglomerados de pessoas.					
Evita participar em festas.					
Evita participar em confraternizações com os amigos ou a família.					
Mantém o distanciamento social.					
Evita o contacto com pessoas doentes.					
Evita estudar ou realizar trabalhos na casa dos colegas.					
Quando realiza as suas refeições, não partilha alimentos ou bebidas com os seus colegas.					

Appendix A.5. Pistas para Ação

Quais as fontes que mais usa para obter informações sobre o COVID-19?

Orientações da Direção Geral da Saúde (DGS).	
Orientações da Organização Mundial de Saúde (OMS).	
Orientações da Instituição de Ensino (website, Manuais, Docentes, etc.).	
Informação divulgada no Telejornal.	
Debates televisivos sobre a temática.	
Opiniões de especialistas através das redes sociais, televisão, rádio ou jornais.	
Opiniões de *influencers* ou outras individualidades não especializadas na área, através das redes sociais, televisão, rádio ou jornais.	
Informação partilhada através das redes sociais.	
Informação divulgada em Jornais/Revistas.	
Artigos científicos.	

Quais dessas fontes considera ter informação mais fiável?

Orientações da Direção Geral da Saúde (DGS).	
Orientações da Organização Mundial de Saúde (OMS).	
Orientações da Instituição de Ensino (website, Manuais, Docentes, etc.).	
Informação divulgada no Telejornal.	
Debates televisivos sobre a temática.	
Opiniões de especialistas através das redes sociais, televisão, rádio ou jornais.	
Opiniões de *influencers* ou outras individualidades não especializadas na área, através das redes sociais, televisão, rádio ou jornais.	
Informação partilhada através das redes sociais.	
Informação divulgada em Jornais/Revistas.	
Artigos científicos.	
Obrigada pela sua colaboração.	

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