Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 45 No. 2 (2024)

Unfolding Health Literacy among Adolescents: A Systematic Review in the Usage of Digital Information

Fei Wang*[1] Suhartini Ismail*[2]Ma. Theresa Salinda*[3], Cliff Richard T. Mabasa*[4] Wilfredo D. Quijencio Jr*[5] Orlane Marybhel D. Dimaunahan*[6] Daryl Jake S. Fornolles*[7] Reggie Mae D. Jasmin *[8]

[1]Far Eastern University, Graduate School, Manila, Philippines

[2]Assoc. Professor. Emergency and Critical Care Nursing Division, Nursing Department Faculty of Medicine, Universitas Dipoengoro, Java Indonesia*

[3]Far Eastern University, Institute of Health Sciences and Nursing, Manila, Philippines

[4]National University, College of Nursing, Manila, Philippines

[5]Far Eastern University, Institute of Health Sciences and Nursing, Manila, Philippines

[6]Far Eastern University, Institute of Health Sciences and Nursing, Manila, Philippines

[7]Far Eastern University, Institute of Health Sciences and Nursing, Manila, Philippines

[8]Tninity University of Asia, College of Nursing, Quezon City, Philippines

Abstract

Background: Health literacy is a crucial determinant for creating sound health decisions that are especially significant to improve the general state of public health and to achieve beneficial outcomes. In recent years, adolescents have faced challenges pertaining to their holistic well-being concerning the various plethora of health data accessible via the Internet. With the ongoing growth and transition to digital health information, this age group is expected to be potential key drivers in health data governance as they are known to be digital natives who are exposed to technological advancements since their birth. Consequently, understanding the level of their health literacy is vital as it prospectively indicates the future health condition of society

Objective: This study aims to s to inform people about the health literacy of young people who use digital information. In addition, the objectives of this study are to recapitulate several scientific evidence that identifies the health literacy of adolescents in different settings, recognize the elements that affect their health literacy and understand the implications or results of this study's findings in regard to public health.

Methods: The process by developing a methodological framework for the review process, including the definition of the issue, creating research questions, executing a focused literature search, and using mixed-methods or qualitative data processing strategies to lessen risks of bias and error

Results: The result shows that were twenty (20) studies about the topic that were analyzed and generated three themes (1) Health Literacy of Adolescent (2)Usage of digital Information (3)Stakeholders' roles to health literacy of adolescents.Health literacy is highly multifaceted and immensely affected by various individual and environmental conditions. This should then be further magnified and be put into account as a basis for future research, policies, or strategies aimed at enhancing adolescents' health literacy.

Conclusion: This study showed the current issues and challenges that public health faces in ameliorating the e-Health literacy of adolescents and its impacts on society. Also, factors that contribute to adolescents' present health literacy condition were also enumerated and their interrelatedness was highlighted.

Keywords: *Adolescents, Digital, Health Literacy, Information*

1.Background

With the advent of the digital age, all kinds of information have been universally accessible to most of the global population through various technological advancements. This made a tremendous impact on the general knowledge of the public regarding different disciplines that pique their curiosity or interests. Digital devices such as smartphones, laptops, and tablets become alleyways for a free flow of information to various age groups, most specifically to adolescents who are much known as digital natives as they are exposed to digital technologies throughout their lives. According to a recent WHO report by Wong et al. (2021), 69% of the world's youth population, including adolescents (defined as people aged 10 to 19), are online, making them potential key drivers and empowered active agents for the adoption of health digital technology. Even though it is anticipated that they will understand how to access health information more clearly, it is still unclear how well-versed they are in using digital resources to access information on their health. The article by Park & Kwon (2021) highlights the limited number of studies that have measured the health literacy of adolescents, despite their increasing reliance on digital health information. This is concerning because adolescence is a critical period for developing health literacy skills and habits. Research suggests that adolescents generally have lower levels of health literacy, with only 35% of Taiwanese adolescents found to have sufficient health literacy. Disadvantaged adolescents with limited English proficiency may face even greater challenges in accessing digital health information due to socioeconomic factors. It is important to address the issue of health literacy among adolescents, given their reliance on digital media for health information. While digital platforms provide greater availability and convenience, there is also a risk of encountering misinformation and adopting ineffective health practices. Therefore, efforts to improve health literacy among adolescents should consider their unique needs and provide targeted interventions to promote accurate and effective health behaviors The ability and motivation of a person to acquire, comprehend, and use health information in a way that improves their well-being are reflected in their intellectual and social abilities, according to the WHO's definition of health literacy. It is a crucial variable to consider in health promotion, disease prevention, and healthcare improvement as it affects

how an individual can choose pertinent health decisions. Thus, with this context, one can derive that digital health literacy is the usage of electronic sources in seeking, understanding, and evaluating health information to give attention to or solve the health problems of an individual or a community. This rising trend had been of great significance in its implication for public health for it contributes to providing vast opportunities for developing preferable health outcomes through the enhancement of patient engagement (Free, 2013). Furthermore, adolescents currently face a range of health issues in sexual health such as increasing HIV cases in the youth and mental health problems like substance abuse, among others. It is also a vital developmental phase in establishing healthy behaviors about the holistic changes in their overall health that they could integrate into their adulthood (Sawyer et al., 2012). Indubitably, this age group would preferably use digital resources in accessing and consuming information for their learning or entertainment as it is of great convenience and is faster than scanning a book or hardbound resources. With their biological and sociological transitions along with the emergence of open and free access to knowledge about their health concerns available in ubiquitous social platforms like Facebook, Instagram, and TikTok, most of their queries get easily answered through only a scroll or a click. However, free access to health information through the Internet could also cause an upbringing of certain issues that entirely depend on adolescents' level of health literacy. According to Taba et al. (2022), adolescents with poor digital health literacy have higher risks of being misinformed which could potentiate undesired health consequences. With unregulated digital platforms, most of them could potentially fall and easily believe biased, inaccurate, and poor evidence-based health information that may result in a quick widespread of misinformation that causes negative health outcomes. For instance, the recent COVID-19 infodemic that happened which supports the notion that the utilization of web and social media could escalate health misinformation and stresses the necessity of having a high degree of health literacy in order to use online health information securely and efficiently (Zarocostas, 2020). Moreover, assessing the reliability of health information and tackling disinformation at its source remain challenging tasks given the fluidity and complexity of the Internet and digital platforms. (Swire-Thompson & Lazer, 2020). However, it still is as relevant and should be magnified with foremost importance as the risks and dangers that it induces not only affect adolescents but as well as most age groups concerning the health malpractices that they believe in which leads to an increasing risk of stress and mortality. Through only a click of a share button, a community could be in the demise of indecent health belief that affects their health and safety. Thus, this concern raises the issue that adolescents might lack the skills needed to evaluate the accuracy and quality of health information they find online, which could potentially have an impact on public health. For this reason, salient factors such as their socio-economic status and educational background must also be focused on in understanding their level of health literacy which plays a huge role in shaping their skills and knowledge of evaluating digital health information. As it offers thorough and integrative reviews to further clarify and comprehend the problem in its entirety, this paper review specifically contributes to the improvement and development of effective health literacy. Also, this study aims to apprise integral people such as policymakers, educators, public health practitioners, and future researchers who have an interest in this topic about the

level of health literacy among adolescents using digital information. Health misinformation among adolescents is a significant and prevailing public health issue, especially during these times of global health crisis that drastically affects the overall holistic health of people globally. Determining its factors and implications are crucial approach in successfully finding ways how to create and improve guidelines for the development of effective health literacy interventions that target specific subgroups of adolescents, and in enhancing the capacity to make wise judgments about one's health on the basis of reliable and accurate digital health information sources. Thus, the objective of this study is (i) to recapitulate several scientific evidence that identifies the health literacy of adolescents in different settings, (ii) to distinguish the factors that influence their health literacy, (iii) and lastly, to know the consequences or outcomes of the findings of this study in relation to public health.

2.Objective: This study aims to s to inform people about the health literacy of young people who use digital information. In addition, the objectives of this study are to recapitulate several scientific evidence that identifies the health literacy of adolescents in different settings, recognize the elements that affect their health literacy and understand the implications or results of this study's findings in regard to public health.

3. **Methods**

In this study, an systematic literature review method was employed to explore the current state of research on adolescents' health literacy and their utilization of digital health information. The process involved gathering relevant clinical investigations, including systematic reviews, cross-sectional surveys, and focus group studies. To identify relevant articles, the researcher began by examining the reference lists of existing systematic reviews in the field. This approach helped identify potential articles that met the inclusion criteria. Additionally, studies that specifically examined adolescents' health literacy in relation to factors such as gender, educational background, and socio-economic factors were considered, as they provided insights into the key variables influencing their ability to appraise digital health information. To maintain the focus of the study, research involving other age groups was excluded, as it was not relevant to the objectives. Given the relevance of the current pandemic, the researcher also considered aspects of adolescent health literacy related to the epidemic. The inclusion criteria included a time frame of the last ten years to ensure the review captured recent research. Language constraints were also taken into account to include studies published in languages accessible to the researchers. Electronic databases such as PubMed, Scopus, Web of Science, and Scielo were utilized to conduct a comprehensive search for relevant literature. Through this integrative literature review method, the researcher aimed to synthesize and analyze the findings from diverse studies to gain a deeper understanding of adolescents' health literacy and their engagement with digital health information.

3.1.DESIGN

Health literacy directly helps people to efficiently cope during health threats or health crises. However, the limits of the available instruments have an impact on the determination of a group's level of health literacy. Thus, most research concerning this topic is qualitative focus-

group studies or crosssectional surveys. Furthermore, this paper used an integrative review as it provided several literature reviews from various credible sources. Similarly, it utilized the Whittemore & Knafl (2005) process by developing a methodological framework for the review process, including the definition of the issue, creating research questions, executing a focused literature search, and using mixed-methods or qualitative data processing strategies to lessen risks of bias and error. This study's primary goal is to educate the public on adolescent health literacy, including its important components and consequences for public health care.

3.2.Search Strategy

The entire review was conducted using a search technique that complied with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standard (Page et al., 2021). The supplemental materials contained the PRISMA checklist. The literature was also searched electronically in the Google Scholar, PubMed/MEDLINE, ScienceDirect, Wiley Online Library, EBSCO, and Springer databases to find pertinent studies. The search was conducted using appropriate terms like "Digital Health Literacy of Adolescents," "Level of Digital Health Literacy Among Adolescents," and "Digital Health Information and Adolescent's Health Literacy." From the beginning through March 2023, an evaluation of every piece was conducted

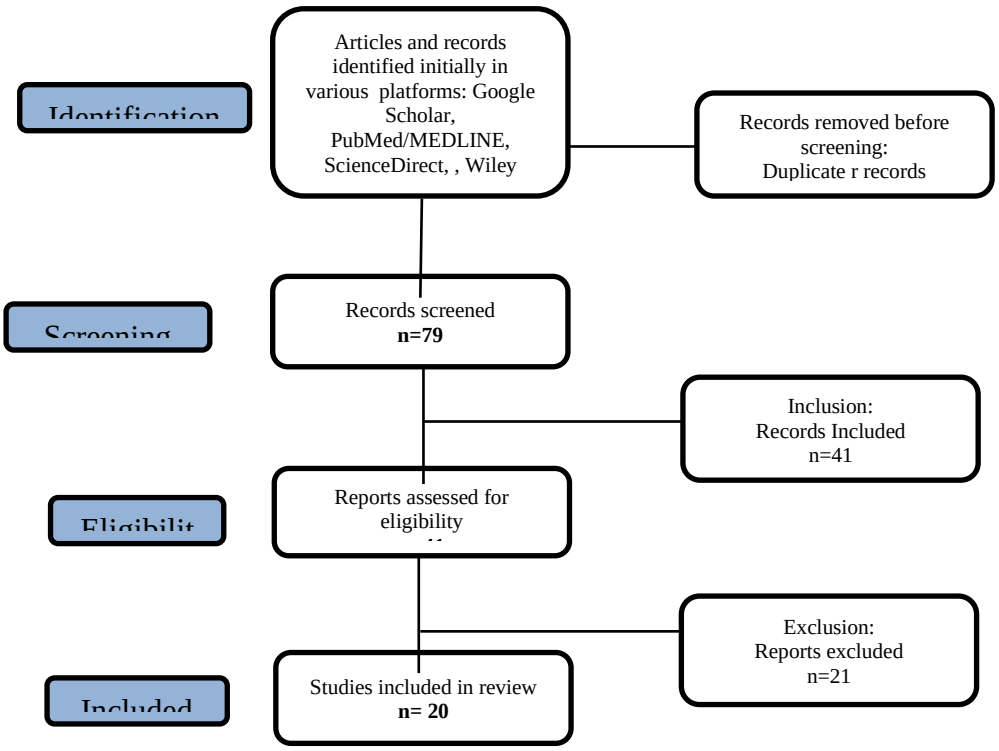

Figure 3. 1 PRISMA Flow Diagram

Moreover, the total number of studies were discussed using the PRISMA Flow Diagram that was utilized in the entirety of the integrative review. As seen in Figure 1, one hundred and ninety-two (192) studies were picked out, and ten (10) duplicates were removed. Moreover, twenty-two (22) studies were excluded as they were deemed irrelevant to the objectives of this study. Seventy-nine (79) records were then screened and forty-one (41) records were included in the basis of the inclusion criterion. These studies were then thoroughly analyzed for eligibility. Afterward, twenty-one (21) studies were excluded and only a total number of twenty (20) were finalized to be included in the review. Six (6) studies were qualitative, eleven (11) were quantitative, and three (3) were mixed methods. Additionally, the twenty-one (21) that were excluded were removed based on the result of a comprehensive screening, and the remaining twenty were considered to be part of the final records and reports incorporated in the review.

3.3. Inclusion And Exclusion Criteria

Studies assessing teenagers' health literacy utilizing data from diverse digital sources were included by the researcher. As a result, the following inclusion criteria were used to select all studies that present primary data using qualitative, quantitative, or mixed methods: (1) Teenagers between the ages of 12 and 18 must have participated, (2) it must have been published between 2019 and 2023 in the English language, (3) and it must have evaluated the health literacy of teens who have looked up health information on digital platforms. Also, systematic reviews in relation to the topic were also listed to further find relevant primary studies and no geographical exclusions were noted. Concerning the age range, studies that have a broader age bracket were still included under the condition that it still covers the determined 12-18 years and has not extended below the age of 10 or above 27. On the other hand, exclusion criteria are as follows: (1) studies that were done before 2019 and did not focus on the pre-determined and specified age group; (2) papers that are not published in the English language; (3) research that did not assess adolescents' digital health literacy and was not peer-reviewed.

3.4. Data Evaluation/ Quality Appraisal

Three unbiased reviewers independently screened and examined the collected literature. Disagreements were settled through meetings with several investigators until a firm consensus was reached, such as the paucity of concordance in the evaluation of study selection. Similar to this, during screening, the abstract and relevancy of the title of the collected papers were evaluated. We eliminated duplicate studies using Mendeley Reference Manager. The following details were then gathered from the reference literature: (1) the study design type, (2) the study location (state or country), (3) the sample size and population of the study, (4) and the common theme throughout the entire literature. All outcome variables were summed and aggregated using the Review Manager (RevMan) 5.4.1 software (Cochrane Collaboration) for a meta-analysis. Mantel-Haenszel was also applied to the analysis of dichotomous data, which was then depicted as the odds ratio (OR). The mean difference was then utilized to illustrate the continuous data, which was analyzed using the Inverse Variance technique. In addition, the I2 test was used to assess the heterogeneity of the data. If I2 was greater than 25%, the data were

deemed homogenous, and a fixed-effect model was employed. Begg's funnel diagram was implemented for assessing publication bias visually. During periods of publication bias, the trim-and-fill method was used to correct it. If the two-tailed p-value was less than 0.05, consideration of statistical significance was done. Lastly, a comprehensive table was employed for classifying the data which had been extracted from the database through the Sparbel & Anderson (2000) tool with the corresponding information: year of publication, author, aim, design, method, participants, and sample size, data collection and the findings of the study (Table 1). Expert reviewers were also invited to independently validate the table.

4.0 Results

Study, Location & Sample	**N**	**Age Range & Sex Distribution**	**Design**	**Data Collection**	**Analysis**	**Theme**
Loer et al. (2022) *Germany* Nonclinical sample from four German federal states attending grammar school	24	13-17 years old *Male: 11 (45.8 %)* *Female:12 (50%)*	Qualitative	Focus groups	Content analysis	Examine adolescent pandemic-related health literacy in the context of various components
Fleary & Joseph (2020) *United States* Nonclinical sample from a school setting	37	14-20 years old *Male: 5 (13.5%)* *Female: 32 (86.5%)*	Qualitative	Focus groups	Thematic analysis	How adolescents perceive and use health literacy in creating sound health decisions
Çınar Özbay,	1082	14-18 years old	Quantitative	Sociodemographic	Statistical analyses	Relation between social

Boztepe & Özcebe (2022) *Turkey* Nonclinical sample from different socioeconomic settlements		*Male: 606 (56.0%)* *Female: 476 (44.0%)*		questionnaire & survey	(t-test, one-way ANOVA (Analysis of Variance) test & linear regression model)	and economic determinants and e-heath literacy levels of adolescents and their decision-making skill
Park & Kwon (2021) *United States* Nonclinical sample from youth community centers and universities	34	10-18 years old *Male: 17 (50%)* *Female: 17 (50%)*	Qualitative	Cognitive interviews	Miles & Huberman 1994 qualitative data analysis	Assess the usability and content validity of a Digital health literacy instrument (DHLI) among adolescents.
Maitz et al. (2019) *Austria* Nonclinical sample from secondary school	14	12-14 years old *Male:(57.1 %)* *Female: 8 (42.9%)*	Quantitative	Survey	Descriptive statistical analyses	Examine the disparity between the actual and internet-based literacy levels of infants and adolescents
Korkmaz Aslan et al. (2021) *Turkey* Nonclinical sample	409	14-19 years old *Male:243 (59.2%)* *Female:166 (40.6%)*	Quantitative (cross-sectional)	Questionnaire	Statistical analyses (Multiple regression analysis)	Determine the relationship between adolescents' e-health literacy and their

from high school						health behavior
Taba et al. (2022) *Australia* Clinical sample from multiple avenues such as the Children's Hospital at Westmead	21	12-17 years old *Male: 5 (24%)* *Female: 16 (76%)*	Mixed method	Survey, health information search task & semi-structured interviews	Quantitative analysis, observational checklist & thematic analysis	Compare the digital health literacy and self-efficacy of adolescents with their capacity.
Pendl, Maitz & Gasteiger-Klicpera (2022) *Austria* Nonclinical sample from secondary schools	544	11-16 years old *Male: 295 (54%)* *Female: 249 (46%)*	Quantitative	Survey	Statistical analyses (Kolmogorov–Smirnov tests, Spearman, Pearson, point-biserial correlations & hierarchical regression analyses)	Distinguish individual and socioeconomic influences on the health literacy of secondary students.
Guo et al. (2020) *China & Australia* Nonclinical samples	770	11-17 years old *Male: 430 (55.8%)* *Female: 340 (44.2%)*	Quantitative (cross-sectional)	Questionnaire	Statistical analyses (Descriptive statistics, t-test, ANOVA, nonparame	Cross-cultural differentiation of adolescent health literacy in Beijing and Melbourne

from university					tric test & multivariate analysis)	
Riiser et al. (2022) *Norway* Nonclinical sample from higher secondary schools	17	16-18 years old *Male: 8 (47.1%)* *Female: 9 (52.9%)*	Qualitative	Survey and focus groups	Content analysis	Explore how adolescents' access and utilize pandemic-related information online
Quansah et al. (2022) *Egypt* Nonclinical sample from senior high schools	1392	14-25 years old *Male: 702 (50.4%)* *Female: 654 (47.7%)* *Diverse: 26 (2.6%)*	Quantitative	Questionnaire	Statistical analyses (correlational analysis, Pearson-product moment correlation & simple mediation and moderation analyses)	Assessment of the direct relation of adolescents' COVID-related digital health literacy and their well-being
Ustuner Top & Yigitbas (2020) *Turkey* Nonclinical sample from secondary schools	326	14-19 years old *Male: 167 (51.2%)Female: 159 (22.7%)*	Quantitative (cross-sectional)	Sociodemographic questionnaire, survey & face-to-face interview	Statistical analyses (Chi-square test, Mann Whitney-U test and Kruskall Wallis tests)	Determine the e-Health literacy levels of adolescents from diverse socioeconomic backgrounds
Camiling (2019)	274	15-18 years old	Mixed method (explanator	Survey, focus group and	Descriptive statistics, thematic	Describe the state of e-Health literacy

Philippines Nonclinical sample from private and public schools		*Male: 128 (46.7%)* *Female:146 (53.3%)*	y sequential)	observational study	analysis, inferential statistics (Chi-square test, t-test)	levels among adolescents together with their actual and perceived e-Health literacy levels
Adewole et al. (2021) *Africa* Nonclinical sample from three local government areas	150	10-18 years old *Male: 32 (21.3%)* *Female: 118 (76.7%)*	Mixed method	Structured questionnaire and in-depth interview	Content analysis, statistical analysis (Pearson's correlation coefficient)	Compare the health literacy and health behaviors of obese adolescents to those of adolescents who are not obese
Raeside et al. (2022) *Australia* Nonclinical sample from an existing database of a previous cross-sectional study	32	13-18 years old *Male: 13 (41.0%)* *Female: 18 (56%)* *Prefer not to say: 1 (3%)*	Qualitative	Focus groups	Thematic analysis	Evaluate perceptions of adolescents in using digital platforms in seeking lifestyle health information
Park (2019) *South Korea* Nonclinical sample	784	Age range was not stated but indicated that the used tool was meant	Quantitative (cross-sectional)	Questionnaire	Statistical analyses (t-test, one-way ANOVA, and post-hoc test,	Determine the e-Health literacy of Korean adolescents and its

from middle schools		for 13-21 years old Male: 385 (49.1%) Female: 399 (50.9%)			Mann-Whitney U-test, Pearson correlation coefficient, multiple linear regression analysis)	influencing factors
Choi et al. (2021) *South Korea* Nonclinical sample from middle schools	138	Age group was not specified but population are first grade to third grade middle students (approximately 12-15 years old) *Male: 44 (31.9%)* *Female: 94 (68.1%)*	Quantitative (correlational)	Questionnaire	Statistical analyses (Kolmogorov–Smirnov test, parametric analyses, t-test, one-way ANOVA test, Scheffépos thoctest, Pearson's correlation coefficients)	Identify the relationship between adolescents' eHealth literacy, their healthy lifestyle and awareness of pandemic infectious diseases
Alhodaib (2022) *Saudi Arabia* Nonclinical sample from secondary schools	2658	15-20 years old *Male: 1435 (53.9%)* *Female: 1223 (46.1%)*	Quantitative	Questionnaire-based survey	Statistical analysis (t-test)	Investigate the e-Health literacy of Saudi Arabian adolescents

Na, Jeong & Yang (2021) *South Korea* Nonclinical sample from middle schools	40	12-24 years old *Male:12* *Female: 28*	Qualitative	Semi-structured interview	Thematic analysis	Describe adolescent South Koreans' health literacy and information seeking behaviors
Eyimaya et al. (2021) *Turkey* Nonclinical sample from first-year university students	390	18-19 years old	Quantitative	Survey	Statistical analyses (Descriptive analyses, t-test, variance, Kruskal-Wallis, Mann-Whitney U and Pearson Correlation tests)	Differentiate adolescents' levels of e-health literacy and health lifestyle behaviors

Table 4.1. Qualities of Included Studies

These studies were conducted in various countries, including Germany, the United States, Turkey, Australia, China, Norway, Egypt, Austria, the Philippines, Africa, Saudi Arabia, and South Korea. The studies employed different research designs, such as qualitative, quantitative, and mixed methods, to examine various aspects of adolescents' health literacy One study by Loer et al. (2022) conducted focus groups with German grammar school students to explore adolescent pandemic-related health literacy. The researchers used content analysis to examine how adolescents perceive and engage with health information during the pandemic. Similarly, Taba et al. (2022) conducted a mixed-method study in Australia, comparing digital health literacy and self-efficacy among adolescents using surveys, health information search tasks, and semi-structured interviews. They employed quantitative analysis, observational checklists, and thematic analysis to gain insights into adolescents' capacity in utilizing digital health information. Several studies focused on the relationship between socioeconomic factors and

health literacy levels among adolescents. Çınar Özbay, Boztepe & Özcebe (2022) conducted a quantitative study in Turkey, utilizing sociodemographic questionnaires and surveys to examine the relationship between social and economic determinants and e-health literacy levels of adolescents. They employed statistical analyses such as t-tests, one-way ANOVA, and linear regression models to understand the impact of these factors on adolescents' decision-making skills. The studies by Guo et al. (2020) and Ustuner Top & Yigitbas (2020) investigated the e-health literacy levels of adolescents from diverse socioeconomic backgrounds in China, Australia, and Turkey. These studies employed questionnaires, surveys, and face-to-face interviews, and used statistical analyses including chi-square tests, Mann Whitney-U tests, and Kruskall Wallis tests to assess the relationship between socioeconomic factors and e-health literacy levels.

4.1. Health Literacy of Adolescent

The impact of the COVID-19 pandemic on adolescents' health literacy was explored in several studies. Riiser et al. (2022) conducted a qualitative study in Norway, utilizing surveys and focus groups to explore how adolescents' access and utilize pandemic-related information online. The implications of the reviewed studies on digital health literacy in adolescents have significant relevance in promoting and improving the health literacy of adolescents, both in traditional healthcare settings and in the digital realm.

They employed content analysis to examine the themes that emerged from the data. Quansah et al. (2022) conducted a quantitative study in Egypt, assessing the direct relation of adolescents' COVID-related digital health literacy to their well-being. The implications of the reviewed studies on digital health literacy in adolescents have significant relevance for nursing practice. Nurses play a crucial role in promoting and improving the health literacy of adolescents, both in traditional healthcare settings and in the digital realm.

4.2 Usage of digital Information

Assessment on the usability and content validity of a Digital Health Literacy Instrument (DHLI) among adolescents in the United States. (Park & Kwon (2021) They used qualitative cognitive interviews and qualitative data analysis to evaluate the instrument. Fleary & Joseph (2020) conducted qualitative focus groups in the United States to understand how adolescents perceive and use health literacy in making sound health decisions. They employed thematic analysis to identify key themes. Studies collectively contribute to our understanding of adolescents' health literacy and their utilization of digital health information. One study conducted in the Philippines by Camiling (2019) found that adolescents who are more inclined to read digital information based on its design tend to overestimate their e-Health literacy.

4.3 Stakeholders' roles to health literacy of adolescents

The collective effort of healthcare providers, educators, policymakers, and communities is essential in implementing interventions and policies that prioritize and address the factors influencing adolescents' health literacy. The findings highlight the importance of considering socioeconomic factors, the impact of the COVID-19 pandemic, and the usability of health

literacy instruments when designing interventions and initiatives to improve adolescent health literacy. The diverse research methods and analyses employed in these studies provide a comprehensive view of the multifaceted nature of adolescent health literacy across different countries and contexts. Numerous factors influence adolescents' health literacy when using digital information, and these factors often overlap and interact with one another. Educational attainment, economic status, diagnosed diseases, age, online reading habits, and healthy lifestyle behaviors are some of the key variables identified in the reviewed studies.

5.Discussion

The use of online health information by adolescents is a prevalent topic of interest in numerous studies. Several common themes have emerged regarding adolescents' perceptions and preferences when it comes to digital health information. It has been consistently found that adolescents are more likely to engage with and trust information that is presented in a clear, organized, and visually appealing manner (Raeside et al., 2022; Loer et al., 2022). The design and aesthetics of websites and online resources play a significant role in capturing their attention and maintaining their interest. However, it is important to note that relying solely on the design of health information does not guarantee the accuracy or extent of adolescents' health literacy. Drawn to aesthetically pleasing materials, their perception of their own abilities may not align with their actual literacy levels. This highlights the need to go beyond superficial factors and consider the broader aspects of health literacy, including critical evaluation and understanding of health information. For instance, low-income families may have limited access to digital devices and may face barriers in acquiring appropriate health literacy knowledge (Çınar Özbay, Boztepe & Özcebe, 2022; Quansah et al., 2022). Additionally, adolescents with diagnosed diseases, such as obesity, tend to have lower health literacy compared to their healthier peers (Park, 2019; Adewole et al., 2021). Age also plays a significant role, as adolescents' health literacy is expected to develop and improve as they grow, supported by factors such as online reading and healthy lifestyle behaviors. These findings highlight the interconnected nature of these factors and the need for a comprehensive approach to address adolescents' health literacy. The roles of various stakeholders, including healthcare practitioners, institutions, and policymakers, are crucial in promoting and enhancing the health literacy of adolescents. The findings consistently emphasize the importance of educational activities, programs, and workshops targeted at adolescents, particularly in the context of the increasing reliance on digital information due to the COVID19 pandemic (Choi et al., 2021). The integration of skill development and critical analysis in health education in schools is also advocated as a means to address the underlying causes of low health literacy. Furthermore, the development of assessment tools to evaluate adolescents' health literacy is highlighted as an area for further improvement Importantly, the findings underscore the inclination of adolescents to improve their health literacy and the need for collaborative efforts among healthcare providers, such as nurses, and community institutions. Co-designed approaches involving various stakeholders are necessary to effectively enhance adolescents' health literacy. In conclusion, the use of online health information by adolescents is influenced by various factors, including the design and presentation of information. However, it is crucial to consider

other dimensions of health literacy beyond aesthetics to ensure accurate understanding and critical evaluation. Factors such as educational attainment, economic status, diagnosed diseases, age, online reading habits, and healthy lifestyle behaviors interact and influence adolescents' health literacy. Stakeholders, including healthcare practitioners, institutions, and policymakers, play pivotal roles in promoting and enhancing the health literacy of adolescents. Educational activities, skill development, improved assessment tools, and collaborative efforts are essential for addressing the multifaceted nature of adolescents' health literacy and improving their decision-making skills.

Implication for Practice

As this review highlights the significance of adolescents' digital health literacy, its implications for practice greatly rely on how healthcare providers would utilize the findings of the studies in considering the potential impacts of having low health literacy in adolescents on public health. Thus, clinicians should be critically cognizant in posting health information on the Web as they should tailor their corresponding health data in accordance with the needs of adolescents, making it simple by using plain and easily comprehensible language and visual aids. More so, awareness of the potential barriers and facilitators such as socio-economic status, cultural background, and language proficiency that were consistently considered variables in the included studies must also be put into focus and utilized by public health officials in providing digital health information that is linguistically and culturally appropriate, while avoiding bias and stereotypes that may impact the adolescents' understanding of the health data. This paper accentuates the demand to promote health literacy among adolescents, resources, and tools could also be tailored on the basis of this study and in accordance with the needs of this age group, such as the creation of digital health apps or interactive health education programs. Similarly, healthcare providers must also aim to empower this population to take an active role and play their expected part as key drivers in health data governance by encouraging them to have a shared dialogue on various social media platforms that enhances good health behaviors and to ask queries and seek information in credible and reliable online sources, which then prospectively results to positive health outcomes.Firstly, nurses can utilize the findings of these studies to inform their own practice in disseminating health information. It is essential for nurses to be mindful of the specific needs and preferences of adolescents when providing health information online. This includes using clear and easily understandable language, incorporating visual aids, and tailoring information to be culturally and linguistically appropriate. By doing so, nurses can enhance the accessibility and comprehension of health information for adolescents, thereby improving their digital health literacy. Secondly, nurses can advocate for the development of resources and tools that address the unique needs of adolescents. This may involve collaborating with other healthcare professionals, educators, and technology experts to create interactive health education programs, digital health apps, or online platforms that engage and empower adolescents in their health journey. By leveraging technology and providing engaging digital resources, nurses can promote active participation and decision-making among adolescents, ultimately improving their health literacy and facilitating positive health outcomes. Furthermore, nurses can harness the potential of digital

health interventions to enhance health literacy in adolescents. This may include utilizing chatbots or mobile health apps to provide personalized health information, answer questions, and facilitate communication between healthcare providers and adolescents. By leveraging these digital advancements, nurses can create opportunities for ongoing engagement and support, improving access to healthcare services and fostering health literacy development. Lastly, nurses can collaborate with policymakers, schools, communities, and other institutions to create projects and initiatives that promote digital health literacy among adolescents. This may involve advocating for health literacy education in school curricula, supporting community-based health programs, and participating in policy discussions to address the broader social determinants of health literacy. By engaging in these collaborative efforts, nurses can contribute to the creation of a health culture that values and prioritizes digital health literacy, ultimately improving the overall health and well-being of adolescents. As this study highlights the potential role of digital health interventions in improving health literacy among adolescents, healthcare workers could also use this study as a foundation for utilizing technology as a leverage to interact and engage with people, via digital advancements like chatbots or mobile health apps. These interventions could improve the health literacy of adolescents and foster engagement and improve access of the general public to the healthcare system. In conclusion, the implications of the reviewed studies on digital health literacy in adolescents have significant implications for nursing practice. Nurses can play a vital role in tailoring health information, advocating for resources and tools, utilizing digital health interventions, and collaborating with stakeholders to promote and improve the digital health literacy of adolescents. By doing so, nurses can empower adolescents to make informed decisions, engage with healthcare services, and navigate the vast landscape of online health information effectively

Limitations and Recommendations

The limitations of this paper were mostly about the majority of quantitative research that was included in the final set of studies. Only a few amounts of mixed-method and qualitative research designs were highlighted; thus, the researchers recommend that the inclusion of various study designs should also be incorporated in future systematic reviews. Similarly, it also has not set any geographical exclusion criterion which leads to a broader scope of studies to be reviewed and analyzed. This results in a dispersed area of researched circumstances for adolescents' health literacy over the globe. Additional advice from the researcher focuses mainly on using this paper as a foundation for the development of future studies pertaining to the formulation of policies and health literacy interventions that aim to enhance adolescent health literacy using digital information in various settings.

To improve the digital health literacy of adolescents, several recommendations and activities can be proposed based on the findings and implications discussed. First, there is a need to develop comprehensive health education programs by collaborating with educational institutions. This collaboration would involve integrating health literacy education into school curricula and designing interactive and engaging activities that promote critical thinking, information evaluation, and effective communication skills regarding digital health

information. Second, fostering partnerships with digital platforms is crucial. Collaboration with social media platforms, websites, and health apps would ensure the dissemination of accurate and reliable health information to adolescents. These partnerships can encourage the development of age-appropriate content, implement fact-checking mechanisms, and provide resources for enhancing health literacy. Third, enhancing healthcare provider training, including nurses, is essential. Health literacy training should be incorporated into the education and professional development of healthcare providers. This training should focus on effective communication strategies, health information assessment, and the ability to address the unique needs and preferences of adolescents. Promoting media literacy skills among adolescents is another key recommendation. Educating adolescents about media literacy and critical evaluation of online health information is crucial. They should be taught to identify credible sources, recognize bias and misinformation, and understand the potential risks associated with sharing personal health information online. Engaging in collaborative partnerships is vital. Collaboration among healthcare professionals, educators, policymakers, and community organizations is necessary to develop initiatives that address the multifaceted factors influencing adolescents' health literacy. Workshops, seminars, or community events can be organized to promote health literacy and provide resources for adolescents and their families. Continuously evaluating and improving digital health interventions is important. Assessing the effectiveness of interventions targeting adolescents' health literacy and conducting research to identify innovative approaches, such as gamification or virtual reality, can enhance engagement, knowledge retention, and decision-making skills. Empowering adolescents as health advocates is a valuable recommendation. Encouraging active participation in their own health management and advocating for accurate and reliable health information is crucial. Supporting the development of youth-led initiatives, online forums, and social media campaigns that promote health literacy can empower adolescents to share their experiences and knowledge with peers. Promoting parental involvement is essential. Recognizing the role of parents and guardians in supporting adolescents' digital health literacy, providing educational resources, and organizing workshops can enhance their understanding of health information online. This will enable them to guide their children in navigating digital platforms safely. Furthermore, it is important to encourage further research.

Conclusion

This systematic and integrative review thoroughly discussed the up-to-date status and level of health literacy among adolescents who use digital information. This study showed the current issues and challenges that public health faces in ameliorating the e-Health literacy of adolescents and its impacts on society. Also, factors that contribute to adolescents' present health literacy condition were also enumerated and their interrelatedness was highlighted. Proposed interventions and suggestions of the reviewed studies were also summarized and have been underscored. Overall, adolescents' level of health literacy is highly multifaceted and immensely affected by various individual and environmental conditions This should then be emphasized more and taken into consideration as a foundation for future studies, regulations, or other initiatives that seek to raise adolescents' digital health literacy. Researchers should

explore additional factors and determinants influencing adolescents' health literacy, including cultural influences, socioeconomic disparities, and the impact of emerging technologies. This research will contribute to the development of evidence-based interventions and policies. By implementing these recommendations and engaging in targeted activities, healthcare providers, policymakers, educators, and communities can work collectively to improve the digital health literacy of adolescents. Ultimately, this will empower adolescents to make informed decisions, promote their well-being, and contribute to a healthier society as they transition into adulthood.

Declaration of Conflicting Interest

The authors declares there are no significant competing financial, professional, or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

Funding

No funding for this study.

Acknowledgments

The authors would like to extend gratitude to Dr. Elizabeth Baua, Dr. Jesus Pizarro for imparting us knowledge. To St. Paul University Philippines and Universitas Diponegoro, Indonesia for supporting us in our research work.

Authors 'Contributions

The authors have equally contributed writing all the part of the study until the final revision. TS did a data analysis and created the manuscript. SI conducted the critical review for all content of the manuscript.

Data Availability

All the data generated and analyze are available upon request from the authors.

Ethical Consideration

Not Applicable

References

[1] Adewole, K., Ogunfowokan, A. & Olodu, M. (2021). Influence of Health Literacy on Health Promoting Behaviour of Adolescents with and without Obesity. *International Journal of Africa Nursing Sciences*, 15. 100342. 10.1016/j.ijans.2021.100342

[2] Alhodaib, H. (2022). E-health literacy of secondary school students in Saudi Arabia. *Informatics in Medicine Unlocked*, 30(1): 100922. DOI: 10.1016/j.imu.2022.100922

[3] Amanu A, A., Birhanu, Z., & Godesso, A. (2023). Health Literacy Among Young People in Africa: Evidence Synthesis. *Risk management and healthcare policy*, 16, 425–437. https://doi.org/10.2147/RMHP.S399196

[4] Bak, C.K., Krammer, J.Ø., Dadaczynski, K., Orkan, O., von Seelen, J., Prinds, C., Søbjerg, L.M. & Klakk, H. (2022). Digital Health Literacy and Information-Seeking Behavior among University College Students during the COVID-19 Pandemic: A Cross-Sectional

Study from Denmark. *Int. J. Environ. Res. Public Health*, 19, 3676. https://doi.org/10.3390/ijerph19063676

[5] Camiling, M. (2019). eHealth Literacy of High School Students in the Philippines. *IAFOR Journal of Education*. 7. 69-87. 10.22492/ije.7.2.04

[6] Choi, S., Bang, K. S., & Shin, D. A. (2021). eHealth Literacy, Awareness of Pandemic Infectious Diseases, and Healthy Lifestyle in Middle School Students. *Children (Basel, Switzerland)*, 8(8), 699. https://doi.org/10.3390/children8080699

[7] Çınar Özbay, S., Boztepe, H. & Ozcebe, H. (2022). Inequality Among Adolescents in the Developing Countries is the Main Determinant of E-Health Literacy. *Acibadem Universitesi Saglik Bilimleri Dergisi*, 13. 10.31067/acusaglik.1059083

[8] Dudley, D. A., Van Bergen, P., McMaugh, A., & Mackenzie, E. (2019). The role of social media in developing young people's health literacy. In V. A. Goodyear, & K. M. Armour (Eds.), Young people, social media and health (pp. 147-161). (Routledge studies in physical education and youth sport). *Routledge, Taylor and Francis Group.* https://www.taylorfrancis.com/books/e/9781351026970/chapters/10.4324%2F9781351026987-13

[9] Eyimaya, A. Ö., Özdemir, F., Tezel, A., & Apay, S. E. (2021). Determining the healthy lifestyle behaviors and e-health literacy levels in adolescents. *Revista da Escola de Enfermagem da U S P*, 55, e03742. https://doi.org/10.1590/S1980-220X2020021603742

[10] Fleary, S. A., & Joseph, P. (2020). Adolescents' Health Literacy and Decision-making: A Qualitative Study. *American journal of health behavior*, 44(4), 392–408. https://doi.org/10.5993/AJHB.44.4.3

[11] Free C, Phillips G, Galli L, Watson L, Felix L, et al. (2013). The Effectiveness of Mobile-Health Technology-Based Health Behaviour Change or Disease Management Interventions for Health Care Consumers: A Systematic Review. *PLOS Medicine* 10(1): e1001362. https://doi.org/10.1371/journal.pmed.1001362

[12] Freeman, J. L., Caldwell, P. H. Y., & Scott, K. M. (2022). How Adolescents Trust Health Information on Social Media: A Systematic Review. *Academic pediatrics*, S1876-2859(22)00637-4. Advance online publication. https://doi.org/10.1016/j.acap.2022.12.011

[13] Guo, S., Yu, X., Davis, E., Armstrong, R., Riggs, E., & Naccarella, L. (2020). Adolescent Health Literacy in Beijing and Melbourne: A Cross-Cultural Comparison. *International journal of environmental research and public health*, 17(4), 1242. https://doi.org/10.3390/ijerph17041242

[14] International Communications Union. (2021). *Youth Internet use.* https://www.itu.int/itu-d/reports/statistics/2021/11/15/youth-internet-use/

[15] Korkmaz Aslan, G., Kartal, A., Turan, T., Taşdemir Yiğitoğlu, G., & Kocakabak, C. (2021). Association of electronic health literacy with health-promoting behaviours in adolescents. *International Journal of Nursing Practice*, 27(2). doi:10.1111/ijn.12921

[16] Lee, Y. H., Chen, C. Y., & Tsao, L. I. (2020). Digital health literacy among Taiwanese adolescents: A cross-sectional study. *Journal of Medical Internet Research*, 22(1), e15242

[17] Loer, A. M., Domanska, O. M., Stock, C., & Jordan, S. (2022). Exploring pandemic-related health literacy among adolescents in Germany: a focus group study. *Archives of public health = Archives belges de sante publique*, 80(1), 182. https://doi.org/10.1186/s13690-022-00937-9

[18] Maitz, E., Maitz, K., Sendlhofer, G., Wolfsberger, C., Mautner, S., Kamolz, L. P., & Gasteiger-Klicpera, B. (2020). Internet-Based Health Information-Seeking Behavior of Students Aged 12 to 14 Years: Mixed Methods Study. *Journal of medical Internet research*, 22(5), e16281. https://doi.org/10.2196/16281

[19] Na, K., Jeong, Y. & Yang, C. (2021). Exploring Cognitive, Affective, and Physical Aspects of Early Adolescents' Health Information Seeking Behaviors. *Journal of the Korean Society for Library and Information Science*, 55 (2), 289–324. https://doi.org/10.4275/KSLIS.2021.55.2.289

[20] Page, M.J., McKenzie, J.E., Bossuyt, P.M. et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Syst Rev 10, 89 (2021). https://doi.org/10.1186/s13643-021-01626-4

[21] Park B. K. (2019). Factors Influencing eHealth Literacy of Middle School Students in Korea: A Descriptive Cross-Sectional Study. *Healthcare informatics research*, 25(3), 221–229. https://doi.org/10.4258/hir.2019.25.3.221

[22] Park, E., & Kwon, M. (2021). Testing the Digital Health Literacy Instrument for Adolescents: Cognitive Interviews. *Journal of medical Internet research*, 23(3), e17856. https://doi.org/10.2196/17856

[23] Pendl, D., Maitz, K. M., & Gasteiger-Klicpera, B. (2023). Examining the relationship between health literacy and individual and sociodemographic factors in secondary school students. *Zeitschrift fur Gesundheitswissenschaften = Journal of public health*, 1–12. Advance online publication. https://doi.org/10.1007/s10389-023-01836-1

[24] Quansah, F., Ankomah, F., Agormedah, E. K., Abieraba, R. S. K., Srem-Sai, M., Hagan, J. E., Jr, Okan, O., Dadaczynski, K., & Schack, T. (2022). COVID-digital health literacy and subjective well-being of students in Ghana: Mediation-moderation analyses. *Health science reports*, 5(6), e916. https://doi.org/10.1002/hsr2.916

[25] Raeside, R., Jia, S. S., Redfern, J., & Partridge, S. R. (2022). Navigating the Online World of Lifestyle Health Information: Qualitative Study With Adolescents. *JMIR pediatrics and parenting*, 5(1), e35165. https://doi.org/10.2196/35165

[26] Riiser, K., Richardsen, K. R., Haraldstad, K., Helseth, S., & Torbjørnsen, A. (2022). "It's hard to keep a distance when you're with someone you really care about"-A qualitative study of adolescents' pandemic-related health literacy and how Covid-19 affects their lives. *PloS one*, 17(4), e0266510. https://doi.org/10.1371/journal.pone.0266510

[27] Sawyer, S. M., Afifi, R. A., Bearinger, L. H., Blakemore, S. J., Dick, B., Ezeh, A. C., & Patton, G. C. (2012). Adolescence: a foundation for future health. *Lancet (London, England)*, 379(9826), 1630–1640. https://doi.org/10.1016/S0140-6736(12)60072-5

[28] Smith, C., Goss, H. R., Issartel, J., & Belton, S. (2021). Health Literacy in Schools? A Systematic Review of Health-Related Interventions Aimed at Disadvantaged Adolescents. *Children (Basel, Switzerland)*, 8(3), 176. https://doi.org/10.3390/children8030176

[29] Swire-Thompson, B., & Lazer, D. (2020). Public Health and Online Misinformation: Challenges and Recommendations. *Annual review of public health*, 41, 433–451. https://doi.org/10.1146/annurev-publhealth-040119-094127

[30] Taba, M., Allen, T. B., Caldwell, P. H. Y., Skinner, S. R., Kang, M., McCaffery, K., & Scott, K. M. (2022). Adolescents' self-efficacy and digital health literacy: a cross-sectional mixed methods study. *BMC public health*, 22(1), 1223. https://doi.org/10.1186/s12889-022-13599-7

[31] Ustuner Top, F., & Yigitbas, C. (2021). E-health literacy level in adolescents in terms of some descriptive characteristics. *Annals of Medical Research*, 27(1), 0340–0347. Retrieved from https://annalsmedres.org/index.php/aomr/article/view/542

[32] Wong, B., Holly, L., Gray, W., & Kessel, R. (2021). Youth: Key Drivers of Digital Adoption and Health Data Governance. Eurohealth, 27 (2), 18 - 21. World Health Organization. Regional Office for Europe. https://apps.who.int/iris/handle/10665/352269

[33] Wong, C. A., Madanay, F., Ozer, E. M., Harris, S. K., Moore, M., Master, S. O., Moreno, M., & Weitzman, E. R. (2020). Digital Health Technology to Enhance Adolescent and Young Adult Clinical Preventive Services: Affordances and Challenges. *The Journal of adolescent health : official publication of the Society for Adolescent Medicine,* 67(2S), S24–S33. https://doi.org/10.1016/j.jadohealth.2019.10.018

[34] Wong, C., Madanay, F., Ozer, E., Harris, S., Moore, M., Master, S., Moreno, M. & Weitzman, E. (2020). Digital Health Technology to Enhance Adolescent and Young Adult Clinical Preventive Services: Affordances and Challenges. *Journal of Adolescent Health*, 67. S24-S33. 10.1016/j.jadohealth.2019.10.018

[35] World Health Organization. (2023). Improving health literacy. https://www.who.int/activities/improving-health

[36] Zarocostas J. How to fight an infodemic. Lancet. 2020;395(10225):676. Doi: 10.1016/S0140-6736(20)30461-X