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The Effect of Online Games Tumpeng Gizi Seimbang to Balanced Nutrition Knowledge, Fat Intake, and Carbohydrate Intake in Overweight Adolescents in High School Surakarta

Nur Sitra Buamona[1*], Sapja Anantanyu[2], Suminah[3]

[1]Department of Nutrition Science, Sebelas Maret University,Surakarta, Indonesia.
[2,3]Department of Agriculture, Sebelas Maret University, Surakarta, Indonesia
*Correspondence author : nursitrabuamona@gmail.com

Abstract

Introduction: Obesity is a chronic health problem in adolescents and can cause various non-communicable diseases in adults. Lack of nutritional knowledge and excessive intake of fats and carbohydrates can cause obesity. Nutrition education is needed through a tumpeng balanced nutrition with innovative methods and media so the information can be effective. The methods of learning by playing and using internet media are familiar to adolescents.
Objective: To know the effectiveness of online games tumpeng balanced nutrition to balanced nutrition knowledge and fat and carbohydrate intake in overweight adolescents.
Methods: Qquasi-experimental research with a pre-test and post-test with a control design. A total of 84 adolescents in Surakarta were sampled in this study using the multistage random sampling technique, which is a gradual sampling process. Sampling technique, namely the process of sampling in stages. The first stage is from senior high school and the equivalent in the Jebres and Laweyan sub-districts, namely SMAN, SMA Swasta, and SMK N. using a simple random sampling technique on each school to obtain SMAN 8 Surakarta, SMA Muhammadiyah. 3 Surakarta, SMAN 1 Surakarta, and SMA Batik 1 Surakarta. Then, the process The sample selection in each group was selected using the purposive sampling technique. The sampling technique is a selection process that is carried out deliberately by setting certain goals and planning. Setting certain goals and planning. The screening was conducted at the start of this study via Google Forms. Adolescents with *z-score* >1 SD were chosen as respondents. Nutrition knowledge was measured with a questionnaire. Fat and carbohydrate intakes were obtained with a food record. The data was analyzed with Wilcoxon and Mann-Whitney.
Results: There were differences in nutritional knowledge between the case and the control group (p=0.001). The results showed that there were differences in carbohydrate intake (p=0.001) in the game group, and there was no effect in the lecture group (p=0.299). There was no effect before and after the intervention in the two groups in the fat intake treatment group, p=0.230 and the control group, p=0.299.
Conclusion: There was a difference in nutritional knowledge and carbohydrate intake between the two groups. Meanwhile, there is no difference in fat intake in all groups before and after the intervention.

Keywords: Adolescents, Overweight, Tumpeng, Nutrition Knowledge, Fat, Carbohydrate

Introduction

Obesity in Adolescents According to a WHO study in 2016, the prevalence of overweight and obesity among children and adolescents aged 5-19 has increased drastically from just 4% in 1975 to more than 18% in 2016 Obesity in adolescents based on WHO studies in 2016 the prevalence of overweight and obesity among children and adolescents aged 5-19 years has increased drastically from only 4% in 1975 to more than 18% in 2016. Adolescents are one of the most susceptible groups to nutritional problems because, at this time, adolescents require nutrient intake as needed for growth and development. If adolescent obesity is not dealt with early, it will have an impact on health and decrease productivity. Obesity is a multi-factor nutritional problem. Nutrition knowledge is an individual's understanding of nutrition science, nutritional substances, as well as the interaction between nutrients and nutritional status and health. It is in accordance with previous research by Muliyati on high school adolescents of Palu, who have good nutritional knowledge, all have normal nutritional status with a percentage of nutrition knowledge of 92.1%. It proves that the knowledge of balanced nutrition influences a person's nutrition status and is also affected by the eating habits of individuals (Muliyati *et al.*, 2019). Individual eating habits that exceed need are factors that cause obesity, i.e. carbohydrate intake and excess fat intake. In Indonesia, Central Java is one of the provinces with a prevalence of obese adolescents above the national figure, with the total number of obesity cases rising from 6,04% in 2017 to 7,9% in 2018 (Hasil Riset Kesehatan Dasar Tahun 2018). Surakarta City is one of the regencies or cities in Central Java Province with a prevalence of adolescent obesity aged 16-18 years of 11.47%, this shows that Surakarta City has a higher overall number of obesity cases when equalized with the number of obesity cases in Central Java Province (Riskesdas Provinsi Jawa Tengah, 2018).

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Surakarta City Health Service obtained obesity based on IMT by age 15-18 in the highest teens located in the work areas of the Laweyan, Jebres and Banjarsari puskesmas. Nutrition education on food and health then became a priority for adolescent groups through balanced nutrition guidelines. The government, through the Ministry of Health, has issued balanced nutrition guidelines and has a visual form to be easy to understand and implement (Permenkes RI No.41 Tahun 2014. Pedoman Gizi Seimbang, 2014). The educational process requires the media to be tailored to the objectives in order to the educational objectives. Education can be done with the media as a help to facilitate and clarify the students in receiving and understanding the message delivered besides also facilitating educators in delivering education. The education given to adolescents must be through an attractive medium so that adolescents do not feel saturated while the educational process is going on and so that the material is easy to understand (Safitri, 2016). Nutrition education can be done through a variety of media and methods. Conventional methods commonly used are lectures or other methods, one of which is a game method commonly called learning by playing. *(online* games and *offline* games*).* Online game-based learning can be used as an alternative to increasing interest and motivating students in the learning process in the era of the digital native generation. It is in line with previous research that games applied in nutrition education can enhance knowledge, attitudes and healthy eating practices in adolescent groups. When it comes to games with educational content it's called educational games (Ogunsile & Ogundele, 2016). One example of a game-based educational platform with website technology capabilities is Kahoot. This platform can be used through any digital device with a browser and existing infrastructure with good internet connection capabilities Kahoot! aims to make the learning process fun and can be applied virtually to both distance and face-to-face learning (Kalleny, 2020). So, in this study, the visual shape of the balanced nutritional stack was modified into the Kahoot. Platform as a medium of delivering balanced nutrient stack material to adolescents in order to improve the nutritional knowledge of adolescents as well as decrease fat intake and carbohydrate intake in adolescents with obesity nutritional status.

Methods

This design of the study is quasi-experimental with the use of a pre-post control design research plan that aims to find out the impact of online games on nutritional knowledge, carbohydrate intake and fat intake in overweight adolescents before and after getting the intervention. The locations of this research were SMAN 1 Surakarta, SMAN 8 Surakarta, SMA Muhammadiyah 3 Surakarta, and SMA Batik 1 Surakarta. Determination of the number of samples in this study using the Lemeshow formula to calculate the sample size to be used. The Lemeshow formula obtained a sample size of 84 people. The population in this study were students aged 16-18 years at senior high schools and equal in the 2021-2022 school year. The first stage is the sample of the research taken with a multistage sampling technique or the process of gradual duplication. The first phase is the overall research population with the target population of Higher Secondary Schools and equals in Jebres district and Laweyan district: public Senior High Schools, Private Senior High Schools, Public Vocational High Schools and Private Vocational High Schools, then selecting research locations, using simple random sampling techniques in each Senior High School and equivalent so that SMAN 1 Surakarta, SMAN 8 Surakarta, SMA Muhammadiyah 3 Surakarta and SMA Batik 1 Surakarta are obtained. Then, the sample selection process in each group was selected using a purposive sampling technique.

The criteria for inclusion are respondents who are registered as active eleventh-grade students at each study location, respondents aged 16-18 years who are nutritionally obese, have a personal smartphone and are willing to be respondents and participate in research activities. The exclusion criterion is that respondents are absent and participate during the research process. Respondents have a disease that requires a particular diet. The samples were divided into each group, namely the treatment group (intervention with lectures accompanied by online game is Kahoots and the control group (lecture method intervention).

The instruments used in this research are the instruments that have already passed the process of validation, such as a nutrition knowledge questionnaire, a nutritional knowledge questionary made in the form of a google form and filled by the nutrition information respondents consisting of 23 questions such as The instrument used in this study is a questionnaire filled out by respondents using google forms consisting of a nutritional knowledge questionnaire consisting of 23 questions in the form of multiple choice questions interpreted according to the knowledge score, which is said to be good knowledge if the score is 76-100, sufficient if the score is 56-75% and said to be lacking if <56 % (Budiman, 2013). Then fat and carbohydrate intake using food record forms distributed via google classroom and monitoring via Whatsapp is and then grouped according to gender and are categorized into categories do not sufficient with RDA (Recommended Dietary Allowances) (More: 110% RDA and less: <80% RDA) and the

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comlpiance with RDA (Good: 80 -110% RDA).Interpreted with the nutritional adequacy rate of adolescents said to be less if <80% AKG, good if 80-110 AKG, more if >100% AKG

Results and Discussions

Respondent characteristics

Based on **Table 1.** There were 84 known subjects, mostly of the gender of the subject, with the proportion of the female gender greater than that of the male, being 25 people and 23 people (treatment group 59.5% and control group 54.8%).

Table 1. Subject Demographic Data

General characteristics	Treatment group		Control group	
	n	%	n	%
Gender				
Male	18	42,9	17	40,5
Female	24	57,1	25	59,5
Total	42	100	42	100
Age				
16 years old	9	21,4	12	28,6
17 years old	27	64,3	25	59,5
18 years old	6	14,3	5	11,9
Total	42	100	42	100

Source: Primary data (2022)

This study obtained data characteristic of the subject of the study, including age and gender. Of the 84 subjects of the study, the percentage of female students was higher by 9.5% compared to 40.5% of male students. This is related to the problem of being overweight, which is more common in women than men. In adolescents, women tend to store more of their excess energy in the form of fat storage, so they are more susceptible to nutrition, while in men, the excess energy is used as a process for protein synthesis (Nisa & Rakhma, 2019)

The characteristics of respondents based on knowledge scores, fat intake and carbohydrate intake before and after intervention.

Table 2. shows that there is an increase in knowledge in both groups after the intervention, namely that in the group with game treatment, there was an increase in the percentage in the good category by 14.3% to 71.4% and an increase in the percentage of knowledge in the group with lecture treatment in the good category by 11.9% to 40.5%. Carbohydrate intake in each group also changed to a good category, namely in the group given intervention in the form of online games with a percentage of 23.8% to 78.6 with a percentage of the category 76.2 to 21.4%. As for the group given the intervention in the form of lectures with a good category of 21.4% to 28.6%. From the results of these percentages, the game group has more influence on changing carbohydrate nutrient intake into a good (balanced) intake category. Fat intake of respondents in each group before getting the intervention was in the more category, namely in the online game group of 92.9% and the lecture group of 95.2%. Before getting the intervention, each group was in the good category of 7.1% and 4.8%. After getting the intervention, there was a change in the good category with a percentage of 31.0% in the online game and 7.1% in the lecture group.

Table 2. Distribution of Nutrition Knowledge, Carbohydrate Intake and Fat Intake of Respondents Before and After Intervention

Dependent Variable	Treatment group				Control group			
	Before		After		Before		After	
	n	%	n	%	n	%	n	%
Nutrition knowledge								
Less	28	66,7	3	7,1	29	69,0	7	16,7
Simply	8	19,0	9	21,4	8	19,0	18	42,9
Good	6	14,3	30	71,4	5	11,9	7	40,5
Total	42	100	42	100	42	100	42	100
Carbohydrate Intake								
Less	0	0	0	0	0	0	0	0
Simply	0	0	0	0	0	0	0	0
Good	10	23,8	33	78,6	9	21,4	12	28,6

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More	32	76,2	9	21,4	33	78,6	30	71,4
Total	42	100	42	100	42	100	42	100
Fat Intake								
Less	0	0	0	0	0	0	0	0
Simply	0	0	0	0	0	0	0	0
Good	3	7,1	13	31,0	2	4,8	3	7,1
More	39	92,9	29	69,0	40	95,2	39	92,9
Total	42	100	42	100	42	100	42	100

Source: Primary data (2022)

In this study, obtained data characteristic of knowledge respondents better improvement of the post-intervention was found in the online game group with a score of 71.4%. If compared with the improvement in knowledge of the respondents in the control group, in the treatment group, it is more effective to improve the knowledge of respondents. This is because the learning process is done by playing (learning by playing), and respondents are not only given one-way education (receiving) but respondents also given the opportunity to train memory related to the material that has been acquired. Hence, it affects the results of the posttest obtained at the end of learning. The increased knowledge of respondents in each group also indirectly affects the eating behaviour that is based on fat intake. Respondents' fatty intake is shown in Table 2. which shows a decrease in percentage in the above category and an increase in the good category, although overall remains in the higher category. This is due to teenagers eating less fibre and more peppers because teenagers prefer to eat foods that are exciting but fast in the presentation process and economical. In the picture of carbohydrate intake, there is a percentage increase in this good category because respondents/teens are already beginning to know the daily portion of carbs they are supposed to consume so that they can be applied. It is consistent with previous research that food selection as satisfaction of nutritional needs is obtained from nutritional knowledge so that it influences the eating behaviour that is implemented as a certain food consumption attitude that affects the individual's nutritional status (Aulia, 2021).

The effect of online games on respondents' knowledge

Based on **Table 3.** Shows the results of the average value of nutritional knowledge before intervention in the treatment group was 60.62, and the control group was 56.43. After the intervention, there was an increase in the average value of 78.38 in the treatment group and 72.40 in the control group. The results also showed that the average value of the difference in nutritional knowledge in the two groups before and after the intervention was greatest in the treatment group, namely the group with online game intervention, which was 17.76. Based on the results of the Wilcoxon test, the results of nutritional knowledge in the treatment group p = 0.001 (p < 0.05) and the control group p = 0.000 (p < 0.05). This value indicates that there is an effect of online games and lectures on the nutritional knowledge of respondents after receiving the intervention. Furthermore, the results of comparative statistical analysis using the Mann-Witney test on the pre-test value of knowledge between groups before treatment showed a value of p=0.052, so there was no difference between the two groups before treatment. After the intervention, the post-test value between groups showed a value of p=0.013, which means there is a significant difference in the knowledge of respondents, so it can be concluded that nutrition education with online game media is more effective in increasing respondents' knowledge.

Table 3. Effectiveness of Online Games on Respondents' Knowledge

	Treatment Group=42					Control Group (n=42)					intra group *p-value*[a]		*p-value* between groups[b]
	Min	Max	Mean	SD	Difference value	Min	Max	Mean	SD	Value Difference	KP	KK	
Pre test	45	93	60.62	11.7	17.76	31	79	56.43	13,6	15.97	0,001[a]	0,001[a]	0,052[b]
Post test	50	94	78.38	9.8		49	87	72.40	10,2				0,013[b]

Source : Primary data (2022)
Description : Treatment group (KP), Control group (KK)
[a]Wilcoxon test, [b]Mann Whitney test; N= 84 ; Significant if p-value < 0,05

The process of nutrition education carried out in this study using the game media is the implementation of one of the forms of intervention to manage obesity, namely, the realization of nutritional education. Nutrition education is implemented as an attempt to improve the knowledge of respondents and is expected to be able to change a person's habits in the fulfilment of daily nutrition (Chiutsi-Phiri *et al*., 2017). Previous research conducted by Sineke has shown

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that adolescents who have poor nutritional knowledge influence adolescent obesity, where adolescents are obese due to imbalances in energy intake and energy use due to adolescents' knowledge of balanced nutritional intake (Sineke *et al*., 2019). So, the selection of the media in the process of nutrition education is very important as a medium of information with a view to the objectives, objectives and expected results. Learning needs to be carried out with innovative and interactive media so that the message of balanced nutrition can be delivered to adolescents. Based on that, online gaming media is used as an intermediary in the delivery of information, in addition to the method of lectures (conventional method).

Based on the results of the Wilcoxon statistical analysis, it show that there is a meaningful difference in knowledge scores before and after intervention using online games with a value (p=0.001). The results of this study are consistent with the study Amanah *et al.* (2019), which shows that there is a significant difference in the average value of knowledge score of respondents before and after being given education using communicative game media. Other studies have also shown that nutrition education using digital game-based media can improve knowledge in adolescents positively and related to nutrition and healthy eating patterns (Ezezika *et al*., 2018). The effectiveness of learning with digital/online-based game media is also demonstrated by research from Arif *et al*. (2022) that online learning processes can shape respondent thinking more critically because the stimulation given can stimulate the recipient of information to think more critically so that it influences the process of intelligence and is able to apply the information obtained.

The results of the Wilcoxon analysis test in the control group showed that the method of lectures also improved knowledge in adolescents. Although both methods are capable of improving knowledge, significantly higher scores are found in the online game groups with an average difference of 17.76 and the mean value of posttest knowledge **(see Table 3).** The lecture method in the control group has a weakness when the learning process is going on. That is, the learning process is one-way. Whereas in the treatment group, in addition to respondents receiving information through the lecture method, respondents also get the game so that information is easier to accept and easy to learn by respondents. The effectiveness of online media games was demonstrated by the results of different test analyses using Mann-Whitney's statistical test, which obtained results that there were significant differences in knowledge between groups after the given intervention. It indicates that online games are used in research as one of the proper forms of intervention in the nutrition education process. It is supported by other research that the media interactive online quiz game is based on Kahoot. That is used in nutritional education about the importance of effective consumption of fruits and vegetables, improving students' knowledge (Ladiba *et al*., 2021). Other research also suggests that one of the nutritional innovations is the media online interactive quiz game based on the platform of Kahuot. However, the use of these media can boost the interests and learning outcomes of students (Wigati, 2019).

The effect of online games on fat intake and carbohydrate intake

Based on **Table 4**. Interpretation of the Wilcoxon test results obtained data on fat intake before and after the intervention in the treatment group showed a p-value = 0.230 (p> 0.05), and in the control group showed a p-value = 0.299, which means there was no significant difference in intake fat of respondents after being given nutritional education intervention in the form of online games in the treatment group and the control group. Then, a follow-up test was carried out with Mann Whitney, which showed no difference in fat intake before the intervention, indicated by a p-value of 0.385> 0.05 and the results of the test for differences between groups after receiving the intervention showed a significant difference in p-value 0.011 <0.05. Based on the significance of the Mann-Whitney results, it can be stated that the treatment group or the group that was given nutrition education with interventions in the form of online games was more effective in changing the subject's fat intake than the control group, which can be seen in **Table 2** where the percentage of fat intake and carbohydrate intake of respondents compared to daily nutritional adequacy figures.

Table 4. Effectiveness of Online Games on Fat Intake

Fat intake	P-value Treatment Group[a]	P-value[b] Control group	p-value
Pre intervention	0.230	0.299	0,385
Post Intervention			0,011

Source : Primary data (2022)
Description : [a]Wilcoxon test, [b]Mann Whitney Test

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Interpretation of the results of the *Wilcoxon* test obtained by the intervention carbohydrate intake data in the treatment group showed a difference after the intervention, indicated by a value of 0.001 ($p < 0.05$). The same result was also shown in the control group with a value of 0.002 ($p<0.05$), which indicated that there was a significant difference in the carbohydrate intake of respondents before and after receiving a balanced nutrition lecture. Furthermore, further tests were carried out with *Mann Whitney*, which showed that there was no difference in carbohydrate intake between groups before being given the intervention indicated by carbohydrate intake $p=0.520$ ($p>0.05$). The results of the difference test between groups after getting the intervention showed a significant difference with a value of $p=0.001$ ($p<0.05$). Based on the significance of the mann-whitney results, it can be stated that the treatment group or the group given nutrition education with an intervention in the form of an online game is more effective in changing the carbohydrate intake of the subject than the control group, which can be seen in **Table 2** where the percentage of carbohydrate intake of respondents decreased to the good category most in the online game group.

Obesity in adolescents is a serious problem because it continues until adulthood. One of the factors causing this obesity problem is the intake of macronutrients as a source of energy for the body (Kurdanti *et al*., 2015). The imbalance of energy expended or used by the body with excessive intake is generally the cause of overnutrition. Energy imbalance is a habit of eating high calories but not accompanied by physical activity. That this nutritional problem is influenced by a sedentary lifestyle and a diet that is high in calories, and high in fat intake, high fat intake but low in fibre (Budiono *et al.*, 2022).

Based on the results of the study, it is known that the fatty intake of respondents did not experience significant differences between the groups both before and after the intervention. This can happen because respondents are still consuming excess fried foods every day, such as chopped fries, chopsticks, fries and other fried fries. So, even though the food ingredients contain a fairly high amount of protein, these foods also contribute to the fat derived from oil. The results of this study are also similar to the research of Darni (2020), that nutrition education given using the nutrition and nutrition comic media showed no significant difference in the intake of pre-intervention fat sources shown with a $p=0.119$ ($p>0.05$) value in the treatment group and the control group with the $p=0.04$ value ($p >0.05$). It is also due to the fat intake that is easier to burn consumption if it has been processed into food forms such as fries. Because of the intake of fat in a balanced diet of 67 grams/day or 5 tablespoons of oil, this fat consumption is difficult to avoid due to the intake of foods that have to be fried.

Based on the results of the study, it was revealed that the respondents' carbohydrate intake showed significant differences in the treatment group after obtaining the intervention of online games. A significant difference was also shown in the control group with lecture intervention. Although there were significant differences in each group after the intervention was given, the results of the study showed that the carbohydrate intake of respondents after compared with AKG (number of nutritional sufficiency) with the highest percentage of both categories was found in the game group **(see table 2).** Advanced trials also showed there was a significant difference between the groups, so it can be said that online games were effective in reducing the carbs intake in the respondents in the category well faster because of the sources of carbs such as rice, strawberries, potatoes and other things that are easy to restrict their consumption by respondents according to the daily intake recommendations because of their ease of burning. The results of this study are in line with Palupi's research (2022). The nutritional education "EMPIRE" educational media with an online-based psychological approach has an effect on carbohydrate intake in obese indicated by a value of $p = 0.001 (p<0.05)$.

Conclusions

There is an increase in learning after getting an online game education, and there is also an improvement in knowledge after getting a lecture education. However, knowledge improvement is faster if given online games education, so online games are more effective as a balanced nutritional education medium. There is no difference in the intake of fat after getting educational games online. The same thing is also after being given education in the form of lectures. However, online games are more effective in changing carbohydrate intake.

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