DOES MEDIA USAGE ENHANCE NUTRITION LITERACY? A SYSTEMATIC LITERATURE REVIEW AND THEMATIC ANALYSIS

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ABSTRACT

The aim of this article is to show in-depth view about the potent of different media usage aid in enhancing nutrition literacy in society. In this review article, 25 studies were selected from the year 2010 to 2021 to identify the gaps and recent trends in media and nutrition literacy. The incorporated studies are selected from the databases- Science Direct, PMC, Sage, Taylor and Francis, and Willey as all of them are well established for their authenticity. The studies discussed are analysed quantitatively and thematically. In the quantitative phase, seven categories are defined and in the thematic analysis phase, four themes are extracted from the conclusion of each literature about various media harnessed to improve nutrition literacy. From the quantitative data and the thematic analysis, following media category are found: (1) Traditional media as a source of nutrition literacy; (2) Online media as a source of nutrition literacy; (3) Intervention of nutrition app as a source of nutrition literacy, and (4) Intervention of gaming as a source of nutrition literacy. Media usage is considered as a substantial avenue to improve nutrition literacy globally by researchers.

Keywords: Media Usage, Nutrition Literacy, Mobile App, Health Communication

INTRODUCTION

Media Technologies are the fastest medium to spread information among masses collectively and individually. People obtain new knowledge and information through new media technologies as well as from the other forms of media sources. Many prominent health institutions and health professionals believe media could play a vital role in promoting good health (Flora et al., 1989). In present world with highly advanced technologies, leading physical inactivity clearly visualize that for promoting optimal health, a balanced diet having low calories with diversified nutrition values is highly recommended (Chen et al., 2018).

Many consumers, especially women, seek nutrition supplement information from different sources like health professionals or friends but their most frequent source is media (Rowe & Toner, 2003). Nutrition information articles from newspapers, booklets and internet have positive influence towards adolescents' intake of food whereas radio commercials are the least successful (Freisling et al., 2009). It is revealed from last twenty years that print media and electronic media could play a pivotal role in health behavior (Goldberg, 2009)

Penetration of mobiles in developed and developing countries disseminated internet knowledge among people and increased usage of social media and mobile apps (Salehan & Negahban, 2013). mHealth is a primary factor of mobile technologies and hoped as one the best options for health communication and BCC (behavioral change communication) intervention to improve health system (Mildon & Sellen, 2019). Integration of smartphone apps is successful in improving nutrition knowledge and weight management (Coughlin et al., 2015).

In recent years, use of social media platforms like blogs, Wikipedia and different websites of social network by health professionals have increased substantially (Panahi et al., 2014). Social media is also accepted as a potential intervention in increasing healthy nutrition and introduction of new platforms comprising

health information and would inspire to improve good healthy behaviours (Chau et al., 2018).

Health is a paramount factor for humans to lead a successful life. The basic feature for healthy life is food, particularly consumption of necessary nutritious food. Many articles emphasize the importance of nutrition literacy for people. Here, media is a paramount factor for fast and regular communication.

In this study, efforts have been made to systematically analyse the connection between media and nutrition literacy from the selected past studies (2010 – 2021) and find out missing factors and gaps in the topic's recent literature. This systematic literature review gives answers to two research questions: 1. Does media usage have an impact in increasing nutrition literacy? 2. What are the academic gaps identified in the selected literature?

LITERATURE FINDINGS AND GAPS

In table 1, conclusion, findings and gaps identified in each selected study are described. This would help to improve the quality of study in this domain.

Table 1:

Sr. No.	Author/ years	Findings and Gaps
1	Byrd-Bredbenner et al., 2010	Television played a promising role in increasing nutrition cognizant among young girls. From findings of the study, major point noticed was content consideration because perception differs for every viewer and very little could be identified about individuals filters and meaning about construction of the visuals. The limitation of this study was that participants were viewers of a single program with no distraction; therefore, the findings cannot be generalized. Further research is needed with prominent nutritious and health messages including characters played in the advertisements to find the potential of television to improve nutrition cognitions and intended behavior.
2	Abdullah & Mal-Allah, 2011	Websites were the most frequently used source by female athletes for nutrition followed by magazines, regional newspapers, television, radio than medical doctors and nutritionists. Free access was the main reason for the girls to approach traditional and digital media more than human resource. No theory was involved in the study.
3	Ali et al., 2012	Elderly people for developed digital nutritional package gave positive responses and preferences. Incorporating appropriate guidelines with proper design is imperative, as understanding the content by elderly people would educate them, regarding healthy diets and make them experience positive interactive feel with the system. Research should be done with larger samples of different community with different demographic background for more relevant finding to evaluate the impact on wellbeing of community and society. No theory was involved in the study.
4	Duncan et al., 2012	In this study, intervention of online media and nutrition app showed a positive influence compared to base line survey result. There were not much improvement in physical activity literacy, nutrition behavior but there is a subsequent increase in nutrition literacy among intervention group. This positive response was an added advantage for further intervention by websites and mobile apps to improve nutrition knowledge among men. Only 90 samples were used that limits the study.
5	Coughlin et al., 2015	Smartphones were accepted as useful and cost-effective interventions for enhancing dietary habits and nutrition

		measurements, and indicating obesity among common people. Further research is needed to know about components of smart phone platforms effectiveness. Appropriate culturally tailored smartphone apps with research test are needed for people lagging in health literacy and non-English speakers.
6	DiFilippo et al., 2015	There are many apps available for nutrition information but their focus is more on weight loss and nutrition behavior than to disseminate in-depth and holistic information on nutrition. A significant number of people are using mobile apps frequently for various purposes. Base of usage of mobile app is increasing exponentially in recent times. However, studies availability in this area is limited. Therefore, further research is recommended on mobile apps with intervention of behavioral theories and new strategies.
7	Vandelanotte et al., 2016	The eHealth and mHealth were welcoming factors among people in dietary intervention. Around the year 2014, accessibility of internet among people of ethnic minorities, socially and economically backward is low. In this study, the eHealth and mHealth played promising role in increasing dietary habits and physical activity, and were also widely accepted and used by people. However, gradually, there was a substantial growth in use of smartphone and its technology, social media, mobile application and different platforms of digital media. Authors suggest going for higher level of research in the domain by intervening various behavioral and communication theories, and novel strategies for health information to reach large number of people.
8	Nour et al., 2017	Smartphone platforms were frequently used and accepted by young adults for nutrition information. They desired to have mobile apps for nutrition information, self-monitoring and games for motivation purpose. The study suggested more research in the application of new theories and strategies by consulting nutritionists for developing content and behavioral researchers for choosing appropriate theories.
9	Rose et al., 2017	Digital intervention for dietary habits is considered successful among adolescents. It is inexpensive, therefore, extensively used by them. This study mostly shows website based interventions followed by mobile apps, social media and gaming. Smartphone based interventions are very much accessible and convenient for regular touch. Authors suggest further research in performing higher level of trails on existing mobile apps for health to find behavior change among users. No theory was involved in the study.
10	Chau et al., 2018	Integration of social media along with mobile apps and gaming intervention for nutrition information produced a positive effect on adults and adolescents. The available studies in this area and usage of obsolete and rudimentary features of social media again limit this study. However, social media is still becoming amenable and fascinating among people and its intervention would be a promising feature for enhancing nutrition literacy. Authors suggest more research to be conducted in this domain using new creative features and familiar platforms to explore the potential of social media for nutrition information.
12	Hsu et al., 2018	Social media is a promising platform to improve nutrition behavior of adolescents, as it is a widely used medium. However, authors observed that studies reviewed by them were scare and social media platforms used in those studies were out of date and not

		enough to prove the long term continued adoption of nutrition behavior. Further research should be done focusing on contemporary and highly used social media platforms for better assessment of this domain.
13	Khoury et al., 2018	Mobile dietary apps are effective and have enough potential to improve nutritional outcome and weight loss of adults. Authors suggest that incorporation of additional behavioral theories along with counselling would give better benefits. The limitations include that the studies covered are from developed countries, therefore, the samples could not be generalized. The authors advocate that more research is needed.
14	Klassen et al 2018	Wide and frequent use of internet by young adults helped them to accept nutrition information delivered through social media. However, authors recommend more research to know about different social media platforms used by young adults. How to focus on a particular platform more effectively for peer and social support for choosing healthy food? No theory was involved in the study.
15	Loehmer et al., 2018	Accessibility of internet by rural Illinois people irrespective of social profile; and low-income people irrespective of place of residence were almost same. The participants' internet use for nutrition information varied depending on age where. Young adults' usage frequency was found to be more than middle-aged people were Text message, Facebook and e-mail were the most used platforms for nutrition information. Limitation of this study was that only participant's data of SNAP was taken, therefore, the results could not be generalized. Authors suggest more research to find out credibility of the information available in SMA_(text messages, face book, twitter, and websites). No theory was involved in the study.
16	Maher et al., 2018	Ubiquitous use of internet made everyone to explore nutrition information available in all online sources including Australian women as well. However, online sites are doubted for information inaccuracy sometimes. In this study, authors suggested that health professionals' stamp/ recognition or contribution would guide the women about authenticity of the online nutrition information they explored. The authors also recommended further research by increasing the sample size to extend the study's findings.
17	Nour et al., 2018	Social media and gaming integration for nutrition behavior and knowledge were considered as a new dimension of intervention and had positive impact in young adults. Long-term success range for gaming should be explored well to find engagement timing of users. The authors found that there were less number of available studies on social media and gaming associated with nutrition outcomes and knowledge. Therefore, the authors recommended further research on evidence based novel strategies for diffusion of more nutrition education and intervention, and to get clarity about this domain. The authors also suggested exploring model with intervention of other theories other than behavioral theories.
18	Dunne et al., 2019	Sports nutritionists' usage of social media was high in prevalence and found benefits for providing service effectively. WhatsApp and Facebook were the most used platform. Authors suggested that good training to the nutritionists could be beneficial to communication process. Adding the network with innovative intervention and platforms with credible information would help the nutritionists to communicate with players during training/

		practice, on tour and during rest period.
19	Tallon et al., 2019	Technology intervention through websites, text messaging and gaming had good impact in gaining nutrition knowledge and is cost effective, practical and attractive for school students. Authors hypothesized developing tailored interventions and strategies with theoretical components and practical skills facilitate adolescent interaction more conveniently. Lesser studies with heterogenic intervention components including inclusion and exclusion criteria limit the study. No theory was involved in the study.
20	Vander Wyst et al., 2019	Access to social media by adolescent pregnant women was high and could not find much change in acquiring knowledge and diet. Larger studies are needed to be done in this domain as social media have potential to reduce health risk for women. Usage of sample from just single clinic was the drawback of this study because the results could not be generalized then. Authors recommend that further effective parameters for health and nutrition should be included in social media intervention.
21	Chow et al., 2020	Gaming approach for improving eating habits of children was highly effective with positive outcomes. However, gaming integration had good impact in diet habits in short-term but long-term results and underlying mechanisms should be explored because gaming is a temporary entertainment factor. Further research was recommended by authors in the intervention of health practitioners and game developers for more knowledge and clarity.
22	Froome et al, 2020	Intervention of mobile gaming apps had a positive impact in nutrition knowledge of children. Data in this study hypothesized that implementation of mobile gaming app with long-term assessment of diet and healthy habits would help to understand the effectiveness of game intervention better. The limitation of the study was that particular gaming apps were used for the research. Authors suggested that more digital tools should be explored with behavior change techniques to get more clarity in this domain.
23	Griauzde et al, 2020	Social media has well influenced Hispanic mothers in feeding their child. Mothers having high access to social media and mobile technologies also desired its intervention for health information. Authors suggested introduction of novel strategies to reduce obesity and adopt proper diet. In addition, the authors recommended targeting highly used platform by mothers to give better intervention for health related information. No theory was involved in the study. The limitations was that the sample included only mothers who attended a particular health centre, therefore, findings could not be generalized for all Hispanic mothers.
24	Kundu et al., 2020	School going adolescents of Bangladesh prioritized and trusted family members for nutrition information followed by health workers, traditional media and online source. The reasons for online media not being in the top list included more reliability for information in other sources and low access to online media. Authors mentioned that in many studies, online media was considered as a successful medium for nutrition information and to enrich nutrition knowledge. However, students with different demographic backgrounds have different circumstances, which could influence their information seeking behavior for nutrition knowledge. The authors suggested further research to get more clarity about sources of nutrition information. Critically analysis of this study found that no behavior theories, health models or

		strategies were applied.
22	Samoggia et al., 2020	This study concluded that nutrition mobile apps play a promising role in enhancing nutrition behavior and knowledge. Promotion of mobile nutrition information apps could help consumers comprehensibly to buy and consume nutritious food. Limitation in this study was that convenient sampling and only a particular app was explored. Authors recommend further research by incorporating more nutrition apps with heterogeneous people with the support of nutritionist, app developers, marketing researchers, and behavior scientists for long-term positive results from the consumers.
25	Choi et al., 2021	Diet and nutrition apps were widely used by Korean people. Content and quality of the apps should not be judged by star rate shown for that particular app. Mostly, people choose apps depending on ratings; however, it was found that an app with high star ratings could show poor quality of information and content. App developers and nutritionists should work together consistently with the help of host platforms to improve the quality of information and parameters in the app. This would help to increase the plausibility for app users to gain appropriate understanding and knowledge for nutrition and diet. Limitation of this study included that apps with low ratings and behavioral theories were not included, and there was no categorization of people. The unit of analysis in this study was individual apps only. Therefore, authors strongly recommended more research considering people from different sociodemographic background and their app usage.

Author's Own Table

METHODS AND PROCEDURE

Inclusion / Exclusion Criteria

In this systematic literature, each research article was selected by considering the following factors:

- Articles only published in English language.
- Only research and review studies published from January 2010 to February 2021 are included to find recent development in the phenomena investigated.
- Articles regarding media (traditional media, digital media, and mobile apps) associated with nutrition information, knowledge and behavior.
- Book reviews, thesis/ dissertations, articles from magazines, websites, conferences, and newspapers are excluded.

Development of Web Strategy

Key terms like "media usage", "media consumption", "nutrition literacy", "mobile app", "nutrition knowledge", "nutrition awareness", "and nutrition behavior" were used to choose articles related to the topic. The pertinent technique to be noted is considering title, keywords and abstract to focus on studies relevant to our topic (Tamilchelvan & Rashid, 2017). This kind of strategy clearly visualized full and partial content available regarding media connected with nutrition.

Observation Protocol

In this study, the keywords mentioned in the above paragraph have been used to select relevant articles (research articles and review articles) from the databases of publishers like Science Direct, PMC, Taylor and Francis, Wiley and Sage. PRISMA (Preferred Record Items for Systematic Review and Meta-Analysis) method was used to filter and choose final articles for the present research.

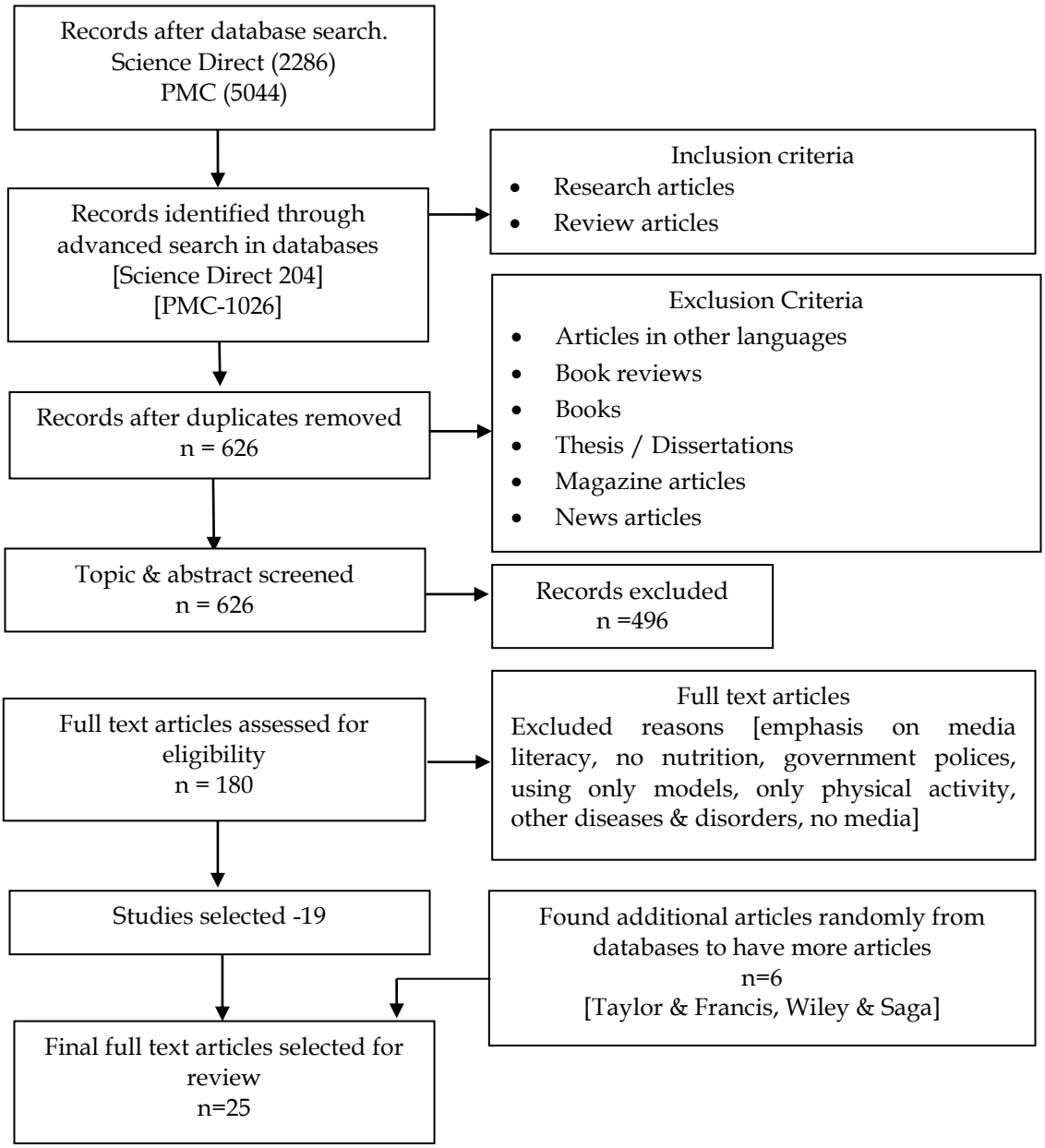
Steps followed for the systematic literature review are defined below:

- Keywords like 'media usage', 'media consumption', 'mobile app', 'nutrition literacy', 'nutrition knowledge', 'nutrition awareness', and 'nutrition behavior' were chosen.
- Following that, the search of studies was exclusively done in databases of Science

Direct, PMC, Taylor and Francis, Wiley and Sage to filter literature relevant to our study for analysis. To understand recent status of our topic, only relevant literature from 2010 to 2020 was selected. Considering the already mentioned inclusion and exclusion criteria, only 25 relevant articles were selected.

- After thorough analysis of the 25 articles, the quantitative part was classified with seven categories and 4 themes were extracted under qualitative part to analyse thematically.
- Results obtained from the analysed data of coding and classification visualized the strengths as well as weaknesses in the chosen studies.
- Finally, suggestions and recommendations were given by finding main academic gaps from the analysed results.

Following PRISMA flowchart explains the selection process of the 25 articles from the five databases:



Analytical Process

The two-step analytical process developed by Ahmed and Mathes (2017) was used in the present review. The two analytical processes used for analysis are Qualitative and Quantitative analysis. To understand the

recent trend of the topic and find gaps in the research conducted, quantitative analysis is the first step to be followed in this study, which answers research question no. 2. The second step is to answer research question no. 1 for which qualitative analysis is applied in which the extracted themes are investigated thematically from the analysed literature.
Main themes are identified from selected literature through qualitative analysis is role of different media in enhancing nutrition literacy

Quantitative Analysis Phase
In quantitative analysis, the first step was to code and categorize the studies as shown below:

- Journal and year of the article published
- Geographical region where the research was conducted
- Country of first author's affiliation during the publication time
- Research methods
- Data collection instrument: In this study subset, method by Abdullah & Osman (2017) for quantitative, qualitative and mixed methods have been chosen. The categories of quantitative methods are content based analysis, survey, mixed instrument (combines two or more instruments) etc. In addition, categories of qualitative phase are interviews, discourse or textual analysis, mixed instruments, etc. Studies with mixed methods were coded with quantitative and qualitative headings.
- Theoretical Lens: Studies selected for analysis has been examined for utility and usage of theory. Theories related to health, behavioral change and media consumption were elicited in the theoretical lens. Major theories found from selected studies were social cognitive theory, social network theory, ecological model of health behavior, trans-theoretical theory, self-efficacy model, model of persuasion, conceptual model, reinforcement theory, health belief model, entertainment education theory, theory of planned behavior, self-regulation theories, self-constructs of different theories, health behavioral theory, psychological model, theory of reasoned action, and theory of interactive technology. The code "theory employed" was used to represent the studies using one or more of the above mentioned theories. Similarly, the code "No theory employed" was used for studies using no theory.

Media usage categories in the selected studies:
The different media categories, Traditional Media (A), Online (B), Nutrition information app (C) and gaming (D) elicited for nutrition literacy enhancement in every study were mentioned. In the studies selected, either one of the media was used or studies having two or three media categories were jointly harnessed to find the positive association of media with nutrition literacy. Percentage of different media usage for the selected literature is analysed quantitatively.

Qualitative Analysis Phase
From the conclusion of each selected study, a theme were identified and thematically analysed.

FINDINGS AND DISCUSSIONS
In this systematic review, major objectives were to find the role of media usage in enhancing nutrition literacy, and to identify vital research gaps in the literature incorporated. In this section, results of the present study are explained and discussed.

Distribution (2010- 2020) & Journals
The average number of available studies is 2.08 per year for 12 years, which seems to be very low in rate. However, as seen in figure 1, the inclination is randomly increasing after 2015 (N= 2) and again shows a rise in 2017 (N = 2), 2018 (N = 7), 2019 (N= 3). The pandemic situation in 2020 (N = 5) and 2021 (N = 1) has taken a toll on research. There is a clear indication that limited number of research has been found on comprising media usage and nutrition knowledge in the last 2 years.

As people are becoming so much aware of chronic diseases, and idle and mundane lifestyle, they have started giving attention to their life style to change it to a healthy one. The list prioritizes consuming healthy and nutritious food. Therefore, more research should be conducted in upcoming years regarding the enhancement of nutrition literacy through different media. This kind of

research will constantly bring improvement in nutrition knowledge and behavior among people for healthy population.

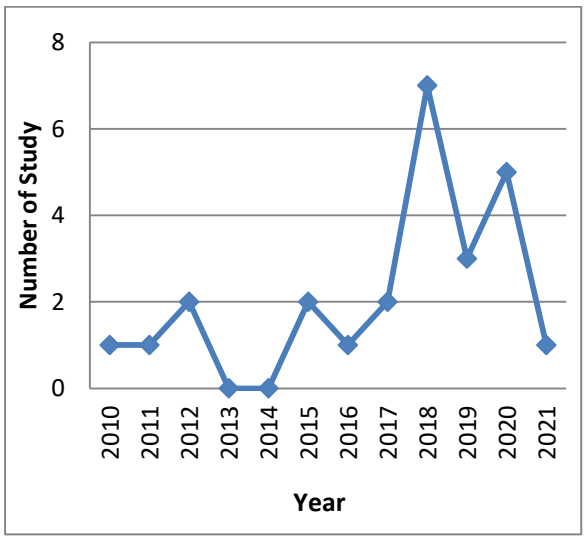


Figure 1. Research trends since 2010

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As the people are becoming so much aware of chronic diseases and idle and mundane lifestyle, they started giving attention on their life style to change for healthy lifestyle. The lists prioritize consuming the healthy and nutritious food. Therefore, more research will be conducted in the upcoming years regarding the enhancement of nutrition literacy through different media. This kind of research will constantly bring improvement in nutrition knowledge and behavior among people for healthy population.

Geographical area focused on

In this research, the geographical areas focused on are categorized into nine regions: South East Asia, South Asia, Middle East, America, Australia, United Kingdom and Worldwide. As per figure 2, large number of studies focused Worldwide (N = 11, 44%). America (N = 5, 20%) holds next position in the list followed by Australia (N = 3, 12%), and Western Europe (N = 2, 8%). South East Asia (N = 1, 4%), South Asia (N = 1, 4%), Middle East (N = 1, 4%) and the United Kingdom (N = 1, 4%) share equal number of studies.

According to the amalgamated studies' geographical distribution, many have been perceived in understanding and gaining knowledge about media usage and its association with nutrition literacy in regions like Europe and far East. In countries like Africa and Nigeria where nutrition problems are high in prevalence, there are no studies available in the recent years (2010- 2021) to represent the current scenario of people's nutrition knowledge and behavior in addition to media usage. Similarly, very few studies were found in Asia where malnutrition is a serious problem. In many underdeveloped and developing countries of Asia, severe acute malnutrition (SAM) is considered as a crucial problem and internal resources were mob (Ahmed et al., 2014).

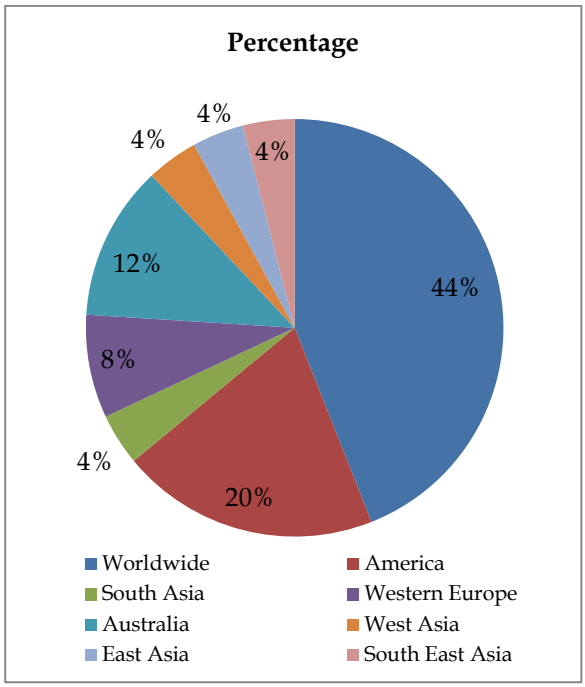

Figure 2. Geographical region focused in each paper

Country (First author's university affiliation)

In the present research, in case of two or more authors of a particular selected study, only the university affiliation of first author has been contemplated. Additionally, another factor to

be clarified is that countries' inner geographical regions are excluded.

In terms of a country's research production related to the concerned topic, the US (N = 8, 32%) stood at first place following by Australia (N = 7, 28%), and the UK (N = 2, 8%). Countries like Bangladesh (N = 1, 4.1 %), Canada (N = 1, 4.1 %), Denmark (N = 1, 4.1 %), Kuwait (N = 1, 4.1 %), Malaysia (N = 1, 4 %), Netherland (N = 1, 4 %), and Portugal (N = 1, 4 %) covered equal number of research studies.

As shown in Figure 3, except Australia and the U.S, other countries produced very less number of studies on media usage and nutrition literacy. The imperative point to be noticed here is that there are no research studies found in developing countries like African countries and India where malnutrition is a challenging problem until date. As per the phrase "health is wealth", a nation's prosperity lies on its healthy people. Therefore, conducting research in this area in the above mentioned countries would give more idea and knowledge to improve the communication and attain sustainable development goals. Different media usage for nutrition information could be investigated to know about authenticity of media nutrition information among people.

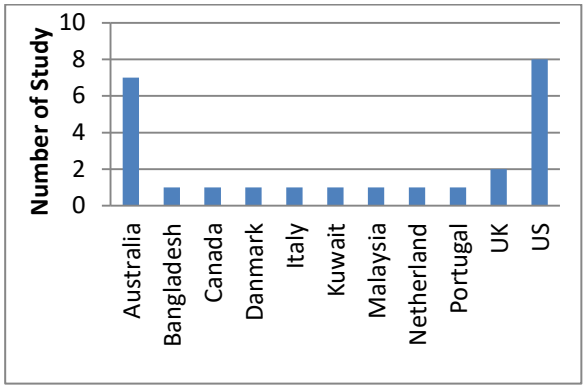

Figure3. Country of first author's research affiliation during the time of publication

Method used

Table 1 shows complete findings of quantitative analysis. Table 2 shows the three methods' prevalence and percentage used in the research. According to both tables, qualitative methods (N = 11, 44%) were used more than the other methods in the selected literatures for media usage and nutrition literacy usage. Quantitative methods (N = 7, 28%) and mixed method approach (N = 7, 28%) comprised similar number of studies.

Table1. Overview of the findings of quantitative screening

Sr. No	Authors/ Year	Focused Region	Affiliation	Method	Theoretical Perspective	Instruments used	Media usage: Traditional media (A), Online media (B), Nutrition apps (C), Gaming (D)
1	BYRD-BREDBENNER et al., 2010	US	US	Quantitative	Social cognitive theory, Cultivation Theory	Multiple	A
2	Abdullah & Mal-Allah, 2011	Kuwait	Kuwait	Quantitative	NA	Survey	A,B
3	Ali et al., 2012	Malaysia	Malaysia	Quantitative	NA	Survey	B
4	Duncan et al., 2012	Australia	Australia	Quantitative	Social Cognitive theory, self-regulation theory	Multiple	A,B
5	Coughlin et al., 2015	Worldwide	US	Qualitative	Social cognitive theory, self-regulation theories.	Content analysis	B,C
6	DiFilippo et al., 2015	Worldwide	US	Qualitative	Theory of planned behaviour, social cognitive theory	Content analysis	B,C
7	Vandelanotte et al., 2016	Worldwide	Australia	Qualitative	Model of persuasion, conceptual model, Persuasive system	Content analysis	B, C

Sr. No	Authors/ Year	Focused Region	Affiliation	Method	Theoretical Perspective	Instruments used	Media usage: Traditional media (A), Online media (B), Nutrition apps (C), Gaming (D)
					design model, Traditional behavior change theory		
8	Nour et al., 2017	Australia	Australia	Mixed	Psychological model, Behavioral change theory, Health behavioral theory	Other Survey	B,C,D
9	Rose et al., 2017	Worldwide	UK	Qualitative	NA	Content analysis	B,C
10	Chau et al., 2018	Worldwide	US	Qualitative	Trans-theoretical model of motivation, Theory of planned behavior, Attitude-Social Influence-Self-efficacy model, Theory of planned behavior, social cognitive theory, social network theory, ecological model of health behavior, Theory of interactive technology	Content analysis	B,C,D
11	Hsu et al., 2018	Worldwide	Australia	Qualitative	Social cognitive theory, Mentoring models, Attitude social influence and self-efficacy, Theory of interactive technology, Social learning theory, The public health promotion models.	Content analysis	B
12	Khoury et al., 2018	Worldwide	Netherland	Qualitative	Trans-theoretical theory, self-efficacy theory, self-constructs of different theories, theory of planned behavior	Content analysis	B,C
13	Klassen et al., 2018	Worldwide	Australia	Mixed	NA	Content analysis	B
14	Loehmer et al., 2018	US	US	Quantitative	NA	Survey	B
15	Maher et al., 2018	Australia	Australia	Qualitative	Grounded theory	Interview	B
16	Nour et al., 2018	Worldwide	Australia	Qualitative	Theory of planned behavior, Pender	Content analysis	B,D

Sr. No	Authors/ Year	Focused Region	Affiliation	Method	Theoretical Perspective	Instruments used	Media usage: Traditional media (A), Online media (B), Nutrition apps (C), Gaming (D)
					model of health, promotion that integrates expectancy, Value model of human motivation and Social Cognizant Theory, goal setting theory, social learning theory, Reinforcement theory, health belief model, theory of reasoned action, Entertainment education theory		
17	Dunne et al., 2019	UK Ireland	UK	Mixed	Behavioral change wheel	Interview, Survey	B
18	Tallon et al., 2019	Worldwide	Portugal	Qualitative	NA	Content analysis	B,D
19	Vander Wyst et al., 2019	US	US	Mixed	Social cognitive theory, Univariate general linear model	Multiple, Multiple	B
20	Chow et al., 2020	Worldwide	Denmark	Qualitative	Self-efficacy theory	Content analysis	D
21	Froome et al., 2020	Canada	Canada	Quantitative	Self-determination theory	Multiple	C,D
22	Griauzde et al., 2020`	US	US	Mixed	NA	Interview, Survey	B
23	Kundu et al., 2020	Bangladesh	Bangladesh	Quantitative	NA	Survey	A,B
24	Samoggia et al., 2020	Italy	Italy	Quantitative	Trans-theoretical model, Health belief model	Content analysis, other	B,C
25	Choi et al., 2021	Korea	US	Mixed	NA	Content analysis, Survey	C

Table2. Comparative analysis of research approaches taken

Approach	Number of studies	Percentage
Qualitative	11	44%
Quantitative	7	28%
Mixed	7	28%

Instruments used

In this category, the instruments/ tools used under the three methods in the literature discussed are identified. As shown in Table 4, studies that followed qualitative approach for analysis, mostly used content analysis (N = 11, 90.9%) followed by interview (N = 1, 9.1%). Most of the studies which used quantitative approach for analysis incorporated survey method (N = 4, 57.1%) followed by multiple instrument (N = 3, 42.9%). Multiple instrument represents using more than one tool for analysis.

In the studies using mixed methods, the qualitative portion used tools like content analysis (N = 3, 42.9), interview (N = 2, 28.5%), multiple tools (N = 1, 14.3%) and 'other' (N = 1, 14.3%) meaning focus group discussions.

Quantitative portion of mixed method studies used tools like survey (N = 5, 71.4%), multiple tools (N = 1, 14.3%), other (N = 1, 14.3%).

Table 3 and Table 4 laid out the understanding of gaps in the selected studies on media usage in enhancing nutrition literacy. The qualitative method was used in 11 studies (44%) where content analysis was mostly used (in 10 out of the 11 studies, 99.9%).

Table 4: Instruments used in the studies

Instruments	Frequency of studies	Percentage
Content analysis	Qualitative analysis 10	90.9%
Interview	1	9.1%
Total	11	100%

Qualitative approach		
Survey	4	57.1%
Multiple	3	42.9%
Total	7	100%
Mixed Method approach		
Qualitative Portion		
Content analysis	3	42.9%
Interview	2	28.5%
Multiple	1	14.3%
Other	1	14.3%
Total	7	100%
Quantitative Portion		
Survey	5	71.4%
Multiple	1	14.3%
Other	1	14.3%
Total	7	100%

Theoretical Lens

More than half of the selected literature (64%) incorporated theories in it while 36% had no application of any theories. Around 11 selected literatures for analysis are review articles, therefore, multiple theories were found in most of those studies. The present topic comprised of nutrition awareness and knowledge, therefore, many selected studies used health behavioral change theories like social learning theory, social cognitive theory, self–efficacy theory, theory of planned behavior, theory of reasoned action, health belief model and trans-theoretical model. In addition, there were many self-motivation theories used, namely self-determination theory, self-regulation theory, behavioral change wheel, and self-constructs of different theories. Other theories found in the selected articles were attitude-social influence self-efficacy theory, ecological model of health behavior, model of persuasion, conceptual model, persuasive system design model, psychological model, Pender model of health, goal setting theory, social network theory, entertainment education theory, grounded model, univariate general linear model, mentoring models, and public health promotion models. Few media related theories were also used, namely, theory of interactive technology, cultivation theory and entertainment education.

Most of the theories employed comprised of behavioral and attitude change theories that show the gap in the selected studies. In addition, intervention of more media related theories is necessary because changes in everything using mobile platforms to large-scale technological ambiance involve technologies concern with media technologies (Giraud, 2018).

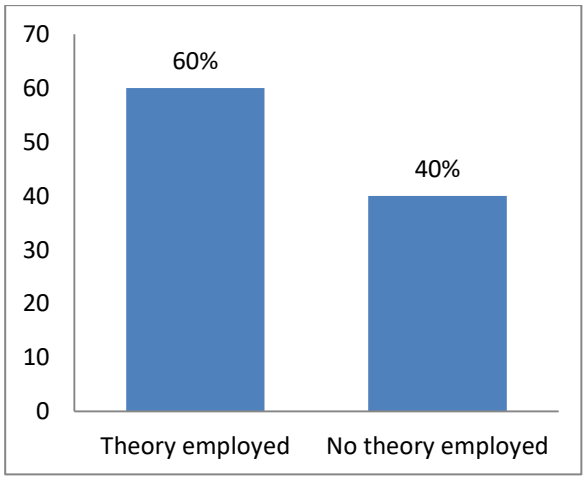

Figure4. Theoretical lens used in studies

Different Platforms of Media Usage (Traditional, online, nutrition app or gaming)

In figure 5, percentage and frequency of different media usage is represented from the conclusions of the selected studies. In certain selected studies, combination of different media approach was followed for testing the improvement in nutrition knowledge and behavior. For convenience and clarity, each media was given codes like traditional media (A), online media (B), nutrition apps (C) and gaming (D). According to table 5, the highest

media usage platform in the selected literature was online media (N= 21, 80%) followed by nutrition app (N= 10, 40%), gaming (N= 6, 24%), and traditional media (N = 5, 20%).

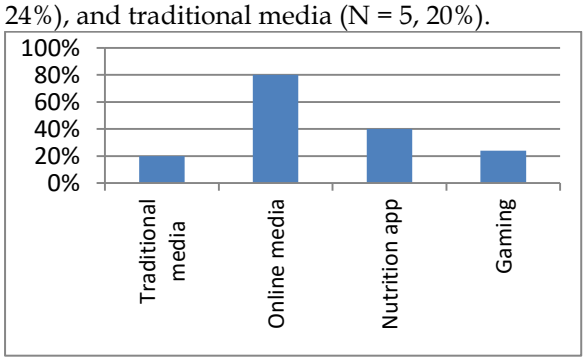

Figure5. Graphical representation of media category used in the studies

Thematic Analysis

Four themes were identified after in-depth analysis of literature to contribute to better technological methods and strategies to improve nutrition literacy globally using different media.

This section will answer research question no.1 and identify the exclusion factors be focused in the analysed literature.

Table5. Overview of findings of thematic analysis

S.No	Authors/ Year	Themes Drawn
1	Byrd-Bredbenner et al., 2010	Traditional media as a source of nutrition literacy
2	Abdullah & Mal-Allah, 2011	Online media as a source of nutrition literacy/ Traditional media as a source of nutrition literacy
3	Ali et al., 2012	Online media as a source of nutrition literacy
4	Duncan et al., 2012	Online media as a source of nutrition literacy/ Traditional media as a source of nutrition literacy
5	Coughlin et al., 2015	Online media as a source of nutrition literacy
6	DiFilippo et al., 2015	Online media as a source of nutrition literacy/ Intervention of nutrition app as a source of nutrition literacy
7	Vandelanotte et al., 2016	Online media as a source of nutrition literacy/ Traditional media as a source of nutrition literacy
8	Nour et al., 2017	Online media as a source of nutrition literacy/ Intervention of nutrition app as a source of nutrition literacy
9	Rose et al., 2017	Online media as a source of nutrition literacy/ Intervention of nutrition app as a source of nutrition literacy
10	Chau et al., 2018	Online media as a source of nutrition literacy/ Gaming intervention as a source of nutrition literacy
11	Hsu et al., 2018	Online media as a source of nutrition literacy
12	Khoury et al., 2018	Online media as a source of nutrition literacy/ Intervention of nutrition app as a source of nutrition literacy
13	Klassen et al., 2018	Online media as a source of nutrition literacy
14	Loehmer et al., 2018	Online media as a source of nutrition literacy
15	Maher et al., 2018	Online media as a source of nutrition literacy
16	Nour et al., 2018	Online media as a source of nutrition literacy/ Gaming intervention as a source of nutrition literacy
17	Chow et al., 2019	Gaming intervention as a source of nutrition literacy
18	Dunne et al., 2019	Online media as a source of nutrition literacy
19	Tallon et al., 2019	Online media as a source of nutrition literacy/ Gaming intervention as a source of nutrition literacy
20	Vander Wyst et al., 2019	Online media as a source of nutrition literacy
21	Froome et al., 2020	Intervention of nutrition app as a source of nutrition literacy/ Gaming intervention as a source of nutrition literacy
22	Griauzde et al., 2020	Online media as a source of nutrition literacy
23	Kundu et al., 2020	Online media as a source of nutrition literacy/ Traditional media as a source of nutrition literacy
24	Samoggia et al., 2020	Online media as a source of nutrition literacy
25	Choi et al., 2021	Intervention of nutrition app as a source of nutrition literacy

Theme 1: ***Traditional Media as a source of nutritional literacy***

Traditional media comprised of television, radio and print media in this study. Although there is a rapid growth of advanced digital media, it has not led to end to traditional media (Blech & Blech, 2014). In fact, traditional media exists as a main source of communication in many regions of the world and in developing countries like India; it still plays a pertinent role in disseminating message to large number of people (Catalan-Matamoros & Peñafiel-Saiz, 2017). The reason could be its easy, cheap, and effective accessibility, especially in rural areas.

The reach and power of traditional media could influence all facets of human life including health, and could be harnessed for health promotion of information, empowerment and motivation for behavioral changes of people (Maryon-Davis, 2012). Health and well-being of people are the most imperative factors to improve prosperity of a country. Nutrition literacy is important for all humans because lack of micro and macro nutrition intake, inadequate healthy food choices would adversely affect the health and nutrition condition (Kalkan, 2019).

Influence of individual's perception of media content regarding health promotion on others stimulates their own intention to follow healthy behaviours of diet and nutrition, skin and cancer prevention (Chapman et al., 2014). Television programs are a potential platform for delivering information related to nutrition affecting children's knowledge and behavior (Byrd-Bredbenner et al., 2010).

According to a study conducted by Ramadasmurthy et al. (1992), the exposure extent for communication media (television, radio, newspaper and magazine) having close association between media usage and dietary practices and knowledge were elucidated. They concluded that media played a greater role in generating credible health and dietary information.

In a longitudinal study conducted with the application of health belief model, it was found that self-efficacy and susceptibility increased through health motivation because viewing TV programs boosted viewers credence in their nutrition knowledge regardless of education and socio-demographic conditions (Chew et al., 1998). Mass media programs and commercials with endorsement of celebrities also play a substantial role in healthy food consumption and physical activity promotion (Maheswar et al., 2018).

According to Wakefield et al. (2010), campaigns using mass media promoting health and nutrition behaviours produce positive impact or ameliorate negative impact among large number of people. For better result of media exposure, community based programs along with long-term investment in campaigns are suggested by the researchers. Broadcast media (TV and radio) also has high potential in conveying health and nutrition information but such strategies need to be planned well for optimum results (Nuguid, 1985).

The intervention of traditional media as a source for improving nutrition mostly showed a positive response in large population. Incorporating new and innovative programs and advertisements comprising nutrition and health message with implication of appropriate communication theories and strategies would improve the reach and delivery of messages for better nutrition knowledge and behavior.

Theme 2: ***Online media as a source of nutrition literacy***

Online media is a new and rapid means of communication born out of rebel of conventional technology for wider reach and faster communication. The online media comprising social media, websites and blogs plays numerous but vital roles in disseminating health information to public and holds responsibility to report credible information. The quality of online media has brought substantial changes in various fields like academics, publishing, entertainment, journalism, and business. Hence, online media intervention in health field is not a surprising factor either (Smith, 2013).

In 2018, the WHO suggested to incorporate digital platforms in health promotion for better communication and to make people aware about the consequences of consuming

unhealthy food (Saura et al., 2020). Social media has developed new and different avenues for nutrition and dietetics communication in many ways. It has also been considered as a potential tool for educating patients, supporting peers, nutritional counselling and public health campaigns. Nutrition and dietetics practitioners use and accept social media as a supporting tool to improve knowledge on diet and reach larger population (Helm & Jones, 2016).

According to Leak et al. (2014), the ubiquitous use of social media has made nutrition educators believe that it plays a promising role in disseminating message and adequate communication with good health outcomes. Facebook was a highly used platform by low-income people to access health information and cognizant. The nutrition educator exemplifies creditability and while posting content on social media should refer to scientific information.

There are numerous social media pages, websites, blogs, and digital books available for good health and diet information because nutrition has become a familiar topic among internet users. In addition, universal access of internet leading to wide social media usage and search engines has literally made people to explore various information including nutritional food and health (Adamski et al., 2020).

Social media sites like Facebook, Twitter, WhatsApp, blogs, and forums have been explored for many diet practices and public health. They are also used to expand nutrition programs for education. Although social media usages of diet practice are infancy, the inclination of consumption of information from social media is increasing. In parallel, many registered dieticians' usage of social media is increasing, as they believe that they play a prospective role in exchanging nutrition knowledge (Dumas et al., 2018).

Mobile platform integration is highly capable for increasing intake of healthy diet, nutritional behavior and knowledge. For producing adequate support for mHealth, there is need of understanding and cooperation among academies, industry and government organizations. In addition, intervention of health workers, social media advertisements, encouraging gifts with improved strategies are also required (Seyyedi et al., 2019).

From the above discussed analysis, it is clear that online media has a big advantage to disseminate nutrient information and develop knowledge for a healthy life. Health professionals' participation in creating content must be considered for increased credibility and authenticity of health related content provided on the sites. Online social media platforms with proper tools, new strategies, and credible content would reach to various socio-demographic populations, thereby, reducing health social inequalities

Theme 3: ***Intervention of nutrition apps as a source of nutrition literacy***

Nutrition apps promote the consumption of healthy food, enable people to purchase and follow healthy diet, and show the nutritious value of food for healthy life style. Nutrition apps motivate people to incorporate healthy lifestyle in their routine. Among frequent mobile users, health, nutrition and diet apps are the most familiar ones because awareness and concern for good health is maximizing. Nutrition information app could be more constructive for consumers in overcoming confusion about their limitations in perception of food and healthy food approach. In specific, nutrition information apps reduce the view about barriers for eating healthy food and enhance subjective and objective knowledge of wholesome food (Samoggia & Riedel, 2020).

According to Samoggia et al. (2020), consumers who consult these nutrition apps mostly expect suggestions for cooking, nutritional counselling, and to acquire knowledge about healthy diet. To improve the perception of consumers and break barriers for healthy eating, nutrition information apps play a positive role. In currently available fitness and health apps in Android/ Apple store, nutrition apps are very popular and comparatively considered low-cost approach to evaluate food intake to provide consumers benefits, nutritional advice, educational settings and research (Berens & Evenson, 2020).

Multiple elements play the hindrance role in fidelity and use of nutrition mobile apps.

Professionals could intervene and collaborate with app developers to improve the credibility of information and authenticity of the apps among consumers as nutrition apps are easily accessible apps for weight management and knowledge gaining (Lieffers et al., 2018). These apps can be able to streamline nutrition components and nutrition assessment from dietary record of patients and facilitates dieticians to utilize more time in nutrition counselling and education. To conclude, usage of apps increases the patient-provider communication and aid to monitor patient progress through apps itself (Chen et al., 2018). According to DiFilippo et al. (2014), many people are using nutrition apps in routine to explore different nutritious food and monitor themselves. There are numerous nutrition apps available, maximum of which focus on weight loss. Very few studies have been found on nutrition education and knowledge, leading to a need for more research. The usage of diet and nutrition apps influences people with action, awareness and self-education regarding physical activity, nutrition and social life. Such apps motivate users to do regular exercise and follow healthy diet. Tailoring the apps with personal needs will improve utility of these nutrition and physical activity apps (Wang et al., 2016). Installation of high number of apps for diet and nutrition clearly shows the opportunity that these apps have to make potential change in nutrition intake and knowledge (Franco et al., 2016).
The above mentioned studies talked about the availability of different diet and nutrition apps and their access by the people. Although these apps are considered helpful for promoting nutrition behavior and knowledge the app users must be reassured frequently about the platforms' credibility and the authenticity of dieticians involved in the platform.

Theme 4: ***Gaming intervention as a source of nutrition literacy***

Many other fields have incorporated gaming approach in their pool of activities to entertain, engage and educate customers. This game intervention mechanics are recently promoted by health sector to discourse bigger issues in health for behavioral changes. In digital game play, a lot of adolescents and children obtain nutritional information. In fact, games with target on high nutrition could play a significant tool for nutrition education, nutrition knowledge and healthy nutrition behavior (Holzmann et al., 2019). Playing 'Vita Village' (a nutrition game) provides opportunity for children of ages 9 to 12 years to enhance their knowledge in nutrition and become aware about the availability of different nutritious food (De Vlieger et al., 2020).

According to a study conducted by Yang et al. (2015), technology based game intervention fosters the intake of different micro and macro nutritious food like fruits, vegetables, milk products, meat, and proteins. It further aids adolescents to gain knowledge about the nutrition value of various food items. 'Common Bytes', an online game comprises of 12 games with three levels to improve, and cooking and nutritional cognizant had a positive impact in increasing nutritional knowledge and behavioral change and supported nutrition education (Mier et al., 2005).

According to Holzmann et al. (2019), 'FFF' (fit, food, fun) game for imparting knowledge about nutrition in a format of entertainment showed an optimum result in improving nutrition knowledge among targeted groups. Digital game play is familiar, and an earnest or consequential game play in entertainment layout would play as a sufficient tool to relay nutritional education. 'FoodRateMaster', another nutrition gaming app influences children interest positively in exploring and consuming many healthy foods resulting in improved nutritional knowledge outcomes (Espinosa-Curiel et al., 2020).

According to Hermans et al. (2018), playing games like 'Feed the Alien' (nutrition game), is capable of enhancing short-term nutritional knowledge and healthy behavior. However, to know about the long term effects among children, further investigation with application of different game apps is warranted. Hassanzadeh-Rostami et al. (2018) developed a computer game for nutritional messages based on the snake-ladder and found it simplified the understanding of nutrition wellness and aided in lifting the nutritional knowledge among pre-school students.

Gaming intervention for improving nutrition knowledge is still an emerging field. Therefore, to strengthen the usage of apps,

necessary teamwork of academic researchers along with game developers is required to create reusable and innovative games. It can cover larger audience for longer term to obtain constructive impact on nutritional knowledge (Froome et al., 2020). Game approach has been accepted as a better and helpful factor to find content requirement and recommendation to increase nutritional wellness and knowledge. The contemporary strategy for nutritional education in games can be designed to improve knowledge, attitude and behavior for consumption of healthy diet in routine. Amusing and innovative strategies should be included to reinforce the gaming app.

CONCLUSION

Quantitative and thematic analyses are conducted in this systematic literature to explore the association between media usage and nutrition literacy, which answered research question no. 1. Four themes were extracted via thematic analysis for media usage as a source of nutrition literacy. According to the first theme, despite the fact that there is an exponential growth of digital media in present world, traditional media is still widely used. To harness the energy of traditional media, new strategies, creative programs and innovative advertisements should be made. This would help them play a positive role in improving nutrition literacy. Only five studies were related to traditional media, which could not be an enough proof to make conclusions. In the second theme, online media was considered as an upcoming field for disseminating health and nutrition messages rapidly but there were maximum chances for misinformation on these sites. As per the third theme, numerous nutrition apps are used and accepted by many people positively to gain nutrition knowledge. However, there is big concern in the reliability of the apps and the credibility of the content including its long term-effects. In addition, the fourth and final theme conveyed imparting knowledge through gaming as an avenue of entertainment to raise interest among people. However, this might not work out for all categories of people except for children and adolescents. No such proof has come to show its compatibility and need for advanced design and strategy to reach large number of people along with long duration engagement. The quantitative analysis answered research question no. 2. Despite high prevalence of malnutrition in all developing countries, there were not many studies available in connection to media usage and nutrition literacy in these countries. Highest number of studies found in the year 2018. The US conducted many studies in this domain followed by Australia. Asian and African countries lacked research studies in this research area despite the fact that many developing countries located in this region are suffering with severe malnutrition problems. Most of the discussed literature used qualitative analysis comprising content analysis as an instrument resulting in another major gap in the domain because primary data and hands-on information is more authentic for analysing improved nutrition literacy from media usage. At last, from the conclusion of the selected literature, it was found that all media are highly capable to increase nutrition literacy but they lag in contributing strategies to make people adapt to them for gaining nutrition knowledge.

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