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Birth Weight and Obesity in Children in Indonesia: Evidence from Basic Health Research 2018

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BIRTH WEIGHT AND OBESITY IN CHILDREN IN INDONESIA: EVIDENCE FROM BASIC HEALTH RESEARCH 2018

Abstract: Childhood obesity is one of the most serious public health issues of the twenty-first century. Obesity in children can be influenced by both genetic and environmental factors. The aim of this study is to determine the association between birth weight and obesity in children, as well as the impact that residence has on this relationship. The 2018 Riset Kesehatan Dasar (or Basic Health Research), cross-sectional, Indonesian population survey with a nationwide representative sample, was subjected to secondary analysis. In 2018, parents of children aged 0 to 5 years (n = 71,925) provided height, weight, child's birth weight, and other basic characteristics. With LBW, there was a substantial rise in weight, BMI z-score, and the likelihood of pediatric obesity. LBW children from rural had higher BMI z-scores (mean + Standard Error (SE): 1.39 + 0.03) and higher odds of obesity (odds ratio (OR) (95 percent confidence interval (CI)): 7.45 (6.76 – 8.21)), than those from urban areas. Childhood obesity must be adequately prevented and addressed as soon as possible. Initiatives, policies, and goals are needed to reduce LBW prevalence. According to our findings, children born to LBW in rural areas should be treated as soon as possible with forceful intervention.

Keywords: childhood obesity, low birth weight, Indonesia, residence

Introduction

Obesity in children is one of the most serious public health challenges of the twenty-first century. Over the last thirty to forty years, there has been a significant increase in the prevalence of childhood obesity in practically all countries (Wang and Lobstein, 2006). Few studies have found a link between childhood obesity and later-life cardiovascular disease risk factors such as dyslipidemia, high blood pressure, insulin resistance, endothelial function, and left ventricular mass problems (Reilly *et al.*, 2003).

Obesity is a one-of-a-kind subject with limited conceptual frameworks, especially its unique problem that considers the interactions from hereditary and environmental influences (Monasta *et al.*, 2010). When low birth weight (LBW) was specifically explored in relation to its link with childhood obesity, the findings were conflicting. Some previous research (Brophy *et al.*, 2009, Hirschler *et al.*, 2008, Zhang *et al.*, 2009) revealed no link between obesity and LBW, whereas other research indicated that LBW (2500g) was related with a lower risk of obesity (Loaiza *et al.*, 2011, Schellong *et al.*, 2012, Yu *et al.*, 2011). The fact that LBW is related with a decreased risk of later child obesity/overweight can be linked to a higher central adiposity of body composition. Few studies have found a link between low birth weight and subsequent childhood obesity in children *(Cottrell and Ozanne, 2008, Ibanez et al.*, 2006, Stettler et al., 2002, Chen *et al.,* 2019). LBW children acquire weight more quickly to compensate for their lack of growth, a process known as catch-up growth (Mehrkash *et al.,* 2012). LBW is a reflection of uterine nutritional deficiency (McCance and Widdowson, 1974) and may prevent the fetal pancreas from growing (Swenne *et al.*, 1980). It may also make children more susceptible to childhood obesity and noncommunicable diseases.

The incidence of LBW is influenced by socio-economic factors. The level of education is significantly important: A lower-level school-leaving certificate has been discovered to be an indicator of LBW. It was also discovered that monthly net equivalent income has an impact: When monthly income dropped below 60% of median income, the risk of getting an LBW baby increased. Income and employment status are inextricably related. Other research into the causes of prematurity and LBW has found that as maternal job status rises, the risk of having an LBW baby decreases (Reime *et al.,* 2006).

These conclusions could be the consequence of discrepancies in research design, study population, or limited sample size. The individual cause, on the other hand, is not the birth weight. Other factors may play a role in the link between birth weight and childhood obesity. Typical obesity in children in Indonesia include distinctions between rural and urban residency (Julia *et al.,* 2008, Usfar *et al.,* 2010). Nonetheless, substantial study into whether birth weight and childhood obesity vary by residence is needed. The aim of this study is to determine the association between birth weight and childhood obesity, as well as the impact that residence has on this association.

Methods

A secondary analysis of the 2018 Riset Kesehatan Dasar (or Basic Health Research), cross-sectional, Indonesian population survey with a nationwide representative sample, was used in this study. The 2018 Basic Health Research is the third survey undertaken by the National Institute of Health Research and Development (NIHRD) of the Indonesian Ministry of Health. The survey sample was chosen using a two-stage stratified cluster sampling method. Each stage had two sampling frames. In Indonesia, a nationwide sample of 150 sub census blocks was taken from all 33 provinces and 497 districts/cities. For 29 people, a full interview was obtained. From the targeted 300,000 households, 294,959 households (98.3 percent) had completed interview. All biological, step, or adoptive children of the home head and spouse, and any child fostered to any adult in the household, were eligible.

In 2018, parents of children aged 0 to 5 years provided anthropometric measures (height and weight), information on a child's birth weight, and other basic characteristics. Standing height measurements (for children over the age of two) and recumbent length measurements (for children younger than two years old) were obtained using a "Multifunction"; weight measurements were taken with a "Fesco" brand digital weight scale that was calibrated daily. Because of their portability, durability, and accuracy, these instruments have been utilized in survey work in other nations and are suited for fieldwork (Development, 2018)

Body Mass Index (BMI) was calculated using height and weight. The BMI z-scores for each kid were calculated using the 2006 WHO Child Growth Standards for children under the age of five, which were age and gender specific. BMI z-score -2 SD was used to identify underweight. BMI z-score -2 SD was used to determine normal weight. Overweight was defined as a BMI z-score of 2 SD or higher. Obesity was defined as a BMI z-score of 3 SD or higher (Group, 2006, de Onis *et al.*, 2007).

In 2018, there were 91,354 children under the age of five. A total of 12,150 (13.3%) children with missing height and weight measurements had to be removed from the sample. According to the WHO, children who were classed as underweight (7,279 children, or 8.0 percent) were also eliminated from the study, leaving only children who were normal weight, overweight, or obese. A total of 71,925 children were included in the final sample. The birth weight of a kid was determined using the mother's self-reported pregnancy and birth history. Mothers of study participants were asked questions such as, "How much did your baby weigh at delivery (in grams)?". The child's weight (kg) and BMI z-score were the constant outcomes. For categorical data, a new group named "non-obesity" was created, consisting of normal weight and overweight with a -2 SD BMI z-score of 3 SD. The outcome was divided into two categories: non-obesity and obesity.

The potential covariates for childhood obesity were as follows: child's gender (boy and girl), breastfeeding (no and yes), mother's education (none, elementary, junior high school, senior high school, and post-graduate), parental BMI (both parents underweight 25 kg/m2, only mother normal >25 kg/m2, only father normal >25 kg/m2, and both parents normal >25 kg/m2), household wealth quintiles (low-income, middle-income, and wealthy), maternal education (no education, primary, junior high school, senior high school, and post-graduate), and residence (urban and rural). These potential covariates allowed characteristics that could influence childhood obesity to be controlled.

SPSS 25.0 for Windows was used to conduct all statistical analyses. Chi-squared tests were conducted to see if there were any differences between a child's birth weight and the basic characteristics. The connections between a child's birth weight and continuous outcomes (weight and BMI z-score) were investigated using multivariable linear regression with variables controlled. The odds ratios (ORs) and 95 percent confidence intervals of overweight were calculated using a logistic regression model with non-obesity as a reference group and variables accounted for. The statistical significance level was set at 0.05.

Results

Table 1 shows the distribution of basic study population characteristics and children's weight status by birth weight. Breastfeeding, parental BMI, household affluence, domicile, and children's weight status have all been shown to have a significant relationship with birth weight. The proportions of normal and LBW children were determined to be 89.9% and 10.1 percent, respectively. Non-breastfed children (36.2%), children whose parents had a BMI of more than 25 kg/m2 (18.8%), children from a low-income family (10.6%), children who lived in a rural area (10.7%), and obesity in children (46.4%) were all more likely to have LBW.

Table 1: Study population's basic characteristics and the weight status of children in various categories of birth weight

	Child's Birth Weight		
	Normal n (%) (n = 62,510)	Low n (%) (n = 7,018)	*p*
Child's Gender			0.158
Boys	29551 (90.1)	3247 (9.9)	
Girls	35136 (89.8)	3990 (10.2)	
Breastfeeding			<0.001
No	2616 (63.8)	1484 (36.2)	
Yes	65175 (91.4)	5833 (8.6)	
Mother's Education			0.501
No Education	6509 (89.6)	755 (10.4)	
Primary	15034 (90.1)	1652 (9.9)	
Junior High School	14887 (89.6)	1728 (10.4)	
Senior High School	19700 (90.1)	2164 (9.9)	
Post-graduate	8545 (90.0)	949 (10.0)	
Parental BMI			<0.001
Both parents underweight	36065 (89.7)	4141 (10.3)	
Only mother normal	13164 (88.0)	1795 (12.0)	
Only father normal	8065 (88.3)	1069 (11.7)	
Both parents normal	6191 (81.2)	1433 (18.8)	
Household Wealth			0.031
Low-income	12860 (89.4)	1525 (10.6)	
Middle-income	24728 (90.0)	2748 (10.0)	
Wealthy	27088 (90.1)	2976 (9.9)	
Maternal and Child Health			0.175
Available	45636 (90.0)	5070 (10.0)	
Not Available	19033 (89.7)	2186 (10.3)	
Residence			<0.001
Urban	29715 (90.6)	3083 (9.4)	
Rural	34940 (89.3)	4187 (10.7)	
Children Weight Status			<0.001
Non-obese (Normal + Overweight)	60798 (90.6)	6308 (9.4)	
Obese	2583 (53.6)	2236 (46.4)	

Breastfeeding, parental BMI, household wealth, residence, and children weight status were all found to be significant factors in a birth weight. The mean weight and BMI z-score were shown to be substantially linked with LBW in Table 2. LBW children had weight of 0.74 and BMI z-score of 1.39 higher than normal birth weight children after controlling for variables. Obesity was significantly increased by LBW (OR=8.37, $p<0.010$). After adjusting for variables, LBW exhibited a significant 6.09-fold increase in the chances of obesity relative to normal birth weight (aOR=6.09, 95 percent CI [5.66, 6.55], $p<0.010$).

Table 2: The mean weight and BMI z-score for obesity in comparison to non-obesity

	Linear regression				Logistic regression	
	Weight[a]		BMI z-score[a]		Obesity[a]	
	mean± SE	*p*	mean± SE	*p*	cOR	aOR (95% CI)
Child's Birth Weight						
Normal (≥ 2500 g)	11.64 ± 0.02	-	-0.10 ± 0.01	-	1	1
Low (< 2500 g)	12.38 ± 0.05	<0.001	1.29 ± 0.02	<0.001	8.37**	6.09** (5.66 – 6.55)

Note: cOR = Crude Odds Ratio; aOR = Adjusted Odds Ratio; CI = Confidence Interval
*p<0.05; **p<0.01
[a]adjusted for breastfeeding, parental BMI, and household wealth

Table 3: The mean weight and BMI z-score for obesity in comparison to non-obesity in urban and rural areas

	Urban					
	Linear regression				Logistic regression	
	Weight[a]		BMI z-score[a]		Obesity[a]	
	mean± SE	*p*	mean± SE	*p*	cOR	aOR (95% CI)
Child's Birth Weight						
Normal (≥ 2500 g)	11.84 ± 0.03	-	-0.05 ± 0.01	-	1	1
Low (< 2500 g)	12.62 ± 0.08	<0.001	1.13 ± 0.03	<0.001	6.50**	4.65** (4.16 – 5.21)
	Rural					
	Linear regression				Logistic regression	
	Weight[a]		BMI z-score[a]		Obesity[a]	
	mean± SE	*p*	mean± SE	*p*	cOR	aOR (95% CI)
Child's Birth Weight						
Normal (≥ 2500 g)	11.46 ± 0.02	-	-0.15 ± 0.01	-	1	1
Low (< 2500 g)	12.18 ± 0.06	<0.001	1.39 ± 0.03	<0.001	10.33**	7.45** (6.76 – 8.21)

Note: cOR = Crude Odds Ratio; aOR = Adjusted Odds Ratio; CI = Confidence Interval
*p<0.05; **p<0.01
Adjusted for breastfeeding, parental BMI, and household wealth

Discussion

Obesity has become a global problem affecting both adults and children. We presented representative population-based statistics on obesity in Indonesian children. LBW children's average weight and BMI z-score were greater than normal birth weight children's average weight and BMI z-score. After controlling for confounders, children born to LBW had a roughly six-fold increased risk of becoming obese than those born to normal birth weight. LBW babies, who had quick "catch-up" growth in the first two years had a higher amount of growth hormone, were more likely to develop abdominal obesity, were fatter by the age of five than other children (Ong *et al.,* 2000). LBW causes people to become increasingly vulnerable to environmental hazards in later stages of their lives (Barker, 2004). According to a study by Sawaya (Sawaya *et al.*, 2004), catch-up growth during LBW recovery contributes to increased fat mass and lower muscle protein stores. LBW children exhibited reduced fat-free mass in their youth and early adulthood (Singhal *et al.*, 2003). These findings confirmed that LBW does not cause overweight or obesity, but rather causes body adaption mechanisms (i.e., catch-up growth and hormone alterations), which then lead to overweight/obesity. As a result, the assumption of a link of LBW with overweight or obesity must be continually investigated, particularly when assessing the body's composition in terms of fat-free mass and fat mass.

After adjusting for covariates, many cohort studies have found that rapid weight growth in infancy is linked to an increased risk of subsequent obesity in all children (Baird *et al.*, 2005, Druet *et al.*, 2012, Ong and Loos, 2006). The shift from LBW to normal or increasing BMI has been linked to body composition changes during childhood; LBW was linked to increased central fat deposition in children (Yajnik, 2000). Studies from Australia also discovered a link between LBW and increasing current weight (Garnett *et al.*, 2001). Hulme and Blegen discovered that mothers who lived in rural regions had a higher probability of having LBW kids (Hulme and Blegen, 1999). Women from low-income family have a higher risk of giving birth to LBW babies (Hughes and Simpson, 1995). Poverty predicts LBW at the regional and household level, according to research (Hillemeier *et al.*, 2007, Luo *et al.,* 2006). People in rural areas usually have similar jobs and rely on agriculture. Work has a huge impact on income, but mothers who work are at risk of having LBW babies in stressful jobs, such as standing for long periods of time (Mozurkewich *et al.*, 2000). In addition, rural women have lacked access to prenatal and obstetric care, which might help them avoid pregnancy difficulties (Peck and Alexander, 2003).

Other factors, such as breastfeeding history and parental BMI, were found to be useful in preventing childhood obesity in our study. A child's chance of becoming obese is reduced if he or she is breastfed for a longer period. Breastfeeding protects babies from becoming obese later in life, as breastfed babies had somewhat lower fat levels at one year of age than formula-fed babies (Dewey *et al.*, 1993, Kramer *et al.*, 1985). Obesity in parent may be the best predictor of childhood obesity prevention, at least in part because obese parents appear to teach their children similar unhealthy behaviors. The BMI of the parents can help identify children who are at high risk (Vos and Welsh, 2010, Kuhn-Santos *et al.*, 2019).

A unique link of birth weight with child weight, BMI z-score, and obesity in children, large sample size, notably in Indonesia, and in urban-rural settings, are just a few of the study's strengths. The number of people who took part in this study was bigger than in previous investigations. Professional interviewers' (typically nurses') methods of measuring height and weight are more reliable than self-reported measurements. However, since this was a cross-sectional and retrospective study, retrospective bias was unavoidable. Several factors, such as obesity-related family history of illness, children born with a congenital abnormality, dietary energy consumption, infant feeding guidance such as formula feeding, feeding habits, as well as limitations on more active play and sedentary activity, can all skew the association of birth weight with child weight status (Parsons *et al.,* 2001, Yu *et al.,* 2008). These criteria were not present, which is the study's major flaw. These unmeasured components are almost definitely not consistently linked to the outcome, but they can weaken the observed association. BMI might have misclassification problems, resulting in an estimating bias for the link of birth weight with obesity in children. The birth weight was based on previous birth results or self-reported pregnancy, and it was not validated by monitoring these enrolled children's correct birth data in their respective delivery hospitals.

Conclusion

Obesity in Indonesia has been spreading rapidly among children under five. In our analysis, an effect modifier was found to be residence. Powerful intervention and prevention in obesity in children should be undertaken as early as possible. Identification of early risk factors was important. The impact of variables such as dietary energy consumption, feeding habits, and sedentary activity deserves further research. The correlation with LBW was found to be a substantial increase in weight and BMI z-score, as well as an increased risk of obesity in children. To reduce the prevalence of LBW, initiatives, policies, and goals are needed as far as our study is concerned. Children born to LBW who lived in rural areas should be handled as soon as possible with emphatic intervention.

Author Contributions

The author conceptualized and designed the study, performed statistical analyses, examined the data, read the draft, and produced the final version of the paper for publication.

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Conflicts of Interest

The author declares that she has no conflict of interest.

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