Research Article

THJPH

Effect of Pedagogical Tools for Fostering Nutritional Knowledge in School-Aged Children in Pathum Thani Province, Thailand

Sujarinee Sangwanna[1], Weerasak Seelarat[2], Teerapap Panklai[3]

[1]Division of Nutrition and Dietetics, Faculty of Science and Technology, Valaya Alongkorn Rajabhat University under the Royal Patronage, Khlong Luang, Thailand

[2]Division of Food and Beverage Innovation for Health, Faculty of Science and Technology, Valaya Alongkorn Rajabhat University under the Royal Patronage, Khlong Luang, Thailand

[3]Division of Food and Nutrition, Faculty of Home Economics Technology, Rajamangala University of Technology Thanyaburi, Khlong Luang, Thailand

Correspondence: Teerapap Panklai, 39 Moo 1, Klong 6, Khlong Luang Pathum Thani 12110 Thailand, Teerapap_p@rmutt.ac.th

Received: April 20 2024; Revised: July 30 2024; Accepted: November 15 2024

Abstract

Background: In Thailand, there is a projected annual increase in childhood obesity at a rate of 6.2% from 2020 – 2035. The emphasis on effective interventions, particularly well-planned, behavior-focused nutrition education, has substantially enhanced children's behavior and health indicators. Therefore, it is important to develop appropriate nutritional education methods to help maintain the good health of school-age children.

Objective: This study aims to assess the effects of various pedagogical tools in enhancing the nutritional knowledge of school-aged children in Pathum Thani Province, Thailand.

Materials and methods: This study employs a quasi-experimental research design and was conducted among 126 school-age children aged 8-12 years in Thailand. Data were collected from March 2020 to October 2021.

Results: After implementation of the pedagogical tools, the scores increased in all three groups. While there was no statistically significant difference in nutritional knowledge scores among the three groups before using the tools, the scores postimplementation varied significantly. Notably, the board game group exhibited was significantly different from the booklet group and the control group ($p < 0.001$). The satisfaction scores for pedagogical tools indicated that board games and booklets received ratings ranging from moderate liking to very liking across all the parameters.

Conclusion: Pedagogical tools led to a noteworthy increase in nutritional knowledge scores for all groups, particularly the board game group. These findings underscore the efficacy of innovative pedagogical tools, especially board games, in enhancing nutritional knowledge among school-age children.

Keywords: Board games, School-aged children, Pedagogical tools, Nutritional knowledge, Thailand

What was Known

- The incidence of obesity and overweight among children is increasing, and obesity is an important problem worldwide.
- Obesity and overweight in children are caused primarily by poor eating habits and a lack of nutritional knowledge.

What's New and Next

- When children gain more nutritional knowledge, it will affect their future good health.
- Effective nutritional education methods can enhance children's understanding of nutrition.

Introduction

From 2020 to 2035, global obesity rates among 5–19-year-old children and adolescents are expected to notably rise. The number of boys globally is projected to increase from 10% to 20%, whereas the number of girls is estimated to increase from 8% to 18%. Southeast Asian areas are estimated to dramatically increase from 3% to 11% in girls and from 5% to 16% in boys. It is projected that in Thailand, childhood obesity will increase annually by 6.2% from 2020 to 2035[1]. In Pathum Thani Province, however, the nutritional status of school-aged children remains below an appropriate level[2]. In children and adolescents in South Asia, various notable individual risk factors associated with overweight, and obesity include insufficient physical activity, prolonged periods of watching TV or playing computer games, frequent consumption of fast food or junk food, and regular intake of high-calorie foods[3]. Childhood obesity is linked to a multitude of accompanying health conditions, covering various areas, such as metabolism, the heart, mental health, bones, nerves, liver, lungs, and kidneys. This connection is important because obesity in childhood often continues into adulthood, increasing the likelihood of developing issues such as metabolic syndrome, type 2 diabetes mellitus (T2DM), polycystic ovarian syndrome, high blood pressure, high cholesterol, and heart disease later in life.

Recognizing these additional health problems highlights the crucial need to address childhood obesity to prevent potential long-term health issues[4, 5]. The approach to addressing childhood obesity involves nutrition education, prevention, sustainable interventions for healthy nutrition, and the encouragement of physical activity. The emphasis on effective interventions, particularly well-planned, behavior-focused nutrition education, has substantially enhanced children's behavior and health indicators. For example, nutrition education has the potential to enhance physical activity[6]. These interventions are specifically designed to instill healthy habits and foster improved overall health outcomes[7, 10]. Previous studies have demonstrated that there are various methods for delivering nutritional knowledge and improving nutritional status. These include integration into the regular curriculum; cooking; and gardening activities; educational talks and workshops; individualized dietary counseling[11]; the restriction of energy[12]; and computer-mediated approaches such as programs, games, websites, emails, and mobile phones[13, 14]. Specifically, the use of board games[15] and booklets[16] as nutrition education materials has been shown to be effective in improving nutritional status; however, few studies have compared their effects on improving nutritional knowledge. Therefore, it is important to develop appropriate nutritional education methods to help maintain the good health of school-age children. This study aims to assess the effects of various pedagogical tools in enhancing the nutritional knowledge of school-aged children in Pathum Thani Province, Thailand.

Materials and Methods

1. Participants

This study employs a quasi-experimental research design to investigate the effects of pedagogical tools on nutritional knowledge among school-aged children in Pathum Thani Province, Thailand. The study was conducted among school-aged children in Khlong Luang District, Pathum Thani Province, Thailand. Data were collected from August 2021 to September 2021. The inclusion criterion consisted of elementary school students in grades 4-6, both male and female. The exclusion criterion was students who did not attend school on the day of data collection. A total of 126 school-aged children, aged 8-12 years, including 62 males and 64 females in grades 4-6, were chosen from three schools located in Pathum Thani Province. The participating schools were the Sungaum School, Lumsanoon School, and Thawiwit School.

2. Sample size

The sample size was calculated via the formula of Lwanga, S. K., et al.[17] and referenced the results of Yien J-M., et al.[18]. The calculation indicated a requirement of 40 students in each

group, adding a 25% nonresponse rate, thus setting the sample size at a minimum of 50 participants in each group. Consequently, 150 students were invited to take part in this study.

3. Study procedure

This study was conducted to provide nutritional knowledge to students, who were divided into three groups via simple random sampling. Group 1 engages in learning through board games[19], Group 2 through a booklet (Figure1), and Group 3, also known as the control group, through lectures. The pedagogical tools include content on the benefits of vegetables and fruits, with a focus on their vitamins and minerals. These groups will receive nutritional knowledge daily for one hour (except on Saturday and Sunday) for four weeks. Before and after the study, all the students underwent pre- and posttests to assess their nutritional knowledge. Both before and after the study, the students took a 10-minute nutritional knowledge test. Additionally, a 5-minute satisfaction evaluation will be conducted at the end of the study. The nutritional knowledge test comprises 20 questions, with a total possible score of 20 points, of which there are four options and only one is the correct answer. The satisfaction evaluation includes five questions that cover aspects of beauty, difficulty, usability duration, benefits, and overall preference for pedagogical tools. The panelists scored different parameters on a scale of 1 - least liked, 2 - moderately liked, and 3 – very liked (Figure 2).

Figure1 Pedagogical tools for fostering nutritional knowledge (A) Board games and (B) Booklets.

The examination of the quality of the pedagogical tools used in this study and the nutritional knowledge test involved the use of the Index of Item-Objective Congruence (IOC) to measure the content experts' judgments regarding the fit between test items or an instrument quantitatively. To establish content validity, three experts assessed the quality of the pedagogical tools and the nutritional knowledge test. The IOC values were within the accepted

range (between 0.2 and 0.8). Both the pedagogical tools and the nutritional knowledge test subsequently underwent trials to evaluate their reliability, refine the content, and were administered to a group of 30 school-aged children. Using the formula to test Cronbach's alpha coefficients resulted in a coefficient of 0.855, which is considered acceptable.

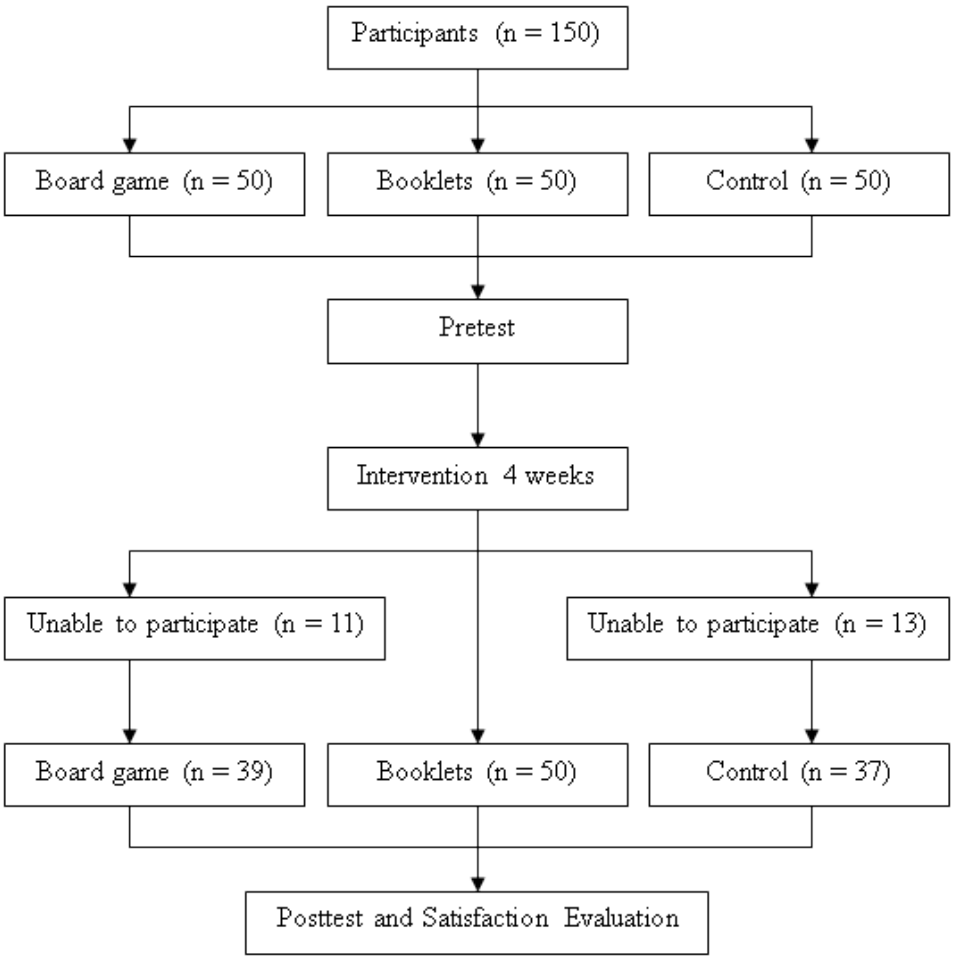

Figure 2 Flow of this study.

4. Statistical methods

Descriptive statistics, such as the mean ($\bar{x}$), standard deviation (S.D.), and percentage (%), were utilized to analyze demographic characteristics and nutritional knowledge scores. The relationship between each variable was analyzed via the chi-square test. The differences in nutritional knowledge scores within groups before and after treatment were analyzed via the Wilcoxon signed-ranks test, whereas the differences among groups were analyzed via the Kruskal-Wallis test. A significance level of $p \leq 0.05$ was considered statistically significant.

Results

1. Effect of Pedagogical Tools

The participants in this study included 126 students in grades 4-6, aged between 8 and 12 years. The average ages of the three groups were not significantly different ($p > 0.05$). The participants consisted of 50.8% females and 49.2% males, with 12.7% in 4th grade, 77.0% in 5th grade, and 10.3% in 6th grade. Table 1 shows that pedagogical tools were significantly associated with participants' age and education ($p < 0.05$); but not with sex.

Table 1 Demographic characteristics of the participants.

Characteristics	Total (n = 126)	Board game (n = 39)	Booklet (n = 50)	Control (n = 37)	*P* value*
	n (%)	n (%)	n (%)	n (%)	
Gender					
Male	62 (49.2)	25 (64.1)	22 (44.0)	15 (40.5)	0.077
Female	64 (50.8)	14 (35.9)	28 (56.0)	22 (59.5)	
Age (years)					
8 - 9	9 (7.2)	-	-	9 (24.3)	0.000
10 - 11	100 (79.3)	37 (94.9)	44 (88.0)	19 (51.4)	
12	17 (13.5)	2 (5.1)	6 (12.0)	9 (24.3)	
Mean ± S.D.[ns]	10.7 ± 0.8	10.6 ± 0.6	10.8 ± 0.6	10.5 ± 1.2	
Education					
Grade 4	16 (12.7)	-	-	16 (43.3)	0.000
Grade 5	97 (77.0)	39 (100.0)	50 (100.0)	8 (21.6)	
Grade 6	13 (10.3)	-	-	13 (35.1)	

*Pearson chi-square test

ns = no significant difference

After the implementation of pedagogical tools, the nutritional knowledge scores of school-age children significantly increased compared with the scores before the use of these tools. An examination of the differences in nutritional knowledge scores among the three groups using pedagogical tools, revealed that the scores after implementation increased in all three groups (Board game = 11.3 ± 2.5, Booklets = 7.6 ± 2.8, and Control = 8.6 ± 3.4). Specifically, the nutritional knowledge scores after the use of the pedagogical tools in the board game group and the control group were significantly different from the scores before the use of the pedagogical

tools. While there was no statistically significant difference in nutritional knowledge scores before using the pedagogical tools among the three groups, the scores after using the tools differed significantly, particularly in the board game group compared with the booklet group and the control group (p <0.001), as shown in Table 2.

Table 2 Nutritional knowledge scores before and after the intervention.

Pedagogical Tools	Nutritional Knowledge Scores				*P* value*
	Pretest	P value**	Posttest	*P* value**	
Total	6.6 ± 2.3		9.0 ± 3.3		< 0.001
(Min – Max)	(3 – 12)		(2 – 18)		
Board game	6.3 ± 2.2	0.441	11.3 ± 2.5[a]	< 0.001	< 0.001
(Min – Max)	(3 – 12)		(6 – 15)		
Booklets	6.9 ± 2.3		7.6 ± 2.8[b]		0.051
(Min – Max)	(3 – 12)		(2 – 14)		
Control	6.7 ± 2.3		8.6 ± 3.4[b]		< 0.01
(Min – Max)	(3 – 11)		(2 – 18)		

Pre- and posttest values are expressed in terms of the mean ± standard deviation.

* Wilcoxon signed ranks test between pre- and posttest; ** Kruskal-Wallis test

Mean values with different superscripts in the same column are significantly different (p<0.001)

2. Satisfaction scores

The satisfaction scores for pedagogical tools indicated that board games and booklets received ratings ranging from moderate liking to very liking across all parameters. These scores are shown in Figure 2.

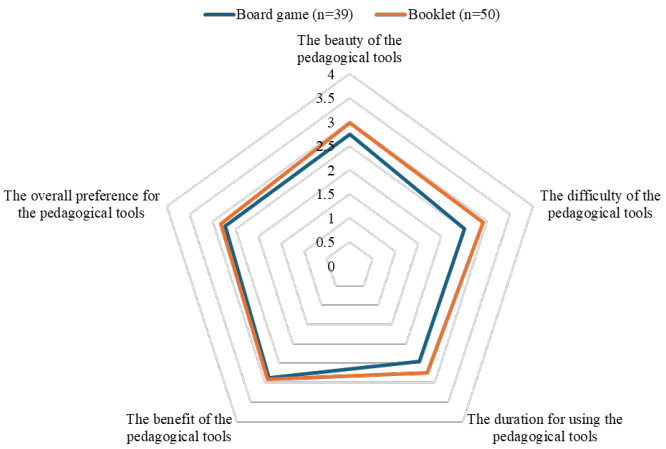

Figure 3 Satisfaction scores of pedagogical tools.

Discussion

Our study aims to identify effective methods for enhancing nutritional knowledge among school-aged children in Thailand, thereby reducing the risk of chronic noncommunicable diseases (NCDs). Thailand has shown an increased likelihood of future obesity among school-aged children[1]. We conducted our study with 126 students in grades 4-6 from three schools in Pathum Thani Province, Thailand, and exposed them to nutritional knowledge through various methods over four weeks. The findings of this study indicate that imparting nutritional knowledge to school-age children through various methods can effectively enhance their understanding of nutrition. These results align with those of many previous studies that have shown improvements in the nutritional knowledge of various methods. Although all previous studies have shown the positive effects of increasing nutritional knowledge when pedagogical tools are used, many studies, have shown that nutritional status, such as BMI, waist circumference, and percent body fat, is affected in two ways: improved nutritional status[20] and no change in nutritional status[21]. These results indicate that in addition to increasing nutritional knowledge, other factors may also affect nutritional status.

In this study, three pedagogical tools, board games, booklets, and lectures, were compared. The results of the study indicated that the most effective method for increasing nutritional knowledge scores was the use of board games, which yielded the highest scores and was significantly different (Table 2). Many previous studies have indicated positive impacts on various outcomes, particularly nutritional knowledge, resulting from the use of board games[22-25]. This study suggests that board games are appropriate pedagogical tools for school-aged children to gain a better understanding of nutrition.

A strength of our study is that the participants were school-aged children, aged 8-12 years, from schools located in Pathum Thani Province, Thailand, suggesting that they were school-aged children. The results of this study could be applied to other schools in Thailand. A limitation of this study is that it was conducted over a short period, and the number of participants was lost during the study. Additionally, this study did not collect information on nutritional status, such as weight, percentage of body fat, waist circumference, and BMI, etc. This information should be collected in further studies.

Conclusion

This study involved 126 students in grades 4-6, aged 8 - 12, with no significant age differences among the groups. The implementation of pedagogical tools led to a noteworthy increase in nutritional knowledge scores for all groups, particularly the board game group, where a statistically significant difference was observed. These findings underscore the efficacy of innovative pedagogical tools, especially board games, in enhancing nutritional knowledge among school-age children.

Ethical Approval Statement

This study was approved by the Committee for Research Ethics, VRU (REC No. 0001/2562). All of the students and guardians were informed about the objectives of the study and guardians were asked to sign the consent form.

Author Contributions

TP: Manuscript writing, literature review, data collection, data analysis, results, and discussion. SS: literature review, data collection, data analysis, results, and discussion. WS: data collection and data analysis.

Acknowledgements

This work was supported by the Research and Development Institute, Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani Province, Thailand.

Source of Funding

The work presented in this article was self-funded.

Conflicts of Interest

The authors report no declarations of interest.

References

1. Lobstein T, Jackson-Leach R, Powis J, Brinsden H, Gray M. World Obesity Atlas 2023 5th Floor, 38 Chancery Lane, London WC2A 1EN: World Obesity Federation; 2023. Available from: https://s3-eu-west-1.amazonaws.com/wof-files/World_Obesity_Atlas_2023_Report.pdf., accessed 12 March, 2024.
2. Ministry of Public Health. Percentage of school-age children (6-14 years) with good and proportionate height, Pathum Thani Province 2024 . Available from:

https://region4.anamai.moph.go.th/hdc/dashboard/height614/changwat?year=2024&cw=13., accessed 12 March, 2024.

3. Mistry SK, Puthussery S. Risk factors of overweight and obesity in childhood and adolescence in South Asian countries: a systematic review of the evidence. Public Health. 2015; 129(3): 200–9. DOI: 10.1016/j.puhe.2014.12.004
4. Bussler S, Penke M, Flemming G, Elhassan YS, Kratzsch J, Sergeyev E, et al. Novel insights in the metabolic syndrome in childhood and adolescence. Horm Res Paediatr. 2017; 88(3–4): 181–93. DOI: 10.1159/000479510
5. Jebeile H, Kelly AS, O'Malley G, Baur LA. Obesity in children and adolescents: epidemiology, causes, assessment, and management. Lancet Diabetes Endocrinol. 2022; 10(5): 351–65. DOI: 10.1016/S2213-8587(22)00047-X
6. Damghanian A, Sharietpanahi G, Khieltash A, Barahimi H. Effect of peer education on physical activity and nutrition among iranian adolescents. Asian J Soc Health Behav. 2019; 2(2): 52–7. DOI:10.4103/SHB.SHB_8_19
7. Seidell JC, Halberstadt J. The global burden of obesity and the challenges of prevention. Ann Nutr Metab. 2015; 66(2): 7–12. DOI: 10.1159/000375143
8. Nittari G, Scuri S, Petrelli F, Grappasonni I. Fighting obesity in children from European world health organization member states. Epidemiological data, medical-social aspects, and prevention programs. La Clinica Terapeutica. 2019; 170(3): e223–e30. DOI: 10.7417/CT.2019.2137
9. Pem D, Jeewon R. Fruit and vegetable intake: benefits and progress of nutrition education interventions- narrative review article. Iran J Public Health. 2015; 44(10): 1309–21.
10. Jacob CM, Hardy-Johnson PL, Inskip HM, Morris T, Parsons CM, Barrett M, et al. A systematic review and meta-analysis of school-based interventions with health education to reduce body mass index in adolescents aged 10 to 19 years. Int J Behav Nutr Phys Act. 2021; 18(1): 1–22. DOI: 10.1186/s12966-020-01065-9
11. Leis R, Lamas Cd, Castro M-Jd, Picáns R, Gil-Campos M, Couce ML. Effects of nutritional education interventions on metabolic risk in children and adolescents: a systematic review of controlled trials. Nutrients. 2020; 12(1): 31. DOI: 10.3390/nu12010031
12. Sangwanna S, Seelarat W, Panklai T. Effects of consumption of energy-restricted lunch boxes and nutrition education on nutritional status among overweight and obese

students and staff of the Valaya Alongkorn Rajabhat University, Thailand. J Dow Univ Health Sci. 2023; 17(1): 11-6. DOI: 10.36570/jduhs.2023.1.1766

13. Tallon JM, Dias RS, Costa AM, Leitão JC, Barros A, Rodrigues V, et al. Impact of technology and school-based nutrition education programs on nutrition knowledge and behavior during adolescence—a systematic review. Scand J Educ Res. 2021; 65(1): 169-80. DOI: 10.1080/00313831.2019.1659408
14. Mateo GF, Granado-Font E, Ferré-Grau C, Montaña-Carreras X. Mobile phone apps to promote weight loss and increase physical activity: A systematic review and meta-analysis. J Med Internet Res. 2015; 10(17): e253. DOI: 10.2196/jmir.4836
15. Chiang F-K, Wang S, Tang Z. Design and evaluation of a board game in food and nutrition education. Educ Sci. 2022; 12(3): 162. DOI:10.3390/educsci12030162
16. Firmansyah, Tamtomo DG, Cilmiaty R. Nutritional booklet and social media: Their effects on adolescents' fattening-food knowledge and consumption. IOP Conf Ser: Mater Sci Eng. 2019; 633(1): 012057. DOI:10.1088/1757-899X/633/1/012057
17. Lwanga SK, Lemeshow S, World Health Organization. Sample size determination in health studies: a practical manual: World Health Organization; 1991.
18. Yien J-M, Hung C-M, Hwang G-J, Lin Y-C. A game-based learning approach to improving students' learning achievements in a nutrition course. Turk Online J Educ T. 2011; 10(2): 1-10.
19. Sangwanna S, Seelarat W, Panklai T. Development a board game : the fruit-veggie wonderlands game, nutrition education tools for elementary school students. Journal of Roi Kaensarn Academi. 2022; 7(6): 382-9.
20. Price C, Cohen D, Pribis P, Cerami J. Nutrition education and body mass index in grades K-12: A systematic review. J Sch Health. 2017; 87(9): 715-20. DOI: 10.1111/josh.12544
21. Murimi MW, Moyeda-Carabaza AF, Nguyen B, Saha S, Amin R, Njike V. Factors that contribute to effective nutrition education interventions in children: a systematic review. Nutr Rev. 2018; 76(8): 553-80. DOI: 10.1093/nutrit/nuy020
22. Noda S, Shirotsuki K, Nakao M. The effectiveness of intervention with board games: a systematic review. BioPsychoSocial medicine. 2019; 13(1): 1-21.
23. Chiang F-K, Wang S, Tang Z. Design and evaluation of a board game in food and nutrition education. Educ Sci. 2022; 12(3): 162. DOI: 10.3390/educsci12030162

24. Ogunsile SE, Ogundele BO. Effect of game-enhanced nutrition education on knowledge, attitude and practice of healthy eating among adolescents in Ibadan, Nigeria. Int J Health Promot Educ. 2016; 54(5): 207-16. DOI: 10.1080/14635240.2016.1157509

25. Hassanzadeh-Rostami Z, Mirshekari M, Ranjbaran H, Khosravi S, Faghih S. Effect of game-based nutrition education on nutritional knowledge of preschool children. Int J Nutr Sci. 2018; 3(1): 50-5.