Assessing secondary school students' digital health literacy, information searching behaviours, and satisfaction with online COVID-19 information in Northern Ghana

Francis Sambah [a], Frank Quansah [b,*], Medina Srem-Sai [c], James Boadu Frimpong [d,e], Edmond Kwesi Agormedah [f], Francis Ankomah [g,h], John Elvis Hagan Jr. [d,i]

[a] *College of Public Health, Medical and Veterinary Sciences, James Cook University, Townsville, QLD 4811, Australia*
[b] *Department of Educational Foundations, University of Education, P. O. Box 25, Winneba, Ghana*
[c] *Department of Health, Physical Education, Recreation and Sports, University of Education, P. O. Box 25, Winneba, Ghana*
[d] *Department of Health, Physical Education and Recreation, University of Cape Coast, MB Cape Coast, Ghana*
[e] *Department of Kinesiology, New Mexico State University, Las Cruces, NM 88001, USA*
[f] *Department of Business & Social Sciences Education, University of Cape Coast, PMB Cape Coast, Ghana*
[g] *Department of Education and Psychology, University of Cape Coast, PMB Cape Coast, Ghana*
[h] *Department of Education, SDA College of Education, P. O. Box AS 18, Asokore-Koforidua, Ghana*
[i] *Neurocognition and Action-Biomechanics-Research Group, Faculty of Psychology and Sports Science, Bielefeld University, Postfach 10 01 31, 33501, Bielefeld, Germany*

ARTICLE INFO

ABSTRACT

Available evidence suggests that managing the complexities of health information and the behaviours associated with information search call for adequate digital health literacy (DHL). Students' ability to judge the relevance of health-related information largely affects their level of satisfaction with the information. The study assessed DHL, information searching behaviours, and the link between DHL and COVID-19 information. The cross-sectional study utilised the multistage sampling technique in the selection of 1392 secondary school students in the Northern Region of Ghana. A DHL questionnaire was used to survey the students. The students displayed inadequate level of DHL concerning the relevance of online information. Predictably, most of them had not searched for information in the past four weeks prior to the data collection. Search engine portals, websites of public bodies, and news portals were the predominant platforms used for information search. Majority of the participants reported not being satisfied with the information they found on the internet about coronavirus. A significant association between DHL levels and utilization of COVID-19 information platforms was identified, such that students who showed high levels of DHL used platforms which had reviewed/professional content compared to those with low levels of DHL. Advanced DHL may serve as a disincentive to the consumption of information from sources which are not credible. There is an urgent call for collaboration among the ministries/agencies responsible for education and health, telecommunication networks, and civil society organisations for interventions aimed at integrating DHL in schools..

* Corresponding author.
E-mail addresses: francis.sambah@stu.ucc.edu.gh (F. Sambah), fquansah@uew.edu.gh (F. Quansah), mssai@uew.edu.gh (M. Srem-Sai), james.frimpong@stu.ucc.edu.gh (J.B. Frimpong), edmond.agormedah@ucc.edu.gh (E.K. Agormedah), francis.ankomah@stu.ucc.edu.gh (F. Ankomah), elvis.hagan@ucc.edu.gh (J.E. Hagan).

1. Introduction

During the emergency outbreak of Coronavirus disease (COVID-19), both offline and online media outlets were used to develop and disseminate useful health information to assist in informing health decisions among the general public, including in-school adolescents [1,2]. The use of digital platforms (e.g., social media) is regarded as an effective means of passing on public health content to consumers on a large scale [3,4]. This notwithstanding, led to an "infodemic" during the crisis. Spreading misinformation and disinformation amidst pandemics like COVID-19 poses serious public health challenges as it causes severe public panic and depletes public trust [2,5].

Available empirical investigations have suggested that managing the complexities of health information demands adequate digital health literacy (DHL), a component of health literacy [6,7]. Health literacy (HL) has been defined as "the degree to which individuals can obtain, process, understand, and communicate about health-related information needed to make informed health decisions" [8], [p. 16]. Essentially, DHL involves the special ability to search, obtain, analyse, review, integrate, and apply information derived from online sources [9,10]. Even though the terms "eHealth literacy" (eHL) and "DHL" are mostly used interchangeably, the measurement of eHL focuses mainly on the gathering of online health information [11,12], whereas the measurement of DHL entails interactivity of web-based platforms (e.g., social media) [12].

Given the intricacies of available health systems, DHL is recognized as an evolving research area where no individual is considered as being fully health literate, hence, requiring the needed support to appreciate and act upon health information [13]. Research has indicated that minority groups such as less educated people, migrants, old adults, people from marginalized ethnic and racial backgrounds, people from low socio-economic backgrounds, and those with poor health status are relatively more likely to have low HL and/ or DHL [7]. Young students (i.e., between the ages of 15 and 21 years) in secondary schools with deficit DHL cannot be neglected. Inadequate DHL among young students would prevent them from sieving 'infodemic' related to COVID-19, thus likely to increase stress, anxiety, and other health complications among young students [14–18].

Some studies have indicated a moderate to high level (i.e., sufficient) of DHL among students [10,13,19] while others have found a low/limited level of DHL among students [20–23]. For instance, in the USA [10], Denmark [24] and Pakistan [13], it was found that students had high DHL levels. Also, Dadaczynski et al. [19] in Germany and Rosário et al. [25] in Portugal, established that students had a moderate level of DHL. Similar findings (i.e., moderate to high DHL) were reported in Germany [26], Slovenia [27], Vietnam [28,29] and China/Malaysia/Philippines [30]. However, students in other jurisdictions like the USA [31] and some Asian countries (e. g., Lebanon, Pakistan) [20,22,23] were found to have low levels of DHL.

Mixed evidence on information searching behaviours of students during COVID-19 has also been noted [13,19]. For instance, in Germany [19], Demark [24] and Pakistan [13], students accessed COVID-19-related information from varied sources (including personal social media posts, search engines, experts' opinions, media spokespersons, researchers, news portals, websites of official institutions and government officials). Similar findings were reported in Europe (e.g., Slovenia) [27] and Asia (e.g., China, Malaysia, Philippines, Vietnam) [29,30,32]. From these sources, the students searched for information related to the spread of COVID-19, symptoms, and individual measures to protect against COVID-19 [29,30] and shared health information [24]. Conversely, students had challenges locating the COVID-19-related information they were looking for, assessing the reliability of the information, and selecting from the information retrieved [19,24,27]. These outcomes indicate the existence of inconsistencies in the literature regarding information-searching behaviours of students during the COVID-19 pandemic.

Students' inability to judge the relevance of health-related information during the COVID-19 pandemic could affect their level of satisfaction with the information. For example, in China, Zhang et al. [32] discovered that students lacked confidence in COVID-19 related information, and were dissatisfied with the results. Also, Kor et al. [33] in China found that people with chronic diseases were dissatisfied with online information during the pandemic compared to people without chronic diseases. However, empirical evidence from parts of Europe (e.g., Denmark and Slovenia) [24,27] and Asia (China, Malaysia, and the Philippines) [13,30] indicated that most students were either fully or partly satisfied with COVID-19 information found on the internet or social media platforms. Researchers have noted a substantial association between DHL and the use of COVID-19 information-seeking platforms. For instance, Patil et al. [10] in the USA found that higher DHL was significantly associated with a greater willingness to acquire the COVID-19 vaccine and the belief that being infected with COVID-19 would negatively impact one's life whereas those with lower DHL were more likely to consider the pandemic as an overreaction. Bak et al. [24] in Denmark and Vrdelja et al. [27] in Slovenia found that students with a sufficient level of DHL sought information through search engines and websites of official institutions and shared health information, while students with a limited level of DHL often used social media for health information searches. Dadaczynski et al. [19] in Germany also found that social media utilization was associated with a low ability to critically evaluate COVID-19 information. Conversely, public website utilization was associated with a high ability to critically evaluate COVID-19 information. However, this nexus was established among only university students. Hence, creating a void in literature with secondary students as samples with unique characteristics concerning digital media. This study, therefore, intends to fill this gap by using secondary students from the Northern part of Ghana where digital technology is somehow limited.

Despite the documented importance of DHL during pandemics, it appears little research attention has been given to the phenomenon, particularly in the Ghanaian context. A critical examination of the literature indicated that no study has assessed the DHL of secondary school students in the Northern part of Ghana during the COVID-19 period. Moreover, there is sparse literature regarding information searching behaviours of students during COVID-19 and whether any marked association exist between DHL and the use of COVID-19 information-seeking platforms. This gap could impactpolicymakers' attempt to design appropriate interventions to curb the dissemination of misinformation and disinformation during the COVID-19 era and help reduce the debilitating impact of the disease.

Therefore, the study assessed (a) the extent of COVID-19 DHL among secondary school students, (b) their information-searching behaviours (c) and the association between DHL and COVID-19 information-seeking in the Northern part of Ghana. It is expected that findings from this study could help with needed DHL interventions in the secondary schools in the region..

2. Materials and methods

2.1. Study participants

The study was conducted as part of the global COVID-HL network (www.covid-hl.org). The study was carried out among students in selected secondary schools (presently called senior high schools [SHS]) in Northern Ghana with over 100,000 students. The descriptive cross-sectional survey design was utilised to select 1392 participants for the study. The sample size was determined based on Israel's [34] proposed plan for deciding on a sample; with a population size of more than 100,000 and analysis conducted using a 95% confidence interval using a ±3 precision with a sample size of 1111. Following this estimated sample, 30% of 1111 was computed leading to a total sample of 1444. However, 1392 students completed the survey instrument and thus, participated in the study which yielded a response rate of 96.4%. Out of the 1392 participants, males constituted seven hundred and two ($n = 702$, 50.4%) and females, six hundred and fifty-four ($n = 654$, 47.0%), while thirty-six ($n = 36$, 2.6%) of the participants reported having diverse sexes. Participants' ages ranged from 14 to 25 years (Mean age = 18.9; SD = 1.95). Using a multi-stage sampling procedure, a number of sampling techniques were adopted at different sampling phases. A simple random sampling technique was first used to sample the Savannah and Upper West regions of Ghana. Through the cluster sampling technique, five schools were selected within the two selected regions via the various districts. For each school, a list of students was obtained and a simple random technique (i.e., Table of random numbers method) was adopted to select between 100 and 150 students based on calculated proportions.

2.2. Instrumentation

The COVID-HL Questionnaire for Secondary School Students developed by the COVID-Health Literacy Consortium (https://covid-hl.eu/) was adapted for this study. The adapted areas for this particular research include three sections. First, the demographic profile of respondents comprised sex and age. The second section comprised the digital health literacy (DHL) scale initially developed by Van der Vaart and Drossaert [12] and re-developed by COVID-HL Network [35]. We adopted four dimensions of the COVID-19 Digital Health Literacy Instrument recommended by Lorini et al. [36], which include searching the web for information on COVID-19; adding self-generated content on COVID-19; evaluating the reliability of COVID-19-related information; and determining the personal relevance of COVID-19-related information. The last dimension (i.e., protecting privacy) was excluded because it had shown low reliability in previous studies [37]. Each of the sub-domain had three items with a 4-point scale response option, "very difficult", "difficult", "easy", and "very easy". The DHL scale has been widely validated and its psychometric properties are sufficient [35,36,38,39].

The third section of the instrument measured issues about the information-searching behaviours of students. Items include asking participants about the utilization of COVID-19 information sources by selecting from ten listed web-based sources rated on a 4-point scale (often, sometimes, rarely, never) [19]. For purposes of interpretation, 'often' and 'sometimes' responses were classified as high utilization whereas 'rarely' and 'never' responses reflect low utilization. Further, a list of thematic areas was provided for the students to indicate (by checking) which topics were searched for through online platforms [19]. We also measured students' satisfaction with COVID-19 related online information by indicating whether they were satisfied or not satisfied. Participants were asked whether they have searched the internet in the last four weeks for coronavirus information at the time of the data collection exercise.

2.3. Procedure

A reference number DAA/P.1/Vol.1/39 was obtained once ethical approval was granted by the Ethical Review Board (ERB) of the University of Education, Winneba. Additionally, headmasters of all secondary schools involved in the study approved the conduct of this research. For a student to be eligible to take part in the study, he or she must have schooled and stayed in any part of the Northern Region of Ghana for 10 years or over. Secondly, the student should be able to read the English Language fluently, write and understand it without any assistance irrespective of their individual tribes. Again, only students or their parents (those below 18 years) signed and returned the informed consent forms. Due to the wide geographical nature of the Northern Region, the researchers trained 12 research assistants who consented willingly to help with the data collection. The training involved explaining individual items and specific instructions on the questionnaire. Participants' recruitment began by paying familiarization visits to the various secondary schools to discuss the study's purpose and significance to all students and teachers, while those interested in taking part in the study were asked to sign written informed consent forms. Individual items, including all specific instruction and measurement scales on the survey instrument were thoroughly explained to participants. An opportunity was given to them to seek more explanations or ask questions for further clarification. Prior to data collection, ethical considerations including anonymity, the confidentiality of responses given and freedom to continue or not in answering the questionnaire were all assured. All COVID-19 safety protocols (wearing nose masks, sanitizing hands, washing hands with soap and running water) were also provided and strictly adhered to prevent any potential COVID-19 infection.

With the help of the research assistants, the questionnaires were then given to participants to provide answers to only on school days during their free periods in their various classrooms. Participants used between 15 and 20 min to respond to the survey items. The research assistants collected all answered survey instruments, put them in brown envelopes, sealed them and handed them over to the

researchers. The data collection period took approximately two months.

2.4. Data analyses procedure

The data collected were analyzed using frequencies and percentages, means and chi-square test. Regarding the level of DHL, the participants' responses were first grouped into inadequate DHL, problematic DHL and sufficient DHL based on their mean scores on the measure. Frequency and percent distribution were used to identify the proportions of students who could be found in each of the DHL categories. Further, frequency and percentage distribution were employed to identify the platforms utilised by the participants to seek COVID-19 information, the nature of the information searched, and their satisfaction with COVID-19 related information they searched for. A series of chi-square analyses were also conducted to examine the association between DHL levels and the utilization of COVID-19 information platforms. The decision criterion was pegged at a 0.05 level of significance. All the analyses were conducted with IBM SPSS statistics software version 25 (IBM Corp., Armonk, NY, USA).

3. Results

3.1. COVID-19 DHL of secondary school students

We assessed the DHL of the students based on the four dimensions of literacy as well as their global DHL, based on whether the individual had inadequate DHL, problematic DHL or sufficient DHL. Fig. 1 presents the pictorial view of the results.

As shown in Fig. 1, majority of the students exhibited inadequate levels of DHL on all the dimensions: information searching (55.8%), adding self-generated content (55.6%), evaluating the reliability of information (51.1%), and determining the relevance of information (67.0%). Notably, the relevance of the online information sub-domain recorded the highest level of inadequate DHL and the least level of sufficient DHL (see Fig. 1). Overall, over 62% of the students demonstrated an inadequate level of DHL (62.9%), with 20.9% reporting sufficient DHL.

3.2. Information searching behaviours of secondary school students

The information searching behaviours of students were assessed based on (a) whether students have searched the internet in the last four weeks for information on COVID-19; (b) the COVID-19 information sources (including the extent of use), (c) the nature of information searched, and (d) students' satisfaction with COVID-19 related information they searched for.

As presented in Fig. 2, the results discovered that the majority of the students had not searched for information in the last four weeks (45%). Several students also reported that they searched for information for themselves and others (28%).

The analysis of the online platforms utilised by students for searching for information on COVID-19 showed that even though the students used several platforms, the three predominant platforms were search engines portals (66.4%), websites of public bodies (e.g. Ministry of Health, Ghana Health Services, Food and Drug Authority) (49.1%), and news portals (e.g., TV stations) (see Table 1) (48.1%). The least used platforms were health portals (41.2%) and websites of doctors or health insurance companies (41.2%). Although social media (eg., Facebook, Instagram, Twitter) (47.6%) and WhatsApp (45.7%) were among the top five most utilised podiums, they were the least on the list (see Table 1).

Further analysis (see Table 2) was performed to identify the specific topics students searched for in relation to coronavirus. The outcome of the analysis revealed that the percent of cases for the specific topics ranged between 12.4% and 51.9%, indicating a generally low rate of information searching among the students. This notwithstanding, the top three most searched information were symptoms of coronavirus (23.9%), transmission routes of the coronavirus (16.0%), and individual measures of protection against infection (14.4%). Current situation assessments and recommendations (5.9%) and information on restrictions (5.7%) were less searched by the students.
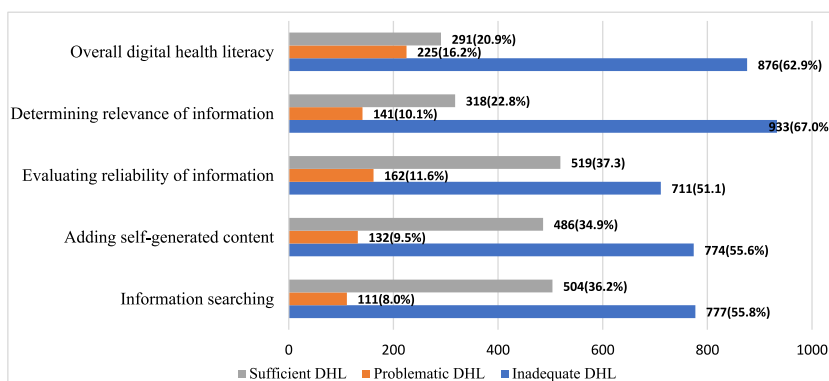

Fig. 1. Frequency and Percentage Distribution of Students based on their DHL Level.
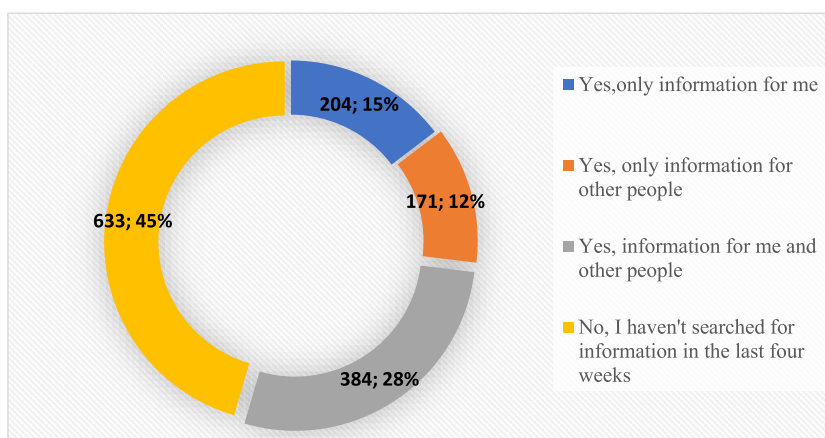
Fig. 2. Distribution of responses on whether students have searched the internet in the last four weeks for information on COVID-19.

Table 1
Online platforms used for searching COVID-19 information.

Platforms	High utilization, n (%)	Low utilization, n (%)
Search engines (e.g. Google, Bing, Yahoo!)	924 (66.4)	468 (33.6)
Websites of public bodies (e.g. Ministry of Health, Ghana Health Services, Food and Drug Authority)	684 (49.1)	708 (50.9)
News portals (e.g., news, TV stations)	669 (48.1)	723 (51.9)
Social media (e.g., Facebook, Instagram, Twitter)	663 (47.6)	729 (52.4)
Information shared via WhatsApp	636 (45.7)	756 (54.3)
YouTube	645 (46.3)	747 (53.7)
Wikipedia and other online encyclopedias	576 (41.4)	816 (58.6)
Blogs on health topics	576 (41.4)	816 (58.6)
Health portals	573 (41.2)	819 (58.8)
Websites of doctors or health insurance companies	573 (41.2)	819 (58.8)

Table 2
Specific topics searched for in the context of coronavirus.

COVID-19 related topics searched	Responses		Percent of Cases
	N	Percent	
Symptoms of coronavirus	390	23.9%	51.9%
Transmission routes of the coronavirus	261	16.0%	34.7%
Individual measures to protect against infection (e.g., hand washing tips)	234	14.4%	31.1%
COVIDd-19 vaccines	216	13.3%	28.7%
Economic and social consequences of COVID-19	135	8.3%	18.0%
Dealing with psychological stress caused by COVID-19	99	6.1%	13.2%
The current spread of COVID-19 (e.g., the number of infected cases)	106	6.5%	14.1%
Current situation assessments and recommendations (e.g., Ministry of Information)	96	5.9%	12.8%
Restrictions (e.g., exit restrictions, stay-at-home orders)	93	5.7%	12.4%
Total	1630[a]	100.0%	216.8%

[a] Multiple responses (n = 1392).

Regarding the information-seeking behaviours, we also examined how satisfied the students were regarding information they found on the internet about coronavirus. It was revealed that most (*n* = 735, 53%) of the participants reported not being satisfied with the information found on the internet about coronavirus.

3.3. Association between DHL and the use of COVID-19 information platforms

The study also examined the association between DHL levels and utilization of specific COVID-19 information platforms. Table 3 presents the details of the results..

The results showed a significant association between DHL levels and the utilization of COVID-19 information platforms. Generally, students who had sufficient levels of DHL demonstrated minimal use of platforms like search engines (59.8%), Wikipedia (77.3%), social media (76.3%), Youtube (73.2%), Blogs on health topics (76.3%), WhatsApp (70.1%), and news portal (68%) (see Table 3). Meanwhile, a larger proportion of the students who had inadequate DHL was found to highly utilize these COVID-19 information

Table 3
Chi-square output for the association between DHL levels and use of COVID-19 information platforms.

Platforms		DHL Levels			Chi-square	p
		Inadequate DHL	problematic DHL	sufficient DHL		
Search engine	High Use	651 (74.3)[a]	156 (69.3)	117 (40.2)	114.92	<.001
	low use	225 (25.7)	69 (30.7)	174 (59.8)		
Websites of public bodies	High Use	360 (41.1)	126 (56.0)	222 (76.3)	111.08	<.001
	low use	516 (58.9)	99 (44.0)	69 (23.7)		
Wikipedia	High Use	411 (46.9)	99 (44.0)	66 (22.7)	53.66	<.001
	low use	465 (53.1)	126 (56.0)	225 (77.3)		
Social media	High Use	471 (53.8)	123 (54.7)	69 (23.7)	84.44	<.001
	low use	405 (46.2)	102 (45.3)	222 (76.3)		
Youtube	High Use	462 (52.7)	105 (46.7)	78 (26.8)	59.10	<.001
	low use	414 (47.3)	120 (53.3)	213 (73.2)		
Blogs on health topics	High Use	423 (48.3)	84 (37.3)	69 (23.7)	56.20	<.001
	low use	453 (51.7)	141 (62.7)	222 (76.3)		
WhatsApp	High Use	459 (52.4)	90 (40.0)	87 (29.9)	48.07	<.001
	low use	417 (47.6)	135 (60.0)	204 (70.1)		
Health portals	High Use	438 (50.0)	150 (66.7)	231 (79.4)	84.65	<.001
	low use	438 (50.0)	75 (33.3)	60 (20.6)		
Websites of doctors	High Use	453 (51.7)	141 (62.7)	225 (77.3)	60.77	<.001
	low use	423 (48.3)	84 (37.3)	66 (22.7)		
News portal	High Use	471 (53.8)	105 (46.7)	93 (32.0)	41.83	<.001
	low use	405 (46.2)	120 (53.3)	198 (68.0)		

[a] % within categories of DHL; df = 2.

platforms. Further, students who demonstrated sufficient levels of DHL were found to highly utilize websites of public bodies (76.3%), health portals (79.4%), and websites of doctors (77.3%).

4. Discussion

This study assessed secondary school students' digital health literacy, information searching behaviours, and satisfaction with online COVID-19 information in Northern Ghana. Specifically, our findings showed that SHS students exhibited inadequate levels of DHL with the relevance of the online information sub-domain recording the highest level of inadequate DHL and the least level of sufficient DHL. This finding is expected as previous studies have indicated a wide digital literacy (DL) divide in Ghana among younger people [40,41]. More so, among secondary school students amidst the COVID-19 pandemic, where the Northern part of Ghana is seriously underserviced in terms of reliable internet connectivity, digital infrastructure, and a wide gap in mobile device usage [41]. Once digital literacy correspondingly relates to DHL, a low digital literacy may affect DHL. One reason that may plausibly relate to the inadequate DHL among the students could be the poor integration and challenges in Information and Communication Technology (ICT) education in schools [42,43] as well as the restrictions on owing and usage of mobile phones by students in SHSs across Ghana [44]. Though similar studies among SHS students are rarely available, one study in South Africa also found low DHL among grade 12 (SHS) students [45]. Our finding contradicts previous findings in Slovenia [27], the USA [10], Denmark [24], the Philippines [30], Germany [19], Pakistan [13], and Vietnam [29]. The difference observed in our study and the studies compared could be that DHL can be affected by factors like age, health, education, background, digital competence, and information-seeking goals, and that how individuals seek information relevant to COVID-19 may differ by group [9,46]. Therefore, it is suggested that Ghana Education Service (GES) could allow students in SHS to own and use digital devices like mobile phones in a regulated manner in schools as their usage have the potential to help improve DHL and enhance learning.

Further, the present findings indicate that the majority of the students had not searched for information on the virus in the last four weeks prior to the data collection. Only few reported they had searched for information for themselves and others. This outcome affirms the poor DL of the students which may be due to lack of access to digital devices, inability to buy data, and fear to be caught with prohibited digital devices such as mobile phones which are the commonest and cheapest devices most students can possess. Many factors influence people's information-searching tendencies. Extant literature has shown that factors such as infomediaries as transmitters of digital skills to other household members, where households with a larger number of internet users generate positive externalities by encouraging new internet users [47] can enhance internet usage. Moreover, digital competencies enable information seeking, interaction with others, and access to government, commercial and health services among others [48]. As shown by Martínez-Domínguez et al. [47] and Alderete [49], the availability of electronic devices, such as computers, tablets, cell phones, and Smart TVs, fosters internet use. Besides, income is the economic barrier conditioning the diffusion of the internet [50], which is fundamental in Ghana, and more so, in Northern Ghana where most families are below the poverty index. Recently in Mexico, it was found high school students were challenged in internet usage due to a lack of telecommunication infrastructure, low socioeconomic status, geographical location, educational level, frequency of use, and school as a space that can facilitate DL among students [51]. This observation resonates the calls for the GES and the Conference of Headmasters of Assisted Secondary Schools (CHASS) in Ghana to reconsider their position of prohibiting students in SHS from possessing mobile phones within the school environment because it is distractive and counterproductive to quality education delivery and learning outcomes [52]. Although our study is not exhaustive and

not across all SHS in Ghana and Northern Ghana, other results showed that social media (e.g., Facebook, Instagram, Twitter) and WhatsApp though among the top five most utilised podiums, were the least reported for searches by students. Besides, lower-grade users of technology, including smartphone devices in Canada showed that students' use of DL devices such as mobile phones increases DHL which led to healthy life choices [53]. So, for infectious disease outbreaks such as COVID-19, the availability, access and freedom to use digital devices like phones in SHS, coupled with other DHL interventions could be beneficiary to the population's health. The government of Ghana, the GES, non-governmental organisations (NGOs) such as the telcos (e.g., MTN Foundation, Vodafone Ghana, Airtel/TIGO) and other education-based NGOs could work to improve digital technology devices and make them available and accessible to students in high schools across the country.

Most governments across the world, including Ghana implemented various response measures to the pandemic including; lockdowns as a preventive measure to break, reduce and control the transmission of the virus thereby embracing social and academic interactions online [54,55]. The task force and digital media platform engagements formed part of other government responses to the COVID-19 pandemic [55]. However, overreliance on specialised task forces may fail to meet the drastic demand of the population in urgent cases, such as the COVID-19 outbreak [56]. It is advisable, in such situations, to make prudent use of local organisations and on-site resources to ensure a sufficiently broad base workforce to respond quickly to the pandemic demands [56]. Though this public health action potentially benefitted the population [54], it has negative psychosocial impacts, exposed DHL gaps as well as the need to invest in the DHL of students to help in public health promotion among others. This call is because most COVID-19 information was published online. The Ministry of Health (MoH) of Ghana, the Ghana Health Service (GHS) and other international and academic institutions put out COVID-19 related information online. This path prompted most people, including students who desired to monitor and know the preventive practices to stay safe to go online for COVID-19 information. Our findings showed that the students used several platforms, although three predominant platforms were search engine portals, websites of public bodies (e.g. MoH, GHS, Food and Drug Authority), and news portals (e.g., news, and TV stations). The least used platforms were health portals and websites of doctors or health insurance companies. This finding is indicative of an inference, intention to search for health-related information relative to the COVID-19 pandemic, and the reason for searches at the MoH and GHS websites and news portals. This may be healthful as it enhances the DHL of the students and safeguards their health and utilization of certain health services such as the COVID-19 vaccines. This finding concurs with similar web search behaviour of students in other jurisdictions outside Ghana [19,24,30] where students were found to visit public base websites for information regarding COVID-19. For example, Htay et al. [30] found that the websites of doctors and insurance companies were the least searched platforms for COVID-19 information among university students in East and South-East Asia. This information gateway is good and worth encouraging among students as public-regulated websites are content censored with adequate and reliable content specific to issues, and free from COVID-related "infodemics". Another study in Vietnam highlights the extent of coverage of COVID-19 related information outlets during the pandemic, where "mass media and peer-educators" channels had a higher score of accessing COVID-19 information, compared to "organisations/agencies/associations" sources. Participants utilised most of their COVID-19 information via the "internet, online newspapers, and social networks" [57]. Besides, mass media, public health campaigns and outreach activities were deemed the most suitable means to reach communities with COVID-19 information in Uganda [58]. Gui et al. [59] also indicated social media such as Twitter as an effective outlet for the dissemination of risk information communication during the Zika-virus outbreak. It is also worth noting that though the demand for health information increased during the pandemic across various media outlets, the demand for each category of information differs from person to person based on the most current news on the epidemic, information about the disease symptoms and latest news on the outbreak [56]. This may therefore affect the appraisal and satisfaction or otherwise of the information sought at the site. What this study has uncovered for stakeholders in education and across all the divide to do, is to strategically use policies and school-based interventions, to improve health literacy and DL, which have a corresponding impact on DHL in times of disease outbreak [23]. Also, our findings highlight an urgent need to re-design training programmes and communication activities for more effective dissemination of information relative to the COVID-19 pandemic or epidemics in general. It further highlights the feasibility of collaborative mechanisms involving grassroots networks that will use on-site local resources across all geographical regions within Ghana targeted at various demographic groups and sensitive to individual needs and requests. This may help improve the health of the future workforce of Ghana as these students who may become digitally abreast, and health competent may sufficiently nose their way around websites for health-enhancing information, now, and in future pandemic situations. Also, in a digitally active world, as it is now, important websites should be integrated into schools' curricula and platforms that will create students' awareness. The lack of knowledge of the importance of certain websites may be the reason for students' inability to access them, though our study did not inquire about the students' source of knowledge of the websites visited. It is also plausible that the DHL and HL competencies might have influenced the online information-seeking behaviour of the respondents [10].

Notably, most of the participants reported not being satisfied with the information they found on the internet about coronavirus. This outcome implies that the students have appraised the information they sought from the internet and based on their level of health information literacy about the COVID-19 pandemic, found that, information retrieved were not adequate and satisfactory. This finding may signify that public health education and promotion on the COVID-19 pandemic had gone deep, positively affecting students in the study area. It may also be possible that they lacked confidence in the search content they found, hence their dissatisfaction. Notwithstanding the methodological differentials of our study with that of Nguyen et al. [29], both findings revealed respondents were unsatisfied with COVID-19 related information they encountered through similar online platforms. Similarly, Kor et al. [33] reported dissatisfaction with online information among persons with chronic diseases. On the contrary, some other scholars [13,30] found students to be satisfied with their search content. The dissatisfaction of the students regarding COVID-19 related information online, may lead to panic, anxiety, and depression. This situation may negatively impact their psychological well-being as they may become frustrated with the sort of information received online [60]. Already, previous studies have found the constant use of social media and

other online information sources for COVID-19 related information to increase anxiety among subjects [61]. So, if COVID related information gleaned from online sources is even more dissatisfying, it may result in amplified anxiety [62]. This link may sustain the spread of misconceptions and mistrust of preventive measures, including vaccine hesitancy among others [63]. Further, it may also be due to the lack of confidence in COVID-19 related information, the reason for their dissatisfaction as discovered in a similar study in China [32]. Students' satisfaction with COVID-19 health information is quintessential as it helps lower anxiety and stress levels and an overall psychological health outcome [60]. Wang et al. [60]showed that up-to-date and accurate health information (e.g., treatment, local outbreak situation) and particular precautionary measures (e.g., hand hygiene, wearing a mask) were associated with a lower psychological impact of the outbreak and lower levels of stress, anxiety, and depression [60]. Health information provided during pandemics such as COVID-19 needs to be evidence-based to avoid adverse psychological reactions. Through collaborative mechanisms involving intersectoral efforts at combating the COVID-19 pandemic were implemented and enhanced in Ghana [55,64], little on-site resources that are online base, especially in the study area could be cited for preventive measures. Educational institutions are encouraged to establish online psychoeducation intervention platforms during pandemic periods, to deliver lectures on the pandemic, build healthy social networks and provide reliable up-to-date information which has been found in other studies to be beneficial [60].

Furthermore, a significant association was established between DHL levels and the utilization of specific COVID-19 information platforms. Generally, students who showed high levels of DHL used platforms which had reviewed/professional content compared to those with low levels of DHL. This affirms the findings of Vrdelja et al. [27] study in Slovenia and Bak et al. [24] in Pakistan where students with sufficient DHL were found to conduct COVID-related searches across the internet platforms. However, Patil et al. [10] revealed that the level of DHL is independent of the HL information-seeking behaviour of participants. The implication of our finding underscores the need to increase the DHL of people since that correlates to the utilization and drive of COVID-19 related information-seeking behaviour. Current findings further highlight the need of training students in terms of health education and pandemic control measures, the need for digital health training both for students who would use digital tools for information seeking during pandemics. The training of health staff who would use digital tools to put out credible and evidence-based information for public consumption is also quite essential. For instance, UNFPA Ghana, together with the GHS during the pandemic, launched and trained the youth and health professionals on a web-based platform known as the Wawa Aba App meant to direct the youth to hospitals and health facilities during pandemic times such as the COVID-19 [64]. These initiatives are welcomed news if they can be replicated across academic institutions. Besides, the SHSs curricula at all levels could consider DHL and disease preventive measures to help enhance students' competence during pandemics. Stakeholders such as the GES could consider DHL a priority for students' health.

4.1. Strength and limitations

One major strength of the study is the use of a globally validated COVID-HL Questionnaire for SHS which was adapted to suit the Ghanaian setting for the first time during the COVID-19 pandemic. This study has revealed the DHL and HL levels of students in SHSs in the Savannah region of Ghana for stakeholders to put in the necessary interventions now and in the future to enhance health outcomes during disease outbreaks. The study, therefore, provides a base for further research across similar SHSs in Ghana. That notwithstanding, the cross-sectional nature of our study limits causal inferences. Identified findings should be noted with caution. Again, the study is limited to SHSs in the Savannah region of Ghana and cannot be generalized to all SHSs in Ghana.

5. Conclusion

Boosting SHS students' DHL and HL would help fight the negative effect of infodemic and enhance good preventive health practices. SHSs with sufficient DHL are better equipped to avoid misinformation from, e.g., different social media than students with limited HL who often use social media to search for health information. The GES should consider lifting the ban on SHS students possessing and using digital devices like smartphones in school environments to help boost their DHL, especially during pandemic situations. The GES, the GHS, the telecommunication networks and civil society organisations with an interest in education could collaborate to provide both HL and DHL interventions in schools and integrate digital training in the curricula of learners.

Institutional Review Board statement

The study was approved by the Institutional Review Board of the University of Education, Winneba, Ghana with document number DAA/P.1/Vol.1/39. Written informed consent was taken from all study participants before data collection.

Author contribution statement

Francis Sambah: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Frank Quansah: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Medina Srem-Sai, James Boadu Frimpong, John Elvis Hagan Jr.: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Edmond Kwesi Agormedah, Francis Ankomah: Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

Data will be made available on request.

Declaration of competing interest

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

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e17936.

References

[1] J. Pool, F. Fatehi, S. Akhlaghpour, Infodemic, misinformation and disinformation in pandemics: scientific landscape and the road ahead for public health informatics research, J. Public Health Inf. (2021) 764–778, https://doi.org/10.3233/SHTI210278. IOS Press.

[2] World Health Organization, Immunizing the public against misinformation, Available at: https://www.who.int/news-room/feature-stories/detail/immunizing-the-public-against-misinformation, 2020. Accessed June 10, 2022.

[3] H. Bao, B. Cao, Y. Xiong, W. Tang, Digital media's role in the COVID-19 pandemic, JMIR mHealth uHealth 8 (9) (2020), e20156, https://doi.org/10.2196/20156.

[4] A.K. Chan, et al., Social media for rapid knowledge dissemination: early experience from the COVID-19 pandemic, Anaesthesia (2020), https://doi.org/10.1111/anae.15057.

[5] J. Zarocostas, How to fight an infodemic, Lancet 395 (10225) (2020) 676, https://doi.org/10.1016/S0140-6736(20)30461-X.

[6] T. Sentell, S. Vamos, O. Okan, Interdisciplinary perspectives on health literacy research around the world: more important than ever in a time of COVID-19, IJERPH 17 (9) (2020) 3010, https://doi.org/10.3390/ijerph17093010.

[7] L. Paakkari, O. Okan, COVID-19: health literacy is an underestimated problem, Lancet Public Health 5 (5) (2020) e249, https://doi.org/10.1016/S2468-2667(20)30086-4.

[8] N.D. Berkman, T.C. Davis, L. McCormack, Health literacy: what is it? J. Health Commun. 15 (S2) (2010) 9–19, https://doi.org/10.1080/10810730.2010.499985.

[9] C.D. Norman, H.A. Skinner, eHealth literacy: essential skills for consumer health in a networked world, JMIR 8 (2) (2006) e506, https://doi.org/10.2196/jmir.8.2.e9.

[10] U. Patil, et al., Health literacy, digital health literacy, and COVID-19 pandemic attitudes and behaviors in US college students: implications for interventions, IJERPH 18 (6) (2021) 3301, https://doi.org/10.3390/ijerph18063301.

[11] M. Duplaga, The determinants of conspiracy beliefs related to the COVID-19 pandemic in a nationally representative sample of internet users, IJERPH 17 (21) (2020) 7818, https://doi.org/10.3390/ijerph17217818.

[12] R. Van Der Vaart, C. Drossaert, Development of the digital health literacy instrument: measuring a broad spectrum of health 1.0 and health 2.0 skills, J. Med. Internet Res. 19 (1) (2017) e27.

[13] R. Zakar, et al., COVID-19 and health information seeking behavior: digital health literacy survey amongst university students in Pakistan, IJERPH 18 (8) (2021) 4009, https://doi.org/10.3390/ijerph18084009.

[14] J.E. Hagan Jr., et al., Gender digital health literacy gap across age: a moderated moderation effect on depression among in-school adolescents in Ghana during COVID-19, Psychol. Sch. (2023), https://doi.org/10.1002/pits.22942.

[15] S. Jung, S. Jung, The impact of the COVID-19 infodemic on depression and sleep disorders: focusing on uncertainty reduction strategies and level of interpretation theory, JMIR Format. Res. 6 (1) (2022), e32552.

[16] S.L. Lin, Generalized anxiety disorder during COVID-19 in Canada: gender-specific association of COVID-19 misinformation exposure, precarious employment, and health behavior change, J. Affect. Disord. 302 (2022) 280–292, https://doi.org/10.1016/j.jad.2022.01.100.

[17] F. Quansah, et al., COVID-digital health literacy and subjective well-being of students in Ghana: mediation-moderation analyses, Health Sci. Rep. 5 (6) (2022) 1–10.

[18] G. Verma, et al., Examining the impact of sharing COVID-19 misinformation online on mental health, Sci. Rep. 12 (1) (2022) 1–9.

[19] K. Dadaczynski, et al., Digital health literacy and web-based information-seeking behaviors of university students in Germany during the COVID-19 pandemic: cross-sectional survey study, JMIR 23 (1) (2021), e24097, https://doi.org/10.2196/24097 PMID: 33395396.

[20] C. Bouclaous, et al., Digital health literacy and online information-seeking behaviour of Lebanese university students, Eur. J. Publ. Health 31 (Supplement_3) (2021) ckab164-041.

[21] F. Britwum, et al., Assessing internet surfing Behaviours and digital health literacy among university students in Ghana during the COVID-19 pandemic, COVID 3 (3) (2023) 405–417, https://doi.org/10.3390/covid3030030.

[22] R. Rajah, M.A.A. Hassali, M.K. Murugiah, A systematic review of the prevalence of limited health literacy in Southeast Asian countries, Publ. Health 167 (2019) 8–15.

[23] R. Shaukat, M.A. Naveed, Health literacy of university students in covid-19 pandemic and infodemic: a Pakistani perspective, Libr. Philos. Pract. 4708 (2021) 1–10.

[24] C.K. Bak, et al., Digital health literacy and information-seeking behavior among university college students during the COVID-19 pandemic: a cross-sectional study from Denmark, IJERPH 19 (6) (2022) 3676.

[25] R. Rosário, et al., Associations between COVID-19-related digital health literacy and online information-seeking behavior among Portuguese university students, Int. J. Environ. Res. Publ. Health 17 (2020) 8987.

[26] O. Okan, et al., Coronavirus-related health literacy: a cross- sectional study in adults during the COVID-19 infodemic in Germany, Int. J. Environ. Res. Publ. Health 17 (2020) 5503.

[27] M. Vrdelja, et al., Facing the growing COVID-19 infodemic: digital health literacy and information-seeking behaviour of university students in Slovenia, Int. J. Environ. Res. Publ. Health 18 (16) (2021) 8507.

[28] H.C. Nguyen, et al., People with suspected COVID-19 symptoms were more likely depressed and had lower health-related quality of life: the potential benefit of health literacy, J. Clin. Med. 9 (2020) 965.

[29] L.H.T. Nguyen, et al., Digital health literacy about COVID-19 as a factor mediating the association between the importance of online information search and subjective well-being Among university students in Vietnam, Front. Digit. Health 3 (2021), 739476.

[30] M.N.N. Htay, et al., Digital health literacy, online information-seeking behaviour, and satisfaction of Covid-19 information among the university students of East and South- East Asia, PLoS One 17 (4) (2022), e0266276, https://doi.org/10.1371/journal.pone.0266276.

[31] M.K. Paasche-Orlow, et al., The prevalence of limited health literacy, J. Gen. Intern. Med. 20 (2005) 175–184.

[32] D. Zhang, et al., Online health information-seeking behaviors and skills of Chinese college students, BMC Publ. Health 21 (1) (2021) 1–9, https://doi.org/10.1186/s12889-021-10801-0.

[33] P.P.K. Kor, et al., Are people with chronic diseases satisfied with the online health information related to COVID-19 during the pandemic? J. Nurs. Scholarsh. 53 (1) (2021) 75–86.

[34] G.D. Israel, Determining Sample Size, University of Florida: Florida Cooperative Extension Service. Fact Sheet PEOD-6, 1992, pp. 1–5.

[35] K. Dadaczynski K, et al., Digitale Gesundheitskompetenz von Studierenden in Deutschland während der Corona-Pandemie. Ergebnisse einer bundesweiten Online-Befragung, Hochschule Fulda, Universitä t Bielefeld, Germany, 2020.

[36] C. Lorini, et al., Validation of the COVID-19 digital health literacy instrument in the Italian language: a cross-sectional study of Italian university students, Int. J. Environ. Res. Publ. Health 19 (2022) 6247, https://doi.org/10.3390/ijerph19106247.

[37] C. Lorini, et al., Health literacy in Italy: a cross-sectional study protocol to assess the health literacy level in a population-based sample, and to validate health literacy measures in the Italian language, BMJ Open 7 (11) (2017), e017812.

[38] E.K. Agormedah, et al., Assessing the validity of digital health literacy instrument for secondary school students in Ghana: the polychoric factor analytic approach, Front. Digit. Health 4 (968806) (2022) 1–12, https://doi.org/10.3389/fdgth.2022.968806.

[39] H. Chun, et al., Validating the digital health literacy instrument in relation to COVID-19 information (COVID-DHL-K) among South Korean undergraduates, Int. J. Environ. Res. Publ. Health 19 (2022) 3437, https://doi.org/10.3390/ijerph19063437.

[40] International Finance Corporation, Digital Skills in Sub-saharan Africa Spotlight on Ghana, 2019.

[41] W.F. Mohammed, What COVID-19 reveals about educational inequality in Ghana, retrieved from: https://www.aljazeera.com/features/2020/4/7/what-covid-19-reveals-about-educational-inequality-in-Ghana, 2020.

[42] M.V. Aikins, E. Arthur-Nyarko, Challenges facing information and communication technology implementation at the primary schools, Educ. Res. Rev. 14 (13) (2019) 484–492.

[43] A. Soma, I. Nantomah, R. Adusei, The Challenges Facing the Integration of ICT in Ghanaian Educational System: A Systematic Review of Literature, 2021, https://doi.org/10.20431/2349-0381.0810002.

[44] C.S. Aggor, et al., Mobile phone usage among senior high and technical school students in Ghana and its impact on academic outcomes–a case study, in: International Conference on Interactive Collaborative Learning, Springer, Cham, 2018, pp. 903–913.

[45] T.P. Gamede, Digital Literacy Among Grade 12 Learners at Centocow High School at Harry Gwala District, KwaZulu-Natal, South Africa (Doctoral Dissertation), 2022.

[46] D.N. Ortiz, Digital health literacy, in: Proceedings of the First Meeting of the WHO GCM/NCD Working Group on Health Literacy for NCDs, 2017.

[47] M. Martínez-Domínguez, J. Mora-Rivera, Internet adoption and usage patterns in rural Mexico, Technol. Soc. 60 (2020), 101226, 10.1016/.

[48] A. Scheerder, A. Van Deursen, J. Van Dijk, Determinants of internet skills, uses and outcomes. A systematic review of the second-and third-level digital divide, Telematics Inf. 34 (8) (2017) 1607–1624, https://doi.org/10.1016/j.tele.2017.07.007.

[49] M.V. Alderete, Examining the drivers of internet use among the poor: the case of Bahía Blanca city in Argentina, Technol. Soc. 59 (2019), 101179, https://doi.org/10.1016/j.techsoc.2019.101179.

[50] Z. Song, C. Wang, L. Bergmann, China's prefectural digital divide: spatial analysis and multivariate determinants of ICT diffusion, Int. J. Inf. Manag. 52 (2020), 102072, https://doi.org/10.1016/j.ijinfomgt.2020.102072.

[51] M. Martínez-Domínguez, I. Fierros-González, Determinants of internet use by school-age children: the challenges for Mexico during the COVID-19 pandemic, Telecommun. Pol. 46 (1) (2022), 102241.

[52] E. Bonney, We will stick to ban on mobile phone use in SHSs — CHASS. https://www.graphic.com.gh/news/general-news/we-will-stick-to-ban-on-mobile-phone-use-in-shss-chass.html, 2017.

[53] A. Hyman, et al., Testing a school-based program to promote digital health literacy and healthy lifestyle behaviours in intermediate elementary students: the Learning for Life program, Prev. Med. Rep. 19 (2020), 101149.

[54] Y. Lee, et al., Government response moderates the mental health impact of COVID-19: a systematic review and meta-analysis of depression outcomes across countries, J. Affect. Disord. 290 (2021) 364–377.

[55] B. Sarkodie, et al., Overview of preparedness and response to COVID-19 in Ghana, Ghana Med. J. 55 (2) (2021) 38–47, https://doi.org/10.4314/gmj.v55i2s.6.

[56] H.T. Le, et al., Feasibility of Intersectoral collaboration in epidemic preparedness and response at Grassroots levels in the threat of COVID-19 pandemic in Vietnam, Front. Public Health 8 (2020), 589437.

[57] B.X. Tran, et al., Coverage of health information by different sources in communities: implication for COVID-19 epidemic response, Int. J. Environ. Res. Publ. Health 17 (10) (2020) 3577.

[58] C.A. Fergus, et al., COVID-19 information dissemination in Uganda: perspectives from sub-national health workers, BMC Health Serv. Res. 21 (1) (2021) 1–12.

[59] X. Gui, et al., Understanding the patterns of health information dissemination on social media during the Zika outbreak, vol. 2017, in: AMIA Annual Symposium Proceedings, American Medical Informatics Association, 2017, p. 820.

[60] C. Wang, et al., Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China, Int. J. Environ. Res. Publ. Health 17 (5) (2020) 1729.

[61] J. Gao, et al., Mental health problems and social media exposure during COVID-19 outbreak, PLoS One 15 (4) (2020), e0231924, https://doi.org/10.1371/journal. pone.0231924.

[62] J. Xiong, et al., Impact of COVID-19 pandemic on mental health in the general population: a systematic review, J. Affect. Disord. 277 (2020) 55–64.

[63] S. Shahsavari, et al., Conspiracy in the time of corona: automatic detection of emerging COVID-19 conspiracy theories in social media and the news, J. Comput. Soc. Sci. (2020) 1–39, https://doi.org/10.1007/s42001-020-00086-5 PMID: 33134595.

[64] United Nations Ghana, United Nations support to the government of Ghana, Retrieved from:https://ghana.un.org/sites/default/files/202102/Bulletin%20No.%205_UN%20support%20to%20the%20Government%20of%20Ghana%20on%20COVID_Final%20%5B1%5D.pdf, , 2020.