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Leveraging the ability of the online health information seekers to find credible online sources

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A B S T R A C T

Background: The spread of misinformation about different health issues has become a growing threat nowadays. The process of identifying credible information became a real problem of high urgency. During the current pandemic of COVID-19, misinformation is not the only challenge, the infodemic is another serious consequence of growing digitization. **Objective**: The current study was designed to evaluate the effect of implementing a digital intervention training module, to educate participants about choosing credible online health information, according to the quality standards and protocols. **Methods:** This is a quasi-experimental study with pre/post-assessment comparisons. It took place between October 2019 and May 2020 with the recruitment of a group of 480 medical students, from the first three academic years, at the Faculty of Medicine. They were assigned to an intervention and a control group. The intervention group attended the digital health module, which was conducted online with both its theoretical and practical components. Participants responded to the pre- and post-online questionnaire through google forms, in addition to a post-intervention assessment. **Results:** Results showed post-assessment significant improvements in all items related to seeking online health information and the ability to check the credibility of such information, among the intervention group in comparison to the control group with p-value<0.05. **Conclusion:** The infodemic caused by COVID- 19 pandemic, with all its associated psychological pressure and panic due to misinformation, can be combated by improving the skills and abilities of online health information seekers to check the credibility of such information.

INTRODUCTION

Misinformation and lack of information reliability, carry a great risk to online health information seekers, due to the wide gap and disconnection between health promotion digital platforms and scientific validation and quality checking.[1] Misinformation is a real threat that can destroy public trust in governments and health authorities. It has been aggravated during the COVID-19 pandemic, which occurred in a highly connected world, to reach a broad range of spread in what WHO has called "an infodemic". Anxiety, confusion, and trust destabilizing are serious consequences of the COVID-19 infodemic. They represent a real public health challenge as regards COVID-19 control and mitigation measures.[2] Mistrust in the health authorities decreases capacities for decision-making and undermines public responses, especially during disease outbreaks or pandemics.[3]

The spread of non-credible information about different health issues threatens health outcomes. It took a new dimension with the creation of numerous web platforms and ubiquity of the Internet coverage, which enabled more individuals to search for online information.[4]

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With the great digital revolution and the enormous number of mobile applications, there is a lack of regulations and quality control measures. This has negatively impacted the users' ability to make the proper decision for choosing mobile applications.[5]

The problem is magnified due to the vulnerability of most Internet users, especially young information seekers, who lack the needed skills to evaluate and choose online health information.[6] Medical students use internet regularly, with a propensity for mobile devices, social networking, and text messaging. Although health information seeking is one of their primary purposes,[7] yet they usually do not depend on quality criteria when choosing online health information sources. The choice of some users can sometimes be based on the design and the quality of pictures.[8] This made testing the accuracy of the information and evaluating the sources by applying objective measures and using preset standards and criteria, highly crucial.[9]

Many studies and research explored factors affecting the process of online health information seeking.[1,4,10] Other studies emphasized the fact that focusing on the users would be more effective and less costly[5] and recommended applying strategy-based judgment techniques to reduce the negative effect of cognitive biases, which will enhance users' ability to evaluate and apply online information.[11] But to the best of our knowledge, there is a lack of studies focusing on providing Internet users with the knowledge and skills they might need to combat the infodemic threats. The current study was designed to cross such gap, by educating university students about the criteria and quality standards for choosing a credible source of online health information.

METHODS

A quasi-experimental study, with pre/post-assessment comparisons. Medical students from the first three academic years, at the Faculty of Medicine, Helwan University were recruited and assigned to the intervention or the control groups, using the simple randomization method. Participants were assigned to each group randomly once they agreed to join the study. The study took place over the period between October 2019 and May 2020.

Students in the 1st, 2nd, or 3rd years of the Faculty of Medicine, Helwan University, were enrolled if they fulfill the following inclusion criteria; having a digital device, having internet access, and agree to participate.

According to similar previous studies, a convenience sample of 250 participants in each group (intervention and control) was calculated, after considering an effect size of 0.295,[5] an estimated standard deviation of change in the outcome of 1.55, and an attrition rate 10 to 15%, with a confidence level of 95%.

Phases and Tools of the study: The study was implemented in four phases: preparatory, pre-intervention, digital module intervention, and post-intervention phase. During ***the preparatory phase***, a structured questionnaire form was designed to inquire about the participants' sociodemographic, health, and digital usage characteristics. The digital intervention module was also prepared during this phase. Questions about socio-demographic characteristics included three items: age, gender, and nationality. Participants were asked about suffering from health problems and the type of such health issues if present.

Due to the absence of a previously validated tool, questions for digital usage were validated according to expert opinion and reliability was checked by Cronbach's alpha test using SPSS. These questions were about: 1. Usage pattern (type of technology used frequently, preferred type of digital media,

Table 1: Digital usage characteristics among participant students (n=480)

	No.	%
Technological devices frequently used		
Mobile phone	422	87.9
Laptop	54	11.3
Desktop	4	0.8
Preferred digital media		
Applications	51	10.6
Websites	81	16.9
Social media	348	72.5
Using mobile health applications	170	35.4
Types of digital information*		
Lifestyle	314	65.4
Specific health problems	270	56.3
Diet	183	38.1
Checking the reliability of received messages	218	45.4
Checking the qualifications of the provider	186	38.8
Know the advantages of digital tools	113	23.5
Know the disadvantages of digital tools	94	19.6

** Total may count to more than 100% due to multiple responses given by participant students.*

using mobile applications as well as the type of online health information sought by the study participants.[12] 2. Participants' ability to decide which mobile application they can use and which health information they can trust by asking about checking the reliability of digital messages as well as checking the qualification of the provider. 3. Participants' knowledge about the advantages and disadvantages of using digital tools.[5]

Table 2: Digital usage characteristics among intervention group versus control group

	Intervention No. (%)	Control No. (%)	p-Value
Technological devices frequently used			
Mobile phone	141 (88.7)	122 (89.7)	0.646
Laptop	17 (10.7)	14 (10.3)	
Desktop	1 (0.6)	0 (0.0)	
Preferred digital media			
Applications	21 (13.2)	15 (11.0)	0.755
Websites	26 (16.4)	20 (14.7)	
Social media	112 (70.4)	101 (74.3)	
Using mobile health applications			
Yes	48 (30.2)	46 (33.8)	0.504
No	111 (69.8)	90 (66.2)	
Checking the reliability of received messages			
Yes	72 (45.3)	63 (46.3)	0.980
No	87 (54.7)	73 (53.7)	
Checking the qualifications of the provider			
Yes	63 (39.6)	53 (39.0)	0.909
No	96 (60.4)	83 (61.0)	
Know the advantages of digital tools			
Yes	39 (24.5)	31 (22.8)	0.024
No	120 (75.5)	105 (77.3)	
Know the disadvantages of digital tools			
Yes	33 (20.8)	26 (19.1)	0.035
No	126 (79.3)	110 (80.8)	

Digital Module Intervention Preparation started by choosing the suitable Learning Management System (LMS): which fulfilled the criteria of being easy to be used, allowing the needed number of participants, and allowing follow-up as well as audio and videos. The module content was written per the desired study objectives. Standards were simplified and written in both languages "English" and "Arabic". Audios for all lectures were recorded then edited and saved. A practical example of protective measures against Coronavirus was added with illustrative videos to emphasize the importance of referring to credible sources whenever such important information is needed. The module included 18 lectures,1 practical example illustrated in 2 lectures, and a complete assessment. The module was about 1 hour if taken at a time, but the participants were allowed to attend it at their own pace. It was made available for two weeks on the LMS.

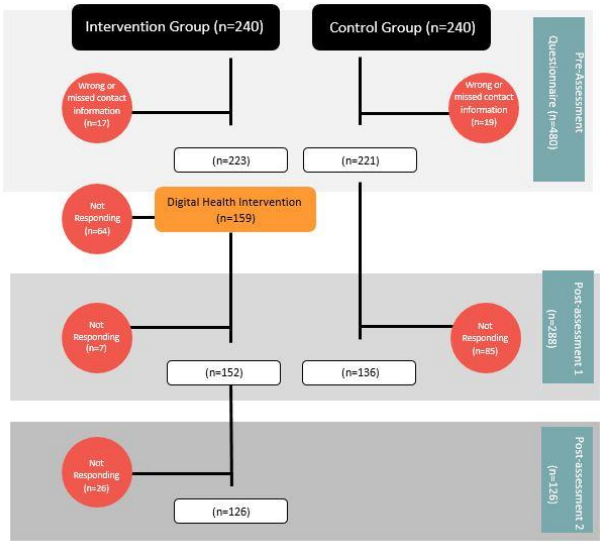

Figure 1: Actual study flow chart showing participant students' distribution on study phases.

During ***the pre-intervention phase***, participants were recruited by contacting the students' leaders through administrative authority at the Faculty of Medicine, Helwan University. The recruitment

started in March 2020 and ended in April 2020. Participants were then allocated into two groups, an intervention, and a control group, each has 240 students. Actual study flow chart showing participant students' distribution on study phases, refusal and drop out are illustrated (Figure 1). The digital module intervention allowed participants to receive a general introduction to: "Digital Health"

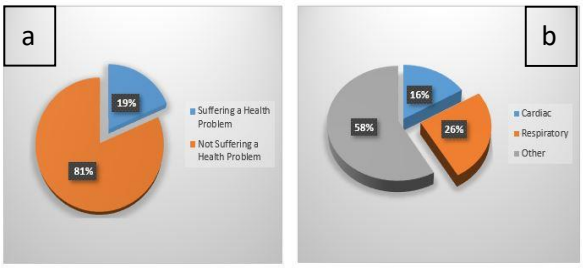

Figure 2: (a) Participants suffering from health problems (n=480) and (b) types of the health problems (n=86)

definition, impact, advantages, and disadvantages. They were trained on how to choose the suitable mobile application by using the evaluation framework of standards, which were driven from the quality principles modeled on ISO/IEC 25010 for health software and compiled by Albrecht et al. in their study.[5] They included: mobile practicality and usability, risk adequacy, legal standards, content validity, and technical adequacy. They were also trained on how to evaluate website messages by applying Information Quality Evaluation Guidelines derived from the DISCERN instrument which was used to evaluate text-based information quality. It included a set of items (e.g., content authority, content sources, objectivity, and content currency). By the end of the training module participants were eligible to take an immediate post-intervention assessment (post-intervention1) to evaluate the change in digital aspects that were included in the pre-assessment questionnaire. Another assessment was conducted 3 months later (post-intervention2).

Statistical Analysis: Responses to the self-administered questionnaire were gathered and saved into an Excel file, to be prepared for presentation and analysis. Package for Social Sciences (SPSS) version 23 was used for data analysis. Descriptive statistics were performed for all socio-demographic variables. Mean and SD were used for quantitative data, while number and percent were used for qualitative data. McNemar test was used to detect pre-intervention and post-intervention assessments (1 and 2) significant differences among the study groups with p value< 0.05.

RESULTS

A group of 480 medical students was recruited for this study. Their mean age ± SD (19.7 ± 1.3), and the females were slightly more than the males (50.8% and 49.2%, respectively). Most of them were Egyptians (88.7%). Most of the participant students (81%) were not suffering from any health problem, while (19%) were suffering from health problems. By asking about the type of health problems suffered by participant students, 86 responded and it was found that about a quarter of the respondents had respiratory diseases (26%), while (16%) had cardiac diseases and more than half of the participants (58%) had other diseases (including digestive problems, anemia, and diabetes) (Figure 2).

It was found that mobile phones were the most frequently used technological devices by participants (87.9%), as compared to laptops (11.3%) and desktops which were the least frequently used (0.8%). Most of the participants chose social media to be their preferable type of digital media (72.5%) over other types including websites which were preferred by (16.9%) and mobile applications which were preferred by (10.6%) only. Almost one-third of participant students use mobile health applications (35.4%). Among those who used mobile health applications (n=170), only (26%) tried to check the quality of the application before using it. Digital information about lifestyle was sought by almost two-thirds of the participants (65.4%), information about specific health problems was sought by more than half of the participants (56.3%), and diet-related digital information was sought by fewer participants (38.1%).

About half of the participants (45.4%) mentioned that they usually check the reliability of the digital messages they receive. About two-thirds of the participants reported that they check the qualifications of the digital message provider (61.3%). Less than a quarter of the sample knew about the advantages of digital tools (23.5%), while only one-fifth of the participants knew about the disadvantages of digital tools (19.6%) (Table 1). By comparing the digital usage among intervention and control groups, "knowing the advantages of digital tools" and "knowing the disadvantages of digital tools" showed statistical significance. (Table 2).

Results of digital usage analysis showed post-intervention significant improvements in the

following items: "checking the reliability of received messages", "checking the qualifications of the provider", "knowing the advantages of digital tools" and "knowing the disadvantages of digital tools" among the intervention group in both the immediate and the 3 months interval post-intervention (post-intervention1and 2). No significant changes were detected in any of the digital usage knowledge and

Table 3: Pre- and post-intervention 1 and 2 (immediate and after 3 months, respectively) assessments of digital usage knowledge and practices among the study groups

	Intervention Group			Intervention Group			Control Group		
	Pre (n=159)	Post 1 (n=152)	*p*-value*	Pre (n=136)	Post 2 (n=126)	*p*-value*	Pre (n=159)	Post (n=136)	*p*-value*
Checking the Reliability of Received Messages									
Yes	72 (45.3)	87 (57.2)	<0.001**	63 (46.3)	79 (62.7)	0.011 **	72 (45.3)	59 (43.4)	0.936
No	87 (55.7)	65 (42.8)		73 (53.7)	47 (37.3)		87 (55.7)	77 (56.6)	
Checking the Qualifications of the Provider									
Yes	63 (39.6)	81 (53.3)	<0.001**	53 (39.0)	72 (57.1)	0.005 **	63 (39.6)	43 (31.6)	0.165
No	96 (60.4)	71 (46.7)		83 (61.0)	54 (42.9)		96 (60.4)	93 (68.4)	
Know the Advantages of Digital Tools									
Yes	39 (24.5)	94 (61.8)	<0.001**	31 (22.8)	86 (68.3)	<0.001**	39 (24.5)	48 (35.3)	0.060
No	120 (75.5)	58 (38.2)		105 (77.3)	40 (31.7)		120 (75.5)	88 (64.7)	
Know the Disadvantages of Digital Tools									
Yes	33 (20.8)	81 (53.3)	<0.001**	26 (19.1)	73 (57.9)	<0.001**	33 (20.8)	34 (25.0)	0.522
No	126 (79.3)	111 (46.7)		110 (80.8)	53 (42.1)		126 (79.3)	102 (75.0)	

** McNemar Test, p-Value < 0.05 ** Direction of change whether improvement or worsening*

Table 4: Post-assessment (1 and 2) of digital usage knowledge and practices among intervention and control groups

	Post-assessment of Control Group (n=136)	Post-assessment 1 of Intervention Group (n=152)	*p* value*	Post-assessment of Control Group (n=136)	Post-assessment 2 of Intervention Group (n=126)	*p* value*
	No. (%)	No. (%)		No. (%)	No. (%)	
Checking the Reliability of Received Messages						
Yes	59 (40.4)	87 (59.6)	0.005	59 (42.8)	79 (57.2)	0.007
No	20 (74.1)	7 (25.9)		20 (64.5)	11 (35.5)	
Sometimes	57 (49.6)	58 (50.4)		57 (61.3)	36 (38.7)	
Checking the Qualifications of the Provider						
Yes	43 (34.7)	81 (65.3)	<0.001	43 (37.4)	72 (62.6)	<0.001
No	93 (56.7)	71 (43.3)		93 (63.3)	54 (36.7)	
Know the Advantages of Digital Tools						
Yes	48 (33.8)	94 (66.2)	<0.001	48 (35.8)	86 (64.2)	<0.001
No	48 (76.2)	15 (23.8)		48 (77.4)	14 (22.6)	
Not Sure	40 (48.2)	43 (51.8)		40 (60.6)	26 (39.4)	
Know the Disadvantages of Digital Tools						
Yes	34 (29.6)	81 (70.4)	<0.001	34 (31.8)	73 (68.2)	<0.001
No	59 (65.6)	31 (34.4)		59 (73.8)	21 (26.3)	
Not Sure	43 (51.8)	40 (48.2)		43 (57.3)	32 (42.7)	

*Significant differences are shown in bold *Chi-square Test of Significance*

Figure 3: (a) checking the reliability of the messages (b) checking the qualifications of the provider (c) know the advantages of digital tools (d) know the disadvantages of digital tools

practices upon analysis of pre and post-assessments of a control group (Table 3)

The intervention group performed significantly better than the control group on questions about "checking the reliability of received messages," "checking the qualifications of the provider," "know the advantages of digital tools," and "know the

disadvantages of digital tools" when the chi-square test was used to evaluate the immediate post-intervention (post-assessment 1) results of digital usage knowledge and practices. The results of evaluating the knowledge and practices surrounding digital usage three months after the intervention (post-assessment 2) using the same significance test (Chi-square Test) also demonstrated significance in the data pertaining to "Know the Advantages of Digital Tools," "Know the Disadvantages of Digital Tools," "Checking the Reliability of Received Messages," and "Checking the Provider's Qualifications," with p values of with better responses in the intervention group (Table 4). By comparing pre-intervention, post-intervention 1, and post-intervention 2 results, it was found that more positive changes occurred between pre-intervention and post-intervention2 than that between pre-intervention and post-intervention1 assessments (Figure 3).

DISCUSSION

In the current study, the effect of implementing a digital intervention training module, to educate participants about choosing credible online health information, according to quality standards and protocols, has been assessed.

The study has investigated some sociodemographic characteristics of medical university students including age, gender, and nationality. The participants' mean age ± SD was found to be (19.7 ± 1.3). During this stage (18-21 years old), youth are highly vulnerable. They are usually at risk of higher exposure to more challenges with a great impact on their health, than any other age group.[13] Females were slightly more than males (50.8% and 49.2%, respectively). Researchers reported that gender-being female- is one of the highly significant factors affecting online searches of health information.[10] In a study done by Jacobs, W. et al, exploring online and alternative sources for health information according to the consumers' seeking behavior, other factors were found to affect such behavior. Health conditions and health status perception were some of these factors. They found that individuals with risks of chronic diseases do not use the web as their primary source of information, but they turn first to their healthcare providers. This finding was explained by the researchers, as being attributed to the need of patients with chronic diseases for a high level of trusted and accurate information, in addition to other important details regarding their disease management which make them rely on their healthcare providers in the first place.[14] In the current study, the majority of the participant students (81%) were not suffering from any health problem, while (19%) were suffering from health problems. Information about specific health problems was sought by more than half of the participants (56.3%), which matched the findings in the Jacobs et al. study. It was also consistent with findings in a study conducted by Montagni I. et al. who reported that 64.5% of the participants were concerned with online information about illnesses,[15] and closer to findings of another study done in Kuwait, where 62.9% of the participants used the internet for the same purpose.[10] Regarding the digital usage characteristics among student participants, it was obvious that mobile phones were the most frequently used technological devices by participants (87.9%) This finding is not surprising due to the increase in the global and local rate of mobile phone ownership and usage. It also agrees with the "ICT Indicators Annual Report 2014–2018", where the reported percentage of individuals using cell phones was 95.7%. [(16)] This can be explained by the sociodemographic characteristics of the study participants, being a group of high internet users. This high percentage also reflects the great vulnerability of this group to misinformation if left without guidance for improving their digital communication awareness and skills. Most of the participants chose social media to be their preferable type of digital media (72.5%) over other types including websites and mobile applications. This percentage matches the percentage of individuals using social networks (78.3%).[16]

Different concerns and challenges related to the quality of online health information were identified in a study done by Skinner H. et al. Their study aimed at describing adolescents' usage of technology for their health information needs.[17] A series of subsequent studies explored the quality of digital health information, among which a study by Albrecht, U., et al., who investigated the perception of medical students to quality principles of health mobile applications as a step for their usage decisions. Their study showed that students were unable to identify the necessary quality information.[5] The current study findings about the ability of participants to identify digital tools quality principles including checking the reliability of the digital messages and the qualifications of the digital health messages provider have indicated that

although university students are good at using technology, they lack the skills which enable them to proper search and evaluate digital information. This is in line with the work of other studies conducted to assess the prevalence of misinformation exposure and beliefs, as stated by Lee et al. The study was concerned with COVID-19 misinformation exposure and its association with defective knowledge and fewer adoption of preventive practices. They highlighted the potential of COVID-19 misinformation to negatively affect the global actions and steps taken to face the COVID-19 pandemic.[18]

Another important finding was about students' awareness of the advantages and disadvantages of using digital tools, which showed a low level of knowledge. This gives insights into the students' need for guidance and support to be more competent at using digital tools in a way that ensures they get the most benefit and at the same time be protected from any harm they may be subjected to.

Students lack digital health literacy and depend mainly on their perception for choosing online health information,[6] and other studies recommended exerting efforts to improve digital literacy skills among adolescents.[19] In the current study digital health module intervention revealed significant improvements among the intervention group as compared to the control group upon analysis of pre- and post-intervention (immediate and after 3 months) assessments of digital usage including the ability to choose credible online information by checking the provider qualifications as well as the reliability of the information. More knowledge about the advantages and disadvantages of digital technology has been significantly improved. This matched the findings of Albrecht, U., et al., whose study showed that informing participants about digital information quality principles, caused a significant change in their perception towards such principles and in turn higher ability for usage decisions.[5]

CONCLUSIONS

Considering the present study, it can be concluded that university medical students are high internet users, who prefer using mobile phones and social media. They are more likely to seek online health information, yet they lack digital health skills which makes them vulnerable to the risks of misinformation. Digital health interventions targeted to enhance students' awareness about online health information quality and credibility are highly fundamental. They are a vital solution to the COVID-19 infodemic, aiming at improving public trust in health authorities, to guarantee better responses and more compliance to the decisions which are concerned with overcoming COVID-19.

Recommendations: It became a real priority to apply more interventions and provide tools to enhance their ability to choose credible sources of information and improve digital health literacy among such vulnerable group. The intervention can be replicated and tailored to target different groups to guarantee better outcomes as regards combating the infodemic and misinformation. Results of comparing pre-intervention, post-intervention1, and post-intervention2, showed that long-term follow-up among participants led to a better outcome. Such results highlighted the importance of designing future interventions across a longer period with close follow-up and feedback.

***Strengths And Limitations*:** Choosing medical university students as the study population is a point of strength because they are future healthcare providers who can communicate what they have learned to their peers and patients. The decision of using an LMS as a digital platform to implement the training intervention was a real practical step, which highly matched the study objectives to improve the participants' digital communication skills. Another great advantage was related to outreach and accessibility without physical contact, especially during the Covid 19 pandemic. Regarding the current study limitations, the difficult terms, and scientific standards, which were hard to be simplified and introduced to the students, were a big challenge. The high rate of dropout was considered another limitation, which could be explained by the COVID-19 consequences of lockdown and changing the location to areas without Internet coverage.

Ethical Approval

The study obtained all required approvals from the Institutional Review Board of the Faculty of Medicine, Cairo University. The study was carried out in accordance with relevant guidelines and regulations of the Helsinki Declarations of biomedical ethics.

Participants indicated consent to participate through a statement of agreement, at the beginning of the questionnaire after reading a full description of the study. Participants were assured that all their data will be highly confidential, with no disclosure of participant personal or social, or cultural details.

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***Author contributions*:** RH and HS made substantial contributions to the conception and design, analysis, and interpretation of data, and writing the manuscript. HS was involved in revising carefully for important content, analysis, conclusion, and recommendations. The authors read and approved the final manuscript.

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