



Healthy snack quartet education on knowledge and sodium intake in overweight early adolescents

Ferliani Fransisca Sa'pang^{1*}, Tri Rejeki Andayani², Muthmainah³

¹ Human Nutrition Departmen, Postgraduate Program, Sebelas Maret University, Surakarta, Indonesia

² Faculty of Psychology, Sebelas Maret University, Surakarta, Indonesia

³ Faculty of Medicine, Sebelas Maret University, Surakarta, Indonesia

*Correspondence: ferliifs.ff@gmail.com

ABSTRAK

Latar Belakang: Kasus kegemukan pada anak dan remaja diperkirakan mencapai 49,5 juta kasus di dunia pada tahun 2030. Intervensi edukasi gizi untuk meningkatkan pengetahuan tentang jajanan sehat pada remaja menjadi penting sebagai salah satu bentuk pencegahan obesitas pada remaja. Kuartet jajanan sehat merupakan media edukasi yang dilakukan dengan metode permainan kelompok sehingga remaja merasa nyaman dalam proses pembelajaran.

Tujuan: Mengetahui pengaruh edukasi kuartet jajanan sehat terhadap pengetahuan dan asupan natrium pada remaja awal overweight.

Metode: Penelitian ini merupakan penelitian quasy eksperimental dengan pre-posttest with control group design. Sampel dipilih secara purposive dan terpilih 54 remaja overweight yang terbagi menjadi kelompok control dan dua kelompok intervensi. Edukasi menggunakan kuartet jajanan sehat dilakukan selama 21 hari sejak September-Oktober 2023 di Kota Makassar. Analisis data dilakukan menggunakan wilcoxon signed ranks test.

Hasil: Terdapat perbedaan yang signifikan pada pengetahuan remaja dengan nilai p-value <0,05 pada P1 ($p=0,001$) dan P2 ($p=0,000$). Namun, tidak terdapat perbedaan yang signifikan pada variabel asupan natrium baik pada kelompok kontrol ($p=0,948$), P1 ($p=0,170$) dan P2 ($p=0,170$).

Kesimpulan: Edukasi menggunakan kuartet jajanan sehat dapat meningkatkan pengetahuan mengenai jajanan sehat pada remaja awal overweight namun tidak berdampak signifikan terhadap asupan natrium remaja overweight.

KATA KUNCI: asupan natrium; edukasi gizi; pengetahuan; remaja overweight.



ABSTRACT

Background: Child and adolescent obesity cases are estimated to reach 49.5 million cases worldwide by 2030. Nutrition education interventions to increase knowledge about healthy snacks in adolescents are important as a form of obesity prevention in adolescents. Healthy snacks quartet is an educational media that is carried out with a group game method so that adolescents feel comfortable in the learning process.

Objectives: To determine the effect of healthy snacks quartet education on knowledge and sodium intake in overweight early adolescents.

Methods: This study is a quasi-experimental study with pre-posttest with control group design. The sample was purposively selected and 54 overweight adolescents were divided into a control group and two intervention groups. Education using healthy snacks quartet was conducted for 21 days from September to October 2023 in Makassar City. Data analysis was performed using Wilcoxon signed ranks test.

Results: There was a significant difference in adolescent knowledge with a p -value <0.05 in P1 ($p=0.001$) and P2 ($p=0.000$). However, there was no significant difference in sodium intake variables both in the control group ($p=0.948$), P1 ($p=0.170$) and P2 ($p=0.170$).

Conclusions: Education using healthy snacks quartet can increase knowledge about healthy snacks in overweight early adolescents but does not have a significant impact on sodium intake of overweight adolescents.

KEYWORDS: *sodium intake; nutrition education; knowledge; overweight adolescent*

Article info:

Article submitted on February 25, 2024

Articles revised on March 13, 2024

Articles received on March 23, 2024

INTRODUCTION

Overweight adolescents exhibit poor dietary quality and frequently lack sufficient incentive to prioritise their long-term health. This is attributed to a lack of comprehension regarding the potential consequences of the present bad dietary habits on the future well-being of adolescents (1). Unhealthy dietary habits result in imbalanced nutrient consumption and obesity is common not just among adults but also in adolescents. Unbalanced nutritional intake in adolescents, especially in school-age adolescents, which is indicated by the behavior of choosing unhealthy snacks such as fast food, snacks and drinks with excess sweeteners, is a supporting factor for overweight (2).

The long-term impact of an unhealthy diet is an increase in the incidence of non-communicable diseases in society. By 2020, as many as 41 million people will die each year from non-communicable diseases. A total of 9.3 million fatalities were attributed to cancer, 4.1 million to respiratory disorders, and 1.5 million to diabetes. Indonesia has recorded 1.3 million fatalities

resulting from degenerative diseases (3). Elevated sodium consumption is linked to various degenerative conditions, including cardiovascular disease, renal failure, kidney stones, osteoporosis, and stomach cancer. Elevated sodium consumption is reportedly associated with higher Body Mass Index (BMI) in children and adolescents. As many as 73% of overweight adolescents had sodium intake that exceeded daily sodium requirements (4).

Unhealthy eating patterns reflect adolescents' low understanding of the importance of healthy food consumption and poor nutrition education in school-age adolescents. Nevertheless, the management of adolescent obesity is highly complex, and several strategies aimed at addressing this issue remain insignificant. Therefore, the development of interventions to prevent overweight in adolescents is needed (5). Implementing nutrition education interventions for adolescents is the initial and obvious approach to enhance their understanding of the significance of maintaining a nutritious diet. A strong understanding of proper nutrition

empowers adolescents to make healthier food choices that fulfil their nutritional requirements, thus preventing overweight in adolescents (6). Nutrition education needs to be delivered using attractive educational media to increase learning motivation in adolescents. Nutrition education through game methods that are professionally designed from the aspects of educational materials and media design can increase knowledge and affect the attitudes of adolescents (7). The delivery method used to deliver educational information plays a significant role in influencing the learning motivation of adolescents, particularly those who are prone to easily becoming bored. This is in addition to the presence of attractive instructional media. The efficacy of education delivered by the lecture technique is inconsistent thus requiring changes or combinations to provide a substantial influence on knowledge enhancement and behaviour transformation in a positive path (8). One approach to educating adolescents involves utilizing a combination of reinforcement rewards and punishments. Providing positive reinforcement to adolescents through rewards for positive behavior and punishment for negative behavior can enhance their motivation to learn, foster a learning environment characterized by positive competition and build the relationship between educators and students (9).

Education is carried out using healthy snacks quartet media that has been professionally designed through the Research and Development stage (R&D). The healthy snacks quartet is played in groups of four players per group with eight educational sub topics about healthy snacks consisting of 32 cards. Quartet educational media is an educational media and can increase learning interest in adolescents over 12 years of age (10). This study aimed to determine the impact of educational interventions using a combination of healthy foods quartet media, lectures, and reinforcement through rewards and punishments on the knowledge of healthy snacks and sodium intake in early adolescents with overweight.

MATERIALS AND METHODS

This study is a quantitative study using a quasi experimental pretest-posttest with control group design. The research was conducted in

September - October 2023 after obtaining ethical approval from the Ethics Commission of the Faculty of Medicine, Sebelas Maret University Surakarta with Letter Number 170/UN27.06.11/KEP/EC/2023 and IP No. 157/02/07/2023.

The sample selection was carried out purposively based on the inclusion criteria determined by the researcher. The study included early adolescents aged 12-15 years who had an overweight nutritional status based on their BMI (Body Mass Index) relative to their age. Participants were excluded if they were currently having hormone treatment or special diets, and were required to express willingness to be research subjects. According to the hypothesis proposed by Gay and Diehl, a minimum of 15 samples per group is necessary for uncomplicated experimental study (11). The study included 18 adolescents per group, resulting in a total of 54 adolescents who matched the research criteria. The participants were selected from three schools in Makassar City, which have the greatest prevalence of overweight adolescents. First, an initial assessment of the subjects' abilities was conducted as a pretest. Following this, the intervention was implemented on the sample for a duration of 21 days. Finally, a final assessment of the subjects' abilities was conducted as a posttest. The sample was divided into three groups: the control group, the intervention group with the provision of healthy snacks and quartet education (P1), and the intervention group with the provision of healthy snacks, quartet education, and lecture method with reinforcement reward and punishment (P2).

The characteristics of the research subjects and the history of obesity in the family are known based on the completion of the characteristics questionnaire obtained from the interview results. Knowledge of overweight adolescents about healthy snacks was known based on the completion of a healthy snacks knowledge questionnaire containing 15 question items using a guttman scale. Sodium intake in adolescents before and after the intervention was known based on interviews with 2 x 24-hour food recall forms on weekends and early weeks to determine sodium intake representing holidays and schools in overweight adolescents and then calculated the

average sodium intake using the NutriSurvey 2007 application.

Education is provided using a snack quartet media that has gone through the Research and Development (R&D) stage conducted by researchers according to the educational needs of early adolescents in Makassar City. The Healthy Snacks Quartet is an instructional media program designed for group settings consisting of four individuals. The quartet consists of 32 cards with eight card subject. The card headings include the advantages of nutritious snacks, attributes of nutritious snacks 1, attributes of nutritious snacks 2, the consequences of unhealthy snacks, prerequisites for healthy snacks, harmful components in snacks, varieties of nutritious snacks, and snacks that should be restricted. In the second intervention group (P2), a series of educational sessions on healthy snacks, using a quartet format, was conducted four times. These sessions were accompanied by lectures.

Additionally, a reward and punishment system was implemented throughout each game session.

Differences in knowledge about healthy snacks and sodium intake in overweight early adolescents were analyzed using the Wilcoxon Test. Data analysis was performed using SPSS Statistic software v. 27.0 for windows.

RESULTS AND DISCUSSIONS

Characteristics of Research Subjects

Table 1 illustrates the characteristics of the research subjects in this study, the majority of research subjects were 12 years old (53.7%) and male (70.4%). Most of the research subjects in this study also carry pocket money ranging from Rp 10,000 to Rp 20,000 (64.8%) and only 5.6% carry pocket money above Rp 20,000. The research subjects in this study were overweight adolescents, most of whom did not have obese family members (48.1%) and only 3.7% of adolescents with obese parents.

Table 1. Characteristics of research subjects

Variables	Control (n=18)		P1 (n=18)		P2 (n=18)		Total (n=54)	
	n	%	n	%	n	%	n	%
Sex								
Male	15	83,3	11	61,1	12	66,7	38	70,4
Female	3	16,7	7	38,9	6	33,3	16	29,6
Age								
12 Years	15	83,3	2	11,1	12	66,7	29	53,7
13 Years	3	16,7	11	61,1	4	22,2	18	33,3
14 Years	0	0	5	27,8	2	11,1	7	13
History of Obesity								
Father	5	27,8	8	44,4	2	11,1	15	27,8
Mother	5	27,8	2	11,1	4	22,2	11	20,4
Father dan Mother	0	0	1	5,6	1	5,6	2	3,7
None	8	44,4	7	38,9	11	61,1	26	48,1
Allowance								
< Rp 10.000	5	27,8	5	27,8	6	33,3	16	29,6
Rp 10.000-20.000	12	66,7	12	66,7	11	61,1	35	64,8
>Rp 20.000	1	5,6	1	5,6	1	5,6	3	5,6

The prevalence of obesity in adolescents is influenced by multiple factors. Female adolescents were shown to have a higher impression of fatness, in addition to excessive nutrient consumption and insufficient physical activity. Female adolescents exhibit a greater inclination towards beauty and possess a more unfavorable perception of weight compared to male adolescents, resulting in a

tendency for them to have a higher body weight than their male counterparts (12). This is illustrated in the table of characteristics of research subjects consisting of 29.6% overweight adolescent girls.

In addition to nutritional intake and adolescents' perception of body weight, family also plays a role in adolescents' health behavior. The family has a crucial role as the primary agent of

socialization, shaping the formation of health behavior patterns in adolescents, especially those who are overweight. Parenting strategies influence the way adolescents manage their dietary intake (13). According to the results of the study, the majority of overweight teenagers (48.1%) had parents who are not obese. This signifies a deficiency in the parental methods employed for overweight adolescents. Parents of overweight adolescents should focus on their parenting methods, particularly in three areas: physical activity, screen time, and nutritional intake. This can be achieved by reducing the consumption of unhealthy food and increasing the consumption of fruits and vegetables (14).

Healthy snacks quartet education on knowledge of healthy snacks in overweight early adolescents

Table 2 presents the difference in knowledge scores pertaining to nutritious snacks prior to and following the implementation of healthy snack quartets on the research participants (control, P1, and P2). According to the provided data, the control group had a mean knowledge score of 80. The

lowest score recorded during the pretest was 67, while the lowest score during the posttest was 73. Wilcoxon analysis conducted on the control group with $p=0.618$ ($p>0.05$) which means there is no significant difference in the control group. The median score of knowledge about healthy snacks in group P1 prior to the intervention was 73, with the lowest score recorded at 47. Following a 21-day intervention involving the consumption of healthy snacks, the median score rose to 87, with the lowest score recorded at 73. The subsequent data analysis yielded a p-value of 0.001 ($p < 0.05$), indicating a statistically significant difference in group P1 after the implementation of the healthy snacks quartet. In group P2, following nutrition education with a combination of healthy snacks quartet, lecture approach, and a reward and punishment system, the median score had a significant rise of 20 points, rising from the previous score of 73 to 93, with the lowest score recorded at 93 points. The results of the difference test analysis obtained $p=0.000$ ($p<0.05$) which means that there are significant changes in knowledge about healthy snacks in group P2.

Table 2. Differences in Knowledge about Healthy Snacks Before and After Intervention in Research Subjects

	n	Mean	Median (Min-Maks)	p
Control				
Pretest		81	80 (67-93)	
Posttest	18	82,1	80 (73-100)	0,618
P1				
Pretest		71,2	73 (47-87)	
Posttest	18	84,7	87 (73-93)	0,001
P2				
Pretest		77,6	73 (53-93)	
Posttest	18	96,1	93 (93-100)	0,000

According to the findings of the preliminary evaluation, adolescents generally possess knowledge about healthy snacks that can be classified into the moderate and good categories. This can be observed by considering the mean value of the pretest responses, which comes within the range of 71.1 to 81 points. Early adolescence is a pivotal stage characterized by significant physical and cognitive growth, as well as the development of essential skills and the formation of positive behaviors. Developing knowledge about nutrition will positively influence teens. Adolescents can quickly obtain information

from many media, particularly social media, due to advancements in information technology and the widespread use of smartphones. There is a growing availability of nutrition education materials that focus on eating and provide explanations on achieving nutritional balance (15). The level of knowledge among overweight adolescents in this study shows a positive influence after 21 days of education. The control group consisted of 66.7% of adolescents who had a good level of knowledge. In groups P1 and P2, 88.9% and 100% of adolescents, respectively, demonstrated a commendable understanding of healthy

snacking. Adolescents who possess a significant amount of nutritional awareness will experience a 0.56-fold decrease in the likelihood of developing

obesity compared to adolescents with a moderate degree of nutritional knowledge (16).

Table 3 Level of Knowledge about Healthy Snacks Before and After Intervention in Research Subjects

Variable	Control				P1				P2			
	Before		After		Before		After		Before		After	
	n	%	n	%	n	%	n	%	n	%	n	%
Knowledge												
Low	0	0	0	0	2	11,1	0	0	2	11,1	0	0
Moderate	7	38,9	6	33,3	10	55,6	2	11,1	8	44,4	0	0
Good	11	61,1	12	66,7	6	33,3	16	88,9	8	44,4	18	100

The Wilcoxon analysis in this study showed a significant influence of education on the knowledge of overweight adolescents. This effect was shown by a p-value of 0.001 in group P1 and 0.000 in group P2, while applying healthy snacks quartets. The research subjects engaged in a 21-day trial of consuming a selection of nutritious snacks. This experiment yielded valuable insights into healthy snacks, resulting in a significant enhancement of adolescents' knowledge on the subject.

The healthy snacks quartet provides information about nutritious snack options and the

criteria for identifying unhealthy snacks, aiming to educate overweight adolescents on making healthy snack choices. Education implemented through the use of multimedia quartet enhances the enthusiasm for learning among study subjects, since it employs a gamified approach that reduces any sense of compulsion associated with learning. Implementing interventions to enhance nutritional awareness across different age cohorts is an effective strategy with long-term benefits, as the prevalence of diet-related illnesses continues to rise annually (17).

Healthy Snack Quartet Education on Sodium Intake in Overweight Early Adolescents

Table 4. Differences in sodium intake before and after intervention on research subjects

	n	Mean (mg/day)	Median (mg/day)	Min-Maks (mg/day)	p
Control					
Pretest	18	1745,9	1126.8	116-4865	0.948
Posttest		1948,5	834.5	72,3-6445	
P1					
Pretest	18	1477	428.9	107,6-4492	0.170
Posttest		872	211.75	105,2-4813	
P2					
Pretest	18	1362	838,8	85,8-4127	0.170
Posttest		745,8	242	63-2731	

Table 3 shows the difference in sodium intake among overweight early adolescents prior to and following the intervention. The total sodium intake in this study is determined based on the findings obtained from two 24-hour dietary recall assessments. The control, P1, and P2 groups exhibited a reduction in sodium consumption during the posttest. However, this reduction in

intake was not statistically significant. The control group had a reduction in sodium consumption of 292.3 mg per day, as indicated by the median sodium intake value. Groups P1 and P2 experienced a reduction in sodium intake by 217.15 mg/day and 596.8 mg/day, respectively. However, there has been no statistically significant decrease in sodium consumption for

the control group (p=0.948), P1 (p=0.170), and P2 (p=0.170), with p>0.05.

Sodium intake is associated with obesity mediated through intake of Sugar-Sweetened Beverages (SSBs) or beverages with high added sugar and energy-dense salty foods (18). Research conducted in several developed countries on adolescents states that there is a significant relationship between sodium intake and obesity. High sodium intake causes leptin resistance through fructose production, increases fasting ghrelin which regulates appetite, causes

glucose homeostatis and induces adipogenesis/lipogenesis in adipocytes thus increasing body fat accumulation (19, 20). The healthy snacks quartet contains information to limit the consumption of sweetened snacks and drinks as well as fried processed foods. This had an impact on reducing the average sodium intake in the intervention group, namely 605 mg in group P1 and 616.2 mg in group P2, while in the control group there was an increase in the average daily sodium intake of 202.6 mg.

Table 5 Sodium Intake Level Before and After Intervention in Research Subjects

Variable	Control				P1				P2			
	Before		After		Before		After		Before		After	
	n	%	n	%	n	%	n	%	n	%	n	%
Sodium Intake												
Low	9	50	9	50	10	55.6	13	72.2	9	50	13	72.2
Moderate	0	0	2	11.1	0	0	1	5.6	1	5,6	0	0
High	9	50	7	38.9	8	44.4	4	22.2	8	44,4	5	27.8

Measurement of sodium intake in adolescents before the intervention based on the results of 2x24 hour recall, it was known that adolescents often skipped breakfast and were given additional pocket money to buy breakfast at school. The first break time between 9:30 am to 10:00 am was used by adolescents for breakfast. This behavior of skipping breakfast has an impact on excessive consumption of unhealthy snacks because adolescents become starving and impulsively choose snacks that look attractive but have low nutritional quality such as instant noodles and iced tea. Adolescents with breakfast skipping behavior lead to overconsumption at the next meal. Adolescents who did not skip breakfast had lower snack consumption habits (21).

Consumption of unhealthy snacks in overweight adolescents also occurs on weekends such as contemporary drinks with excess sweetener content, fried foods, chips and junk food (burgers and pizza). Consumption of unhealthy snacks on school days and weekends increases sodium intake in adolescents. Recommended Dietary Allowance (AKG) (2019) recommends sodium intake in adolescents aged 12-15 years is a maximum amount of 1500 mg per day. Approximately 33% of sodium intake in overweight teenagers is derived from food

consumed at school, where as 7% comes from fast food. The remaining sodium intake is related to food consumed at home (23).

CONCLUSION AND RECOMMENDATION

Education using healthy snack quartets accompanied by lectures and reinforcement reward and punishment has an effect on overweight adolescents' knowledge related to healthy snacks but has no effect on adolescent sodium intake despite a decrease in daily sodium intake. Utilizing healthy snack quartets as an instrument of education can serve as an enjoyable resource for youth education, ensuring that adolescents do not perceive nutrition education programs as forced. Additional investigation is required to assess the long-term viability of boosting awareness about nutritious snacks on the nutritional well-being of adolescents, with the aim of minimizing adolescent obesity.

REFERENCES

1. Rachel, Brown; Jamie A., Seabrook, Saverio, Stranges; Andrew F. Clark JH, Colleen O'Connor, Sean Doherty and JAG. Examining the Correlates of Adolescent Food and Nutrition Knowledge. *Nutrients*. 2021;13(6):15–6.

2. Chung LMY, Fong SSM. Role of behavioural feedback in nutrition education for enhancing nutrition knowledge and improving nutritional behaviour among adolescents. *Asia Pac J Clin Nutr.* 2018;27(2):466–72.
 3. WHO. Non-communicable Diseases Progress Monitor 2020. World Health. 2020.
 4. Aparicio A, Rodríguez-Rodríguez E, Cuadrado-Soto E, Navia B, López-Sobaler AM, Ortega RM. Estimation of salt intake assessed by urinary excretion of sodium over 24 h in Spanish subjects aged 7–11 years. *Eur J Nutr.* 2017;56(1):171–8.
 5. Medeiros G, Azevedo K, Garcia D, Segundo VO, Mata Á. Effect of school-based food and nutrition education interventions on the food consumption of adolescents : a systematic review . *J Environ Res Public Heal.* 2020;1–19.
 6. Pandit-Agrawal D, Khadilkar A, Chiplonkar S, Khadilkar V. Knowledge of nutrition and physical activity in apparently healthy Indian adults. *Public Health Nutr.* 2018;21(9):1743–52.
 7. Andrew L, Barwood D, Boston J, Masek M, Bloomfield L, Devine A. Serious games for health promotion in adolescents – a systematic scoping review [Internet]. Vol. 28, Education and Information Technologies. Springer US; 2023. 5519–5550 p. Available from: <https://doi.org/10.1007/s10639-022-11414-9>
 8. Rizqiyah IR. Efektifitas Pendidikan Kesehatan Reproduksi Dan Seksual Dengan Metode Ceramah Dan Small Group Discussion Terhadap Tingkat Pengetahuan Dan Sikap Remaja Usia 16-17 Tahun. Universitas Airlangga, Surabaya universitas Airlangga. 2019.
 9. Aflizah N, Hasri S. Reward Sebagai Alat Motivasi dalam Konteks Pendidikan : Tinjauan Literatur. *J Pendidik Tambusai.* 2024;8(1):4300–12.
 10. Utami T, Nirwana A. Perancangan Kartu Kuartet sebagai Media Pengenalan Dasar Tanaman Obat dengan Teknik Ilustrasi Botani untuk Remaja Usia 12-15 Tahun. *Pros Semin Nas Desain Komun Vis.* 2021;1:37–49.
 11. Hermawan SA. Metode Penelitian Pendekatan Kuantitatif dan Kualitatif. Malang: Media Nusa Creative; 2016.
 12. Debeila S, Modjadji P, Madiba S. High Prevalence of Overall Overweight/obesity and Abdominal Obesity Amongst
 12. Su-Jung N, Jong-Ho P. The moderating effect of gender on the relationships between obesity, well-being, and stress perception in Korean adolescents. *BMC Public Health.* 2021;21(1):1–9.
 13. Romieu I, Dossus L, Barquera S, Blottière HM, Franks PW, Gunter M, et al. Energy balance and obesity: what are the main drivers? *Cancer Causes Control.* 2017;28(3):247–58.
 14. Fuligni GL, Gonzalez CJ, Figueroa R. Adolescents' proxy reports on obesity-related parenting practices: factorial validity and reliability across four behavioral domains. *BMC Public Health [Internet].* 2022;22(1):1–10. Available from: <https://doi.org/10.1186/s12889-022-12745-5>
 15. Michelle M. Chau, Marissa Burgermaster LM. The use of social media in nutrition interventions for adolescents and young adults—A systematic review. *Int J Med Inform.* 2018;120:77–91.
 16. Wang L, Zhuang J, Zhang H, Lu W. Association between dietary knowledge and overweight/obesity in Chinese children and adolescents aged 8–18 years: a cross-sectional study. *BMC Pediatr [Internet].* 2022;22(1):1–11. Available from: <https://doi.org/10.1186/s12887-022-03618->
 17. Hamulka J, Wadolowska L, Hoffmann M, Kowalkowska J, Gutkowska K. Effect of an education program on nutrition knowledge, attitudes toward nutrition, diet quality, lifestyle, and body composition in polish teenagers. *The ABC of healthy eating project: Design, protocol, and methodology. Nutrients.* 2018;10(10).
 18. Grimes CA, Riddell LJ, Campbell KJ, He FJ, Nowson CA. 24-h urinary sodium excretion is associated with obesity in a cross-sectional sample of Australian schoolchildren. *Br J Nutr.* 2016;115(6):1071–9.
 19. Zhang Y, Li FX, Liu FQ, Chu C, Wang Y, Wang D, et al. Elevation of fasting ghrelin in healthy human subjects consuming a high-salt diet: A novel mechanism of obesity? *Nutrients.* 2016;8(6):1–8.
 20. Lee M, Sorn SR, Lee Y, Kang I. Salt induces adipogenesis/lipogenesis and inflammatory adipocytokines secretion in adipocytes. *Int J Mol Sci.* 2019;20(1).
- Adolescents: An Emerging Nutritional Problem in Rural High Schools in Limpopo

- Province, South Africa. *African J Prim Heal Care Fam Med*. 2021;13(1):1–9.
22. Kemenkes RI. Peraturan Menteri Kesehatan No 28 Tahun 2019 tentang Angka Kecukupan Gizi yang Dianjurkan untuk Masyarakat Indonesia. Duke Law Journal Jakarta; 2019.
23. Quader ZS, Gillespie C, Sliwa SA, Ahuja JKC, Burdg JP, Moshfegh A, et al. Sodium Intake among US School-Aged Children: National Health and Nutrition Examination Survey, 2011-2012. *J Acad Nutr Diet* [Internet]. 2017;117(1):39-47.e5. Available from: <http://dx.doi.org/10.1016/j.jand.2016.09.010>