



Health Education Against Changes in Physical Activity Patterns and Body Mass Index

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Abstract: Obesity problems in children will be at high risk of obesity in adulthood and potentially experience various causes of significant risks for some chronic diseases associated with diets, such as type 2 diabetes mellitus, hypertension, stroke, cardiovascular disease, and certain types of cancer. This research aims to determine the effect of health education based on social media to the pattern of physical activity and body mass index (BMI) adolescent overweight and obesity of each group and between groups in Bulukumba, Indonesia. The design of this research is the "Quasi Experiment," which is a pretest and post-test with control group design. The population in this study were overweight and obese adolescents in Bulukumba Regency. The number of samples is 91 people divided into 4 (four) groups. The analysis used is the Friedman test, Kruskal Wallis, repeated ANOVA, and one-way ANOVA. The intervention was given for six months through health education with a lecture media booklet in groups 1 and 2, leaflets in group 3, and lecture method alone without media in group 4. In groups 1 and 2, we were given re-education through the WhatsApp application in group 1 and through messages in group 2. Periodic time series measurements were taken for six months on the variables of physical activity pattern and BMI. The results showed an effect of health education on the changing of activity patterns in each and between groups. There is an effect of health education on BMI changes in groups of 1,2 and 3 and between groups, but there is no influence on group 4. This study recommends to health workers (nurses, nutritionists, and health promotion) the use of booklets and utilizing social media (WhatsApp) in providing health education related to obesity.

Keywords: Body Mass Index; Health Education; Obesity; Physical activity

Introduction

Adolescent obesity is emerging and is a public health problem that is a concern in the United States and other countries of the world (James & Gill, 2022). Currently, 1 in 3 children in the United States suffers from overweight or obesity (Kumar & Kelly, 2017). Obesity is caused by the interaction between genetic factors and environmental factors. Genetic factors or offspring of parents that are difficult to avoid, the father or the mother has excess weight. It can be passed on to the child (Styne et al., 2017). Environmental factors include activities, lifestyle, socioeconomic, and nutrition. The main factor of obesity is the imbalance of energy intake with energy output (Weihrauch-Blüher &

Wiegand, 2018). High energy intake when food consumption is excessive, while energy output becomes lower if the body's metabolism and physical activity are low (Martin et al., 2018). Physical activity in children affects childhood obesity. It used to be a child's game, which is a physical game that requires children to run, jump, or other movements, but is now replaced with children's games that do not perform physical movements, such as electronic games, computers, the internet, or television is enough to do just sitting in front of him must move. Obesity is not only caused by most intake in terms of carbohydrates, fats, and proteins but also because of a lack of physical activity (Al-Khudairy et al., 2017).

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The prevalence of obesity in Indonesia is expected to continue to increase, especially in urban areas related to changes in living patterns and eating habits of Indonesian society. In addition, Indonesian people tend to have activities that are less sedentary (sedentary activities) due to changes in work patterns and progress in the field of transportation (Heri et al., 2021). Based on data from the Ministry of Health in 2018, the prevalence of overweight in children aged 5 and 12 reaches 18,8 and 10.8 are obese, while in South Sulawesi 6.5%.

Obesity has a high risk of comorbidity (Tsao-Wu et al., 2019). Obesity problems that occur in children will be at high risk of obesity in adulthood and potentially experience various causes of major risks for some chronic diseases associated with diets, such as type 2 diabetes mellitus, hypertension, stroke, cardiovascular disease, and certain types of cancer (Koliaki et al., 2019). The consequences arising from the increased risk of being able to die early until a serious chronic condition that can degrade the quality of life (Zeller et al., 2015). Another effect of obesity is diabetes. Given that overweight in children and adolescents will persist in adulthood and at risk of the disease described earlier, efforts to treat adolescents overweight should be made as early as possible.

Interventions to reduce the prevalence of obesity can handle by behavioral therapy in adolescents, that is, diet and exercise combined with behavior modification through health education (Flodmark, 2018). Health education is a process of dynamic behavior change with the aim of changing or influencing human behavior, which includes components of knowledge, attitude, or practice related to healthy life goals individually, in a groups or in communities, and is a component of health programs (Walter & Pigeot, 2016).

Methods in providing health education continue to be developed through various media, both print, electronic media, and social media. Social media is one of the individual facilities and the virtual world community to socialize. Online social media is a medium designed to facilitate social interaction is interactive with internet-based technology. Based on US Census Bureau data in January 2014, Indonesia has about 251 million inhabitants.

Reality in the smartphone field is mostly used for instant messaging and also as a social network. This opportunity, in the view of researchers, is a land that can be optimized, meaning that during this smartphone students only in use for the purposes of Short Message Service (SMS), telephone, internet, and social networking, it will be better and more efficient if used for learning activities. The effectiveness of education delivery in improving the healthy lifestyle based on mobile phones can be seen from some previous research. Research conducted by Sarno et al. (2014) using m

Health technologies in the practice of medicine or public health through mobile devices, concluded that m Health technology has the potential to be used as a tool for prevention and treatment of overweight and obesity, especially with mobile phones and SMS, which has been used daily by most of the population (Sarno et al., 2014).

Another study was conducted by (Mateo et al., 2015) through a systematic review and meta-analysis study to compare the effectiveness of mobile applications compared to other approaches to weight loss and increased physical activity. The evidence from this study shows that mobile phone-based intervention can be a useful tool for weight loss (Mateo et al., 2015). Research on mobile learning has been done by several researchers both in Indonesia and abroad, but who specifically examines the use of Whatsapp is still rare to do it.

The purpose of this study was to analyze the influence of social media-based health education on changes in physical activity and Body Mass Indeks (BMI) in overweight adolescents and obesity in each and between groups in Bulukumba District.

Method

The design of this research using the "Quasy Experiment" is pre-test and post-test with control group design. The total sample in this research is 91 people with a purposive sampling technique. The study group in this study was divided into 4 (four) groups consisting of 2 (two) treatment groups and 2 (two) control groups. The first group (25 respondents) were given a health education through a lecture with a booklet accompanied by a WhatsApp application, the second group (22 respondents) was given a health education through a lecture with a booklet accompanied by a message, the third group (22 respondents) were given a health education with a lecture accompanied by a leaflet and the fourth group (22 respondents) were given only health education through lectures without media. Group 1 (first) gave health education for six month by giving material about obesity, physical activity patterns, and calculation of BMI, in turn, every week by using a booklet. Over the next six months, education is provided, through the delivery of information related to obesity material, physical activity pattern and BMI calculation through WhatsApp application.

The submitted materials are text with pictures. In the second (second) group, health education was given the same as the first group, but the information provided was sent via message. The submitted material is text only. Group 3 (third) is also given six month of health education by giving the material, in turn, each

week through the leaflet, but not a repetition of health education for the next six months. While in group 4 (to four) given health education through lectures without media every week for six month and also do not do a repetition of health education in next six month.

After the intervention is given, an evaluation of physical activity pattern and BMI is changed every month for 6 (six) months. Data collected from children include sex, age, weight, height, BMI, and physical activity patterns. At the same time, parents have parental education, family income, overweight history, family obesity, family health history, and family structure. Weight measurements using 150 kg stepped scales with 0.1 Kg of footlessness, whereas the height measurement using microtoise scale 200 cm with 0.1 cm accuracy, then determine the BMI of children by WHO Anthro Plus software.

Biodata children and parents use biodata form. Physical activity was measured using the Physical Activity Questionnaire for Adolescents (PAQ-A) suitable for early teenage children. PAQ-A is a recall instrument within the last seven days of student physical activity. PAQ-A can be given in the classroom and gives a summary score of physical activity derived from nine items. On each item, there is a 5-point scale (Kowalski et al., 2004).

The statistical test used for the analysis of each group is the Friedman test for the physical activity pattern variable because the data is normally distributed and the Kruskal Wallis for the physical BMI variable because the data is not normally distributed. While for intergroup analysis is repeated ANOVA test for physical activity pattern variable and one-way ANOVA test for IMT variable with a degree of trust (CI) 95% and a significance value α is 0,05.

Result and Discussion

The characteristics of the respondents indicated that in group I were more female (52%), low father education (64%), low maternal education (60%), high family income (72%), core family structure (72%), family support for obesity (100%), obese parents' risk (52%) and family health risk (80%). Respondents in group II were more female (63.6%), low father education (63.6%), low maternal education (72.7%), high family income (81.8%), core family structure (72.7%), family culture obesity (90.9%), obese parents' risk (50%) and family health risk (59.1%). Respondents in group III were more female (59.1%), low father education (72.7%), low maternal education (95.5%), high family income (63.6%), core family structure (81.8%), family culture obesity (100%), obesity history of the elderly are not at risk (59.1%) and family health history at risk (63.6%).

Respondents in group IV were more female (16%), low father education (95.5%), low maternal education (95.5%), high family income (72.7%), core family structure (68.2%), family culture obesity (100%), obesity history of risky parents (59.1%) and family health history at risk (72.3%). Homogeneity test (Levene's test) response characteristics include: gender (0.048), parental education (0.000), family income (0.064), family structure (0.162), family culture (0.398), obesity history of parents (0.702), and family health history (0.008) indicates the existence of sample equality in all groups.

The final measurement, all respondents experienced an increase in physical activity score compared with baseline measurement. This suggests that there is a difference in physical activity at the start of measurement compared to the second, third, fourth, fifth, sixth, and seventh measurements. Friedman test results obtained $p = <0.001$ in all groups, it shows that there is an influence of social media-based health education on changes in physical activity of children in each group. The result of the Kruskal Wallis test obtained a p -value = 0.365 between groups. It shows that there is no effect of health education based on social media to change the physical activity of children between groups. The highest score increased in group 1, then group 2, group 3, and lowest was the score in group 4.

The final measurement of BMI decreased mean score compared with baseline measurement in all groups. Test results repeated ANOVA got p -value of groups 1 and 2 = <0.001 , group 3 = 0.034, group 4 = 0.140. This shows that there is a difference in child IMT in groups 1,2, and 3, while in group 4, there is no difference. One-way ANOVA test results obtained p -value <0.001 . This suggests that there is a difference in inter-group BMI among children. The highest increase in mean BMI score in group 1, then group 3, group 2, and lowest was the score in group 4.

Before the intervention, all children in all groups had low physical activity (100%) and after the intervention had high physical activity is. Group 1 was 64%, group 2 was 45.45%, group 3 was 13.64%, and group 4 was 18.2%. The results showed that in the final measurement, all respondents experienced an increase in physical activity score compared with the initial measurement. This suggests that there is a difference in physical activity at the start of measurement compared to the second, third, fourth, fifth, sixth, and seventh measurements.

The Changes of physical activity score respondent before and after intervention each group and inter groups

Based on table 1, the difference (Δ) the average physical activity of all groups showed an increase when compared between initial measurement and final

measurement (T0-T6). However, between the time series, each group showed fluctuating changes. In groups 1, 2, and 3, the difference (Δ) of the average

physical activity starting from the initial measurement (T0) continues to increase until the final measurement (T6).

Table 1. Data of Physical Activity

Measurement Physical Activity Pattern	Measurement time (month)							Δ	Test results
	T0	T1	T2	T3	T4	T5	T6		
Groups 1 (n=25)	14.68	16.88	17.04	18.28	22.8	25.56	25.92	11.24	< 0.001*
Groups 2 (n=22)	12.82	13.55	15.86	17.27	18.27	21.05	23.95	11.13	< 0.001*
Groups 3 (n=22)	12.23	16.09	16.86	17.64	18.05	18.77	21.59	9.36	< 0.001*
Groups 4 (n=22)	14.95	16.77	17.77	22.68	18.55	23.45	23.41	8.46	< 0.001*

p** = 0.365

* Friedman test

** Kruskal Wallis test

Group 1 showed there is a significant increase in (Δ) difference between T3-T4 measurements, whereas, in groups of 2 and 3, the difference (Δ) the mean of winter-time measurement is almost uniform. Group 4, there was a decrease in the difference (Δ) of the mean between the measurement times between T3 to T4 and T5 to 6. At the end of the measurement showed that the difference (Δ) in the average of physical activity was highest in group 1, then group 2, followed by group 3 and lowest group 4.

This proves that the provision of health education by using the media can increase physical activity continuously, and the use of booklet media is added by re-education through WhatsApp application media can increase more significant physical activity.

Friedman test results obtained $p = <0.001$ in all groups, which shows that there is an influence of social media-based health education on changes in physical activity of children in each group. However, based on walls test showed no effect of social media-based health education on changes in physical activity ($p = 0.365$) between groups. The analysis of each group, health education intervention showed an influence on the pattern of physical activity, but when analyzed between groups showed no effect of intervention.

The difference in outcomes between the test of each group and the inter-group testing can be due to each group indicating a change in score increase from the initial measurement to the final measurement. Whereas, if analyzed between groups did not show any effect of intervention because, in the beginning, the measurement of all children in all groups was in the low activity category, and at the end of the measurement, there was an increase in each group to the high activity category, but the increase of score in each group was uneven.

This proves that the difference in physical activity before and after the intervention is influenced by the provision of health education with different methods in each group.

Providing health education in group 1 with lectures, booklets and re-education through messaging through WhatsApp application, group 2 with lectures, booklets and re-education through text messaging, group 3 with lectures and leaflets without re-education and group 4 only with lectures so it showed the highest score increase in group 1, then group 2, group 3 and lowest was the score in group 4.

This proves that the selection of different media will result in different changes. By often reminding children of the importance of increased physical activity, it will provide sustainable motivation in children. This can be seen from the re-education in groups 1 and 2, so the increase in physical activity score is higher compared to groups 3 and 4. Similarly, groups 1 and 2 respectively were given re-education but on different media group 1 using WhatsApp application and group 2 using message, and higher score increase in group 1 compared to group 2, because in group 1 interaction and more responses than in group 2.

This is because the education sent through the application w more interesting because it is more colorful, accompanied by emotional features and images compared with a message. Another analysis is the presence of better interaction in group 1 because it does not cost sending repetitive messages. In contrast to group 2, which uses messages, it requires a fee on every message that is sent. This proves that the use of social media in conveying information related to the pattern of true physical activity affects the increase of physical activity.

Related research was conducted by Zhang et al. (2015) about the influence of online social media on the increase of physical activity. The results showed that messages delivered via online social media were more successful than promotional messages to increase physical activity. The study, conducted by Cavallo et al. (2012), in his research to test the effectiveness of physical activity interventions that combine health education and monitoring physical activity with online social networks

to improve social support for physical activity, found out that through the incorporation of health education and monitoring of physical activity through networking online social participants experience increased social support and physical activity over time.

Research conducted by Kadek (2014) showed results that there was a difference in the average change of physical activity before and after intervention in the treatment group and control group (Kadek, 2014). Physical activity is defined as the movement of the body, especially muscles that require energy, and exercise is one form of physical activity. Recommendations from Physical Activity and Health suggest that moderate physical activity should be performed about 30 minutes or more a week. Medium physical activities include walking, jogging, swimming, and cycling (Mustelin et al., 2009).

Physical activity done every day is useful not only to get a healthy body condition but also beneficial for mental health entertainment in the prevention of stress. Low physical activity is a major factor affecting obesity. Physical activity is the main component of energy expenditure, which is about 20-50% of total energy expenditure. Research in developed countries finds a link between low physical activity and the incidence of obesity. Individuals with low physical activity have a risk of weight gain of ≥ 5 kg (Kopelman, 2000). Research in Japan showed a low risk of obesity (OR: 0.48) in the exercise-weighted group, while American studies showed weight loss by jogging (OR: 0.57) aerobic (OR: 0.59) but for sports teams and tennis do not show significant weight loss Fukuda, et.al, 2001).

The main factor of obesity is due to the imbalance of energy intake with energy output. High energy intake when food consumption is excessive, while energy output is lower if the body's metabolism and physical activity are low (James et al., 2004). Obesity is not only caused by most intakes in carbohydrates, fats, and proteins but also due to lack of physical activity. It used to be a lot of children's play is a physical game that required children to run, jump, or other movements, but is now replaced with children's games that do not play as electronic games, computers, the internet, or television is enough to do just sitting in front of him must move (Ip et al., 2017; Odum et al., 2013).

Similarly in school transport. School children used to ride bicycles or on foot. But now as the development of transportation and economic status of the family, children attend school using two-wheel or four-wheeled vehicles. Once things are found in the respondents, children are delivered to school by motor or car. Now the children are already prestigious for cycling or walking to school. Provision of health education can motivate them to adopt a healthy lifestyle, one of which is to increase physical activity so that after the

intervention is given, there is found a change in the increased activity in children (Gurrici et al., 1999).

Several studies show a strong association between BMI and body fat percentage. The relationship differs by age, sex, and ethnic group because there are different activities in each ethnic group (Reiter-Purtill et al., 2020; Zeller et al., 2015). Based on the characteristics of the respondents, overweight and obesity were more prevalent in women than in men, and the majority came from high-income families, the majority of the respondent's parents had a history of obesity, the majority of the respondent's families had a family health history at risk.

Rachmi et al. (2017), in a literature study, revealed that the prevalence of obesity/obesity has increased over the past two decades in children, adolescents, and adults in Indonesia. The prevalence rate is higher for girls than for boys among children but is higher in women in adolescence and adolescence. The prevalence of overweight/obesity is also higher in those who live in urban areas and with income or higher education.

The results showed that the final measurement of the weight of respondents in groups 1 and 2 experienced a decrease in the mean score while groups 3 and 4 increased the average score compared to the initial measurement. Final height measurements showed an increase in mean score compared with baseline measurements in all groups. Final measurements of BMI decreased mean score compared with baseline measurements in all groups.

The Changes of BMI respondent before and after intervention each groups and inter groups.

The difference (Δ) of the mean BMI score of all groups showed a decrease when compared between initial measurement and final measurement (T0-T6). But between the measurement time series, each group showed fluctuating changes. In groups 1, 3, and 4, the difference (Δ) of the mean BMI starting from the initial measurement (T0) continued to decline until the final measurement (T6), and the decline between measurements was almost equally in all three groups. In group 2, there was an increase in the difference (Δ) of the mean BMI between the measurement times ie between T4 to T5.

However, at the end of the measurements showed that the difference (Δ) the mean of BMI was highest in group 1 and then group 3, followed by group 2 and the lowest in group 4. It was proved that the provision of health education using media could decrease BMI, and media booklet re-education through WhatsApp application can decrease the larger BMI. Test results repeated ANOVA got p-value of group 1 = 0.000, group 2 = 0.000, group 3 = 0,034, group 4 = 0,140. This indicates that there is an influence of social media-based health

education to change child BMI in groups 1,2 and 3, while in group 4, there is no influence. The increased mean score of BMI was highest in group 1, then group 3, group 2, and lowest was the score in group 4. One way ANOVA test showed there was the influence of social media-based health education on BMI change ($p = 0.000$) between groups.

The results showed that the provision of health education could change the child's BMI becomes more decreased. Health education is able to change the knowledge of children that will ultimately affect the attitude and behavior, especially in the pattern of eating and activity patterns. The changes in eating intake patterns and physical activity patterns will affect BMI as a measure of the nutritional status of children because the pattern of eating intake and physical activity patterns are part of the cause of overweight and obesity in adolescents. The high intake of food that exceeds the needs and standards of intake as regulated in the calculation of nutritional adequacy (AKG) and low physical activity, then there will be an imbalance between energy input with energy expenditure resulting in fat deposits, causing the occurrence of overweight and obesity.

Along with the increased knowledge on Adolescents about obesity-related to understanding, causes, impact, prevention, and treatment of obesity and healthy lifestyles related to physical activity, this impacts the changing pattern of physical activity between the initial measurement and final measurement. Changes in knowledge before and after intervention are consistent with changes in activity patterns. The results showed that the average score of the physical activity pattern increased in the final measurement compared to the initial measurement. Based on these data means that knowledge is directly proportional to the pattern of physical activity. Increased knowledge about obesity and lifestyle; hence activity patterns will increase which will ultimately affect the decreased BMI.

The difference of mean score and difference of score average at the beginning and end of the measurement is caused by different information delivery media. Providing health education in group 1 with lectures, booklets and re-education through message delivery through WhatsApp application, group 2 with lectures, booklets, and re-education through text messaging, group 3 with lectures and leaflets without re-education and group 4 only with lectures thus showing the highest decrease in BMI in group 1, then group 3, group 2 and lowest was the score in group 4.

This proves that the selection of different media will result in different changes. Frequent reminders of children will provide sustained motivation in children. This can be seen from the reeducation using social media

with application WhatsApp in group 1 so that the BMI decrease higher than other groups. The decrease of BMI was higher in group 3 than in group 2, although in group 2, it was given reeducation. This was because, in the first measurement, the mean score of BMI in group 3 was lower than in group 2.

The difference of test results in each group and between groups, as a result, shows that in the test of each group, there is one group that shows no difference that is in group 4 whereas in the intergroup test all show there is a difference. Based on the results of the analysis of each group in group 4 found no effect of intervention because the average change of scores on the initial measurement compared with the final measurement is very small ie (-0.19). The data show that in the initial measurement, the mean score of IMT in group 4 (2.02) and at the final measurement became (1.83).

Conclusion

Here was an effect of health education on the changing of activity patterns. There is an effect of health education on BMI changes, but there is no effect of health education which is only given lectures. This study recommends to health workers (nurses, nutritionists, and health promotion) the use of booklets and utilizing social media (WhatsApp) in providing health education related to obesity.

Author Contribution

In this study, all researchers contributed actively with the tasks that were carried out together. In other words, this research was supported by equal distribution of roles and contributions of all authors, because each stage was always discussed together.

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Conflicts of Interest

In this research, there is no tug of interest and or hidden interests among the researchers. In addition, this research is also not an order from any funder because it is independent research, or in other words, the research team itself plays a role in preparing proposals, selecting topics, conceptualizing problems, collecting data, analyzing problems, drawing conclusions until the publication stage in this journal.

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