

Sodium, Saturated Fat, and Sugar Added Intake of The Diet of Children 2-12 Years Old

Angga Hardiansyah, Hardinsyah, Dadang Sukandar

Department Nutritional Sciences, Bogor Agricultural University, 16680, Bogor, Indonesia
E-mail: anggahardiansyah@gmail.com, hardinsyah2010@gmail.com, sukandar2010@gmail.com

Abstract— The aims of the study were to analyze intake of sodium, saturated fat (SFA), and added sugar of children 2-12 years old. For this purpose, 38,890 children 2-12 years old from the food consumption data of the basic health survey of the Ministry of Health were analyzed. The intake of sodium, SFA, and added sugar were calculated by using food composition table (FCT) of Indonesia and USDA, and from nutrition facts of labeled foods. The sodium and SFA calculated include both natural resources and which added to food and beverage products. The sugar added calculated include all sugar which added to food and beverage products. The results showed that the intake of sodium, SFA, and added sugar of each children varies greatly. The mean of sodium, SFA, and added sugar intake was 1010.3 ± 963.5 mg, 10.9 ± 9.2 g, and 19.0 ± 35.1 g respectively. There were 30% of children have excessive sodium intake, 28% of children have excessive SFA intake ($> 8\%$ -e), and 14% of children have excessive added sugar intake ($> 10\%$ -e). This implies that some children exposed to high intake of sodium, saturated fat, and added sugar.

Keywords— sugar, saturated fatty acid, sodium, children, diet quality

I. INTRODUCTION

Noncommunicable diseases (NCDs) are the leading global causes of death, causing more deaths than all other causes combined, and they strike hardest at the world's low- and middle-income populations. Of the 57 million global deaths in 2008, and 63% were due to NCDs, principally hypertension, cardiovascular diseases, diabetes, cancers and chronic respiratory diseases [24]. In Indonesia, the prevalence of hypertension, stroke, and diabetes in 2013 was 25.8 %, 12.1%, and 2.1% respectively and tended to increase compared in 2010[11], [12].

A large percentage of NCDs is caused by many factors, such as physical inactivity and unhealthy diet such as more consumption of sugar, sodium, saturated and trans fatty acid of the diet [2],[15],[20],[22],[24]. People who are insufficiently physically active have a 20% to 30% increased risk of all-cause mortality. Regular physical activity reduces the risk of cardiovascular disease including high blood pressure and diabetes [3]. Adequate consumption of fruit and vegetables reduces the risk for cardiovascular diseases. Most populations consume much higher levels of salt than recommended by WHO for disease prevention; high salt consumption is an important determinant of high blood pressure and cardiovascular risk [18]. High consumption of saturated fats and trans-fatty acids is linked to heart

disease. In a population with a relatively low fat intake (19% of energy intake), a moderate increase in total fat intake may be a risk factor for ischemic heart disease [10],[23]. High sugar and food which high glycemic index consumption is a main determinant of diabetes, and may contribute to abnormal plasma lipoprotein [5],[16],[17].

NCDs are common in adulthood, but preventive action should be done in childhood early. Several studies suggest that unhealthy diet in childhood is followed by serious consequences in adulthood, such as obesity, diabetes, and cardiovascular disease [4],[5]. The risk may be reversed with later dietary change. Otherwise, survey about quality of diet of children should be done early. The aims of the study were to analyze intake sodium, saturated fat (SFA), and added sugar of children 2-12 years old.

II. METHODS

A. Design

Design of this study was cross sectional. All of data were obtained from the food consumption data of the basic health survey of the Ministry of Health (secondary data). The data form was electronic file. The Indonesia's Ministry of Health (IMH) collected food consumption data by 24 hour-recall method using trained interviewer in may-august 2010.

B. Subjects

Subjects households in 2010 were selected based listings Census in 2010 by IMH. The process of selection of households conducted by the Central Statistics Agency with a two-stage sampling. As many as 45797 people were a group of childrens aged 2-12 years. Furthermore, the cleaning process was performed to obtain subjects who meet the inclusion and exclusion criteria.

Inclusion criteria were childrens aged 24 months - 12 years. The exclusion criteria were empty data (one of variables was not available), childrens with Z-Score height for age <-6 or> 6, weight for age <-6 or> 5, weight for age <-5 or weight for height, body mass index for age <-5 or> 5 [26], had very low energy intake (<0.3 x bassal metabolic energy) or very high (> 3 bassal metabolic energy), had 400 % nutrition adequacy, and childrens who consumed food in unusual condition (illness, fasting, feasts). The final subjects as much as 38 890 or 84.9% of the initial subjects. Stages cleaning process is presented in Figure 1.

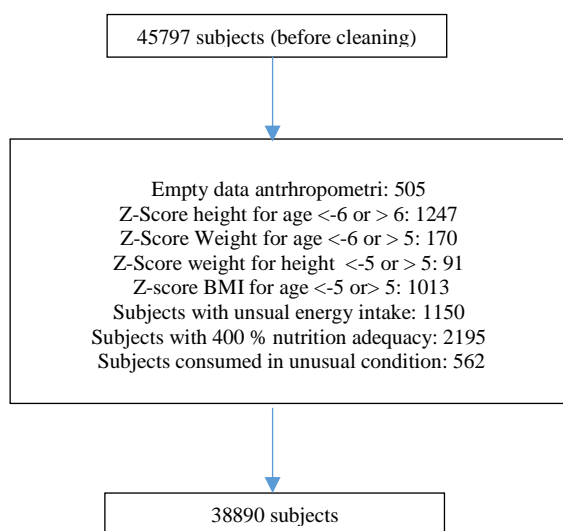


Fig.1 Stages of screening process

C. Data Analysis

All of data were electronic files form (SPSS file), included social and economic characteristic and food consumption. Social and economic characteristics subjects which analyzed were economic strata (1-5 quintiles), regions (rural or urban), education and occupations of parents.

The intake of sodium, SFA, and added sugar were calculated by using food composition table of Indonesia and nutrition facts of labeled foods. If the data of sodium, SFA, or added sugar not found, using food composition table of USDA been done. The sodium and SFA calculated include both natural resources and which added to food and beverage products. The sugar added calculated include all sugar which added to food and beverage products.

Data analysis was performed with SPSS software (version 20 for IBM). We calculated mean, standart deviation, and median of sodium, SFA, and added sugar intake. We corelated sodium, SFA, and added sugar intake by use pearson correlation test.

III. RESULTS AND DISCUSSIONS

A. Characteristic of subjects

Social and economic characteristic of subjects which analyzed were economic strata (1-5 quintiles), region (rural or urban), education and occupation of parents (table 1). Overall, more of the subjects (51.5%) live in rural area. Mother's education (51.3%) most at elementary school, and so did father's education (47.4%). Most of mothers were not working (47.6), 33.9% of fathers were seller/proffesional, and 31.4% were farmer/tailor. Economic strata were divided in to 5 quintiles proportionally.

This implies that both fathers and mothers had low level of education. Several studies suggested that parents which have a low level education tend to have less nutrition informations. Nutrition informations were important for parents to prepare healthy foods in home, and also to give healthy lifestyles to childrens included eat healthy foods. Otherwise, parents needed additional nutrition information from non academic such as nutrition counselling from health practitioners, or nutrition information from mass media [8].

TABLE I
CHARACTERISTICS OF SUBJECTS

Characteristics	Age (years)										Total	
	2-3		4-6		7-9		10-12 (male)		10-12 (female)		N	%
	n	%	n	%	n	%	N	%	n	%		
Region												
Urban	2704	49.1	4903	48.0	5763	49.2	2829	47.2	2673	48.6	18845	48.5
Rural	2807	50.9	5318	52.0	5921	50.8	3169	52.8	2830	51.4	20045	51.5
Total	5511	100	10221	100	11657	100	5998	100	5503	100	38890	100
Mother's education												
Elementary school	2418	43.9	4989	48.9	6014	51.6	3425	57.1	3107	56.5	19962	51.3
Primary school	1226	22.2	2033	19.9	2212	19.0	1029	17.2	959	17.4	7459	19.2
High school/graduate	1867	33.9	3190	31.2	3431	29.4	1544	25.7	1437	26.1	11469	29.5
Totals	5511	100	10221	100	11657	100	5998	100	5503	100	38890	100
Father's education												
Elementary school	2258	41.0	4674	45.7	5554	47.6	3105	51.8	2853	51.8	18444	47.4
Primary school	1099	19.9	1921	18.8	2031	17.5	1010	16.8	890	16.2	6951	17.9
High school/graduate	2154	39.1	3626	35.5	4072	34.9	1883	31.4	1760	32.0	13495	34.7
Total	5511	100	10221	100	11657	100	5998	100	5503	100	38890	100
Mother's occupation												

Not working	2793	50.7	4942	48.4	5534	47.5	2696	44.9	2537	46.1	18502	47.6
Employer	368	6.7	589	5.8	658	5.6	344	5.7	295	5.4	2254	5.8
Seller/entrepreneur	697	12.6	1293	12.7	1551	13.3	803	13.4	772	14.0	5116	13.2
Farmer/fisher	835	15.2	1805	17.7	2147	18.4	1287	21.5	1102	20.0	7176	18.5
Labourer	233	4.2	516	5.0	589	5.1	322	5.4	305	5.5	1965	5.1
Others	585	10.6	1076	10.5	1178	10.1	546	9.1	492	8.9	3877	10.0
Total	5511	100	10221	100	11657	100	5998	100	5503	100	38890	100
Father's occupation												
Not working	65	1.2	123	1.2	152	1.3	95	1.6	99	1.8	534	1.4
Employer	682	12.4	1166	11.4	1395	12.0	727	12.1	627	11.4	4597	11.8
Seller/entrepreneur	1988	36.1	3546	34.7	3977	34.1	1887	31.5	1804	32.8	13202	33.9
Farmer/fisher	1541	28.0	3159	30.9	3619	31.0	2084	34.7	1827	33.2	12230	31.4
Labourer	1033	18.7	1863	18.2	2079	17.8	1033	17.2	963	17.5	6971	17.9
Others	202	3.7	364	3.6	435	3.7	172	2.9	183	3.3	1356	3.5
Total	5511	100	10221	100	11657	100	5998	100	5503	100	38890	100
Economic strata												
Quintiles 1	1176	21.3	2143	2.0	2292	19.7	1134	18.9	1019	18.5	7764	20.0
Quintiles 2	1153	20.9	2038	19.9	2357	20.2	1150	19.2	1073	19.5	7771	20.0
Quintiles 3	1095	19.9	2070	20.3	2344	20.1	1153	19.2	1121	20.4	7783	20.0
Quintiles 4	1081	19.9	2037	19.9	2305	19.8	1266	21.1	1095	19.9	7784	20.0
Quintiles 5	5511	18.3	1933	18.9	2359	20.2	1295	21.6	1195	21.7	7788	20.0
Total	5511	100	10221	100	11657	100	5998	100	5503	100	38890	20.0

TABLE II
MEAN AND STANDART DEVIASION OF SODIUM, SFA, AND ADDED SUGAR INTAKE OF CHILDERN DIET

Intake (mean ± sd)	Age (years)					
	2-3	4-6	7-9	10-12 (male)	10-12 (female)	Total
Sodium (mg)	829.6 ± 772.5	970.0 ± 928.7	1034.5 ± 959.9	1097.1 ± 1066.9	1120.2 ± 1054.1	1010.3 ± 963.5
SFA (g)	9.9 ± 7.4	10.5 ± 9.0	11.1 ± 9.4	11.6 ± 10.3	11.4 ± 9.7	10.9 ± 9.2
Added sugar (g)	17.6 ± 25.2	18.5 ± 31.5	19.5 ± 37.9	19.4 ± 38.5	20.0 ± 39.5	19.0 ± 35.1

TABLE III
CORRELATION BETWEEN SODIUM , SFA, AND ADDED SUGAR INTAKE
OF CHILDERN DIET

	Sodium intake	SFA intake	Added sugar intake
Sodium intake	1	0.369**	0.111**
SFA intake	0.369**	1	0.147**
Added sugar intake	0.111**	0.147**	1

** . Correlation is significant at the 0.01 level (2-tailed).

B. Sodium, SFA, and added sugar intake

The results showed that the intake of sodium, SFA, and added sugar of each childrens varies greatly. The mean of sodium intake, SFA intake, and added sugar intake was 1010.3 ± 963.5 mg, 10.9 ± 9.2 g, and 19.0 ± 35.1 respectively (TABLE 2). There were 30% of childrens have excessive sodium intake, 28% have excessive SFA intake, and 14% have excessive added sugar intake. There were significant correlation ($p < 0.01$) between sodium intake and SFA intake ($r = 0.369$), sodium intake and added sugar intake ($r = 0.111$), and SFA intake and added sugar intake ($r = 0.147$) (Table 3).

Excess sodium intake was associated with high blood pressure, a major risk factor for cardiovascular diseases (CVD) and reduced sodium intake improved the blood pressure and reduced risk all cause mortality [18], [19], [25]. Therefore, WHO recommended to reduce foods and beverages which high sodium contents, such as packaged foods, store foods, snacks with high sodium content [6].

This study showed that 30% of childrens have excessive sodium intake. High blood pressure or cardiovascular diseases was rare in childhood, but childrens were exposed high sodium intake may have higher risk [12]. Information

about sodium contents of foods in FCT of indonesia and USDA were limited, and any sodium which added during food processing were not calculated. For example, we calculated sodium content in fried chicken and fried tempeh only natural sources because we used FCT of USDA (no added sodium). Otherwise, this study may underestimate about sodium contents.

WHO recommended that intake of SFA in childrens should be less than 8% of energy intake [24]. Excess SFA intake was associated with high risk of cardiovascular diseases in adults [1], [13], [15], [21], [24], and few studies have shown this effect in children [14]. This dietary trend that is commenced in childhood is likely to increase age-specific rates of cardiovascular diseases in adulthood, and the risk may be reversed with later dietary change. Dietary changes were effective in achieving modest lowering of LDL cholesterol over 3 years while maintaining adequate growth, iron stores, nutritional adequacy, and psychological well-being during the critical growth period of adolescence. Advice to parents to change to reduced-fat products was effective in reducing children's saturated fat intakes but did not alter energy intakes or measures of adiposity [9], [14].

There were 28% of childrens in this study have excessive SFA intake. SFA calculated include both natural resources and which added to food and beverage products. Information about SFA contents of foods in FCT of indonesia were limited and most of them used USDA FCT and nutrition facts of labeled food. SFA contents of some local were not found in USDA FCT. Therefore, we used similar foods to approach them. For example, any species of fish (bandeng, bawal, mujair, etc) were not found, and we used other fish which have similar form and habitat which found in USDA

FCT. Difference of species may be have difference in SFA contents although in the same habitat (saltwater or freshwater fishes). Therefore, SFA intake of this studi may had little underestimate or overestimate results.

Worldwide intake of free/added sugars were varied by age, setting and country. In Europe, intake in adults were 7-8% of total energy intake in countries like Hungary and Norway, 16-17% in countries like Spain and the United Kingdom. Intake was much higher among children. There are also rural/urban differences. In rural communities in South Africa intake was 7.5%, while in the urban population it is 10.3% [25].

This study showed that intake of added sugar of children's diet was 6-7%. There were 14% of children have excessive sugar intake (>10%). WHO recommended that intake of sugar free or added sugar less than 10% of energy intake [25]. High intake of added sugar was associated with weight gain, diabetes and cardiovascular diseases in childrens and adults [4], [16], [17].

IV. CONCLUSIONS

There were significant correlation between sodium intake, SFA intake, and added sugar intake. Although that was low-moderate correlation, this results showed that childrens which have more consumption of sodium tend to have more consumption of SFA and added sugar. We concluded that some childrens exposed to high intake of sodium, saturated fat, and added sugar. Combination of high sodium intake, high SFA intake, and added sugar intake together may increase the risk of NCDs.

Therefore, Indonesian's government can translate the recommendations into food-based dietary guidelines that consider locally available food and customs. Additionally, some countries are implementing other public health interventions to reduce sodium, SFA, and added sugars intake. These include nutrition labelling of food products, restricting marketing to children of foods and non-alcoholic drinks that are high in sodium, SFA, and added sugar, fiscal policies targeting foods and beverages, and dialogue with food manufacturers to reduce free sugar in processed foods.

REFERENCES

[1] L. Berglund, M. Lefevre, H.N. Ginsberg, P.M.K. Etherton, P.J. Elmer, P.W. Stewart, A. Ershow, T.A. Pearson, B.H. Dennis, P.S. Roheim, R. Ramakrishnan, R. Reed, K. Stewart, K.M. Phillips, "Comparison of monounsaturated fat with carbohydrate as a replasement for saturated fat in subjects with a high metabolic risk profile: studies in the fasting and postprandial states," *Am J Clin Nutr*, vol. 86, pp. 1611-1620, 2007.

[2] G. Danaei, E.L. Ding, D. Mozaffarian, B. Taylor, J. Rehm, C.J. Murray, M. Ezzati, "The preventable causes of death in the United States: comparative risk assessment of dietary, lifestyle, and metabolic risk factors," *PLoS Med*, Vol 6, 2009.

[3] M. Ezzati, A.D. Lopez, A. Rodgers, H.S. Vander, C.J. Murray, "Comparative risk assessment collaborating, Selected major risk factors and global and regional burden of disease," *Lancet*, Vol 360, pp. 1347-1360, 2002.

[4] L.M. Fiorito, M. Marini, L.A. Francis, H.S. Wright, L.L. Birch, "Beverage intake of girls at age 5 y predicts adiposity and weight status in chldhood and adolescence," *Am J Clin Nutr*, vol. 90, pp. 935-942, 2009.

[5] R.A. Forshee, P.A. Anderson, M.L. Storey, "Sugar sweetened beverages and body mass index in children and adolescents: a meta-analysis," *Am J Clin Nutr*, vol. 87, pp. 1662-1671, 2008.

[6] C. Gillespie, J. Maalouf, K Yuan, M.E. Cogswell, J.P. Gunn, J. Levings, A. Moshfegh, J.K.C. Ahuja, R. Merrit, "Sodium content in major brands of US packaged foods," *Am J Clin Nutr*, vol. 101, pp. 344-353, 2015.

[7] M. Guillame, "Defining obesity in childhood: current practice," *Am J Clin Nutr*, vol. 70, pp. 126-130, 1999.

[8] Hardinsyah, M. Aries, "Jenis pangan sarapan dan perannya dalam asupan gizi harian anak usia 6-12 tahun di Indonesia," *JGP*, vol. 7, pp. 89-96, 2012

[9] G.A. Hendrie, R.K. Golley, " Changing from regular-fat to low-fat dairy foods reduces saturated fat intake but not energy intake in 4-13-y-old children," *Am J Clin Nutr*, vol.93, pp. 1117-1127, 2011.

[10] J.E. Hunter, J. Zhang, P.M.K Etherton, "Cardiovascular disease risk of dietary stearic acid compared with trans, other saturated, and unsaturated fatty acids: a systematic review," *Am J Clin Nutr*, vol. 91, pp. 46-53, 2010.

[11] IHM [Indonesia's Health Ministry], Basic health research 2010, Jakarta, 2011

[12] IHM [Indonesia's Health Ministry], Basic health research 2013, Jakarta, 2014

[13] M. Law, "Dietary fat and adult diseases and the implications for childhood nutrition; an epidemiologic approach," vol 72., pp. 1291-1296, 2000study in Korean men," *Am J Clin Nutr*, vol. 73, pp. 722-727, 2001.

[14] R.M. Lauer, E. Obarzanek, S.A. Hunsberger, L.V. Horn, V.W. Hartmuller, B.A. Barton, V.J. Stevens, P.O. Kwitervich Jr, F.A. Franklin Jr, S.Y.S Kimn, N.L. Lasser, D.G.S. Morton, " Efficacy and safety of lowering dietary intake of total fat, saturated fat, and cholesterol in children with elevated LDL cholesterol: the Dietary Intervention Study in Children," *Am J Clin Nutr*, vol.72, pp. 1332-1342, 2000

[15] M.J. Lopez, M.P. Perez, C. Marin, F. Fuentes, J. Delgado, J.F. Perez, "Dietary fat, genes and insulin sensitivity," *J Mol Med*, vol. 85, pp. 213-216, 2007.

[16] V.S. Malik, B.M. Popkin, G.A. Bray, J.P. Despres, W.C. Willett, F.B. Hu, "Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes : a meta-analysis," *Diabetes Care*, vol. 33, pp. 2477-2483, 2010.

[17] V.S. Malik, A. Pan, W.C. Willett, F.B.Hu, "Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis," *Am J Clin Nutr*, vol.98, pp. 1084-1102, 2013.

[18] D.A. McCarron, "The dietary guideline for sodium: should we shake it up? Yes!," *Am J Clin Nutr*, Vol. 71, pp. 1013-1019, 2000

[19] J. Merino, M.G. Ferre, M.A.M. Gonzales, D. Corella, R Estruch, M. Fito, E. Ros, F. Aros, M. Bullo, E.G.G. Gracia, M. Monino, J. Laperta, L.S. Majem, C. Razquin, P.B. Cosiales, J.V. Sorli, M.A. Munos, X. Pinto, L. Masana, J.S. salvado, " Is implying with the recommendations of sodium intake beneficial for health in individuals at high cardiovascular risk? Findings from the PREDIMED study," *Am J Clin Nutr*, Vol. 101, pp. 440-448, 2015

[20] J.P. Midgley, A.G. Matthew, C.M. Greenwood, A.G. Logan, "Effect of reduced dietary sodium on blood pressure: a meta-analysis of randomized controlled trials," *JAMA*, Vol. 275, pp.1590-1597, 1996.

[21] B.M. Rasmussen, B. Vessby, M. Uusitupa, L. Berglund, E. Pedersen, R. Gabrielle, A.A. Rivelles, L. Tapsell, K. Hermansen, "Effect of dietary saturated, monounsaturated, and n-3 fatty acids on blood pressure in healthy subjects," *Am J clin Nutr*, vol.83, pp 221-226, 2006.

[22] A. Rodgers, M. Ezzati, H. S Vander, A.D. Lopez, R.B. Lin, C.J. Murray, "Distribution of major health risks: findings from the Global Burden of Disease study". *PLoS Med*, Vol 1, pp 27, 2004.

[23] I.I. Suh, W. K.W. Oh, K.H. Lee, B.M. Psaty, C.M. Nam, S.I. Kim, H.G. Kang, S.Y. Cho, W.H. Shim, "Moderate dietary fat consumption as arisk factor for ischemic heart disease in a population with a low fat intake: a case-control," *Am J Clin Nutr*, vol. 73, pp. 722-727, 2001.

[24] FAO, Fats and fatty acids in human nutrition: Report of an expert consultation, Geneva, 2008.

[25] WHO website. [Online]. Guidline on sugar intake for adult and children. 2015. Available: www.who.int

[26] WHO, WHO anthro, Geneva, 2011.

[27] WHO, Guideline: Sodium intake for adults and children. Geneva, 2012.