

SYSTEMATIC REVIEW

Effectiveness of Social Media Interventions to Improve Nutrition Behaviour among Adolescents in Asia: A Systematic Review

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ABSTRACT

Aims: The purpose of this review is to evaluate the social media intervention's efficacy, as well as the intervention's theory, model, and framework. **Design:** Systematic review. **Data sources:** Five databases- PubMed, Web of Sciences, Scopus, Science Direct and Google Scholar were searched systematically from June 18 to July 12, 2022. **Methods:** Predefined keywords of "social media", "nutrition", "behaviour" and "adolescents" were used. The inclusion criteria: (1) 10 to 24 years old participants; (2) social media or website as intervention platform; (3) intervention outcomes related to improvement in nutrition behaviour, anthropometric measures, knowledge and awareness; (4) is a randomized controlled trial, non-randomized controlled trial, cluster controlled, cohort, case control or before and after study design; (5) published in 2000 until 2022; (6) written or translated is English; and (7) conducted in Asia. **Results:** Review eligibility included nine studies. Three research were web- or website-based, while the other six used social media such as Facebook, WhatsApp, and LINE. Post-intervention outcomes showed significant gains, however some studies found no differences between the intervention and control groups. **Conclusion:** Social media is a widely accepted platform for educating adolescents about nutrition for behaviour change. However, the evidence shows that the interventions are lack of significant improvement between groups and the used of digital or technological-related theory, model and framework. This review demonstrated the progress of healthy behaviours in nutrition and health literacy among adolescents that can be spread through social network and the value of new technological techniques in managing the targeted population.

Malaysian Journal of Medicine and Health Sciences (2023) 19(5):237-246. doi:10.47836/mjmhs19.5.32

Keywords: Systematic review, Social Media, Nutrition Behaviour, Adolescents, Asia

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INTRODUCTION

Children's exposure to unhealthy meals increases as they get older where at least once a day, 42% of school-aged adolescents in low- and middle-income countries consumed carbonated sugary soft drinks, and at least once a week, 46% consumed fast food meanwhile adolescents in high-income nations had rates of 62% and 49%, respectively (15). This is also evidenced by a review that show adolescents had a poor eating habit such as consuming fast foods, skipping meals, snacking frequently and dieting (16). Moreover, increased trends were found in consumption of unhealthy foods across Asia: (1) fats and oils in South Asia and Southeast Asia;

(2) sugar in South Asia, Southeast Asia and Pacific; and (3) processed foods, sodium and sugar-sweetened beverages (SSBs) in Asia and Pacific (17). With numerous driving elements, the diet consumed by adolescents during childhood and adolescence has a significant impact on their growth and development.

Several levels of factors impact adolescents' dietary choices, including self-influenced factors such as finance, body image, knowledge, social environment (food selection and home-cooked meals by parent), physical environment (foods availability in institutions) and macrosystem (Internet) (19). In addition, adolescents' eating behaviours are influenced by their cognitive and emotion, intention, attitude, subjective norm, perceived behaviour control, parents, food availability and mass media (18). According to a recent study, high-energy density (HED) foods and beverages constituted the majority of the photographs uploaded by adolescents on

social media (67.7%) (5). Besides that, adolescents who are influenced by their peers on social media have been proven to choose high-energy items in bigger portions than is suggested, such as sweet and savoury snacks and SSBs (14).

Various actions have been taken to improve dietary practises, whether digital, school-based, or family-based, with digital being employed more frequently nowadays. This is because, for many individuals, the Internet is their major source of health information, and user-generated health-related material has multiplied since the broad adoption of social media (13). 95% of adolescents own or have access to a smartphone and 45% are online almost all of the time (8). This shows that smartphone ownership has become an almost universal feature of adolescent life with more digital communications and online activities such as social media. Adolescents were more exposed to foods and drinks with high levels of total fat, saturated fat, trans fat, salt, and free sugars than children on social media (9). Digital interventions using social media, web-based, and mobile health (mHealth) are beneficial for positive behaviour change as technology allows treatments to reach a larger audience, cost-effective, practical, customizable and sustainable making it an excellent intervention platform for adolescents (10, 11). For example, social media intervention on dietary raised adolescents' understanding and changed their behaviours by avoiding foods rich in fat, sugar, and salt (12). This is because social media intervention provides numerous uses, including engagement, photo sharing and editing, sub-groups and group chats, information, and gamification, that have a favourable impact on the audience (6). Although countless interventions at improving adolescent's behaviour have been implemented, research on the effectiveness of social media-based interventions especially in Asia countries is scarce. Furthermore, without defined criteria and explicit procedures in facilitating behaviour change, it is unclear which characteristic of the intervention predicts success and efficacy in assessing effectiveness (20).

To ensure effectiveness, social media interventions must be designed in accordance with the local culture, societal values, and using the pertinent learning and multimedia theories or models. Hence, in developing interventions, the use of theories, models and frameworks (TMF) is essential. The theoretical justification for an intervention is developed in the first phase (intervention development), which is frequently represented by a "logic model" describing the inputs that the intervention entails, the processes initiated, and the mechanisms through which these are aimed to acknowledge favourable results (40). Since interventions are often intended to increase knowledge and change the behaviour of target population, TMF related to behaviour change such as transtheoretical model (TTM), cognitive behavioural therapy (CBT) and many more is often used. However, in a digital or technological setting,

the relevant TMF namely Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT) Model or Internet Intervention Model (IIM) that should be included were lacking. Thus, this review aims to identify the effectiveness of the social media intervention, medium of delivery used and TMF applied to the intervention.

METHODOLOGY

Systematic review is a summary of literature search conducted with a clear and systematic methodology that is critically evaluated, synthesized, minimized bias and errors (2). It is developed based on 8 steps by Xiao and Watson (2019): 1) formulate problem of the research; 2) develop and validate review protocol; 3) search for literature; 4) screen the inclusion criteria; 5) assess quality of the articles; 6) extract data; 7) analyse and synthesise data; and 8) report findings.

This systematic review was registered with International Prospective Register of Systematic Reviews, known as PROSPERO (Registration number: CRD42023334107). The goals were to decrease unintentional review duplication and increase openness in the review process, with the goal of reducing reporting bias (1). The review was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. PRISMA consist of a 27-item checklist and a four-phase flow diagram designed to assist writers in improving systematic review and meta-analysis reporting (3).

Literature Search Strategy

The literature searches were conducted on intervention related to nutrition and social media among adolescents in Asia in the following search databases: Science Direct, Scopus, PubMed, Web of Science and Google Scholar. PubMed MESH (Medical Subject Headings) was used in identifying relevant search terms as shown in Table I. Predefined keywords of "social media", "nutrition", "behaviour" and "adolescents" were searched in databases from June 18 to July 12, 2022. The keywords and search terms were combined to create search string that is related to the topic as presented in Table II.

Eligibility Criteria

Studies were included if they met all of the following criteria: (1) participants aged 10 to 24 years old; (2) the intervention platform uses social media or website; (3) intervention outcomes related to improvement

Table I: Keywords and search terms identified

	Keywords	Synonyms terms
1.	Social media	Social medium OR web 2.0
2.	Nutrition	Nutritional OR diet
3.	Behaviour	Behavior OR acceptance
4.	Adolescents	Adolescence OR teens OR teenagers OR youths
5.	Asia	-

Table II: Search string used in identifying related articles

No.	Search Database Used	Search String	Filters / Limits / Refine to	Date Searched
1.	Google Scholar	Social media OR social medium OR web-based OR website OR digital AND healthy eating OR dietary OR nutrition OR weight loss OR health OR obesity OR eating AND behaviour AND intervention AND adolescents OR youth OR teenagers AND asia <hr/> allintitle: intervention nutrition OR diet OR nutritional OR behaviour OR behavior OR acceptance "social media" <hr/> allintitle: intervention nutrition OR diet OR nutritional OR behaviour OR behavior OR acceptance "social medium" <hr/> allintitle: intervention nutrition OR diet OR nutritional OR behaviour OR behavior OR acceptance "web 2.0"	- year (2000 – 2022)	18/6/2022 – 21/6/2022
2.	Scopus	ALL (social AND media OR social AND medium OR web 2.0 AND intervention AND diet OR nutrition OR nutritional AND behaviour OR behavior OR acceptance AND adolescents OR adolescence OR teens OR teenagers OR youths AND asia)	- English - Year (2005 – 2022) - Subject area (social sciences, psychology, neuroscience, health professions) *Article type (article) *Country (Asia) = 20	23/6/2022 - 26/6/2022
3.	Web of Science	TI= (social media OR social medium OR web 2.0 AND intervention AND diet OR nutrition OR nutritional AND behaviour OR behavior OR acceptance AND adolescents OR adolescence OR teens OR teenagers OR youths AND asia)	- English - Search term (social media, nutrition) - Year (2002 – 2022) *Country (Asia) * Article type (article) = 17	28/6/2022 - 2/7/2022
4.	PubMed	social media [Title/Abstract] OR social medium [Title/Abstract] OR web 2.0 [Title/Abstract] AND intervention [Title/Abstract] AND diet [Title/Abstract] OR nutrition [Title/Abstract] OR nutritional [Title/Abstract] AND behaviour [Title/Abstract] OR behavior [Title/Abstract] OR acceptance [Title/Abstract] AND adolescents [Title/Abstract] OR adolescence [Title/Abstract] OR teens [Title/Abstract] OR teenagers [Title/Abstract] OR youths [Title/Abstract] AND asia [Title/Abstract]	- English - MEDLINE - Year (2000 – 2022) * Humans * Age (13 – 24 y/o) * Article type (RCT, Clinical Trial, Controlled Clinical Trial, Observational Study) = 6	4/7/2022 - 7/7/2022
5.	Science Direct	Title, abstract or author-specified keywords (social media AND intervention AND nutrition OR diet AND behaviour AND adolescents OR youth AND asia)	- Year (2000 – 2022) *Article type (article) *Subject area (social science, psychology, neuroscience) = 28	8/7/2022 - 12/7/2022

in nutrition behaviour, anthropometric measures, knowledge and awareness of adolescents; (4) is a randomized controlled trial (RCT) or non-RCT, cluster controlled, cohort, case control or before and after study design; (5) published in 2000 until 2022; (6) language written or translated is English; and (7) conducted in Asia.

Data Collection

The search string in Table II was used in conducting literature search by primary author (HMJ). The articles found were downloaded in Mendeley and duplicates were removed. Primary author (HMJ) assessed title, abstract and full-text articles according to eligibility criteria and eliminated articles that were not related to social media and nutrition intervention program. Two reviewers (SSB and RZT) independently further reviewed the potentially related full-text articles and eliminated the articles that did not fulfil the eligibility criteria.

A consensus will be achieved for all inquiries and disagreements through virtual or face-to-face discussion with all reviewers.

Data Extraction

All data were extracted from the selected articles for results verification. Recorded data that were described are: (1) study details (title, author, year, country, design); (2) intervention details (intervention groups, intervention duration, theories or models used, social media or website featured); (3) participant details (demographics, sample size); and (4) outcomes measured (main key results, tools).

Quality Assessment and Risk of Bias Assessment

A validated evaluation technique was used to assess the risk of bias in the included articles which are Joanna Briggs Institute (JBI) critical appraisal tools for randomized controlled trial (RCT) and quasi-experimental study

(non-RCT). Three reviewers including primary author (HM), SSB and RZT) independently assessed the articles' quality and rate the risk of bias for each article. Articles with high levels of bias were not included in the analysis. Any disagreement between reviewers will be resolved using virtual or face-to-face discussion.

Data Synthesis

The significant elements qualitatively summarised and collated from included studies in Table III.

RESULTS

Study selection

Fig. 1 shows the flow for the process of selecting included articles. Out of 517 articles identified, only nine articles were included after the full articles screening. After two duplicates were removed, 443 titles, 61 abstracts, two full articles screened were excluded due to the following reasons such as not an intervention, not focused on social media and nutrition behaviour, not in Asia, not for adolescents and unclear study design.

Study characteristics

Table I shows the summarized key characteristics of the included studies. All of them were conducted in Asia: Indonesia (n = 2) (21, 28); Thailand (n = 2) (22, 25); Malaysia (n = 2) (23, 26); China (n = 2) (24, 29); and India (n = 1) (27) from 2015 to 2020. Three studies used quasi-experimental design (21, 22, 28), four were RCT (23, 25, 26, 29) and the remaining two were non-RCT (24, 27). Six studies recruited school students (21, 22, 23, 25, 26, 28) while three were college students (24, 27, 29) which four of them focused on overweight or obese students (21, 22, 26, 27). The shortest duration of the intervention was 21 days (24) while the longest

was 7 months (21). Only three studies used theoretical model or framework for behaviour change namely Health Literacy (HL) Framework, RE-AIM framework and Social Cognitive Theory (SCT) (22, 24, 26). Six studies were conducted using social media as an intervention platform such as WhatsApp, LINE and Facebook (21, 22, 24, 26, 27, 28) whereas another three were Internet- or website-based (23, 25, 29). Apart from that, three studies were each accompanied by lectures, face-to-face sessions and school activities (21, 22, 26).

Components and effectiveness of the intervention

Based on content of the intervention, four studies focused on obesity prevention (21, 22, 23, 25), another four on healthy lifestyle (24, 26, 27, 29) and one for nutrition only (28). Two studies did not state the components of the intervention content (21, 27). Other intervention content consists of nutrition and physical activities education as follows: recommended portion and serving sizes; unhealthy snacks; fruit and vegetable intake; SSBs; fattening foods; and weight management. Some of them also include psychology-related knowledge, recording daily meals for calorie control, screen time, sharing exercises routine, healthy habits reminders and behaviour change plans. In four studies, this intervention content was only delivered to the intervention group, not the control group (22, 26, 28, 29) whereas in five studies, both groups received it, but the information was limited given through different ways and platforms (21, 23, 24, 25, 27).

Social media served a range of tasks and goals as part of the intervention in the included studies which is shown in Fig. 2. More interventions took place on social media than on websites. Among all of the platforms, Facebook and WhatsApp were used in two interventions each compared to WeChat and LINE. Almost all interventions used a designated platform to share information and education according to their respective methods such as: lectures with booklets (21, 28); teaching session (22, 26); and posted content (23, 24, 25, 27). They were also utilized as an interaction platform to communicate between researcher, panel of experts and participants (22, 23, 24, 26). Social media act as a reminder for the participants such as water-drinking and anti-sedentary while also provides tasks and challenges such as sharing picture of their meals and exercise performances (24). Two interventions used those platforms for goal setting purpose where action plans were designed for the participants that includes problem solving, outcome expectancies, relapse prevention and many more (26, 29).

The outcomes were measured at baseline and post-intervention for control and intervention group where significant changes were identified for post-intervention measures. Five out of nine studies showed a reduction in BMI (21, 23, 25, 26, 27) where two of them also reduced body fat percentage and waist circumference

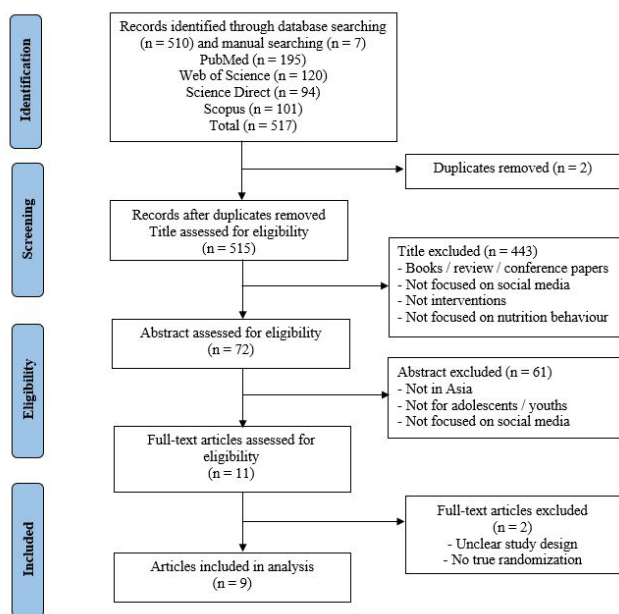


Figure 1: PRISMA flow chart

Table III: Summary of the characteristics of included studies

Author (Year), Country	Study Design	Participants	Study Duration	Theoretical Models	Setting / Platform	Outcomes Measured	Relevant Findings
Asnidar et al. (2018), Indonesia	Quasi-experimental	Overweight & obese junior high schoolers n = 91	7 months (September 2016 – March 2017)	-	- WhatsApp - Text messages - Lectures	Differences in knowledge, food intake patterns and BMI	- Positive differences in knowledge ($p < 0.001$), intake and BMI ($p < 0.001$) in G1, 2, 3 - No difference in intake patterns (energy $p = 0.008$ and CHO $p = 0.027$) and BMI ($p = 0.140$) in G4
Thammasarn & Banchonhat-takit (2020), Thailand	Quasi-experimental	Overweight and obese school students age 9 to 11 years old n = 34	12 weeks	Health Literacy (HL) Framework	- LINE - Smartphone application - School activities	- Health literacy in preventing obesity, dietary and physical activity behaviours - Nutritional status - Fat percentage	- Experimental group improved mean difference on health literacy to prevent obesity (10.18; 95% CI: 7.11 to 13.24, p -value < 0.001) and dietary and physical activity behaviours (13.44; 95% CI: 6.11 to 20.77, p -value < 0.001) for post-intervention. - Experimental group had a statistically significantly lower mean score on nutritional status (weight for height) (0.26; 95% CI: 0.05 to 0.59, p -value < 0.05) and fat percentage (1.71; 95% CI: 0.19 to 3.22, p -value < 0.05) than control group
Nawi & Jamaludin (2015), Malaysia	Randomized controlled trial	16 years old school students n = 97	12 weeks	-	- Website	- Waist circumference - Body fat percentage - BMI	- Small effect for intervention group in reducing BMI, waist circumference and body fat percentage for post-intervention. - No significant difference between both groups.
Wang (2020), China	Non-randomized control intervention	Averagely 18 years old college students n = 110	21 days	RE-AIM framework	- WeChat	- Food intake - Physical activity level - Physical fitness - Body composition	- Intervention group had significant progress for healthy food intake (all $P < 0.05$), and improvement in PA level ($P = 0.004$) and physical fitness: squat time [Median (95% CI), 17 (12,31) s] vs [Median (95% CI), 6 (0,20) s] ($P = 0.005$), plank time [Median (95% CI), 13 (9, 22) s] vs [Median (95% CI), 0 (-8,10) s] ($P = 0.008$) compared to pre-intervention - No changes in control group.
Rerksup-paphol & Rerksup-paphol (2017), Thailand	Randomized controlled trial	Grade 1 to 6 elementary school students n = 217	4 months	-	Internet-based program	- Changes in percentage of overweight and obese participants - BMI - Waist to hip ratio	- Control group had higher percentage of overweight/ obesity than intervention group (56.6% vs. 39.6%; p -value=0.009) and significantly higher increase in net BMI gains than intervention group (1.24kg/m ² vs. 0.40kg/m ² , p -value=0.027). - Intervention group had no changes in BMI z-score (-0.001, 95%CI -0.19 to 0.18, p -value=0.988) than control group, which had significant gain of BMI z-score (0.45, 95%CI 0.27 to 0.63, p -value).
Norliza et al. (2017), Malaysia	Randomized-controlled trial	Overweight/ obese primary school students aged 8 to 11 years old n = 134	- 4 weeks - 3 months (booster sessions)	Social Cognitive Theory (SCT)	- Facebook (4 weeks) - WhatsApp (3 months) - Face-to-face session	- BMI z-score. - Waist circumference - Body fat percentage	- Sixth month post-training, BMI z-scores were significantly reduced in the intervention group than wait-list group, for all children and within the obese subgroup ($F(6, 517) = 2.817, p = 0.010$) and ($F(6, 297) = 6.072, p < 0.001$) respectively. - Waist circumference percentile and body fat percentage: the intervention group had a significant reduction than wait-list group, within the obese subgroup ($F(6, 297) = 3.998, p = 0.001$) and within the overweight subgroup ($F(6, 201) = 2.526, p = 0.022$).

Table III: Summary of the characteristics of included studies (continued)

Author (Year), Country	Study Design	Participants	Study Duration	Theoretical Models	Setting / Platform	Outcomes Measured	Relevant Findings
Krishnamohan (2017), India	Non-randomized control trial	Overweight/obese college students aged 18 to 23 years old n = 45	2 months (July 2014 – August 2014)	-	- Facebook	- Dietary pattern - Physical activity - BMI	- Mean number of days of junk food intake per week was reduced in control and intervention groups from 2.91 days/week and 3.27 days/week to 2.65 days/week to two days/week at respectively. - Significant decrease in the BMI ($p < 0.05$) was found only in control group (baseline: 25.57, follow up: 25.15). - No significant differences for physical activity and intake of fruits and vegetables
Firmansyah et al. (2019), Indonesia	Quasi-experimental	11 th grade science students aged 15 to 17 years old n = 96	4 months (August 2017 – December 2017)	-	- Social media	- Nutrition knowledge on fattening food - Consumption level of fattening food	- Nutritional education with nutrition booklet influenced the greatest for fattening-food knowledge ($p = 0.000$) and consumption ($p < 0.05$). - Nutritional education with social media influenced the fattening-food knowledge ($p = 0.001$) and consumption ($p < 0.05$). - There were different scores of the fattening- food knowledge ($p = 0.001$) and consumption ($p = 0.005$) in the nutritional education group with nutritional booklet and social media.
Duan et al. (2017), China	Randomized-controlled trial	Undergraduate students age 17 to 24 y/o n = 493	8 weeks	Health action process approach (HAPA) model	- Web-based	- Physical activity (PA) level - Fruit & vegetable intake (FVI) - Motivational, volitional, distal for PA and FVI - Stages of change for PA and FVI - Mental health	- Significant time x group interactions revealed superior intervention effects on FVI; motivational, volitional, and distal indicators of FVI; and PA behaviour changes, with an effect size (χ^2) ranging from 0.08 to 0.20. - Overall intervention effects were significant for stage progression to the action group from T1 to T2 in PA ($\chi^2_1 = 11.75, P = .001$) and FVI ($\chi^2_1 = 15.64, P = .03$). - Intervention effect was seen in the improvement of quality of life ($F_{3,492} = 1.23, \chi^2_2 = .03, P = .02$).

(23, 26) compared to pre-intervention. Improvements were found for nutrition-related knowledge (21, 28) and health literacy to prevent obesity (22). The result reported positive impact on food intake (21, 24) while decreasing of consumption of junk food and fatty foods (27, 28). Apart from that, fruit and vegetable intake for intervention group increased (29). Physical activity level increases (24, 29) where overall physical fitness also increases (24). Improvements occurred in dietary and physical activity behaviours, nutritional status and body fat percentage (22). Lastly, higher percentage of obese and overweight were found in control group which they also had greater waist-to-hip ratio (25). However, no significant difference ($p < 0.05$) was found between intervention and control group for post-intervention in fruit and vegetable intake, physical activity level and anthropometric measures such as BMI, fat percentage, muscle mass and waist circumference (23, 24, 26, 27, 29).

Risk of bias

A total of 11 studies were evaluated based on the JBI critical appraisal by two reviewers of which only nine

met the critical appraisal. Table II and III shows four RCT and five quasi-experimental (non-RCT) study design. Both reviewers selected “yes” for all questions and stated an overall rating for each article as worthy of inclusion. To conclude, all studies included are low risk of bias.

DISCUSSION

The current systematic review is the first to assess the efficiency of social media in nutrition interventions among adolescents specifically in Asia as all of the published review related were conducted worldwide. According to this proper evaluation of literature, social media is frequently used as an intervention to change a range of outcomes pertaining to a balanced diet and regular exercise. The studies reviewed here generally support the notion of previous research that social media interventions can affect improvements in physical activity levels, healthy dietary choices, and positive alterations in body composition or weight through increases in healthy food consumption (41). RCT, non-RCT and quasi-experimental studies were among the several study designs included, and their effects ranged

from statistically significant to non-significant. These designs are commonly used in interventional studies as it evaluates the baseline and post-intervention outcomes with RCT using randomization sampling being the strongest design compared to others (32). Other pre-post study designs such as non-RCT and quasi-experimental are often used as well because of the same evaluation measures except without randomization (31).

Although utilising social media as a tool to provide social support has many aspects, young adults appear to view information provision to be a desirable and acceptable approach to use a social media platform (30). Almost all interventions employ social media and website to disseminate information and offer education, as can be observed in this review. For instance, Asnidar et al. (2018) found that group 1 significantly improved in knowledge level, food intake patterns, and BMI as a result of the use of WhatsApp application during lectures, but group 4 without the use of any platforms increased only in knowledge level. This is because those platforms offer the opportunity of multidirectional contact, as well as the ability to observe and reach a broad and/or targeted audience for free or at a minimal cost (33). Hruska and Maresova said that in 2018 and 2019, Facebook and Instagram dominated the social media landscape. Hence, Facebook and WhatsApp are the most frequently used platforms which is in line with previous intervention studies. Tomayko et al. (2021) stated that Facebook had higher satisfaction level and perceived efficacy compared to text messaging in delivering monthly content on healthy lifestyle and obesity to families with young children. Meanwhile, the use of WhatsApp significantly improved the number of days and servings in consuming fruits and vegetables among male firefighters compared to promotion pamphlet (35). Some studies found non-significant effects between intervention and control group which is in accordance with West et al. (2016) where the participant's body weight between both groups were essentially the same. This might be a result of the intervention using a small sample size, as a greater sample size and a successful intervention can result in a larger impact size, such as a significant weight loss (23).

TMF act as a guide to help researchers accomplish their goals. The majority of interventions, however, do not employ any of them, or digital or technological elements. 2 utilised the HL Framework to assess the effectiveness of their intervention, but there is no explicit explanation of the framework's use, including which type and how it was applied. Next, 4 applied RE-AIM framework that emphasize the value of external in addition to internal validity with a focus on transparency in reporting throughout all RE-AIM dimensions (37). To date, the RE-AIM framework has been used in various interventions except those related to nutrition interventions on social media. This study assesses the intervention efficacy according to five dimensions:

Reach, 87 students engaged in the program with engage rate of 79%; Effectiveness, milk and dairy products, fruit, vegetable, physical activity level and fitness improved; Adoption, difficult and repetitious tasks with significant time cost; Implementation, high program engagement; and Maintenance, 64.4% would join the program again while 90.8% would recommend it to others. Lastly, SCT which is frequently applied in the health-related field, describes the interplay between personal or cognitive elements (knowledge, aim, and self-efficacy), environment (social support or barriers) and behaviour (result expectations) in behaviour change (38). It was incorporated in REDUCE (REorganize Diet, Unnecessary sScreen time and Exercise) intervention program where the child is the subject and environmental factors is home and parental elements that support the children's change of behaviour that resulted in improved anthropometric measures. This positive effect also applied to the nutrition intervention using SCT in a face-to-face setting, which successfully decreased fast food intake among students in comparison to before the intervention (39). All studies employed the behaviour change model, but none used digital or technological TMFs such TAM, UTAUT, or IIM for the intervention which is crucial in assessing user acceptance of a digital or technological-based intervention.

This review indicated the progress of healthy behaviours in nutrition and health literacy among adolescents that can be spread through social network. The value of new technological techniques in managing the targeted population for intervention were also demonstrated. Although the eligible studies describe the intervention carried out, some of them do not explain the features of the included technology in detail. As this review depends on the evaluation and judgment of the reviewers, bias may occur even though the process is done independently and discussions are held to reach a consensus. In addition, no checklist to assess the quality of eligible studies specific for social media were found such as mERA for mHealth intervention. Meta-analysis also cannot be performed as the interventions were so diverse some of which employed social media and others websites with various research designs and outcomes. The limitations in the evidence includes small sample size and short intervention duration that resulted in a non-significant effect to the participants.

CONCLUSION

This review offers relevant insight into the state of social media-based nutrition interventions in adolescent populations in Asia. It is a widely accepted platform for educating adolescents about nutrition for behaviour change. However, the evidence shows that the interventions are lack of significant improvement between groups and the used of digital or technological-related TMF. Thus, further studies are required to continue assessing the efficacy of social media as a healthcare aid

as it is a rapidly evolving technology and new platforms might emerge. Besides that, proper reporting and quality assessment of interventions should be done according to a checklist of criteria that authors and reviewers can use when evaluating evidence. Technical features' viability and engagement must also be continuously included and operationalized to comprehend their roles in influencing results. To strengthen the existing body of evidence, research should take into account lengthier interventions with proper follow-up, larger and more diverse study samples, and methods that are sensitive to dietary behaviour change.

ACKNOWLEDGEMENT

This study was a part of a larger research project titled Modelling A Digital Intervention Framework on Limiting the Consumption of High Energy-Dense (HED) Foods and Sugar-Sweetened Beverages (SSBs) among Adolescents. This research is funded by Fundamental Research Grant Scheme (FRGS) [grant number FRGS/1/2021/SS0/UITM/02/40] from Ministry of Higher Education (MOHE) Malaysia.

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