

ARTICLE INFORMATION

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The influence of body mass index (BMI) and physical activity changes on the effectiveness of e-health in obesity among adults: A systematic review

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Abstract

Background: The use of e-health is now widely used as a new intervention e-health can be applications in smart phones, smart watches, or wearables, as well as telemedicine, interactive video and web-based interventions.

Purpose: Submitting the results of exploration related to the impact of e-health use in increasing physical activity and changes in BMI in adults with obesity.

Method: Literature reviews on several databases such as clinical key nursing, sage journal, and Pubmed using PRISMA methods.

Results: This systematic review study proves that eHealth has an influence on physical activity and BMI in adults with obesity. From the 7 articles that used e-health as an intervention in changing physical activity and BMI showed significant results against changes in physical activity, BMI despite using different types of eHealth, such as virtual reality, smartphone applications/wearable devices and telehealth.

Conclusion: The use of e-health can be recommended as part of a body weight management strategy as it has a good impact over time and needs to be integrated with nursing interventions so that nurses can monitor patient progress and adjust recommendations based on the data collected.

Keywords: E-Health; Obesity; Physical Activity.

INTRODUCTION

Overweight and obesity are an ongoing public problem worldwide and have increased over the past five decades. Overweight is known to be a risk factor for a number of accompanying diseases, such as type 2 diabetes, hypertension, stroke, myocardial infarction, obstructive sleep apnea, and some types of cancer (Blüher, 2019). The World Health Organization (WHO) defines overweight and obesity as an abnormal or excessive accumulation of fat and can lead thealtho the emergence of a disease risk with a BMI category > 25.

According to the WHO report in 2018, it is known that approximately 2 billion adults fall into the overweight category and a third of that figure falls into the obesity category with a BMI >30. In Southeast

Asia itself, the prevalence of obesity is still quite large and Indonesia is in second place after the Philippines, it can be seen from data collected by the BPS (Statistics Indonesia) from 2007 to 2018 through risk and circles known that the rate of obedience at age > 18 years is continuously rising.

Factors that cause obesity are lifestyle behaviours such as high alcohol consumption, smoking habits, high consumptions of fatty foods, low consumptions of vegetables and fruits and low physical activity (Wolfenden, Ezzati, Larijani, & Dietz, 2019). Physical activity is generally divided into three types, namely daily physical activity (washing clothes, petting, walking, cleaning windows, gardening, knitting, playing with children, and so on), physical activity with

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exercises performed structured and planned (walking, jogging, push up, stretching, aerobic gymnastics, cycling, etc.) as well as sports which are physical activity exercise but performed with a specific priority for the purpose of a performance. Physical activity can be defined as some movement of the skeletal muscle, which causes the use of energy by the body and according to its level is divided into 3 levels weight, moderate and low (Rozaini, Sariman, Rashed, & Shari, 2023).

Low physical activity is often associated with a sedentary lifestyle, which is a lifestyle where a person tends to be lazy doing physical activity or moving his body so that this kind of life behaviour consumes less energy or <1.5 MET (Metabolic Equivalent Tasks) (Pacific, Kulwa, Martin, & Petrucka, 2022). Physical activity in everyday life such as climbing stairs, walking, doing household work, or cleaning the yard can help keep the body fit and healthy. While structured activity performed by walking or running on a treadmill, weightlifting, and other aerobic exercise programmes is estimated to be able to produce energy of > 3 MET (Metabolic Equivalent Tasks) (Berhimpong, Rattu, & Pertiwi, 2020).

Physical activity is a health action that focuses on prevention and one of the theories that can describe health action is the Health Belief Model (HBM). Health belief model is a theory of health behavior change and a psychological model used to predict health behaviour by focusing on the perception and beliefs of an individual about a disease. The structure of the Health Belief Model encompasses perceived susceptibility which is a perception of the risk of disease, perceived seriousness which is perceptions of the severity of the disease, perceived benefits and perceived barriers which are the benefits and obstacles perceive in adopting preventive behaviour and cues to action are their signals to act as drivers within and outside the family such as: friends, doctors, healthcare providers, media and educational resources. The Health Belief Model is used to predict preventive health behaviour and to explain the behavioural roles of sick people, and has also been widely used in cross-disciplinary research such as medicine, psychology, social behaviour and

gerontology (avarro, Cebolla, Llorens, Borrego, & Baños, 2020). Nowadays in technology era, much of e-health is used to facilitate physical activity that can be used to measure the daily steps and intensity of physical activity by a variety of methods, from the use of apps on smartphones to use of bracelets, pedometers, accelerometers and smart watches that can benefit (Chong, Guo, Deng, & Woo, 2020). Data collected on e-health devices can be utilized as a benchmark in determining advanced intervention because the data is displayed in real time and accurate. (Chong et al., 2020). Based on the description, the author is interested in conducting further analysis of the effectiveness of eHealth in helping to change the physical activity of adults with obesity.

RESEARCH METHOD

The databases used in the literature search are clinical key nursing, pubmed and sage journals. A combination of search terms using Boolean operators: and, or, not, here are some keyword combinations used in literature searches as follows: (overweight) or (obesity) or (obesity, abdominal) or (obesity, central) and (e-health) or (m-health) or (telemedicine) or (virtual medicine) and (physical activity) or (exercise) or (aerobic exercis) or (isometric exercise) and (bmi) or (index, body mass) or (quetelet index) or (quetelet's index); (obesity) and (e-health) and (physical activity) and (bmi); (overweight) or (obesity) and (e-health) or (m-health) and (physical activity) or (exercise) and (bmi) or (quetelet index).

The criteria for inclusion in the systematic review are: the articles are fully accessible, the research articles in the 2018-2023 period, using English and focusing on the use of technology for physical activity, while the exclusion criteria are: articles are not accessible in full text or in book form, articles are systematic review, literature review and meta-analysis, as well as non-adult research subjects with obesity. Searching for literature starts on March 5, 2023 in clinical key nursing, pubmed and sage journals. Assessment of the quality of the selected paper using a checklist carried out independently.

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RESEARCH RESULTS

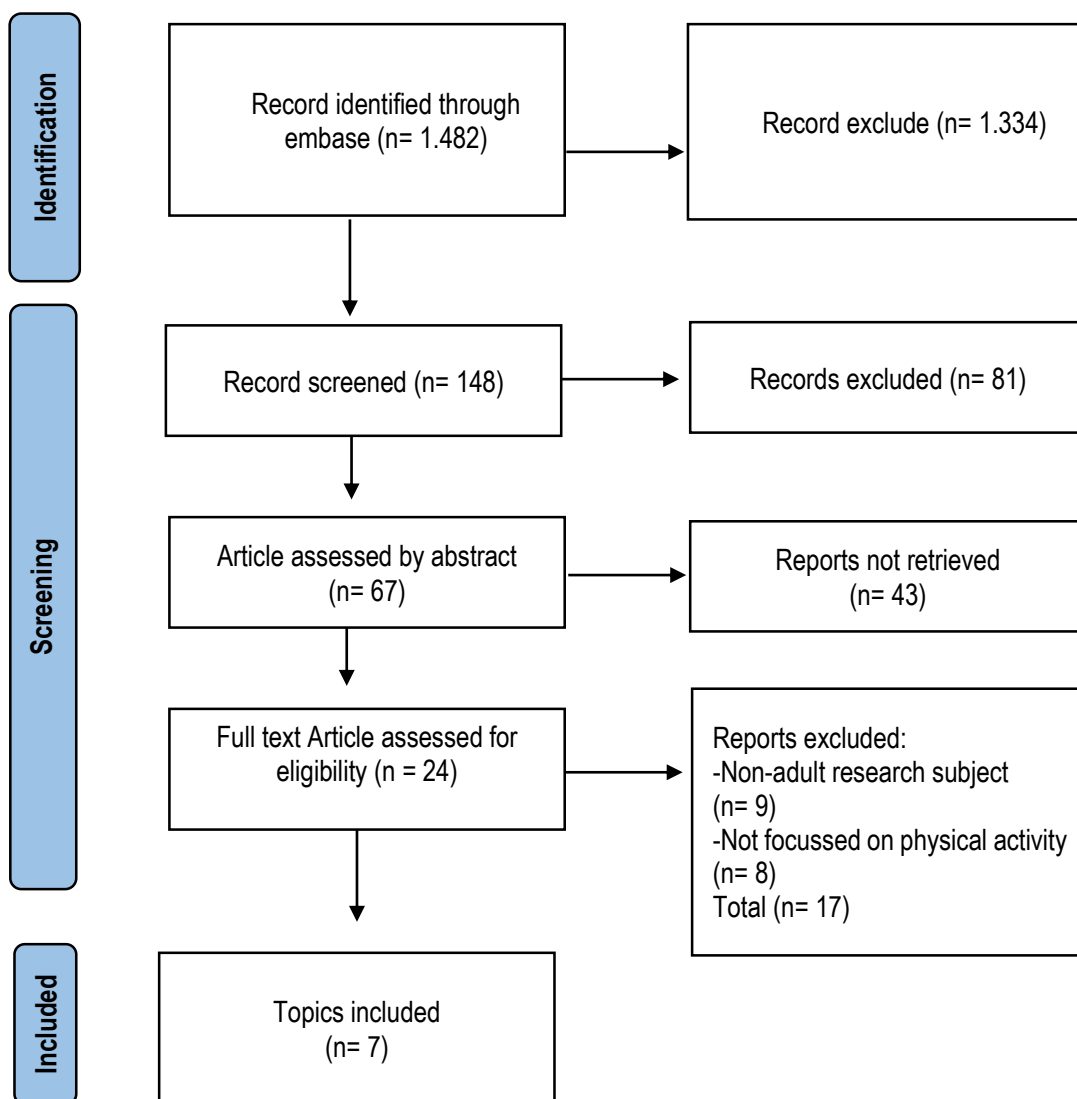


Figure 1. Diagram of PRISMA Flow

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Table 1. The Main Characteristics of Included Studies

Author/Year/Country	Purpose	Method	Results
(Sanchez, Rodriguez, Conde, Gento, Adalia, Manent, & Ortiz, 2022) (Spain).	Assessed the long-term (12 months) effectiveness of mHealth with a wide range of interventions combined with the use of smartphone apps, activity tracker bracelets and brief counselling compared to the control group that only used short counsellors on weight loss, physical activity, calorie consumption in adults with sedentary lifestyle as well as having overweight and obesity.	Randomized Controlled Trial.	From 650 respondents willing to be respondents, 563 (86.6%) completed the visit in 3 months and 443 (68.2%) completed a study in 12 months. After 12 months, the intervention group showed weight loss. (-0.26, 95% CI -1.21 to 0.70 kg; P=0.02), BMI (-0.06, 95% CI -0.41 to 0.28 points; P=.01), waist circumference (-0.48, 95% CI -1.62 to 0.66 cm, P=0.04). There was a difference in calorie intake. The intervention group showed an increase in the time of physical activity. (32.6, 95% CI -30.3 to 95.04 min/week; P=0.02) compared to the control group.
(Gomez-Marcos, Patino-Alonso, Recio-Rodriguez, Agudo-Conde, Romaguera-Bosch, Magdalena-Gonzalez, & Garcia-Ortiz, 2018) (Spain).	Evaluate the impact of the addition of 3 months of application use on traditional advice on physical activity (PA) and a heart-healthy diet	Randomized Controlled Trial.	The results of a 12-month study in the intervention group showed lowered waist circumference by 0.72 cm with (95% CI 2.35 cm - 0.02 cm) and a decrease in BMI 0.082 (95% CI 0.06-0.22)
(Ozturk, & Duruturk, 2022) (Turkey).	Test the effects of exercise through remote rehabilitation applied during the period of isolation of COVID-19 in overweight and obese individuals on physical fitness and quality of life.	Quasi experiments with the control group.	There was a statistically significant improvement in all physical fitness parameters, quality of life in the remote rehabilitation group (p<0.05). At the difference between the two groups, the overall physical fitness parameter and the observed life quality, there were statistically significant differences in support of the rehabilitation groups (p<0.05)

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(Backman, Kohatsu, Padovani, Dao, Ritley, Fleuret, & McCracken, 2023) (USA).	Determine the weight-loss effects of the Koa Family Program (KFP), a community-based obesity intervention, as well as to test the impact of KFP on increased weight-related health indicators.	Randomized Controlled Trial.	The study found significant weight changes in the intervention group, with an average decrease of about 7.69 pounds (about 3.49 kg) on the 18th week and 7.72 pounds on the 25th week, the effect of this intervention is equivalent to a weight loss of about 4% of the study group's average weight of 189 pounds (about 85.73 kg) on the baseline. Between the baseline and week 18, there was a 23.7% decrease in the probability in the inactive group and a 1.6% decline in the less active group. However, the likelihood of becoming active increased by 6.4%. The study also found that the intervention group was more active than the control group.
(Navarro, Cebolla, Llorens, Borrego, & Baños, 2020) (Spain).	Evaluate the effects of using avatars in online interventions designed to increase physical activity and physical satisfaction in women with overweight or obesity.	An experimental design, by dividing it into three groups.	The results of this study show that the online interventions used are effective in improving physical activity practice and self-efficiency expectations in overweight women. However, the manipulation of the avatar's body dimensions did not improve the effectiveness of this intervention. The use of ideal avatars appears to reduce the anxiety experienced during physical activity in this population but this study found no significant changes in the Body Mass Index (BMI) between different groups. BMI values show no significant differences between Non Avatar Condition (NAC), Real Avatar Conditions (RAC), and Ideal Avatars Condition. (IAC)
(Lee, Cheung, Yi, Oh, & Oh, 2018) (South Korea).	Categorize intervention groups and control groups using the International Physical Activity Questionnaire (IPAQ) and analysed changes in biomarker and blood	A multicentre randomized parallel interventional	BMI changes: In the intervention group, participants with Inactive activity (IA) and minimal activity (MA) experienced a significant decrease in BMI. Specifically, the decrease in BMI was -0.7 ± 1.14 kg/m ² for IA participants and -0.9 ± 1.30 kg/ m ² for MA

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	<p>chemical index within and between these groups. The study was a follow-up to a previous study that focused on the difference in body weight and BMI between intervention and control group. The research is also part of a national pilot project for Smart Care Services, with the aim of analyzing the impact of mobile health (m-health) use on 24-week obesity management.</p>	<p>and open-label trial.</p>	<p>participants. This decline was compared to a smaller decline in the control group, where the BMI decreased by -0.2 ± 0.93 kg/sq. for iA and -0.2 ± 0.86 kg/nq. Level of Physical Activity: The study also observed a significant decrease in health-enhancing physical activity (HEPA) for body fat percentage in the intervention group. The decrease in HEPA was $-1.6 \pm 3.69\%$, compared to a change of $-0.1 \pm 3.15\%$ in the control group. In addition, there was a significant decrease in glycosylated haemoglobin (HbA1c) levels in HEPA participants in the intervention group (-0.2 ± 0.67 mg/dL) compared to the control group (0.0 ± 0.34 mg/dL). These results showed that interventions, which included obesity management services using smart phones, positively affected BMI and levels of physical activity, especially in participants with lower or moderate levels of activity.</p>
<p>(Nahorna & Olena, 2023) (Ukraine).</p>	<p>Evaluate the effectiveness of weight management programs carried out through teleHealth services for overweight adult women. The program is designed to integrate physical activity into clinical care.</p>	<p>Research design involves theoretical analysis, anthropometric methods, and mathematical statistics.</p>	<p>There was a significant decrease in body mass index (BMI), waist circle, and abdominal circle. In addition, the program successfully improved the level of physical activity as well as the functional capacity of the cardiovascular and respiratory systems, and increased VO2max, which indicates improved physical performance. The program also had a positive impact on strength and coordination, with significant improvements in tests that measured strength and agility.</p>

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DISCUSSION

Physical activity is one of the factors causing obesity because physical activity is associated with energy consumption. Nowadays, people are trapped in a sedentary lifestyle that leads to reduced physical activity. Sedentary lifestyle refers to a pattern of behaviour in which a person spends most of their time in a physical state that minimizes movement or activity (Alfaris, Alqahtani, Alamuddin, & Rigas, 2023). The main feature of this lifestyle is sitting or lying for long periods of time during day-to-day activities, such as working in front of a computer, watching television, or using other electronic devices. Lack of physical activity makes the energy output low and there is an imbalance between the calorie intake and the energy that is exhausted leading to obesity. From the 7 articles that used e-health as an intervention in changing physical activity and BMI showed significant results against changes in physical activity, BMI despite using different types of eHealth, such as virtual reality, smartphone applications/wearable devices and telehealth (Alligood, 2017).

Based on the article review, there is one article used virtual reality to increase physical activity in adults with obesity. Virtual reality (VR) is a technology that allows users to feel and interact in an artificial environment created by a computer (Biderafsh, & Nasrollahi, 2020). These environments are usually visually and sometimes audio depicted, and are designed to make users feel as if they are inside them. The use of e-health as an avatar through virtual reality is intended to influence the level of physical activity, motivation, pleasure, anxiety, self-efficiency, and purpose of the physical activity. Participants were randomly divided into three groups based on three conditions: ideal avatar condition, real avatar conditions, non-avatar conditions (Nyakotey, Ananga, & Apprey, 2022). The results showed that the use of VR as a body-shaped avatar improved physical activity and self-efficiency in all participants and helped reduce the anxiety experienced during physical activity in adults with obesity and significantly affected BMI (Brand, & Cheval, 2019).

The use of virtual reality in the article describes three states of the participant's body, namely the state of the real body, the ideal body state and the expected body state. This use of the virtual reality is a positive affection because it describes an ideal body condition

and does not describe something negative on the condition of the body so that it becomes a thing that can encourage the individual to enhance physical activity. If a person has a positive affective assessment then it will be a driving force that increases a person's chances and will change the state of his physical inactivity (Park, Moon, Kim, Kong, & Oh, 2020). This digital body imaging can enhance the motivation of participants, both intrinsic motivation and external motivation, thus increasing the level of physical activity and mega-adopting positive health behaviour. This is in line with the health promotion model (HPM) because the model focuses on the factors that motivate individuals to adopt positive health behaviour as the primary determinant in the adoption and maintenance of healthy behaviour (Alligood, 2017).

Weight loss interventions are generally based on behavioural modifications including a healthy lifestyle and regular physical activity. In addition, the use of smartphone and wearables devices such as smartwatches and smart bands can also be used as an intervention that helps weight loss by improving the behaviour of physical activity. There are three articles that utilize the use and wearable devices like smartwatch and smart band for obesity management especially for increased physical activity and weight changes in adults with obesities. Three articles mention that using smartphone and wearing devices can increase physical activity and lose weight in adults who are obese because with increasing physical activity it can increase the energy that comes out because obesity occurs because of the imbalance between incoming calories and energy released so that by increasing the physical activity then the energy released also increases (World Health Organization, 2018).

The first article stated that the intervention group that received obesity management services using the smartphone service showed significant weight loss, BMI, and body fat and had higher levels of physical activity compared to the control group receiving obesities management services in general without a smart phone. The second and third articles also mentioned that by combining smartphone use with wearables device use, after 12 months it was known that the use of smartphone combined with wearables

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devices was able to enhance several health metrics compared with the control groups significantly such as weight reduction, BMIs, body fat index, waist circle, and hip circle and also increased the time spent doing physical activity.

The next use of e-health is telehealth, which is defined as health care activities carried out remotely through information and communication technology services. Telehealth can be seen as an important part of expanding access to health services among communities because it can reach geographical, temporal, social, and cultural boundaries. The article found showing the use of telehealth in physical activity in adults with obesity showed that there was a significant improvement in all parameters of physical fitness and quality of life in the intervention group that received the telehealth service compared to the control group that only received the conventional service.

Studies on teleHealth in the United States also showed the weight loss effects of a community-based teleHealth intervention program called KFP. The results of the study showed significant weight loss in the intervention group, both in the 18th and 25th weeks, with an average drop of about 7.7 pounds. In addition, there are increased physical activity and behavioural changes that lead to a healthier lifestyle (Backman et al., 2023). Significant changes in the intervention group such as a decrease in BMI, waist circumference, and improvement in body composition. The program also contributes to increased functional capacity of the cardiovascular and respiratory systems, as well as increased physical activity (Nahorna & Andrieieva, 2023).

CONCLUSION

Physical activity is one of the risk factors for obesity because in relation to energy consumption, sedentary lifestyle is a static lifestyle that consumes only a small amount of energy. Increased physical activity can raise energy expenditure so it can reduce the risk or even decrease BMI in adults with obesities. Nowadays, general e-health is used as a form of health service or intervention both as an individual and community-based service. From the articles found about the use of e-health in weight management services, all articles mention that e-health has a significant influence on physical activity

and a decrease in BMI as well as some fat indicators in the body.

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