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e-Health Intervention to Improving Quality Nutrition among Adolescents with Malnutrition

Vilda Ana Veria Setyawati[1,*], Arif Kurniadi[2], Guruh Fajar Shidik[3]

[1]Public Health Department, Universitas Dian Nuswantoro

[2]Medical Record and Health Information Department, Universitas Dian Nuswantoro

[3]Informatics Engineering Department, Universitas Dian Nuswantoro

**Corresponding author: Vilda Ana Veria Setyawati*

Abstract

Half of the adolescents grow up in the burden of multiple nutritional problems characterized by complex health problems, including HIV, degenerative diseases, malnutrition, anemia, eating disorders, and a sedentary lifestyle. Nutrition education is given to adolescents regularly to answer solutions to these health problems, but the method used is still classic. Systemic review research aims to classify technology-based nutrition education methods, analyze differences in nutrition education theories used in the outputs of each process, and recommend the most effective technology-based nutrition education media. This article provides a comprehensive and systematic review of the literature from various e-health intervention studies published from 2011 to 2021. Electronic-based educational media developed in the reviewed articles include mobile, web-based, texting messaging, and Facebook applications. Most of these media have passed the effectiveness test stage, but there are still two in the design and qualitative testing stages.

Keyword: Mobile, app, adolescent, malnutrition

I. INTRODUCTION

Adolescence is one of the stages in the life cycle that humans pass through at the age of 12-18 years.[1] The character attached to it is an interest in new things that are felt to benefit itself. In other words, if it is considered useless, then it will not be interested

in further exploration. During adolescence, an individual acquires physical, cognitive, emotional, social, and economic resources that are the basis for health well-being later in life. These same resources define the trajectory to the next generation. Investments for them bring benefits today, decades to come, and into the future. If currently, Indonesia is experiencing double burden nutritional problems, half of the adolescent population grows in a complex burden marked by complex health problems Kincluding HIV, non-communicable diseases (NCDs), undernutrition, anemia, eating disorders, inactivity, low-level physical activity.[2]

A result from nutrition consumption patterns research among high school students in Semarang City shows that the consumption patterns of high school adolescents on daily snacks are dominated by fast food and junk food. 58.5% of respondents experienced malnutrition consisting of being underweight, overweight, and obese.[3] There are two tendencies for adolescents to consume food, namely vertical and horizontal consumption. Vertical consumption aims to meet needs, while flat consumption aims to achieve a level of satisfaction.[4]

Previous data from Costa Rican adolescent showed an increase in fast food intake and a decrease in vegetables. This fast food consist of sugary drinks (+134 g/d), pastries/desserts (+55 g/d), other refined starchy foods (+36 g/d), and snacks/fast foods (+26 g/d) than their 1996 counterparts. In 1996 and 2006, the main source of calories was white rice, whereas in 2017, it was sugary drinks (12% TE and 15% TE, respectively; $P < 0.05$). The intake ratio of beans to white rice was significantly higher in 1996 (1:1.6) than in 2017 (1:3.5)[5]

Kondisi pandemi membatasi pergerakan tenaga kesehatan untuk melaksanakan tugas memberikan pendidikan gizi dan kesehatan, sehingga diperlukan platform yang tetap memberikan konten edukasi tepat tetapi meminimalkan kontak atau tidak ada kontak sama sekali dengan remaja

Nutrition plays a very important role in the transition from adolescence to healthy adult (adult without non-communicable disease). Undernutrion in pre-adulthood is associated with un-achieving growth targets, delayed cognitive maturation, low intellectual intelligence, health behavioral problems, and a high risk of contracting infectious diseases.[6] Research in Jakarta shows multiple nutritional problems in adolescents aged 15-19 years. The consumption pattern of adolescents who joined as respondents did not meet their needs and was exacerbated by low physical activity (94.4%). This result is supported by the fact that sports activities are only carried out in schools (64.4%).[7] Primary health research data in 2013 showed the prevalence of stunting among adolescents aged 16-18 years was 31.4%. [8] WHO says that stunting becomes a public health problem if the prevalence of stunting reaches 20% or more. According to these data, even though Indonesia has experienced a decrease in the majority of stunting, stunting is still a public health problem.[9]

Active middle and high school students expressed a desire to learn more about nutrition, but most of the nutritional information currently received comes from professionals not related to food. Since active students are now getting nutritional information from parents and coaches first, further research is needed on student

education and parent and coach education to convey reliable dietary information to students.[10]

Proper nutritional information is part of nutrition education. Nutrition education is a way to increase knowledge, attitudes, and practices of food consumption. Technology in the industrial revolution 4.0 places youth as the object and the subject product. Cellphones, smart TVs, and personal computers are their friends at any time. Ideally, these products can be used by adolescents to access balanced nutrition information easily. However, surveys in the field show that adolescents have very minimal access to nutritional information. In addition, adolescents are a general group who receive minimal attention from health programs. Most of the health programs for adolescents are the responsibility of the BKKBN and the Ministry of Health. The BKKBN program has the scope for reproductive health, while the program from the ministry of health has a program for giving Fe tablets to young women only. The risk factors for late adolescent stunting can be decreased by increasing knowledge about stunting prevention for the next generation.[11]

Currently, many nutritional applications have been researched for nutrition education in adolescents. From the results of this research, systemic review research aims to classify technology-based nutrition education methods, analyze differences in the nutrition education theory used at the output of each process, and recommend the most effective technology-based nutrition education media. Research that later falls into the criteria may have different subject characteristics because each analysis determines various references.

II. METHOD

Systemic Literature Review (SLR) is described as a flow of activities that aims to identify, determine and analyze all research or publications in a particular field to narrate the answers to each research question. [12]

The proposed bibliography is consistent with a systemic foundation based on the original guidelines offered by Kitcheman and Charter. The stages in this SLR include planning, implementing, and reporting. Each set consists of a substage with a specific purpose. The purpose of implementing the library base is discussed at the beginning of the chapter. Furthermore, existing systemic reviews around the educational media are identified and reviewed. (1). The review protocol was designed to set the direction for conducting the study and reduce the possibility of researcher bias (2). It describes research questions, journal search strategies, research selection process based on inclusion and exclusion criteria, quality assessment, and data extraction and synthesis processes. Review protocols are described in Sections II.A, II.B, II.C, II.D, and II.E. Review protocols are developed, evaluated, and improved basis during the implementation and preparation phases of the review.

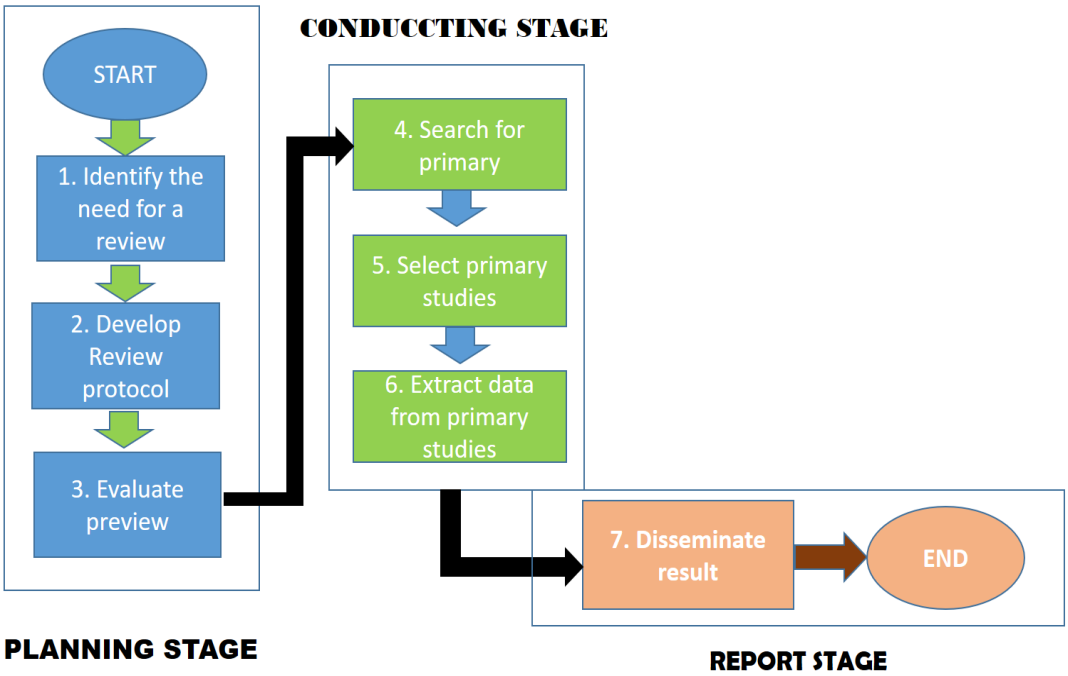

Figure 1. Systemic Literature Review

The research question (RQ) was determined at the outset to keep the review focused. The RQ was structured with criteria for population, intervention, comparison, outcome, and context (PICOC).[12]

Table 1. Summary of PICOC

Population	Adolescent, young, teen, youth,
Intervention	Mobile nutrition
Comparison	Types of mobile nutrition education (how to develop it, what is the each outcome)
Outcomes	Nutrition behavior (food intake, daily habit, snacking, daily activities, exercise, etc)
Context	Study in mobile base nutrition education with a small and large dataset

Based on table 1, the RQ can be compiled for this literature review, as presented in table 2.

Table 2. Research Question on SLR

ID	Research Question	Motivation
RQ1	Which Journal is the most significant electronic-based nutrition education ?	To identify the most significan electronic-based nutrition education field
RQ2	Who is the most active researcher in the electronic-based nutrition education ?	To identify the most acvite researcher who contributed the most electronic-based nutrition education study
RQ3	What is the grand health theory used ?	Identify grand health theory used
RQ4	What is the study designed?	Identify the study designed
RQ5	What kind of the application used, and intervention component?	Identify kind of application used, and intervention component
RQ6	What kind of statistic test is used to data analysis ?	Identify the most statistics analysis
RQ7	What is the outcomes of this study ?	Identify the achievement objective study

From the primary research, RQ1 to RQ4 provide a resume of specific area studies in mobile education for malnutrition in youth. Mobile education datasets, methods, and framework to answer RQ 5-RQ11. The main goals of this SLR are to identify the trends of mobile education research, grand health theory used, intervention method, and framework used in mobile education.

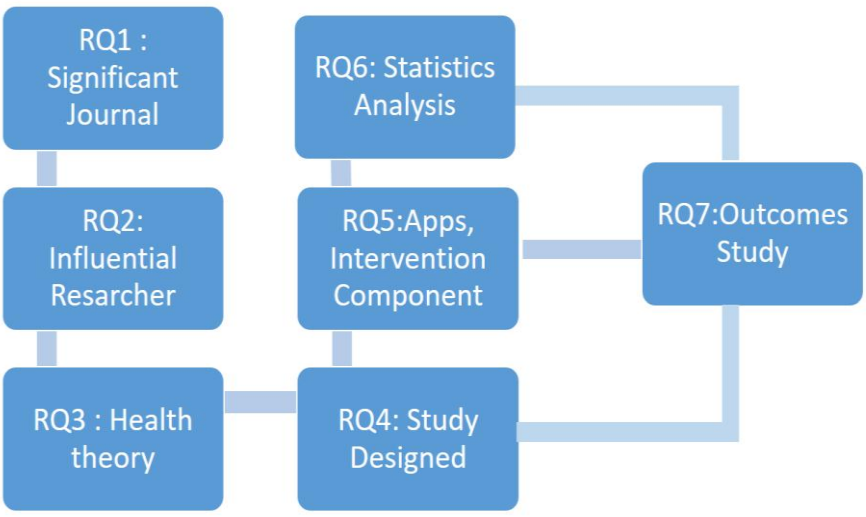

Figure 2. Basic Mind Map of the LSR on mobile education

The search process (no.4 in figure 1) is divided into several activities such as selecting a digital library, defining the search string, performing a pilot search, refining the search string and retrieving the initial list of the main studies from the digital library that match the serach string. Before starting investigation, the correct database set was selected to improve the highly relevant articles. The most well-known and searched database of lirature for a very wide range of studies. A thorough perspective is a required for a broad literature coverage. The following is a list of digital databases to search for :

National Center for Biotechnology Information which can be accessed in https://pubmed.ncbi.nlm.nih.gov

Science direct

The search string was developed depend on the following steps: 1. Identification of search keywords based on PICOC, especially on the Population and Treatment; 2. Selection of seacrh term from research questions; 3. Selection of search terms in the tittle, abstract, and keywords used relevant; 4. Identify the same word, other spellings, and opposites of the search term; 5. Advanced serach string construction using the selected search term, use AND, and OR the follosing search string finallay used:

(mobile OR application OR app OR electronic) AND (Adolescent OR young OR teen OR youth) AND malnutrition)

The adjustment of the search string was conducted. Still, the original one was kept since the adjustment of the search string would dramatically increase the already extensive list of irrelevant studies. The search string was subsequently adjusted to suit the specific requirements of each database. The databases were searched by title, keyword, and abstract. The search was limited by the year of publication: 2011-2021. Two kinds of publication, namely journal papers and conference proceedings, were included. The investigation was limited to only articles published in English.

The inclusion and exclusion criteria were used for selecting the primary studies. These criteria are shown in Table 3.

Table 3. Inclusion and exclusion criteria

Inclusion Criteria	Topic research study: mobile nutrition education for malnutrition adolescent include topics, problem, dataset, and method
	Mobile education used for intervention tool
	Paper with trial both randomized and non-randomized
	Open access articles
	The publication taken were studied from 2000-2021
Exclusion Criteria	Not written in English
	Grey literature

Non-experimental studies

The Mendeley (http://mendeley.com) is used to store and manage search articles. The detailed search process and the number of articles identified at each stage are shonw in figure 3. The figure shows the study selection process (step 5) carried out in two steps: exclusion of the main study by tittle, abstract, and study by full text. Research article based on literature review and non-experimental studies were excluded. The degree of similarity of the research to the prediction of software defects is also included in the study.

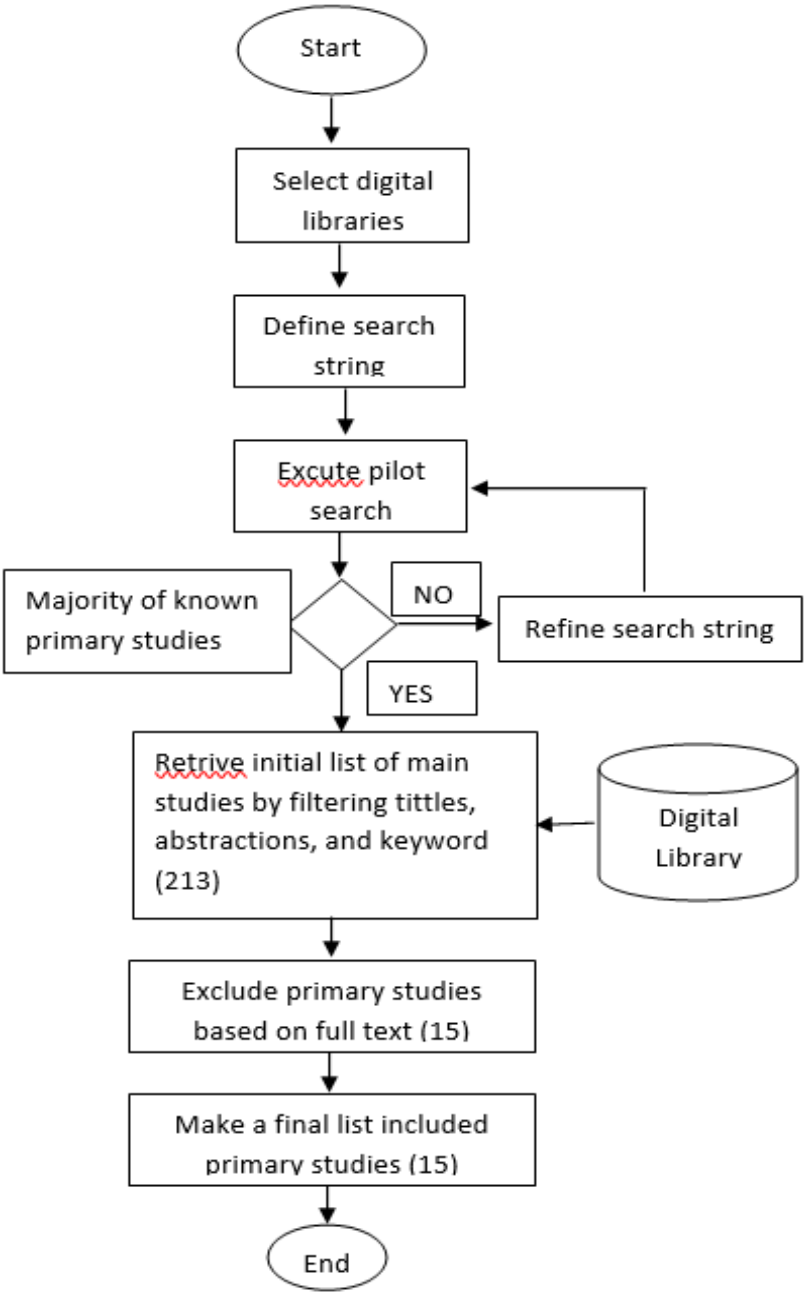

Figure 3. Search and Selection of Primary Studies.

The selected primary studies extracted to collect the data contribute to addressing the research questions in this review. The data extraction form was completed for each of the 16 selected prior studies (figure 1, no.6)—the data extraction form was designed to collect data from the preliminary studies needed to answer the research questions. The properties identified through the research questions and analysis we wished to introduce. Six properties were used to answer the research questions shown in Table 4. The data extraction was performed in an iterative manner.

Table 4. Data Extraction properties mapped to research questions

Property	**Research Question**
Research and Publication	RQ1, RQ2
Health Theory	RQ3,
Study Designed, Apps, and Intervention Component, Statistical analysis and Achivement study	RQ4, RQ5, RQ6, RQ7

The study quality assessment (figure 1, no.8) can interpret the findings and determine the strength of the conclusions outlined. Data synthesis aims to collect evidence from the selected studies to answer the RQ. A piece of evidence may have little power, but the collection of several proofs can make a point stronger. The data extracted in this review is quantitative. Different strategies were used to synthesize the extracted data on the research questions. Several visualization tools, including bar charts, pie charts, and tables, are also used to enhance understanding through visual displays.

This systemic review aims to analyze the research on mobile education for stunting adolescents base on statistical and application techniques. This review does not discuss the existence of bias in the selection of studies.

III. RESEARCH RESULT

In this systemic literature review, 15 primary studies were selected based on the procedure in table 3. These preliminary studies were organized according to their publication years. Thus, the distribution of researches by year can show and illustrate the interest of researchers in mobile nutrition education.

Research and Publication (RQ1, RQ2)

The information about the publication, such as Scimago Journal Rank (SJR) value, impact factor, Q-level categories (Q1-Q4), and the quantity of publications, are ordered alphabetically according to their journal names.

Table 5. Significant Journal Publication

Journal	SJR	Q-category	Impact factor	Number of study
BMC Pulmonary	1,095	Q1	2,18	1

Medicine				
BMC Public Health	1,198	Q1	2,82	4
Nutrients		Q1	4,171	1
Asian Nursing Research	0,51	Q2	0,98	1
International Journal and Behavioral Nutrition and Physical Activity	2,64	Q1	5,548	1
Journal of Pediatrics	1,15	Q1	3,89	1
JMIR Mhealth and Unhealth			4,31	1
Jurnal Nutrition Education Behavior	0,807	Q2	2,502	2
Journal School Health	0,89	Q1	1,67	1
Public Med Journal	0,43	Q3	1,774	1
Journal Obesity Silver Spring	0,34	Q3	4,389	1

During this stage, several researchers were identified by their active roles and many contributions to mobile nutrition education. The distribution of the most active researchers as the first author based on the number of studies on this topic is shown in figure 3. [13] The picture above shows that there is only one name with 1 study. For other researchers, only 1 title each. In addition, this figure does not show the names of researchers other than the first researcher because there is no same name in different journals.

Health Theory (RQ3)

Mobile nutrition education is researched using various health theories, some of the theories used include:

1. Global recommendation on physical activity for health[13]

Low physical activity is included as the fourth major risk factor for global mortality. The level of laziness in doing physical activity is rising in several countries, with an increase in the prevalence of non-communicable diseases (NCDs) and general health condition of the community. The Global Recommendation of physical activity to maintain health is the primary prevention of NCDs through regular physical activity. The recommendations set out address three age grouphs: 5-17 years; aged 18-64 years; and 65 years and over. Section focusing on each age grouph include the following summary of scientific evidence, current physical activity recommendations,

and interpretations made.[14]

2. Self Determination Theory (SDT) and Motivational Interviewing (MI) [15] [16]

Exploring motivation has been widely adopted as a type of counseling to promote behavior change; however, it lacks a coherent theoretical framework to understand the process and its effectiveness. This article proposes that self-determination theory (SDT) can provide such a framework as an alternative. The principles of exploring motivation and SDT are outlined, and parallels between them are drawn out. This theory show how motivational interviews. And SDT are based on the assumption that human have a long-standing innate predisposition for individual growth towards psychological integration and provide the socio-environmental facilitation factors suggested by SDT to promote this tendency. This theory proposes that using SDT perspective can help advance our understanding of the psychological processes involved in exploring motivation.[17]

3. The Theory of Planned Behavior [18]

This theory explains that behavior is formed because of intentions influenced by attitudes towards behavior, subjective norm, and perceived behavioral control. This intention, together with perceived behavioral control, explains the sizeable difference in actual conduct. Studies within the scope of the theory were reviewed. This approach yields empirical facts. However, the exact nature of this relationship remains uncertain. The expected value formulation is only partially successful. Optimal rescaling of the expected values and is offered as a way to overcome measurement limitation. This addition of past behavior in the prediction equation proved to provide a means to test theories and other problems that have yet to be found. Limited evidence on this question suggests thay this approach predicts behavior relatively well than behavioral strength limits.[19]

4. Health promotion by social cognitive means [20]

This theory assumes a multifaceted causal structure in which self-efficacy. In the process, self efficacy works in conjuction with goals, expected outcomes, and environmental constraints and regulates human motivation, behavior, and well-being. Belief in one's effectiveness in exercising control is common pathway through which psychosocial effects influence health functioning. These core beliefs affect all of the fundamental processes of personal change, whether people consider changing their health habits, whether they mobilize the motivation and perseverance needed to succeed if they do, their ability to recover from setbacks and relapses, and how well maintaining habit change is achieved. Health is a social issues, not just an individual problem. A comprehensive approach to health promotion required change in social systems thay have far-reaching effects on human health.[21]

5. Dietary guideline for American[22]

The focus for maintaining health is disease prevention, not treatment. This theory

explains the significant difference between the current consumtion of Americans and the Dietary Guidelines reccomendations. In the diet management, its essential not to focus on individual nutritional intakes or individual foods but on all consumed-a healthy diet as a whole-to improve individual and community health. Chronic diet-related illnesses are on the rise, and levels of physical activity remain low. The progress of implementing the diet requires a comprehensive strategy, including a balance of nutritional intake and physical activity. The Dietary Guidelines translate science into short, food-based guidelines tha can help Americans choose healthy and happy diets.[23]

6. Making health communication Program Work: A Planners Guide[24]

This theory explains the needs and perceptions of intended audience at each stage of the program. The health communication process is divided into four stages: Planning and Strategy Development; develop and test Concepts, messages, and Materials; Implementing the Program; and Assessing Effectiveness and Making Improvements. This stage is a circular process where the last step provides feedback to the first stage.[25]

7. Science and human behavior [26]

The application of science to human behavior is very complex. This theory evaluates human behavior through ignorance or prejudice. Then used as the basis for making effective decisions and moving quickly to a happier world. But now science has applied in other fields shows that there is something more involved. Individuals can act wisely in unscientific ways; science provides understanding. Its leads to the new concept of matter and a new thinking way the part of the world is has dealt with on its own. [27]

8. Social cognitive theory and transtheoritical model[28]

Description this theory includes demographic and socio-economic variables. Evidence identified that this model is not yet commonly used effectively to harness this potential power in nutrition behavior change practice. These findings also have important implication

For the conduct of research and development in the field of public health. These finding are relevant to the future integration of sociological and psychological approaches to understanding and changing health behavior.[29]

In reviewed research, discover eight health theories. Two studies using self-determination theory (SDT) and Motivational Interviewing (MI) theories were used in 2 studies. Six studies do not clearly state the approach used as the basis for nutritional behavior change. However, this does not mean that research includes an unclear theoretical basis. In general, the classical health theory is the Health Theory according to H.L. Blum. This health theory shows four factors: environment, behavior, health services, and genetic. At the same time, the approach found in the review is the development of behavioral characteristics.[30]

Study Designed, Apps, Intervention Component, Stasticically A (RQ4, RQ5, RQ6, RQ7)

All research produces products, be it a new nutritional education application that is the result of research and supports existing applications such as texting massage and existing websites.[31] So most of the studies studied aimed to test the effectiveness of applications designed with experimental studies research designs.

For more details, summarized in the figure below:

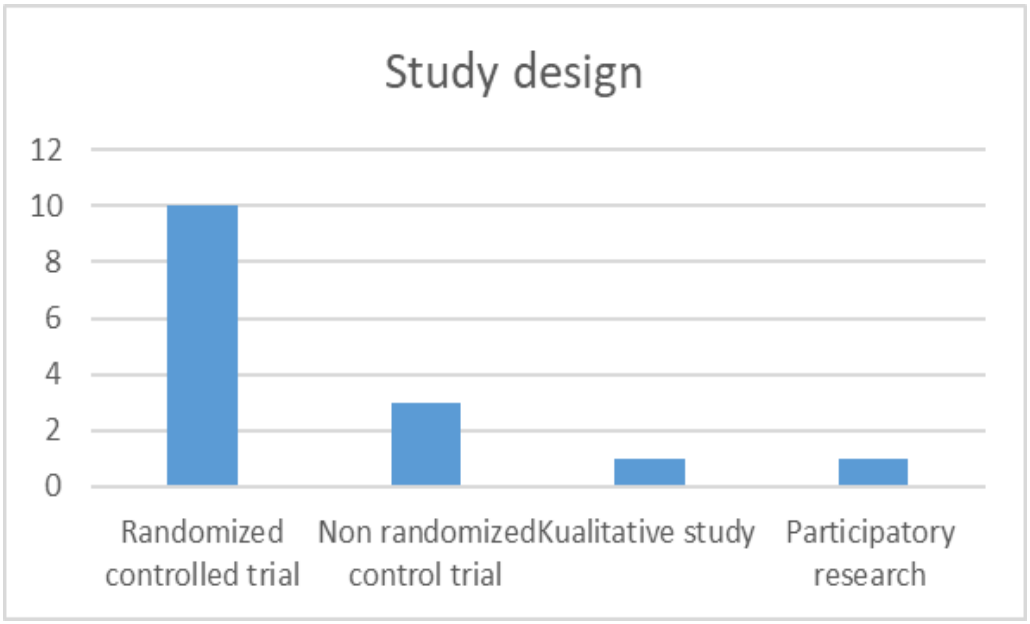

Figure 4. Study design

The Active Online Physical Activity in Cystic Fibrosis Trial (ActionPACT) educates subjects aged 12-35 to actively perform physical activities, including tracking and aerobics, which lasts for 12 weeks. The effectiveness of Action PACT was measured after three months and 12 months. Kaplan-Meier curves and Cox proportional hazards models were used to analyze statistics showing that web-based applications can further increase physical activity participation. The web-based application that can be used can be made quickly and widely available to all individuals with Cystic Fibrosis to support physical activity and sports participation at a user-selected time and location. [13]

Connecting Health and Technology (CHAT) educates the subject to increase consumption of fruits and vegetables and reduce consumption of junk food. CHAT is a text message that contains knowledge, attitude, and belief in food selection. Subjects are required to reply to the news in response to the researcher's sending of a Text

message. The message is sent for six months and once a week. Message effectiveness was tested statistically with multiple logistic regression using IBM SPSS, compared at baseline and after six months. The CHAT project assessed the impact of intervention on behavioral intention to eat healthier foods. If successful, the innovative approach could provide a media for low-cost health promotion programs that can reach large grouphs, particularly young adults/ late teens. [14]

The mobile nutrition education application designed for the subject of an athlete contains recommended dietary habits, fluid requirements, healthy dietary variations and vitamin D. hydration, nutritional intake, and recovery, as well as food choices and a preference for a positive body image. ANOVA statistical analysis showed that nutritional knowledge increased significantly after three education sessions, and there was feedback on filling in the food records diary. Still, the mobile application did not improve further learning. However, nutrition education interventions alone are not sufficient to change food intake but must refer to the grand health theory that many things are related to a favorable health profile.[16]

The nutrition application for bone health with women in late adolescence has educational content on sports, nutrition, and healthy living habits. The indicator for education success is bone health as measured by bone mass density (BMD). This education lasts for 20 weeks. SAS was used to test for variables (BMD, minerals, and bone-related biochemical parameters, knowledge of bone health, nutritional intake). The result, both experimental group I and experimental group II, which only received group education, showed knowledge about the benefits of exercise and calcium compared to the control group. The two experimental groups also showed serum calcium, vitamin D, and sclerostin results compared to the control group. [16]

Mobile food records and text messages with content Food behavioral change in improving food and vegetable consumption; reduce SSB (Sugar-sweetened beverage)and ENDP(Energy dense Nutrition Poor); improving physical activity in late adolescence or early adulthood. The behavioral change targets referred to include increasing fruit consumption, reducing SSB, and EDNP foods consumed each day Height and weight with an intervention period of 6 months. Comparative change measures were started at four days at baseline and six months after that.

Statistical analysis using logistic regression showed dietary feedback adjusted only dietary reductions in EDNP in men and SSB in women, along with weight loss. Using mobile food records for dietary assessment and customized feedback can be applied to future health promotion interventions targeting diet and weight improvement in young adults. Statistical analysis used logistic regression, and the result were Tailor dietary feedback only in decrease in ENDP foods in men and SSB in women, together with a reduction in body weight. Using a mobile food record for dietary assessment an tailored feedback has excellent potential for future health promotion interventions targeting diet and weight in young adult/ late teens. [15]

Smartphone-Enhanced Low-Threshold Intervention for Adolescents with Anorexia Nervosa (SELTIAN) contains food recommendations, behaviors that lead to a healthy lifestyle, and dynamic protocols. This application is made for adolescents

who suffer from anorexia nervosa. Target improvement in environmental factors and diet—assistance with SELTIAN 6 times for three months (once per 2 weeks). Anorexia nervosa and other eating disorders that are difficult to treat, especially in an outpatient setting with only infrequent face-to-face sessions, cannot predict whether an outgoing intervention will directly affect weight recovery. This trial evaluation Smartphone app will provide a basis for more studies on the efficacy, usability, and safety of smartphone m-health applications for the treatment of eating disorders.[18]

Social media is a medium for weight loss which is named Healthy Body Healthy U (HBHU). Subjects are aged 18-35 years with overweight, to be precise, BMI> 25kg / m2. HBHU content is prioritized on how to lose weight with an appropriate diet so that you can achieve a normal BMI with a duration of 18 months. Weight loss was measured at 6, 12, and 18 months. Data analysis is presented descriptively by offering eHealth approach to weight loss in young adults at risk of weight gain and its consequence and technologically savvy. In addition to its rigorous design, the HBHU study will examine essential issues of program translation and sustainability through cost-effectiveness analysis and qualitative interviews to know more about the success of implementing an effective weight loss program in a college setting.[19]

Challenge to go is an application made for adolescents aged 14-21 years with nutritional behavior content covering eating habits, nutritional value, consumption of vegetables and fruits. The expected target eating habits in adolescents often change according to trends. This study was designed and tested qualitatively on several adolescents. Together with the target group's preferences, this is translated through 14 BCTs, such as awards, multilevel assignments, or self-monitoring into the concept of the Challenge to go (C2go) application. Expert evaluations suggest changing some of the app's features for improved compliance, positive health effects, and technical feasibility. The concept of C2go consists of 3 worlds: (1) drinking, (2) the world of vegetables, and (3) fruits. In every world, users are faced with challenges, including feedback and quizzes. Tips used to be developed based on a health action process approach and to help users meet challenges and, in doing so, achieve target behaviors. Challenges can be played alone or against someone in the community. Due to different activities, points can be collected, and levels can be achieved. The facts contained open access to Infothek (information section), where users can select the content that interests them. The avatar guides the user through the application.[25]

TEENCOPE contains self-efficacy (social problem coping skills, stress management, cognitive behavior modification, assertive communication, and conflict resolution.

Managing Diabetes: a diabetes education program that focuses on problem-solving to improve self-management of diabetes in adolescent 11-14-year-olds in 4 weeks intensely. The expected target is a change in self-efficacy and the ability of problem-solving cycles to treat diabetes. Changes were measured in 2-4 months and 5-7 months with the T-tesh test, chi-square, Cochrane Armitage Trend test with SAS software. Eighty-five percent (85%) of the teens who agreed were enrolled for the specified program. Less connected is low, with only 69% of teens complementing any

lesson. After six months, there was no significant difference between the groups. However, the liaison group reported lower perceived stress over time ($p<0.01$).[21]

The REWARD app and evaluation design (nutrition education game) educate adolescents in choosing healthy snacks with subjects aged 14-16 years (middle school). The content of REWARD is a list of healthy snacks, the right time for snacking, the correct number of snacks for consumption, the nutritional value of some snacks. Indicators of change include nutritional behavior and anthropometric parameters as a result of snacking. Subjects received education for four weeks and were analyzed qualitatively. The intervention succeeded in answering the objectives, but the possible success factors for the intervention were based on own and previously collected research, and the intervention focused on automatic and reflective pathways using effective behavior change methods and techniques and intervention techniques of interest to adolescents. [22]

Texting for health is an application compiled with participatory techniques from 12-18-year-old subjects with nutrition content and physical activity, steps to prepare food and snacks according to ingredients (include sample photo snacks during discussion) for eight weeks—indicators of change that are expected to increase physical activity, eating patterns as needed and appropriate snacking. Measurement of change is divided into two stages (Phase I at 1-4 weeks, Phase II at 5-8 weeks), which are analyzed thematically deductively. The result 177 participated in the treatment group (n: 59), discussion (n:86), and a pilot study (n: 32). Teens preferred messages with active voices that reference youth and recommend specific, attainable behaviors; the news should come from a nutritionist who delivered as a text message, with a frequency of 2 times/day.[23]

The use of school websites to prevent obesity in subjects aged 12-19 years with content containing lessons, self-assessments, questions on the range, and individualized feedback to students. Behavioral strategies of self-monitoring and goal-setting activities included a blog by a

"Coach," opportunities to interact with a health coach and other students, and a personal journal section. Changes were measured in 2 stages, namely Stage I 3 months and Stage II 6 months) which were analyzed statistically with the Interclass correlation coefficient using PROC NLMIXED. Student participation (83% of lessons completed) and satisfaction rates are high. Schools that implement the program in a school environment have higher enjoyment and participation than schools that implement the program as homework ($p\leq0.001$, <0.001). Adolescent girls had higher enjoyment and participation than boys ($p=0.02$, 0.03). Younger students had higher participation than older students, but there was no difference in satisfaction ($p = 0.03$).[31]

Application to Increase FITness (AIMFIT) designed to increase physical activity. a trial was conducted to compare AIMFIT with a well-known "off-the-shelf" smartphone for improving cardiorespiratory fitness in young people on subjects 14-17 years. Educational content contains Thinking, Emotions, Exercise, and Nutrition Cognitive aspects (dancing, walking, kickboxing, etc.) with indicators of changes in

Body mass index and cognitive-behavioral depression with a duration of 20 minutes every day for 15 weeks. ANCOVA analyzed changes measured over 15 weeks, six months, 12 months was conducted to evaluate the study's outcomes; SAS Proc Mixed for continuous products; Cohen, For significant interactions, contrasts used to aid in the interpretation. Despite the proliferation of commercially available smartphone applications, a wide range of empirical evidence supports their effectiveness on targeted health behaviors. The AIMFIT randomized controlled trial will provide the needed data on the efficacy of minimal participant contact interventions to improve fitness and physical activity in a young. [32]

The COPE Healthy Lifestyles TEEN Program on Overnutrition and Depressive Symptoms in high school adolescents designed to evaluate the 12-month effects of the COPE (Creating Opportunities for Personal Empowerment) Healthy Lifestyles TEEN (Thinking, Emotions, Exercise, Nutrition) program versus an attention control program (Healthy Teens) on overweight/obesity and depressive symptoms in high school adolescents on subjects aged 14-16 years with content containing Thinking, Emotions, Exercise and Nutrition Cognitive aspects (dancing, walking, kickboxing, etc. indicators of Change in Body mass index and cognitive-behavioral depression with a duration of 20 minutes / w for 15 weeks Change was measured at 15 weeks, six months, 12 months by statistical analysis. ANCOVA conducted to evaluate the study's outcomes; SAS Proc Mixed for continuous results; Cohen, For significant.

Significant result are shown after the use of COPE. There was a decrease in the proportion of overweight and obese COPE adolescents from baseline to 12 month ($\chi 2 = 5.4$, $p = 0.02$) compared to healthy adolescents. For adolescents in very high depressive symtoms, COPE had significantly lower depression at 12 month than Healthy Adolescents (COPE M = 42.39; Healthy Adolescents M=57.9; F1, 12=5.78, p = 0,03).[33]

Cell phone intervention for You (CITY) was designed to determine the effect on the weight of two Mobile technology-based (mHealth) behavioral weight-loss interventions in young adults. The application content contains Behavioral change management and motivational enhancement. Indicators of change in Targeted goals and behaviors including moderate calorie restriction, healthy dietary pattern (based on the Dietary Approaches to Stop Hypertension (DASH) dietary pattern) 20, ≥180 minutes/week of moderate physical activities, limited alcohol intake, and frequent self-monitoring of weight, diet and physical activities for six weekly group sessions and using the CITY app for 24 months. Changes measured over 6, 12, and 24 months were analyzed statistically using a constrained longitudinal data analysis model (cLDA). Despite high intervention involvement and study retention, including behavioral principles and tools in both interventions, and weight loss across all treatment groups, CP did not cause weight loss, and PC did not cause further weight loss in controls. Although mHealth solutions offer broad dissemination and scalability, the CITY results sound a cautionary note concerning intervention delivery by mobile applications. Effective intervention may require the efficiency of mobile

technology, the social support and human interaction of personal coaching, and an adaptive approach to intervention design. [24]

IV. CONCLUSION AND RECCOMENDATION

The electronic-based educational media developed in the articles reviewed include mobile applications, web-based, texting messaging, and Facebook. Most of these media have passed the effectiveness testing stage, but two are still at the design stage and qualitative testing. In general, content with balanced nutrition has been successfully developed by showing a good level of acceptance and liking. Android-based nutrition education media shows better results when compared to websites and other media. Content modification tailored explicitly to the user/subject. Some special conditions cannot be sufficient with a generally balanced diet alone. For example, adolescents with obesity and malnutrition contain slightly opposite content. However, in general, there have been positive changes to research subjects' knowledge, attitudes, and practices. One form of nutrition education activity is counseling. The educational model created here is a medium for counseling because many subjects use it simultaneously. The steps in conducting extension are identifying problems, communities, and areas, determining extension priorities, determining extension objectives by considering precise, realistic (achievable) and measurable goals, determining extension targets, determining extension content, determining extension methods to be used choosing props or extension media.

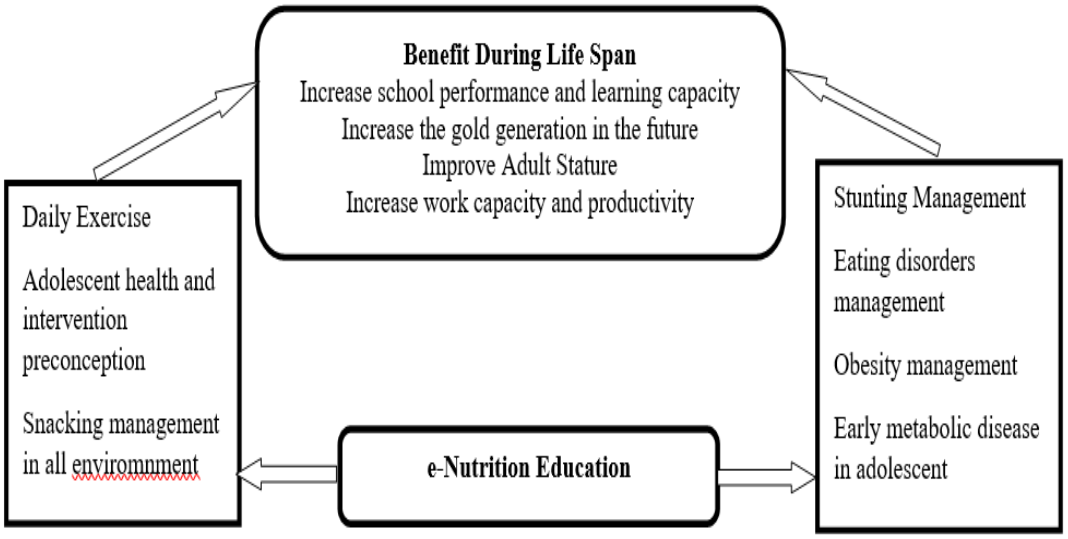

Figure 5. Framework of Nutrition Education Impact

It was found that there was a change in a balanced nutritional diet after the nutritional intervention. It can be concluded that there is no effect of giving application media. It is necessary to develop methods to increase knowledge, attitudes, and behavior of balanced nutrition in adolescents. E-health-based nutrition intervention is one media

that can keep up with technological developments and trends among teenagers. It hoped that it could convey messages to teenagers efficiently and appropriately. However, the provision of media as e-health Nutrition education to adolescents still needs to be developed to improve application deficiencies ranging from media display, content, cellphone or smartphone specifications, better system specifications. Programming and using a more secure domain server will reduce debugging on the application system so that the message delivered and the desired goal can be achieved. In further research, it is necessary to test the acceptance of e-health nutrition education so that it can continue to developed according to the times. In addition, to overcome the problem of eating patterns in adolescents, the application of Remind Me can increase the knowledge, attitudes, and behavior of balanced nutrition in adolescents. However, teenagers need to be exposed to the media intensely and continuously. E-nutrition education is expected to help overcome daily exercise, adolescent health and preconception interventions, snack management in all environments, stunting management, eating disorder management, obesity management, early metabolic disease in adolescents. By overcoming these problems, now and in the future, adolescents will positively impact school achievement and learning capacity, raising the golden generation in the future, increasing adult stature, and increasing work capacity and productivity.

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