IRON-RICH FOOD CONSUMPTION AND ASSOCIATED FACTORS AMONG CHILDREN AGED 6-23 MONTHS: A FURTHER ANALYSIS OF 2017 INDONESIA DEMOGRAPHIC AND HEALTH SURVEYS

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ABSTRACT

Iron deficiency in children age under two years are potentially to get a higher risk of iron deficiency anemia.This research seeks to examine the factors that influencing the consumption of iron-rich food among aged group 6-23 months in Indonesia.This research utilized a cross-sectional design and was conducted through a secondary analysis of 2017 Indonesia Demographic Health Survey (IDHS) data, involving a total weighted sample of 4.622 children aged group 6-23 months. The process of analysis data using a computer program. The statistical test used for bivariable analysis is the *chi-square* test and multivariable analysis uses the logistic regression test. Overall, 71.7% of children aged group 6-23 months in Indonesia exhibited a strong level of consumption of iron-rich foods. Children with aged 18-23 months [aPR= 8.42; 95%CI= 6.61-10.72], highly educated mothers [aPR= 1.14; 95%CI= 1.01-1.98], antenatal care visits <6 times [aPR= 1.77; 95%CI= 1.04-3.02], who took medication for deworming and antiparasitic over the past 6 months [aPR= 1.55; 95%CI= 1.17-2.05], children who were not breastfeeding [aPR= 1.36; 95%CI= 1.10-1.68], relatively rich economic status [aPR= 1.43; 95%CI= 1.11-1.82] and mothers who access of mass media [aPR= 1.40; 95%CI= 1.17-1.68] has a statistically significant with the good consumption of iron-rich foods in children aged 6-23 months in Indonesia. The interventions must have been focused on nutrition education, access to antenatal care (ANC), encouraging health promotion through mass media and support efforts from government to improving socio-economic factors are needed for increase the consumption of iron-rich foods in children.

Keywords: iron-rich food, iron deficiency anemia, children under two years, DHS

ABSTRAK

Kekurangan zat besi pada anak dibawah usia dua tahun berpotensi untuk meningkatkan risiko terjadinya anemia defisiensi besi. Tujuan dilakukannya studi ini adalah untuk mengusut faktor-faktor yang dapat mempengaruhi konsumsi makanan kaya zat besi pada anak kelompok usia 6-23 bulan di Indonesia. Studi ini merupakan studi potong lintang berbasis data SDKI tahun 2017 dengan total sampel tertimbang sebanyak 4.622 anak usia 6-23 bulan. Analisis data dilakukan dengan menggunakan bantuan program komputer. Uji statistik untuk analisis bivariabel adalah uji chi-square dan multivariabel dengan uji regresi logistik biner. Secara keseluruhan, sebanyak 71,7% anak kelompok usia 6-23 bulan di Indonesia dinyatakan memiliki tingkat konsumsi makanan kaya zat besi yang baik. Usia anak 18-23 bulan [aPR= 8,42; 95%CI= 6,61-10,72], ibu berpendidikan tinggi [aPR= 1,14; 95%CI= 1,01-1,98], kunjungan ANC <6 kali [aPR= 1,77; 95%CI= 1,04-3,02], konsumsi obat parasit usus dalam 6 bulan terakhir pada anak [aPR= 1,55; 95%CI= 1,17-2,05], anak yang tidak berstatus menyusui [aPR= 1,36; 95%CI= 1,10-1,68], status ekonomi yang tergolong kaya [aPR= 1,43; 95%CI=

1,11-1,82] serta paparan media massa [aPR= 1,40; 95%CI= 1,17-1,68] secara statistik memiliki hubungan signifikan dengan faktor konsumsi makanan kaya zat besi yang baik pada kelompok anak usia 6-23 bulan di Indonesia. Untuk meningkatkan konsumsi makanan kaya zat besi pada kelompok usia anak tersebut maka diperlukan intervensi yang berfokus pada pendidikan gizi dan akses antenatal care (ANC) serta mendorong promosi kesehatan melalui media massa dan perlu adanya peran pemerintah terhadap perbaikan sosial ekonomi.
***Kata kunci**: makanan kaya zat besi, iron deficiency anemia, anak dibawah dua tahun, SDKI*

INTRODUCTION

Children 6-59 months of age are especially at risk for iron deficiency anemia cause at that time, the need for iron to support growth increases but the intake of iron-rich foods is insufficient. Based on the 2019 nutritional adequacy figures or *Angka Kecukupan Gizi* (AKG), it is stated that the iron requirement for babies aged 6-11 months is 11 mg/day and for those aged 12-23 months is 7 mg/day. After a child is 6 months old, breast milk only provides 3% of iron so that 97% of it must be obtained optimally through complementary foods (1). Despite improvements in the economy condition and quality of life, anemia still remains one of the health emergencies in the 21st century (2).

The World Health Organization (WHO) classifies anemia according to its prevalence is a mild (5%-19.9%), moderate (20%-39.9%), and severe (≥40%) public health issues. Globally, the prevalence of anemia in children among aged group of 6-59 months is 39.8, equivalent to 269 million cases. Africa (60.2%) and Southeast Asia (49%) are the regions with the highest prevalence. In 2019, the prevalence of anemia in Indonesian children aged group of 6-59 months was 38.4%, which is indicating a relatively high rate (3).

Iron plays a crucial role in oxygen transport, *deoxyribonucleic acid* (DNA) synthesis, muscle metabolism and brain metabolism. Iron deficiency for children who aged under two years has significant and permanent impact on the child's brain development, which has negative consequences on the learning process and future school performance. Iron deficiency causing changes in neuro-transmitter homeostasis, decreased myelin production, impaired synaptogenesis and decreased basic ganglia function, thereby affecting cognitive function and psychomotor development in children. A connection has been established between iron deficiency and Attention Deficit Hyperactivity Disorder (ADHD) or autism spectrum conditions (4). The worst danger for people with iron deficiency anemia is ending up with heart disease and kidney complications which can be life-threatening (5).

Eating less iron-rich food and consuming items that hinder iron absorption in the intestines like calcium, folifenol and phytate can increase the likelihood of developing iron deficiency anemia(6). The iron-rich food group has a positive effect in increasing blood hemoglobin levels. Heme iron from animal sources is absorbed better than non-heme iron from vegetable sources. Animal tissue protein helps to inhance the absorption of both heme and non-heme iron, significantly contributing to overall iron intake (7).

The initial two years of a child's life are essential time for their development. The maturation of brain cells, particularly the expansion of nerve fibers and their branches, persists until the child reaches the age of two, making it crucial for them to receive proper nutrition (8). Various factors can affect children's nutritional intake especially to their intake of foods high in iron. This encompasses the mother's unawareness of the significance of these foods, socio-demographics traits, clinical aspects, and feeding habits (9).

Apart from the facts above, some types of formula milk on the market have been fortified with iron and other nutrients

to help meet children's nutritional needs especially if there is a risk of iron deficiency, but the maximum amount of iron obtained from consuming these products, especially formula milk, is still being controversial (10). Therefore, increasing public awareness are needed to boost the consumption of iron-dense foods from animal origins for children. Answering this problem and align research objectives, it is essential to investigate the elements that affect the intake of iron-rich foods in children between 6 to 23 months in Indonesia, using survey data that is representative on a national level. That is hoped the findings from this research will be beneficial in developin successful intervention strategies to increase the iron-dense foods.

METHODS

Data source

The data was obtained from the 2017 Indonesian Demographic and Health Survey (IDHS), utilizing a cross sectional study design. The dataset can be accessed via the official website https://www.dhs-program.com/data/dataset_admin/login_main.cfm. The data set was utilized in this research, the Kids Record (KR) file which includes a compilation of information on pregnancy, postpartum care, immunization and nutritional health data.

Population and sampling procedures

The source population consists of all living children between 6 to 23 months old, while the study population includes those living with their mothers who fall within the same age range. The DHS employed a two-stage stratified sampling technique to select participants for the study. Missing values in the variables studied will be removed from the sample. The final analysis included a combined weighted sample consisting of 4.622 children.

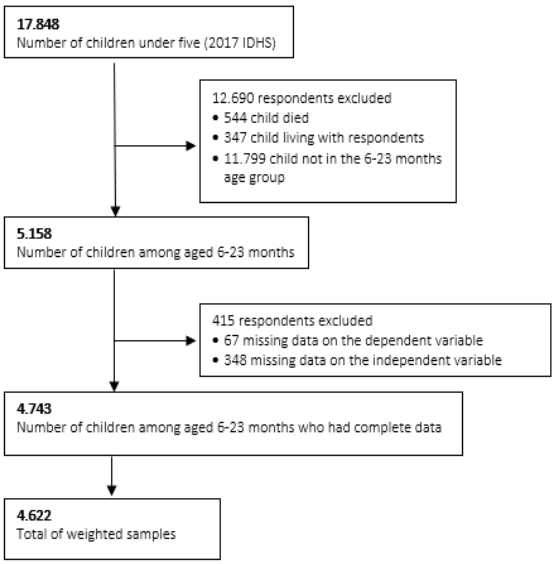

Figure 1. Flow diagram of participant selection in this study

Variable

Dependent variables

The dependent variables in this research is the intake of iron-rich foods by children who were aged 6 to 23 months, categorized as either good or poor. According to DHS guidelines, a child's intake of iron-rich foods is considered good if they have eaten at least one type of such food, along with four other food types, this includes consuming meat (beef, pork, lamb, chicken, etc.), eggs, organ meats (like liver or heart) and fish or shellfish at any point in the 24 hours leading up to the interview. Conversely, consumption is deemed or if there is no record of eating any iron-rich foods in that same timeframe (11).

Independent variables

The independent variables in this study were the age of the child (6-11 months, 12-17 months and 18-23 months), child's gender (boy and girl), age of mother (<20 years, 20-34 years and 35- 49 years old), mother's level of education (low, middle and high), father's level of education (low, middle and high), wealth index (poor, middle and rich), type of residence (urban or rural), household size (1-4 people (small), 5-8 people (medium) or (≥9 people (large)), number of antenatal care visits (no at all, <6 times and ≥6 times), postnatal examination of the child within 2 months or

what is also commonly referred to as a postnatal care (PNC) visit (yes or no), use of medications for intestinal parasites within the past six months (yes or no), child's current breast-feeding status (yes or no) and the mother's access to information on mass media (expo-sure to mass media consists of three variables, namely: reading newspapers, listening to the radio and watching television) (12–14).

Data analysis

Following the download of data from the DHS website, various processes including data extraction, recoding, labelling, tabulation and cross analysis were carried out using software tools. Prior to analysis the data were adjusted to guarantee that the DHS sample accurately reflected the population, which aimed to provide reliable estimates and standard errors. In this study, individual female weight (V005/1000000) was used during the analysis. The *chi-square test* and logistic regression were employed to investigae the elements affecting the intake of iron-rich foods among children aged 6 to 23 months.

Ethics Consideration

This research received written permission to download and utilize the 2017 IDHS data set from the data archiver of the International Review Board of DHS, following the submission of a concept note and a description of the research. All research ethical standards can be accessed via the website https://dhs-program.com/methodology/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm.

RESULTS

The study encompassed a total weighted sample of 4.622 children aged between 6 to 23 months. As shown in table 1, most children in this age category, specifically 3.313 (71.7%), consume at least one variety of iron-rich food. At the same time, 1.309 (28.3%) children aged group 6 to 23 months did not eat any iron-rich foods the day before the 2017 IDHS survey.

Table 1. Proportion of Iron-Rich Food Consumption in Children among Aged 6-23 Months in Indonesia (N= 4.622)

Variable	Category	Weighted Frequency	%
Iron rich food consumption in the last 24 hours	Good	3.313	71.7
	Poor	1.309	28.3
Gave child egg in the last 24 hours	Yes	2.387	52
	No	2.235	48
Gave child meat (beef, pork, lamb, chicken, etc.) in the last 24 hours	Yes	1.631	35.2
	No	2.991	64.8
Gave child liver, heart, other organs in the last 24 hours	Yes	726	15.7
	No	3.896	84.3
Gave child fish or shellfish in the last 24 hours	Yes	1.587	34.3
	No	3.035	65.7

Table 2 shows that most of the children fall within the 12-17 months age group, accounting for 35.4%. Based on gender, the majority of children are boys (52%). Most of the mothers' age group was 20 to 34 years (71.7%). Most mothers reported that their education was in the medium category (59%) meaning up to high school/equivalent education and the same thing was also reported for their husband's education level with the largest category being the education level in the medium category (58.7%). Mothers' access to information from mass media is only 51%.

The result reported that the most mothers who had access to ANC visits were ≥6 times (82%) and 70% of mothers had PNC visits. Most children aged 6-23 months have not taken drugs for intestinal parasite in the last 6 months (80%) and most of all still receive breast milk (72%). A total of 2.338 (51%) respondents lived in rural areas and the majority of respondents were categorized as rich (42%). The largest number of household members in one house consists of 5-8 people (58.4%).

Table 2. Characteristics of Respondents Regarding Intake of Iron-Rich Foods and Related Factors in Children Among Aged Group 6 to 23 Months in Indonesia (N=4.622)

Variable	Category	Weighted Frequency	%
Child age in months	6 to 11 months	1.556	33.6
	12 to 17 months	1.636	35.4
	18 to 23 months	1.430	31
Child sex	Female	2.216	48
	Male	2.406	52
Mother's age in years	<20 years	153	3.3
	20 to 34 years	3.317	71.7
	45 to 49 years	1.152	25
Mother's educational level	Low	1.085	23.5
	Middle	2.731	59
	High	806	17.5
Father's educational level	Low	1.216	26.3
	Middle	2.714	58.7
	High	692	15
Number of ANC	No at all	90	2
	< 6 times	752	16
	≥ 6 times	3.780	82
Child postnatal examination (PNC) within two months	No	1.367	30
	Yes	3.255	70
Medications for intestinal parasites in the past six months	No	3.720	80
	Yes	902	20
Current breastfeeding	Yes	3.321	72
	No	1.301	28
Type of residence	Rural	2.338	51
	Urban	2.284	49

Variable	Category	Weighted Frequency	%
Wealth index	Poor	1.815	39
	Middle	884	19
	Rich	1.923	42
Exposure to Mass Media	No	2.262	49
	Yes	2.360	51
Household size	≥ 9	295	6,4
	5-8	2.700	58,4
	1-4	1.627	35,2

The findings from the bivariable analysis shown in Table 3 reveal that for independent variables include child's age, mother's educational level, father educational level, number of ANC visits, taking drugs of intestinal parasite in the last 6 months, breastfeeding status, type of residence, wealth index and mass media exposure became a candidate variable to be continued with multivariable analysis (*p* <0.25).

Table 3. Descriptive Statistics and *Chi-Square Test* Between Consumption of Iron-Rich Foods and Related Variables (N= 4.622)

Variable	Iron-rich foods consumption				Total		*p-value*
	Poor		Good				
	n	%	n	%	N	%	
Child's age in months							
6 to 11 months	840	54	715	46	1.556	100	
12 to 17 months	301	18.4	1.335	81.6	1.636	100	**<0,001**
18 to 23 months	168	11.8	1.262	88.2	1.430	100	
Child's sex							
Female	610	27.5	1.606	72.5	2.216	100	
Male	699	29	1.707	71	2.406	100	0,339
Mother's age in years							
<20 years	54	35.5	99	64.5	153	100	
20 to 34 years	932	28.1	2.385	71.9	3.317	100	0,325
35 to 49 years	323	28	829	72	1.152	100	
Mother's educational level							
Low	375	35	710	65	1.085	100	
Middle	764	28	1.967	72	2.731	100	**<0,001**
High	171	21	635	79	806	100	
Father's educational level							
Low	413	34	803	66	1.216	100	
Middle	744	27.4	1.970	72.6	2.714	100	**<0,001**
High	152	22	540	78	692	100	
Number of ANC							
No at all	36	40.4	54	59.6	90	100	
< 6 times	220	29.2	532	70.8	752	100	**0,048**
≥ 6 times	1.053	27.9	2.727	72.1	3.780	100	

Variable	Iron-rich foods consumption				Total		*p-value*
	Poor		Good				
	n	%	n	%	N	%	
Child postnatal examination (PNC) within two months							
No	376	27.5	991	72.5	1.367	100	0,533
Yes	933	28.7	2.322	71.3	3.255	100	
Medications for intestinal parasites in the past six months							
No	1.180	31.7	2.540	68.3	3.720	100	**<0,001**
Yes	130	14.4	772	85.6	902	100	
Current breastfeeding							
Yes	1.056	31.8	2.265	68.2	3.321	100	**<0,001**
No	254	19.5	1.047	80.5	1.301	100	
Type of residence							
Rural	723	30.9	1.615	69.1	2.338	100	**0,002**
Urban	587	25.7	1.697	74.3	2.284	100	
Wealth index							
Poor	608	33.5	1.207	66.5	1.815	100	
Middle	263	29.7	621	70.3	884	100	**<0,001**
Rich	439	23	1.484	77	1.923	100	
Exposure to mass media							
No	724	32	1.538	68	2.262	100	**<0,001**
Yes	586	25	1.774	75	2360	100	
Household size							
≥ 9	95	32	200	68	295	100	0,368
5-8	748	27.7	1.952	72.3	2.700	100	
1-4	467	28.7	1.160	71.3	1.627	100	

The multivariable analysis result presented in Table 4 indicated that children aged 18 to 23 months [aPR = 8.42; 95%CI= 6.61-10.72] were 8.42 times more inclined to consume iron-rich foods compared to those in the 6 to 11 month age group. Additionaly, children who received treatment for intestinal parasites within in the last 6 months [aPR= 1.55; 95%CI= 1.17-2.05] were 1,55 times more likely to eat iron-rich foods. Moreover, children who were not breastfeeding [aPR= 1.36; 95%CI= 1.10-1.68] demonstrated 1.36 times higher likelihood of consuming iron-dense foods. In terms on maternal factors, a higher education level [aPR= 1.14; 95%CI= 1.01-1.98], fewer than 6 antenatal care visits [aPR= 1.77; 95%CI= 1.04-3.02], and exposure to mass media [aPR= 1.40; 95%CI= 1.17-1.68] are all significantly associated. Mothers who hold a college degree are 1.14 times more likely to offer their children iron-dense foods than those who haven't graduated from school or have only completed junior high or an equivalent education. The study also found that economic status, individuals who categorized as rich [aPR= 1.43; 95% CI= 1.11-1.82] were 1.43 times more likely to supply their children for iron-rich foods.

Table 4. Results of Multivariable Analysis of Iron-Rich Foods Consumption and Related Factors in Children Among Aged Group 6 to 23 Months in Indonesia (N=4.622)

Variable	aPR	95% Confidence Interval	
		Lower	Upper
Child's age in months			
6 to 11 months	*Ref*		
12 to 17 months	5,39***	4,36	6,66
18 to 23 months	8,42***	6,61	10,72
Mother's educational level			
Low	*Ref*		
Middle	1,20	0,96	1,50
High	1,14*	1,01	1,98
Father's educational level			
Low	*Ref*		
Middle	1,15	0,92	1,45
High	1,37	0,97	1,94
Number of ANC			
No at all	*Ref*		
<6 times	1,77*	1,04	3,02
≥6 times	1,64	0,99	2,71
Medications for intestinal parasites in the past six months			
No	*Ref*		
Yes	1,55**	1,17	2,05
Current breastfeeding			
Yes	*Ref*		
No	1,36**	1,10	1,68
Type of residence			
Rural	*Ref*		
Urban	1,05	0,87	1,27
Wealth index			
Poor	*Ref*		
Middle	1,12	0,87	1,45
Rich	1,43**	1,11	1,82
Exposure to mass media			
No	*Ref*		
Yes	1,40***	1,17	1,68

* p <0,05
** p <0,01
*** p <0,001

DISCUSSIONS

These study results identified various factors that have a positive correlation with the intake of iron-rich foods among children aged 6 to 23 months. The rising age of child is typically linked to the consumption of iron-rich foods derived from animal protein, where children aged 18-23 months has a tendency to eat iron-rich foods better than the children 12-17 month and 6-11 month age group (15). The study findings are in accordance with studies conducted in Senegal. This is linked to the mother's viewpoint and her practices regarding feeding children where consumption of iron-rich foods sourced

from animal protein such as meat, chicken, fish, goat and so on is considered by the mother to be a type of heavy food so it is difficult to digest and not suitable for children to consume those who are younger caused by the condition of their intestines (9) and here are the explanations for why child between 6 to 11 months are at higher risk to have iron deficiency (16).

The children who were breastfed within 24 hours of the date of survey had a tendency not to consume iron-rich foods. Breast milk is indeed an important source of iron. But, its intake and absorption may not be sufficient to meet the required amount, so that complementary foods with breast milk are highly recommended to balance iron intake in children (17).

Children who taking medicine for intestinal parasites have a bigger chance to eat more iron-rich foods. The findings of this study align with those from studies carried out in Sierra Leone. Mothers who administer medication for intertestinal parasites to their children are seen as highly motivated and commited to providing iron rich foods, as well as having the oppurtinity to engage with health service providers (18).

Studies in Ghana state that children aged 6-24 months with low maternal education status tend to have the potential to suffer from anemia (19). Mothers who are educated tend to recognize the significance of providing complementary foods, especially those high in iron and are more informed about the causes of anemia (20)(21). Highly educated mothers are also closely associated with good economic status because mothers tend to have jobs so this condition can help in providing better food availability (22). The government ought to implement policies aimed specifically at uneducated mothers, including enhancements to mother and baby programs, and establishing support network in partnership with healthcare workers.

Health service factors are one of the keys to improving health status. Effective nutritional education and counseling that is often provided during ANC visits can motivate mothers to provide nutritious foods to children, especially for consuming iron foods (23). Therefoe, it’s crucial to optimize the number of ANC visits (a minimum of 6 times throughout pregnancy), adhering to the guidelines established by the Republic of Indonesia Minister of Health Regulation No.21 of 2021.

Based on research findings, mass media also significant. This research aligns with investigations carried out in Rwanda (24). Mass media is an effective means of spreading health messages (25). Mass media is considered to be a reliable source of information that can influence people's knowledge, attitudes, beliefs and even healthy living behavior (26). Programs focused on mother and child care aired on radio and television, especially those that offer question and answer sessions, can help mothers seeking clarification regarding maternal and child health issues (27).

The amount of food available in the household and economic status are positively correlated with household food security (28). Poor households have problems in accessing iron-rich foods and other micronutrient, which has an impact on increasing the risk of anemia (29). Overcoming this problem, especially for low-income households, children can still meet their iron needs by buying iron-rich foods that are more affordable and easy to obtain, such as vegetables and fruit.

Several other variables studied, namely child gender, mother's age, PNC visits and type of residence, were not significant. This was the difference in proportion between children who are categorized as good or poor in consuming iron-rich foods in these variables not much different so that does not provide a significant value. Apart from that, the intake of iron-rich foods in children are caused by multifactors. The study findings also show husband’s education is not significant by multivariable analysis.

The conclusion on thesestudy indicated that the consumption of iron rich-foods by children in Indonesia can be considered fairly adequate. However, to effectively enhance children's consumption of iron-dense foods, it's essential to implements supportive policies such as strengthening health programs especially for nutrition education and increasing access to ANC services. Additionaly, the involvement of health cadres and the utilization of mass media to promote iron-rich complementary foods are also necessary.

This study has the advantage of using demographic and health survey data where the sample is large and nationally representative so it can provide better generalizations. However, it is important to acknowledge several limitations of this research. Since a cross-sectional design was implemented, it's not possible to determine causal relationship. Furthermore, this research concentrated exclusively on the intake of iron rich foods from animal sources and didn't assess overall bioavailability.

CONCLUSIONS AND SUGGESTIONS

Conclusion

The child's aged, mother's level of education, ANC visits, taking medication for intestinal parasite in the past six months, breastfeeding status, wealth index and access to information via mass media by the mother was significantly associated with adequate intake of iron-rich foods in children.

Suggestion

According to these findings, there is a need for interventions based on nutrition and health education, increasing access to health services such as ANC as a medium for counselling and the role of mass media in disseminating information related to nutrition and children's health. The important role of the government with health workers are needed for building a commitment to increasing the promotion of types of complementary breast milk foods especially for rich-iron source food. It is necessary for the role of private sector to improve the consumption of iron-rich like conducting research and development of food variety inovations, making food fortification and providing certification and labelling for food safety. It is also important to increase the consumption of iron-rich foods for toddler growth, such as consumption of meat, chicken, fish, eggs, chicken liver, dark green leafy vegetables, fruits and nuts.

ACKNOWLEDGMENT

The authors would like to appreciate the DHS Program for allowing us to access and examine data from the 2017 IDHS and to the Central Bureau of Statistics Agency or *Badan Pusat Statistik* (BPS), National Population and Family Planning Agency or Badan Kependudukan dan Keluarga Berencana Nasional (BKKBN), Indonesian Ministry of Health and Inner-City Fund (ICF) International who have collaborated in writing the 2017 IDHS report.

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