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COVID-19 Disease Knowledge among Biology Students: Implication for Science Education in the Post-COVID-19 Era

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Abstract

This research investigated the COVID-19 knowledge of 116 undergraduate Biology Education students and its implications for science education in the Fourth Industrial Revolution. Employing a non-experimental descriptive survey design, data were collected via an online questionnaire titled "Knowledge of COVID-19 Disease Questionnaire" (KCDQ), with a reliability coefficient of 0.72. The questionnaire comprised 42 dichotomous items. The study addressed four research questions and one hypothesis. Data analysis involved the use of Median, Standard Deviations, and Independent-Samples T-tests. The findings show that undergraduate Biology Education students exhibit a high level of knowledge about COVID-19. The high-level knowledge of undergraduate Biology Education students on COVID-19 indicates that science education in the Fourth Industrial Revolution can build on a strong foundation of disease understanding. However, further research can explore ways to deepen their understanding and integrate current health challenges into science education curricula to promote health literacy in future scientists and contribute to the preparedness for similar health crises.

Keywords: COVID-19 Disease; STEM Students; Undergraduates; Knowledge; Science Education

INTRODUCTION

Throughout history, education has been universally recognized as a transformative process that empowers individuals through the acquisition of relevant knowledge, attitudes, and skills, facilitating the development of their cognitive faculties. Moreover, the benefits of quality education extend beyond individual growth; they encompass self-development, societal progress, and the overall sustainable development of nations [1]. Hence, the more educated the citizens of a nation are, the higher the chances that such a nation will experience unprecedented growth and development [2]. Among the myriad fields of learning, one stands out for its unique capacity to equip individuals with knowledge that empowers them to contribute meaningfully to the developmental goals of their societies - science education.

Science education, acknowledged as a cornerstone for sustainable development worldwide [3] emerges as a powerful conduit for intellectual and economic growth. Science, as an amalgamation of cognitive activities coupled with emotional engagement and practical experiences, underpins the foundation of science education [4]. [5] aptly characterizes science education as a catalyst for intellectual and economic development. It furnishes individuals with the knowledge and skills essential for advancing societal well-being. The close association between a nation's economic growth and the strength of its science education

system is irrefutable. This is because science education equips individuals with the skills to make substantial contributions to the enhancement of socio-economic conditions within their communities. In essence, science education assumes a central role in the broader context of national development [6]. The universal importance ascribed to the study of science, and its potential benefits for humankind, has elevated it to the forefront of priorities for leaders in developed and developing nations alike [7]. In essence, no nation can develop without adequately planned and implemented science education [8].

Biology is one of the many disciplines in the sciences. Biology studies life and its forms. Biology, being a branch of science, plays an important role in providing students with relevant knowledge of concepts, and necessary scientific skills [9]. Through the study of Biology, an in-depth scientific understanding is provided of how all living and nonliving organisms interact with each other, and with their environments. The study of Biology also provides insights into the lives of various life forms. The study of Biology equips students with vital insights into life science, scientific competencies, environmental awareness, and a profound understanding of their interconnectedness with the living world [10]. As a pre-requisite subject for many other fields of learning, the study of Biology contributes greatly to the scientific and technological development of nations. Its study at the secondary and tertiary levels of education assists in equipping students with relevant knowledge of biological concepts, principles and theories which are critical to sound scientific sustainability. Because of these, the importance of Biology and biology education to sustainable national development cannot be overemphasized [11].

Biology occupies an important position in the study of science in Nigerian schools as it is one of the core science subjects taught in all secondary schools [9], while it is being studied as a discipline at the tertiary levels of education as well. To date, a sound knowledge of Biology and its processes remains a vital requirement for majoring in other life sciences including but not limited to marine biology, forensic science, genetic engineering, anatomy, biochemistry medicine, nursing, physiology, pharmacy, microbiology, biotechnology, and a host of others. Given this, it is deducible that without a sound knowledge of Biology, which is a strong pre-requisite for those intending to major in the life and medical sciences, biological scientists, pathologists, doctors and other life and medical scientists would find it challenging to assist people in the fight against illnesses and diseases.

The knowledge of Biology in action as a prerequisite for intensive life and medical science training was demonstrated when the world experienced the pandemic influenced by the COVID-19 disease. This novel disease known as the Coronavirus (2019-nCoV), officially known as SARS-CoV-2 or COVID-19) which has taken the lives of millions all over the world, was first reported in December 2019, as a cluster of acute respiratory illness in Wuhan, Hubei Province, China. It later rapidly spread to over 198 countries and was declared a global pandemic by WHO on 12th March 2020 [12]; [13]. The urgent need for the expertise of medical personnel who understood the biology (pathology and aetiology) of the viruses, in this case, the Coronavirus, was put to the test during the period of the pandemic. This set of scientists quickly swung into action and came up with a list of preventive measures and almost a year later, a temporary vaccine to stem the tide of the disease, though new variants keep showing up. Treatments and other measures taken by the medical personnel consisting of specialists such as virologists, wouldn't have been possible without sound background knowledge of Biology – the study of life.

Several studies have assessed students' knowledge regarding the Coronavirus disease. A study conducted by [14] and others [15]; [16]; [17] reveals that the majority of students exhibited a high level of understanding about COVID-19. In their study, [14] reported an 85% overall score in knowledge about transmission modes and higher-risk groups for COVID-19. Additionally, approximately 53.71% of respondents correctly identified the disease's modes of transmission. Also, [18] noted that a significant proportion of their respondents were aware that individuals with comorbidities, including the elderly, are more susceptible to COVID-19. Moreover, they recognized that COVID-19-infected individuals can remain asymptomatic. As for the risk of animal-to-human transmission of SARS-CoV-2, the virus causing COVID-19, the [19] suggest that this risk is low but not absent. Further research is needed to understand the potential impact on different animals and the dynamics of transmission. Accordingly, individuals with suspected or confirmed COVID-19 are advised to avoid contact with animals, including pets, livestock, and wildlife. In conclusion, these studies demonstrate that students possess a good understanding of COVID-19, but the risk of transmission between animals and humans remains an area requiring further exploration. Public health guidelines recommend caution regarding animal contact for those with COVID-19 to mitigate potential risks, even though such transmission is rare.

Numerous reports indicate that students possess varying degrees of awareness regarding COVID-19 symptoms and prevention methods. A minority (3.36%) demonstrated a lack of knowledge about disease symptoms. Regarding disease prevention, a substantial majority (91.61%) of participants acknowledged preventive measures aligned with WHO guidelines. These measures included hand hygiene using alcohol-based sanitisers, social distancing, and the use of surgical masks, with 73.15% supporting mask usage to prevent disease transmission [18]. Additionally, reports highlighted that student recognized the inefficacy of antibiotics in treating COVID-19. However, a significant number of participants were unaware that thermal scanners can assist in fever detection among COVID-19-infected individuals [18]. Furthermore, studies investigating gender differences, like [20] and [21], observed that gender influences perceptions and practices related to COVID-19. Females, according to [20], tended to exhibit more frequent handwashing and mask usage compared to males, attributed to a perceived susceptibility to illnesses and a greater health-conscious attitude among women. These reports highlight both strengths and areas for improvement in students' understanding of COVID-19 symptoms and preventive measures. Aspects such as the use of masks and hand hygiene align with global recommendations, yet gaps persist, particularly in understanding the use of thermal scanners and certain disease symptoms, indicating areas for further education and awareness campaigns. Gender-based differences in preventive practices also merit attention for targeted health interventions.

This study is important at this time, especially concerning preparing for another pandemic which might be worse than the Coronavirus. Effective Biology education in a global world which has embraced major industrialization can help to ensure wealthier, healthier, safer and sustainable development all over the world. In particular, the Fourth (4IR) Industrial Revolution which is almost taking centre stage in the 21st Century, and which has been engendered by advancement in science and technology, needs life scientists who can work to ensure that humans live healthier and safer lives based on their ability to tackle pandemics swiftly while also armed with strong knowledge of the biological sciences. The Fourth Industrial Revolution (4IR) is expected to influence the achievement of the 2030 Sustainable Development Goals, including health, clean water, sanitation, energy, cities, and climate action [22]. Biology education is expected to produce graduates who are well-prepared industrially, scientifically and technologically to foster sustainable developments in their national lives, especially concerning motivating students majoring in life and medical sciences to produce the next generation of medical scientists. Given this, there is a need to examine what the present undergraduate Biology students know about the causative agent of the present global pandemic which has shown no significant sign of leaving. It is believed that the outcome of the study would have implications for science education, and specifically, Biology education in Nigeria. The objectives of the study were to find out undergraduate Biology students' knowledge of the COVID-19 disease; its symptoms, transmission and preventive strategies. The study is guided by the following questions: What is the level of undergraduate Biology students' knowledge of the Coronavirus disease? Are undergraduate Biology students aware of the symptoms of the Coronavirus disease? What is the level of undergraduate Biology students' knowledge of the transmission of the Coronavirus disease? What is the level of undergraduate Biology students' knowledge of the prevention of the Coronavirus disease? Will there be any significant mean difference in undergraduate Biology students' knowledge of the Coronavirus disease based on gender?

METHOD

The study employed a non-experimental design with a descriptive survey methodology. A survey is a systematic approach used to collect data from a sample, aiming to construct quantitative descriptions of attributes within a larger population. These data reflect the population's attitudes, behaviours, opinions, and beliefs, which cannot be directly observed [23]. Survey research is valuable for addressing research questions, needs assessment, goal setting, trend analysis, and providing a comprehensive description of existing conditions, including their magnitude and contextual relevance. Surveys are particularly effective in collecting information from large and diverse population samples and excel in gathering demographic data that elucidate the composition of the sample [24].

The choice of the descriptive survey method in this study was deliberate, as it aligned with the objective of assessing the knowledge of undergraduate Biology students regarding the COVID-19 virus, encompassing its symptoms, transmission, and prevention measures. This approach facilitated a thorough

examination of the student's understanding, leveraging the method's capacity to offer a detailed and representative insight into their knowledge. One hundred and sixteen (116) undergraduate Biology students from a University of Education in Southwest Nigeria formed the sample of the study. They are the total number of students who responded to the Google forms-based instrument shared across their online WhatsApp platform. The percentage distribution of the students is shown in Table 1 below:

Table 1. Gender distribution of the respondents

Gender	**Frequency**	**%**
Male	30	25.9
Female	86	74.1
Total	116	100.0

An instrument designed using Google Forms and titled “Knowledge of COVID-19 Disease Questionnaire” (KCDQ)” was used for data collection in the study. The instrument was divided into five sections. Section one requested for participants' demographic data such as age and gender, while sections two to five contained items based on knowledge, symptoms, transmission and prevention of COVID-19, respectively. The questionnaire, which was developed by the researchers, was validated by experts in Biology education. It contained thirty-two (42) items with dichotomous responses of Yes and No, from which the students were expected to pick only one as the correct answer. The items are both positively and negatively worded, hence, positive items were coded with 2 points for Yes and 1 point for No while negatively worded items were coded as 2 points for No and 1 point for Yes. The reliability coefficient of the instrument was .72 and was calculated using the Cronbach alpha reliability method.

The research questions were answered using Median, Standard Deviations and Independent-Samples T-test. The median was chosen for analyzing responses due to the categorical (ordinal) nature of the data. Median is the appropriate measure for ordinal data, while the mode is specifically used for nominal and ordinal (categorical) data, where it identifies the most frequently occurring category (Jenkins & Gauvreau, 2006). Median serves to describe categorical variables based on a numeric variable's value. It is applied to continuous or ordinal variables to dichotomize them, creating categorical variables with two groups. This was achieved by classifying cases below the median as "low" and cases above the median as "high" [25]. As the data is not continuous, using the median is preferable. A Median score of 1.5 or higher indicates that respondents possess knowledge of the construct under investigation, whereas a Median score below 1.5 suggests otherwise. In determining the Mode of the Median score, the highest occurring score from the Median scores was selected. In cases where two scores had the same highest frequency, the two numbers were averaged and divided by two (representing the total number of responses per item). The resultant score was used as the Median score. This approach ensured accurate analysis and interpretation of the study findings. Data analysis was done using the Statistical Package for the Social Sciences (SPSS) version 26.

RESULTS

Research Question 1 - What is the level of undergraduate Biology students' knowledge of the Coronavirus disease?

Table 2. Analysis of the responses on the level of undergraduate Biology students' knowledge of the Coronavirus disease

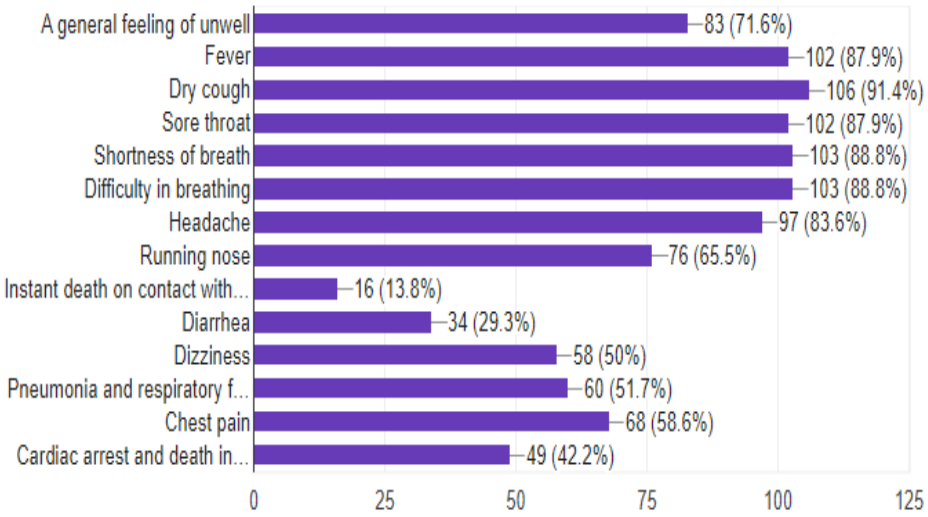
Statements	Responses		Median	S.D
	No (%)	Yes (%)		
COVID-19, the novel coronavirus disease, was initially identified in December 2019.	6 (5.2)	110 (94.8)	2.00	.222
SARS-CoV-2 is the same as COVID-19.	62 (53.4)	54 (46.6)	1.00	.501
COVID-19 does not lead to severe illness in all individuals.	23 (19.8)	93 (80.2)	2.00	.400
Elderly individuals with chronic conditions like diabetes, heart disease, cancer, and chronic kidney diseases are less likely to experience severe COVID-19 cases.	41 (35.3)	75 (64.7)	1.00	.480
It takes 16 days for the coronavirus disease to incubate.	34 (29.3)	82 (70.7)	2.00	.457
There is a cure for COVID-19.	42 (36.2)	74 (63.8)	1.00	.483
Those with chronic illnesses are more likely to have severe cases of COVID-19.	18 (15.5)	98 (84.5)	2.00	.364
Infected persons whose symptoms are not showing cannot spread COVID-19 disease to others.	22 (19.0)	94 (81.0)	1.00	.394
Effective ways to reduce the spread of COVID-19 are Test, Trace and Isolate (TTI).	6 (5.2)	110 (94.8)	2.00	.222
Children and young adults need not take measures to prevent contacting COVID-19 virus since they are naturally immune to it.	43 (37.1)	73 (62.9)	1.00	.485

Mode of the Median score = 1.50

The results presented in Table 2 indicate the level of knowledge among undergraduate Biology students regarding COVID-19. The majority of students, specifically 110 (94.8%), correctly identified that COVID-19 was first identified in December 2019. Additionally, 62 (53.4%) demonstrated awareness that SARS-CoV-2 is distinct from COVID-19, representing the virus responsible for the disease. A significant 93 (80.2%) students recognized that not all individuals with COVID-19 will develop severe cases, while 82 (70.7%) accurately estimated the incubation period for the coronavirus disease to be around 16 days. Furthermore, 98 (84.5%) students correctly identified that individuals with chronic illnesses are at a higher risk of experiencing severe cases of COVID-19. A notable 110 (94.8%) students were aware that effective measures to reduce the spread of COVID-19 include Test, Trace, and Isolate (TTI). However, 75 (64.7%) incorrectly believed that older individuals with chronic illnesses were not likely to have severe cases. Similarly, 74 (63.8%) wrongly assumed that there is a cure for COVID-19. Additionally, 94 (81.0%) incorrectly thought that asymptomatic individuals could not spread the disease, and 73 (62.9%) mistakenly believed that children and young adults were naturally immune to COVID-19. Based on a Median score of 1.50, it can be concluded that undergraduate Biology students possess a substantial level of knowledge about the Coronavirus disease. However, there are some misconceptions regarding disease transmission and immunity that may require further education and clarification.

Research question 2 - Are undergraduate Biology students' aware of the symptoms of the Coronavirus disease?

Figure 1. Representation of responses showing undergraduate Biology students' knowledge of the symptoms of the Coronavirus disease



The findings illustrated in Figure 1 provide insight into the knowledge of undergraduate Biology students regarding the symptoms of COVID-19. A significant majority of students, specifically 83 (71.6%), demonstrated awareness of the general feeling of unwell as a symptom. Moreover, 102 (87.9%) recognized fever, 106 (91.4%) identified dry cough, 102 (87.9%) associated sore throat, 103 (88.8%) linked shortness of breath, and 103 (88.8%) correctly associated difficulty in breathing with the disease. The students were also cognizant of symptoms such as headache (97: 83.6%), running nose (76: 65.5%), pneumonia, and respiratory failure (60: 51.7%), chest pain (68: 58.6%), and dizziness (58: 50%). However, less than half of the surveyed students, specifically 34 (29.3%), were aware that diarrhoea could be a symptom, and 49 (42.2%) associated cardiac arrest and death in severe cases. Only 16 (13.8%) recognized instant death upon contact with the disease. In conclusion, the findings suggest that a majority of undergraduate Biology students possess substantial knowledge of the symptoms associated with COVID-19. However, there are certain symptoms, such as diarrhoea, cardiac arrest, and instant death upon contact, that are less commonly recognized by the students.

Research question 3 – What is the level of undergraduate Biology students' knowledge of the transmission of the Coronavirus disease?

Table 3. Analysis of the responses on the level of undergraduate Biology students' knowledge of the transmission of the Coronavirus disease

Coronavirus disease can be transmitted:	**Responses**		**Median**	**S.D**
	No (%)	**Yes (%)**		
Through animal to human	38 (32.8)	78 (67.2)	1.00	.417
Through exposure to coughing, sneezing or other respiratory droplets of an infected person	13 (11.2)	103 (88.8)	2.00	.317
Through mosquito bite	15 (12.9)	101 (87.1)	1.00	.337
Infected food and water	63 (54.3)	53 (45.7)	2.00	.500
By touching contaminated persons, objects and surfaces	7 (6.0)	109 (94.0)	2.00	.239
Through failure to obey social distancing rules in public places	9 (7.8)	107 (92.2)	2.00	.269
Through sexual intercourse	60 (51.7)	56 (48.3)	2.00	.502
COVID-19 disease is transmissible	15 (12.9)	101 (87.1)	1.00	.337

Mode of the Median score = 2.00

The findings presented in Table 3 indicate that the majority of undergraduate Biology students possess a comprehensive understanding of the transmission modes of COVID-19. The responses to the statements reveal a high level of awareness among the students regarding disease transmission. A significant 78 (67.2%) of the students correctly identified that the disease could be transmitted from animals to humans, albeit with a low probability. Furthermore, 103 (88.8%) students were aware that exposure to coughing, sneezing, or other respiratory droplets of an infected person poses a risk of transmission. While 63 (54.3%) students correctly understood that infected food and water do not transmit the disease, a substantial 109 (94.0%) recognized that touching contaminated persons, objects, and surfaces can lead to transmission. The results also show that 107 (92.2%) students comprehended that failing to adhere to social distancing rules in public places can result in disease transmission to uninfected individuals. Moreover, 60 (51.7%) students correctly identified that the disease is not sexually transmitted, and 101 (87.1%) students were knowledgeable about the fact that COVID-19 cannot be transmitted through a mosquito bite. The findings, with a Median score of 2.00, indicate a robust understanding among undergraduate Biology students regarding the transmission routes of COVID-19. This knowledge equips them with the necessary information to take precautionary measures and contribute to preventing the spread of the disease.

Research question 4 – What is the level of undergraduate Biology students' knowledge of the prevention of the Coronavirus disease?

Table 4. Analysis of the responses on the level of undergraduate Biology students' knowledge of the prevention of the Coronavirus disease

Statements	Responses		Median	S.D
	No (%)	Yes (%)		
By refraining from close contact with individuals exhibiting symptoms of respiratory illnesses like coughing, sneezing, and the flu.	7 (6.0)	109 (94.0)	2.00	.239
By refraining from touching the face, including the nose, mouth, and eyes, with unwashed hands.	1 (0.9)	115 (99.1)	2.00	.093
Through coughing or sneezing loudly in crowded places	62 (53.4)	54 (46.6)	1.00	.501
By maintaining personal and environmental cleanliness	3 (2.6)	113 (97.4)	2.00	.159
By hugging infected persons	27 (23.3)	89 (76.7)	1.00	.424
Through cleaning and disinfecting objects and surfaces	4 (3.4)	112 (96.6)	2.00	.183
By covering the mouth and nose with tissue or handkerchief when coughing or sneezing	4 (3.4)	112 (96.6)	2.00	.183
By wearing face/nose masks when in crowded places.	4 (3.4)	112 (96.6)	2.00	.183
By neglecting social distancing rules.	101 (87.1)	15 (12.9)	1.00	.337
By performing daily hand washing with soap and water	2 (1.7)	114 (98.3)	2.00	.131

Mode of the Median score = 2.00

The results presented in Table 3 reveal that a significant majority of undergraduate Biology students are well-informed about the preventive measures for COVID-19. The responses to various statements indicate a high level of awareness among the students regarding disease prevention. A substantial number of students totalling 109 (94.0%) recognized the importance of avoiding contact with individuals displaying respiratory illness symptoms like coughing, sneezing, and the flu to prevent the disease. Moreover, 115 (99.1%) students are aware of the significance of avoiding touching their face, specifically the nose, mouth, and eyes, with unwashed hands. A considerable proportion, 62 (53.4%), also understood the need to refrain from coughing or sneezing loudly in crowded places. The students displayed comprehensive knowledge of preventive measures, with 113 (97.4%) acknowledging the importance of maintaining personal and environmental cleanliness. In addition, 89 (76.7%) recognized the need to avoid hugging infected individuals, and 112 (96.6%) understood the significance of thorough cleaning and disinfecting objects and surfaces. The majority, specifically 112 (96.6%), are aware that wearing face/nose masks in crowded places is a preventive measure. Furthermore, 101 (87.1%) students knew the importance of adhering to social distancing rules, and 114 (98.3%) understood the necessity of daily handwashing with soap and water. Based on the Median score of 2.00, it is conlcuded that undergraduate Biology students possess a comprehensive understanding of the preventive strategies for COVID-19. This knowledge equips them with the necessary information to protect themselves and others from the disease.

Ho1: There is no significant difference in the mean scores of undergraduate Biology students' knowledge of the Coronavirus disease based on gender.

Table 5. Independent Samples T-test result showing no significant difference in the knowledge of male and female undergraduate Biology students on the Coronavirus disease

Variable		N	Mean	S.D	t	df	Sig.	Remark
Knowledge of COVID-19 Disease	**Male**	30	15.77	1.612	-1.036	115	.302	Not Sig.
	Female	86	16.07	1.291				

Significant at p<0.05

The finding presented in Table 5 highlights an essential aspect of the research, which concerns the potential differences in knowledge about COVID-19 between male and female undergraduate Biology students. The result indicates that there is no statistically significant difference ($t = -1.036$; $df = 115$; $p>0.05$) between the two groups in terms of their knowledge of the disease. The p-value exceeding 0.05 suggests that the observed difference in knowledge between male and female students is not statistically significant. In other words, the knowledge levels of both male and female undergraduate Biology students about COVID-19 do not differ significantly.

DISCUSSIONS

The findings of this study indicate that the undergraduate Biology students who participated have a high level of knowledge about the Coronavirus disease (COVID-19). This finding aligns with previous research conducted by [14], [15], [16] and [17]. These previous studies reported that the majority of students they examined exhibited substantial knowledge about COVID-19. This consistency across studies suggests that a significant proportion of students, in general, are well-informed about the disease, which is crucial in public health contexts. Furthermore, this study's findings also indicate that the majority of the students are aware of the symptoms associated with COVID-19. This aligns with the report by [18], who found that most participants in their study had some level of awareness regarding the symptoms of COVID-19. However, Gohel and colleagues also noted a small minority (3.36%) of participants who were unaware of these symptoms.

Concerning the transmission of the disease, the findings reveal that undergraduate Biology students have a strong grasp of the transmission routes of COVID-19. This knowledge aligns with previous research conducted by [14] and is further supported by the guidelines from the Center for Disease Control and Prevention (CDC) in 2022. The CDC has underscored that the risk of animals spreading the virus that causes COVID-19 to people is low, with rare cases of the virus spreading from people to animals during close contact. Consequently, the CDC advises individuals with suspected or confirmed COVID-19 to avoid contact with animals, including pets, livestock, and wildlife. This finding emphasizes the effectiveness of public health education and the importance of disseminating accurate information about disease transmission. It highlights that educational programs and health communication efforts aimed at increasing public awareness about COVID-19 transmission have been successful, at least within the context of undergraduate Biology students.

Regarding prevention, the finding that undergraduate Biology students exhibit a strong understanding of COVID-19 prevention measures is highly significant. It reflects the effectiveness of educational initiatives and health awareness campaigns within academic institutions. This alignment with [18] research, which also reported participants' agreement with the World Health Organization's (WHO) recommended preventive measures, underscores the consistency and reliability of health education efforts. This finding emphasizes the importance of continuing and possibly expanding health education programs within educational institutions. It indicates that well-informed students can act as ambassadors for disseminating accurate health information within their communities, contributing to broader public health awareness. The knowledge possessed by these students equips them with the information needed to follow best practices in disease prevention. As future biologists and scientists, they may also play essential roles in disseminating and implementing public health policies and interventions effectively. This implies that

educational institutions should maintain strong partnerships with health authorities to ensure that the information being provided to students is aligned with the latest scientific and public health guidelines.

Finally, the finding indicates that there is no statistically significant difference in the knowledge of COVID-19 between male and female undergraduate Biology students, suggesting that both genders possess a similar level of understanding regarding the disease. This result is consistent with previous studies in this area. Notably, [20] reported that perceptions of COVID-19 among students can be influenced by gender. They attributed this variation to the perceived susceptibility to illnesses among females and their health-conscious nature, aligning with the findings of [21]. This finding emphasizes the overall equality in knowledge and awareness of COVID-19 between male and female undergraduate Biology students. It is noteworthy in promoting gender equity in education and public health awareness, demonstrating that both genders are equally well-informed about a critical public health issue. It further highlights the need for inclusive and comprehensive health education programs that cater to diverse student populations and address any gender-specific concerns or perceptions. This finding has implications for the educational context and suggests that the pedagogical approaches or resources used to educate students about COVID-19 are equally effective for both genders.

IMPLICATION AND CONCLUSION

Biology students' possession of a high level of knowledge about COVID-19, as well as the consistency of these findings with previous research, offer several pertinent implications for science education and public health efforts. In the post-COVID-19 era, science students, especially those in the Life sciences would need to be provided with accurate and current information about diseases such as COVID-19, and those that might emerge in the course of the 21st century. Hence, science educators, working with other stakeholders in education should ensure that their curricula incorporate the latest developments in the field, as staying informed is crucial for individual well-being and public health in the post-COVID-19 era. Also, it would be essential to continually equip science students with in-depth knowledge about diseases like COVID-19, and this will not only contribute to their health but also empower them to engage in informed discussions and take appropriate preventive measures in the event of another pandemic. This underscores the role of science education in fostering responsible and informed citizens who can actively contribute to public health. In addition, the finding underscores the importance of ongoing health education in educational institutions and the broader community. Hence, health education should not be limited to specific courses but integrated into various subjects, especially all STEM courses, and made available to students of all ages. Continuous learning ensures that science students are well-prepared to make informed decisions and actively participate in disease prevention and control efforts now and afterwards. Furthermore, the finding stresses the critical role that science education plays in infectious disease prevention.

In conclusion, the results of this study suggest that well-informed students, especially those pursuing biology and related disciplines, are key assets in the fight against infectious diseases. They reinforce the need for continuous, accessible, and tailored health education efforts to ensure that knowledge and awareness about public health issues are widespread, accurate, and up-to-date. Such education not only benefits individuals but also has far-reaching implications for the broader community's health and well-being.

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