

The Effect of Family-based Intervention on Overweight/Obesity in Children: Meta Analysis

Mario Febrianus Helan Sani¹⁾, Yulia Lanti Retno Dewi²⁾, Bhisma Murti¹⁾

¹⁾Masters Program in Public Health, Universitas Sebelas Maret

²⁾Faculty of Medicine, Universitas Sebelas Maret

ABSTRACT

Background: Childhood overweight and obesity is one of the most serious public health challenges of the 21st century. Overweight and obesity are one side of the double burden of malnutrition because more than 1.9 billion people are overweight and of that number more than 650 million are obese. Meanwhile, for children aged 5-19 years, more than 340 million children are overweight and obese. One category of intervention to prevent overweight / obesity in children who have developed rapidly in recent years is family-based intervention. This study aims to estimate the magnitude of the effect of family-based intervention on overweight / obesity based on the results of a number of previous studies.

Subjects and Method: This was a systematic study and meta-analysis carried out by following the PRISMA flow diagram. The process of searching for articles through a journal database which includes: Google Scholar, PubMed, ScienceDirect and SpingerLink by selecting articles published in 2005-2020. Keywords used include: "family-based intervention" OR "family-based program" OR "family-based treatment" OR "family-based" OR "home-based intervention" OR "household based intervention" AND "children overweight OR "childhood overweight" AND "pediatric obesity" OR "children obesity" OR "children obese" OR "childhood obesity" OR "childhood obese" AND RCT OR "randomized controlled trial" OR "cluster-

randomized controlled trial". The inclusion criteria were a full paper article with a randomized controlled trial (RCT) study design, the article used English, the study subjects were overweight / obese children (aged 5-19 years) and the intervention given was family-based intervention. Articles that meet the requirements are analyzed using the Review Manger 5.3 application.

Results: A total of 11 articles reviewed in this meta-analysis study came from Malaysia, the United States, Australia, England, Spain, Denmark and Sweden. Meta-analysis of 11 articles with a randomized controlled trial (RCT) study design showed that family-based intervention had an effect on reducing children's body mass index but it was not statistically significant (Standardized Mean Difference= -0.46; 95% CI -1.05 to 0.13 p= 0.130).

Conclusion: Family-based intervention reduces body mass index for overweight / obese children.

Keywords: family-based intervention, overweight, obesity, children, meta analysis

Correspondence:

Mario Febrianus Helan Sani. Masters Program in Public Health, Universitas Sebelas Maret, Jl. Ir. Sutami 36A, Surakarta 57126, Jawa Tengah. Email: rhyansani@gmail.com. Mobile: 081326-608972.

Cite this as:

Sani MFH, Dewi YLR, Murti B (2021). The Effect of Family-based Intervention on Overweight/Obesity in Children: Meta Analysis. J Health Promote Behav. 06(01): 45-56. <https://doi.org/10.26911/thejhp-2021.06.01.05>.



Journal of Health Promotion and Behavior is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

BACKGROUND

Overweight and obesity in childhood is one of the most serious public health challenges

of the 21st century (WHO, 2016). Overweight and obesity are part of the double burden of malnutrition, and today more

people are obese than underweight in every region except sub-Saharan Africa and Asia. Once considered a problem only in high-income countries, overweight and obesity are now increasing dramatically in low- and middle-income countries, especially in urban environments. Most of the children who are overweight and obese live in developing countries, where the increase is 30% higher than in developed countries (WHO, 2020).

In 2016, more than 1.9 billion people were overweight and of that number more than 650 million were obese. Meanwhile, in children aged 5-19 years, more than 340 million children are also overweight and obese in 2016. In 2019, 38 million children under 5 years are also overweight and obese. This then became a serious concern of the World Health Organization (WHO) so that it declared obesity a global epidemic (WHO, 2020).

Overweight and obesity are abnormal or excessive accumulation of fat in the body that can pose a risk to health. Someone is said to be overweight if the body mass index (BMI) ranges from 25-29.9 kg / m², while someone is said to be obese if the BMI > 30 kg / m² (WHO, 2020).

The increase in obesity rates has also led to a drastic increase in the incidence of obesity-related diseases in adults, such as type 2 diabetes mellitus, cardiovascular disease, obstructive sleep apnea, and mental disorders in children (Kuhle et al., 2011). Children who are obese are more likely to experience body dissatisfaction problems, depressive symptoms, impaired social relationships, obesity-related stigma and decreased quality of life related to health (Wal et al., 2011).

Data released by the NCD Risk Factor Collaboration in 2017 in Martin et al., 2018, as many as 50 million girls and 74 million boys aged 5-19 years were identified as

obese. In the United States in 2014, the prevalence of obesity in children and adolescents (BMI > 95th percentile) was 9.4% (ages 2 to 5 years), 17.4% (ages 6 to 11 years) and 20.6% (ages 12 to 19 years.) (Ogden, 2016 in Martin et al., 2018). In Canada, 8.5% of children aged 5-9 years and 12.9% of 10-14 years are obese (Davison et al., 2013). In the same age group, the rates of overweight were 15.4% (5-9 years) and 23.0% (10-14 years) (Rao et al., 2016).

Meanwhile, in 2016 the United Nations International Children's Emergency Fund (UNICEF) also released data on the prevalence of obesity in children in the Association of Southeast Asian Nations (ASEAN) countries, namely: Indonesia 12%, Thailand 11%, Brunei 8%, Malaysia 7%, Philippines 5%, Vietnam 4%, Myanmar 3%, Cambodia 2% and Lao PDR 2%. The number of children who are predicted to be obese in 2025 is 206 million and in 2030 to 254 million (WOF, 2019). In Indonesia, it is predicted that children who are obese in 2030 are 17.7% (WOF, 2019).

One category of intervention to prevent obesity in children who have developed rapidly in recent years is family-based intervention (Ash et al., 2017). Family-based weight management interventions are the main approach to achieving weight control in children and adolescents. Families or parents encourage children to make behavior changes that focus on children's eating patterns and activity behaviors and also focus on providing a supportive environment for making lifestyle modifications in the home environment (Liu et al., 2019).

Diet is the most important behavior that can affect the state of nutrition. Good nutrition makes a normal or healthy body weight, the body is not susceptible to infection, increases work productivity and is protected from chronic disease and

premature death (Ministry of Health, 2014). Physical activity is any movement of the body produced by skeletal muscles that requires energy expenditure. Lack of physical activity can lead to overweight/ obesity, non-communicable disease, and musculoskeletal disorders (WHO, 2020). Sedentary lifestyle is the habit of someone who does not do much physical activity or does not do much movement (Costigan et al., 2013). Sedentary behavior such as the use of electronic devices (TV, laptop, videogames) in children's rooms is very common in sophisticated times like now and this can be associated with health risks in children (Ferrari et al., 2015).

Meta-analysis is an epidemiological study that combines and combines statistically the results of a number of independent primary studies that are considered combinable, which tests the same hypothesis in the same way, so that finally a quantitative overview is obtained. . Meta analysis is also an inseparable part of a systematic study because no meta-analysis is carried out without systematically reviewing various studies which summarize their findings quantitatively (Murthi, 2018).

Based on this background, a comprehensive study of various primary studies is needed on the effect of family-based intervention on overweight/ obesity in children. The data obtained will be analyzed using a systematic review and meta-analysis by conducting a synthesis of the results of studies conducted to reduce bias.

SUBJECTS AND METHOD

1. Study Design

This was a systematic review and meta analysis. The articles used in this study were obtained from several databases including Google Scholar, Pub-Med, Science Direct and SpringerLink. Keywords for searching articles are as follows: “family-based inter-

vention” OR “family-based program” OR “family-based treatment” OR “family-based” OR “home-based intervention” OR “household based intervention” AND “children overweight "OR" childhood overweight "AND" pediatric obesity "OR" children obesity "OR" children obese "OR" childhood obesity "OR" childhood obese "AND RCT OR" randomized controlled trial "OR" cluster-randomized controlled trial " .

2. Inclusion Criteria

The inclusion criteria for articles that can be reviewed are full paper articles with a Randomized Controlled Trial (RCT) study design, articles in English, research subjects are overweight/ obese children aged 5-19 years when given intervention, the size of the relationship used is Mean SD and the intervention given was family-based intervention (diet, physical activity and sedentary behavior or a combination thereof).

3. Exclusion Criteria

The articles published in this study are articles that have been carried out by meta-analysis. Articles published in addition to using English. Articles with intervention not family-based intervention.

4. Operational Definition of Variables

The article search was carried out by considering the eligibility criteria defined using the PICO model. The population in the study was overweight / obese children aged 5-19 years. Intervention: family-based intervention (diet, physical activity and sedentary behavior or a combination). Comparison: not family-based intervention and overweight / obesity outcome.

Family-based intervention is a program or strategy in the form of diet, physical activity and sedentary behavior or a combination thereof carried out by families or parents at home to process, control and lose weight in children.

Overweight/ obesity is a medical condition that describes the accumulation of fat

in the body. Over-weight is characterized by a body mass index of 25-29.9 kg / m² while obesity is characterized by a body mass index > 30 kg / m². The instruments used were a scale and a stadiometer to calculate the child's body mass index.

5. Data Analysis

Data processing was carried out using the Review Manager (RevMan 5.3) by calculating the effect size and heterogeneity to determine the research model that was combined and formed the final meta-analysis result.

RESULTS

The process of searching for articles by searching through the database according to PRISMA, the flow diagram can be seen in Figure 1.

Research related to the effect of family-based intervention on overweight/obesity in children consisting of 11 articles from the initial search process yielded 1239 articles. It can be seen in Figure 2 that the research articles came from 4 continents, namely the Asian continent (Malaysia), the American continent (United States), the Australian continent (Australia) and the European continent (England, Spain, Denmark and Sweden). Furthermore, in Table 1, the researcher conducted an assessment of the quality of the study. Table 2 shows that there are 11 articles of the Randomized Controlled Trial (RCT) study as evidence of a linkage of the effect of family-based intervention on overweight/ obesity in children.

Based on the results of the forest plot (Figure 3) in the Rrandomized Controlled

Trial (RCT) study, it shows that the family-based intervention -0.46 units has an effect on body mass index (BMI) in children compared to not family-based intervention and it is statistically insignificant (SMD= -0.46; 95% CI -1.05 to 0.13 p= 0.130). The heterogeneity of the research data shows I²= 97% so that the distribution of the data is stated to be heterogeneous (random effect model).

The funnel plot (Figure 4) shows a publication bias characterized by asymmetry of the left and right plots, where there is 1 plot on the left, 9 plots on the right and 1 plot on the line. The left plot has a standard error between 0.2 and 0.3 while the right plot has a standard error of 0.1 and 0.3.

DISCUSSION

This study is a systematic study and meta-analysis with the theme of the effect of family-based intervention on overweight/obesity in children. The independent variable analyzed is family-based intervention. The dependent variable studied was overweight / obese.

Estimates of the combined effect of family-based intervention on overweight/obesity in children processed using RevMan 5.3 with the continuous method, this method is used to analyze the effect size or standardized mean difference in the bivariate data of two groups that have been controlled for confounding factors by means of randomization.

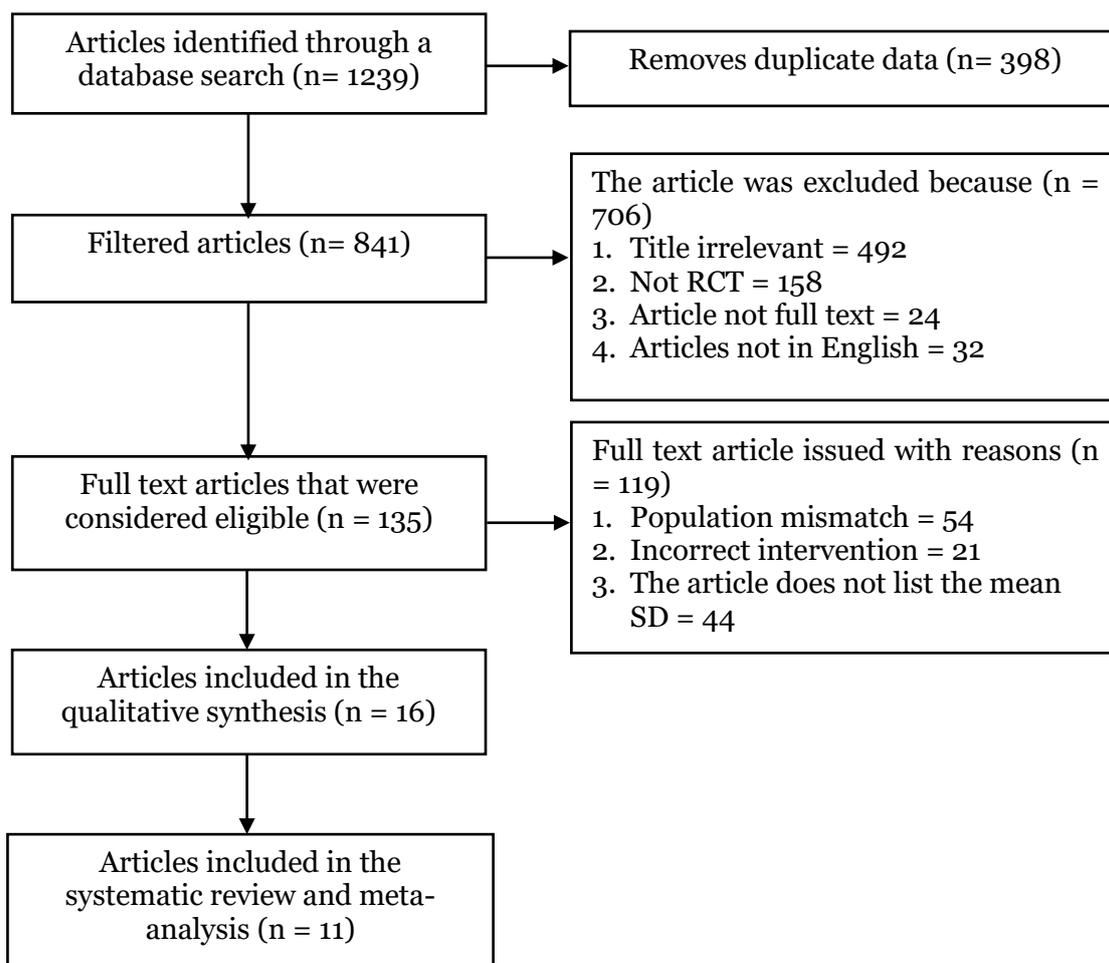


Figure 1. PRISMA flow diagram

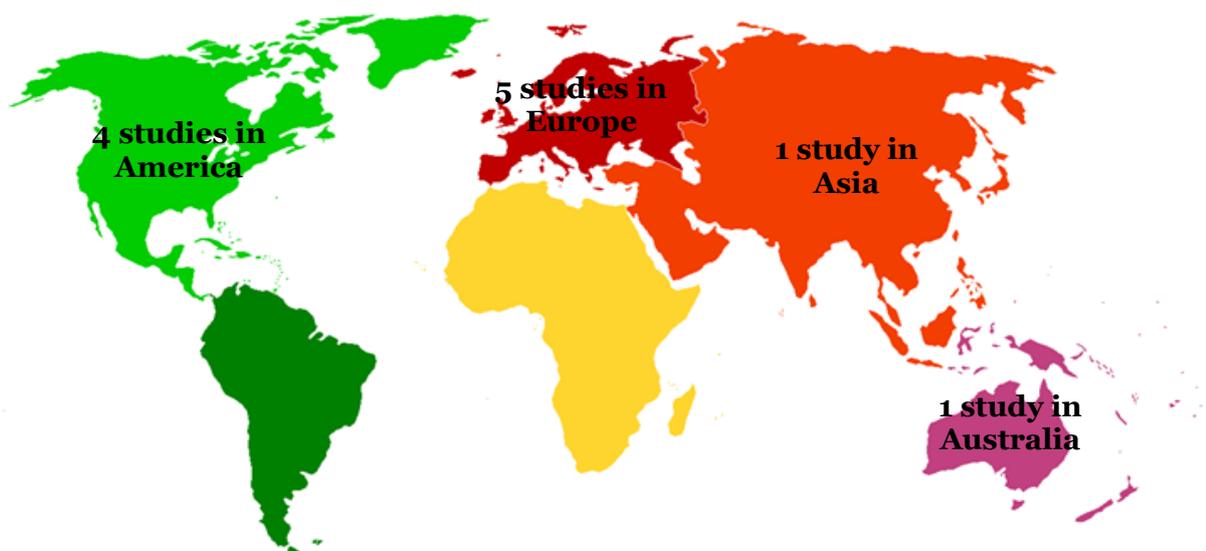


Figure 2. Map of the study area on the effect of family-based intervention on overweight / obesity in children

Table 1. Study Quality Assessment

Checklist Questions	Publication (Author and Year)					
	Ahmad et al., 2018	Backlund et al., 2011	Chen et al., 2011	Crespo et al., 2018	Janicke et al., 2019	Kalarchian et al., 2009
Does this study address a clear research focus?	1	1	1	1	1	1
Is the Randomized Controlled Trial research method suitable for answering research questions?	1	1	1	1	1	1
Are there enough subjects in the study to establish that the findings were not made by chance?	1	1	1	1	1	1
Are subjects randomly allocated to the experimental and control groups? If not, could this be biased?	1	1	1	1	1	1
Are inclusion / exclusion criteria used?	1	1	1	1	1	1
Were the two groups comparable at study entry?	1	1	1	1	1	1
Are objective and unbiased outcome criteria?	1	1	1	1	1	1
Are objective and validated measurement methods used to measure the results? If not, were the results scored by someone who did not know the group assignment (i.e. was the grading blinded)?	1	0	0	1	1	0
Is the effect size practically relevant?	1	1	1	1	1	1
How precise is the estimated effect? Is there a confidence interval?	1	0	1	1	1	0
Could there be confounding factors that have not been taken into account?	0	0	0	0	0	0
Are the results applicable to your research?	1	1	1	1	1	1
Score	11	9	10	11	11	11

Note: Yes= 1, No= 0

Table 2. Study Quality Assessment (Continued)

Checklist Questions	Publication (Author and Year)				
	Larsen et al., 2016	Sacher et al., 2010	Serra-paya et al., 2015	Steele et al., 2018	Wake et al., 2019
Does this study address a clear research focus?	1	1	1	1	1
Is the Randomized Controlled Trial research method suitable for	1	1	1	1	1

answering research questions?

Are there enough subjects in the study to establish that the findings were not made by chance?	1	1	1	1	1
Are subjects randomly allocated to the experimental and control groups? If not, could this be biased?	1	1	1	1	1
Are inclusion / exclusion criteria used?	1	1	1	1	1
Were the two groups comparable at study entry?	1	1	1	1	1
Are objective and unbiased outcome criteria?	1	1	1	1	1
Are objective and validated measurement methods used to measure the results? If not, were the results scored by someone who did not know the group assignment (i.e. was the grading blinded)?	1	0	1	0	0
Is the effect size practically relevant?	1	1	1	1	1
How precise is the estimated effect? Is there a confidence interval?	1	1	1	0	1
Could there be confounding factors that have not been taken into account?	0	0	0	0	0
Are the results applicable to your research?	1	1	1	1	1
Score	11	10	11	9	10

Note: Yes= 1, No= 0

Table 3. Descriptions of primary studies included in the meta-analysis

Authors (Year)	Country	Study Desig n	Sample	P (Population)	I (Intervention)	C (Comparison)	O (Outcome)
Ahmad et al., (2018)	Malaysia	RCT	FBI: 67 Not FBI: 67 Total: 134	Overweight / obese children aged 8-11 years	The REDUCE (REorganise Diet, Unnecessary screen time and Exercise)	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight / obese children
Backlund et al., (2011)	Swedia	RCT	FBI: 36 Not FBI: 35 Total: 71	Overweight / obese children aged 8-11 years	The REDUCE (REorganise Diet, Unnecessary sScreen time and Exercise)	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight / obese children
Chen et al., (2011)	US	RCT	FBI: 27 Not FBI: 27	Overweight / obese children aged 12-15	Knowledge of nutrition, diet and physical activity	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight

Sani et al./ Family-based Intervention on Overweight/Obesity in Children

Crespo et al., (2018)	US	RCT	Total: 54 FBI: 149 Not FBI: 148	years Overweight / obese children aged 5-10	Diet behavior, physical activity and sedentary behavior	Not family-based intervention	/ obese children Changes in Body Mass Index (BMI) in overweight / obese children
Janicke et al., (2019)	US	RCT	Total: 297 FBI: 88 Not FBI: 83	years Overweight / obese children aged 8-12	Diet, physical activity	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight / obese children
Kalarchian et al., (2009)	US	RCT	Total: 171 FBI: 96 Not FBI: 96	years Overweight / obese children aged 8-12	Physical activity and sedentary behavior	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight / obese children
Larsen et al., (2016)	Denmark	RCT	Total: 192 FBI: 55 Not FBI: 51	years Overweight / obese children aged 11-13	Physical activity and a healthy diet	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight / obese children
Sacher et al., (2010)	UK	RCT	Total: 106 FBI: 66 Not FBI: 56	years Overweight / obese children aged 8-12	Mind, Exercise, Nutrition, Do it (MEND) Program: Knowledge of nutrition and physical activity	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight / obese children
Serra-paya et al., (2015)	Spain	RCT	Total: 113 FBI: 54 Not FBI: 59	years Overweight / obese children aged 6-12	Nereu Program (physical activity and eating habits in the family)	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight / obese children
Steele et al., (2018)	UK	RCT	Total: 94 FBI: 47 Not FBI: 47	years Overweight / obese children aged 7-17	Nutrition and physical activity	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight / obese children
Wake et al., (2019)	Australia	RCT	Total: 250 FBI: 132 Not FBI: 118	years Overweight / obese children aged 5-10	Nutrition, physical activity and sedentary behavior	Not family-based intervention	Changes in Body Mass Index (BMI) in overweight / obese children

Note:

FBI= family-based intervention

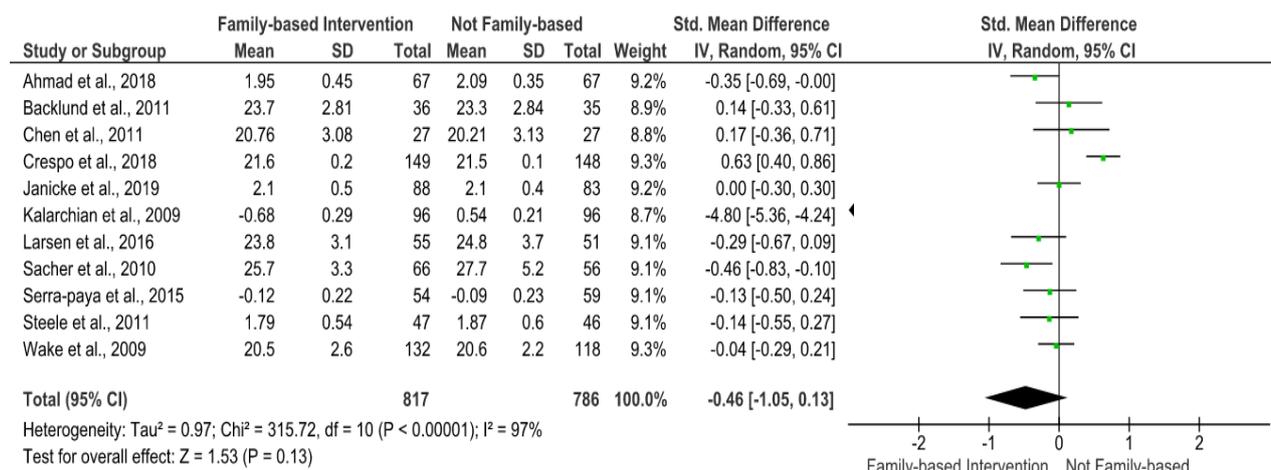


Figure 3. Forest plot for the effect of family-based intervention against the child's body mass index

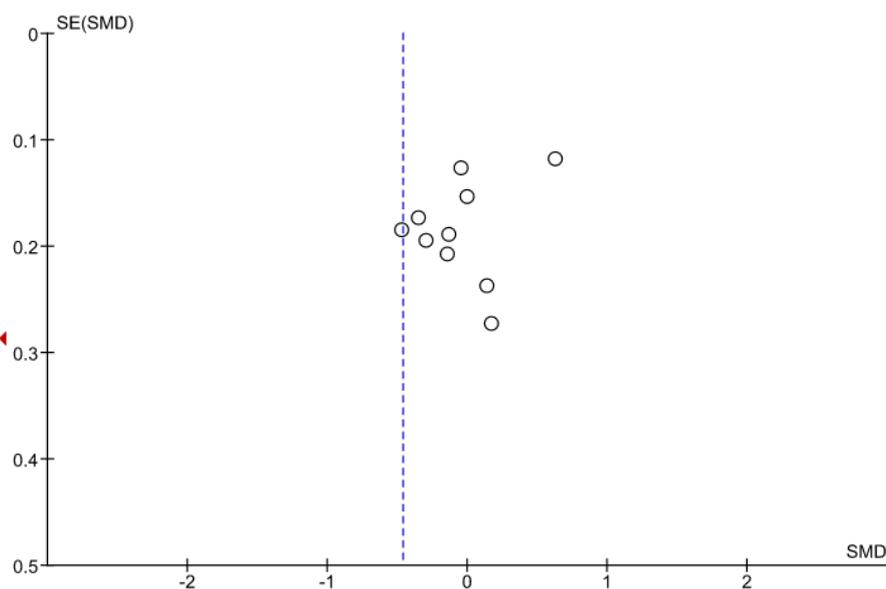


Figure 4. Funnel plot for the effect of family-based intervention against the child's body mass index

The analysis was carried out in a study with a randomized controlled trial (RCT) study design. The results on the forest plot show that family-based intervention affects the body mass index in overweight/ obese children by -0.46 units compared to not family-based intervention (SMD= -0.46; 95% CI -1.05 to 0.13; p= 0.130). The heterogeneity of the research data shows I²= 97% so that it is stated as heterogeneous (random effect model).

Forest plots can show effect sizes and 95% confidence intervals or display the results of meta-analysis (Makowski et al., 2019). The funnel plot shows the effect size and precision of the effect size and makes it possible to evaluate the possibility of publication bias in the form of a symmetrical triangle graphic (Makowski et al., 2019; Li et al., 2020).

This study is in line with Moore et al., (2019), family-based interventions in obese children did not show a statistically signifi-

cant change in body mass index. Several factors may have contributed to this insignificant finding. It is possible that the lack of effect of the interventions tested was due to the high baseline body mass index of the study subjects (mean: 95.5 percentile), suggesting that the weight management behaviors taught in the intervention required a substantial change in lifestyle behavior. As for other factors, the families who are the subjects in this study lead challenging lives (extremely poor environment, violence, and economic stress) that may interfere with their ability to act based on information on healthy lifestyle and behavior change techniques that have been taught. in intervention.

In his study, he said that, there are several factors that cause changes in body mass index in children are not significant, among others: (1) education alone is not enough to change lifestyle behaviors related to weight processing in children; (2) interventions for low-income, urban living and minority families may need to be specially adapted to personal characteristics and family environment.

Benestad et al., (2016) showed that there was no statistically significant difference in children's body mass index between the control and intervention groups. Interventions that focus on healthy diets appear to be insufficient so there will need to be more specific calorie restriction for future trials.

Elder et al., (2013) with the aim of providing family-based interventions for obese children by promoting healthy eating and physical activity. The results showed that there was no statistically significant effect of the intervention on the body mass index of post-intervention children, but in girls it appeared to have a beneficial effect in limiting weight gain whereas boys were more likely to lead to weight gain. The

recommendations given in his study were that the interventions should be differentiated according to gender to obtain more specific results.

Although the study by Elder et al., (2013) did not show a statistically significant change in children's body mass index, this study still had a positive effect on dietary changes in consuming fats and sweetened drinks, indicating that parents and children were in the intervention group took some of the recommended actions or at least had increased their awareness of healthy living behaviors.

This study is supported by a study by Barkin et al., (2018) which states that, family-based intervention does not show a statistically significant change in the children's body mass index. Barkin et al., (2018) also said that, more than 350 randomized controlled trials conducted to prevent or treat obesity in childhood, only a few showed success in changing body mass index.

In general, no intervention appears to be effective in reducing body mass index in children. Childhood is a period at high risk for the development of obesity, and health care professionals have reported increased challenges and complexities in caring for children with chronic disease compared to other age groups (Steinbeck et al., 2008). The interrelated social context of children, prevention efforts and interventions that target existing social networks in the family, school, environment, and community have the potential to promote sustainable and effective weight control behavior (Horst et al., 2008).

From this study it can be concluded that, family-based intervention affects the body mass index of overweight / obese children -0.46 units compared to not family-based intervention but it is not statistically significant (SMD = -0.46; 95%

CI -1.05 to 0.13 $p= 0.130$). The meta-analysis of 11 articles used a random effect model approach with $I^2= 97\%$.

AUTHOR CONTRIBUTION

Mario Febrianus Helan Sani is the principal researcher who selects topics, explores and collects research data. Yulia Lanti Retno Dewi and Bhisma Murti played a role in analyzing data and reviewing research documents.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

FUNDING AND SPONSORSHIP

This study is self-funded.

ACKNOWLEDGEMENT

We are very grateful to the database providers Google Scholar, PubMed, ScienceDirect and SpringerLink.

REFERENCE

- Ash T, Agaronov A, Young T, Aftosmes-Tobio A, Davison KK (2017). Family-based childhood obesity prevention interventions: a systematic review and quantitative content analysis. *Int J Behav Nutr Phys Act*, 14(1): 1-12. doi:10.1186/s12966-017-0571-2.
- Barkin SL, Heerman WJ, Sommer EC, Martin NC, Buchowski MS, Schlundt D, Stevens J (2018). Effect of a behavioral intervention for underserved preschool-age children on change in body mass index. *JAMA*, 320(5): 450-460. doi:10.1001/jama.2018.9128.
- Benestad B, Lekhal S, Smastuen MC, Hertel JK, Halsteinli V, Odegard RA, Hjelmæsæth J (2016). Camp-based family treatment of childhood obesity: randomised controlled trial. *Arch Dis Child*, 102(4): 303-310. doi:10.1136/archdischild-2015-309813.
- Costigan SA, Barnett L, Plotnikoff RC, Lubans DR (2013). The health indicators associated with screen-based sedentary behavior among adolescent girls: a systematic review. *J Adolesc Health*, 52(4): 382-392. doi:10.1016/j.jadohealth.2012.07.018.
- Davison KK, Jurkowski JM, Li K, Kranz S, Lawson HA (2013). A childhood obesity intervention developed by families for families: results from a pilot study. *Int J Behav Nutr Phys Act*, 10(1): 1-11. doi:10.1186/1479-5868-10-3.
- Elder JP, Crespo NC, Corder K, Ayala GX, Slymen DJ, Lopez NV, McKenzie TL (2013). Childhood obesity prevention and control in city recreation centres and family homes: the MOVE/me nuevo project. *Pediatr Obes*, 9(3): 218-231. doi:10.1111/j.2047-6310.2013.00164.x.
- Ferrari GLM, Araujo TL, Oliveira LC, Mat-sudo V, Fisberg M (2015). Association between electronic equipment in the bedroom and sedentary lifestyle, physical activity, and body mass index of children. *J Pediatr*, 91(6):574-582. doi: 10.1016/j.jpmed.2015.01.009.
- Horst KVD, Oenema A, Looij-Jansen PVD, Brug J (2008). The ENDORSE study: research into environmental determinants of obesity related behaviors in Rotterdam schoolchildren. *BMC Public Health*, 8(142):1-9. doi:10.1186/1471-2458-8-142.
- Kementerian Kesehatan RI (2014). Pedoman Gizi Seimbang. Jakarta: Kementerian Kesehatan RI. Retrieved from: http://hukor.kemkes.go.id/uploads/produk_hukum/PMK%20No.%2041%20ttg%20Pedoman%20Gizi%20Seimbang.pdf.
- Kuhle S, Kirk S, Ohinmaa A, Yasui Y, Allen AC, Veugelers PJ (2011). Use and cost

- of health services among overweight and obese canadian children. *Pediatr Obes*, 6(2): 142-148. doi:10.3109/174-77166.2010.486834.
- Li G, Zeng J, Tian J, Levine MA, Thabane L (2020). Multiple uses of forest plots in presenting analysis results in health research. *J Clin Epidemiol*. 117: 89-98. doi:10.1016/j.jclinepi.2019.09-.021.
- Liu S, Marques IG, Perdeu MA, Strange K, Hartrick T, Weismiller J, Naylor PJ (2019). Family-based, healthy living intervention for children with overweight and obesity and their families: a “real world” trial protocol using a randomised wait list control design. *BMJ Open*, 9(10): 1-9. doi:10.1136/bmjopen-2018-027183.
- Makowski D, Piraux F, Brun F (2019). From experimental network to meta-analysis methods and applications with R for agronomic and environmental sciences, France: Springer Nature B.V.
- Martin A, Booth JN, Laird Y, Sproule J, Reilly JJ, Saunders DH (2018). Physical activity, diet and other behavioural interventions for improving cognition and school achievement in children and adolescents with obesity or overweight. *Cochrane Database Syst Rev*, doi:10.1002/14651858.cdo-09728.pub4.
- Moore SM, Borawski EA, Love TE, Jones S, Casey T, McAleer S, Nevar A (2019). Two family interventions to reduce BMI in low-income urban youth: a randomized trial. *Pediatrics*, 143(6): 1-11. doi:10.1542/peds.2018-2185.
- Murti B (2018). Prinsip dan metode riset epidemiologi (5th ed.). Program Studi Ilmu Kesehatan Masyarakat, Sekolah Pascasarjana, Universitas Sebelas Maret.
- Rao DP, Kropac E, Do MT, Roberts KC, Jayaraman GC (2016). Childhood overweight and obesity trends in Canada. *Heal Promot Chronic Dis Prev Can*, 36(9). doi: 10.24095/hp-cdp.36.9.03.
- Steinbeck K, Baur L, Cowell C, Pietrobelli A (2008). Clinical research in adolescents: challenges and opportunities using obesity as a model. *Int J Obes*, 33(1): 2-7. doi:10.1038/ijo.2008.263.
- Wal JSV, Mitchell ER (2011). Psychological Complications of Pediatric Obesity. *Pediatr Clin N Am*, 58(6): 1393-1401. doi:10.1016/j.pcl.2011.09.008.
- World Health Organization (2016). Report of the commission on ending childhood obesity. Retrieved from: http://apps.who.int/iris/bitstream/handle/10665/204176/9789241510066_eng.pdf;jsessionid=37817F80E58B1F6475E0BA1321594669?sequence=1.
- World Health Organization (2020). Physical activity. Retrieved from: <https://www.who.int/en/news-room/fact-sheets/detail/physical-activity>.
- World Health Organization (2020). Obesity and overweight. Retrieved from: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>.
- World Obesity Federation (2019). Atlas of childhood obesity. Retrieved from: <https://www.worldobesity.org/membersarea/global-atlas-on-childhood-obesity>.