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Composite Index of Anthropometric Failure and Early Childhood Cognitive Development Based on the 2018 Indonesian Basic Health Research Data

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Abstract

Delays in early childhood cognitive development may have profound long-term implications on health and life expectancy. Optimal nutrition supports early life development, including a child's cognitive development. This study aimed to determine the association between the Composite Index of Anthropometric Failure and early childhood cognitive development among children aged 36-59 months in Indonesia. This cross-sectional study utilized data from the 2018 Indonesian Basic Health Research that involved 18,027 participants aged 36-59 months. This study outcome demonstrated that children who were stunted-underweight were potentially susceptible to delayed cognitive development compared to those with normal nutritional status (aOR = 1.30; 95% CI = 1.12–1.51) after controlling for child's age, sex, vitamin A supplementation, antenatal care visits, gestational age, access to drinking water and sanitation (combined risk), maternal's education and mental health (combined risk), maternal's occupation and number of household members (combined risk). In summary, malnourished children are vulnerable to impaired physical growth and potential delays in early cognitive development.

Keywords: cognitive development, stunted, underweight, wasted

Introduction

Early childhood is a period when children acquire fundamental skills for development, education, social welfare, and healthy economic productivity that could determine their future.[1,2] Loss of optimal development is often caused by nutritional and environmental factors linked to growth and poverty.[3] Children from families of lower socioeconomic backgrounds generally experience a delay in cognitive function, characterized by a lag in expressive and receptive language, literacy, numeracy, and independence.[3,4]

Sustainable Development Goals (SDGs) indicator 4.2 focuses on age-appropriate developments in the health, learning, and psychosocial well-being of children between 24 and 59 months, measured based on their sex (4.2.1) and preschool learning participation rate (4.2.2).[5] Globally, approximately 200 million children under the age of five suffer from stunted, wasted, or both, and at least 340 million experience hidden hunger due to vitamin and mineral deficiencies.[6] In Indonesia, the prevalence of optimal cognitive development among children aged 36-59 months in the literacy-numeration and learning domains was 64.6% and 95.2%, respectively, in 2018.[7] The statistics reflected a lack of effort in ensuring optimal cognitive development among these children in Indonesia, particularly in the literacy-numeration domain.

Evolving literacy and numeracy capabilities are crucial components of communication.[8] Each individual engages in social practices daily, using literacy as a tool that encompasses knowledge and skills for efficient communication and idea representation.[9] Knowledge of numbers and quantities in numeracy skills has been shown to set the fundamentals for superior math skills and complex problem-solving abilities up to six years later among 54-month-olds.[10]

A previous study reported that children with double failure (stunted-underweight) and triple failure (stunted-underweight-wasted) nutritional status significantly delayed their under-five child development (β = -0.15; 95% CI = -0.20 to -0.10) after controlling for variables such as child's age, sex, maternal's age, parental education, stimulation, participation in early childhood education, number of household members, household wealth, and

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rural residence.[11] While, a longitudinal study by the Institute of Nutrition of Central America and Panama demonstrated a significant relationship between inadequate nutrition in infancy and deficits in cognitive development and academic achievement during childhood and adolescence/young adulthood.[12]

The Early Childhood Development Index (ECDI) has been implemented in more than 70 countries via Multiple Indicator Cluster Surveys as one of the first initiatives to gather population-level data on early childhood development in the last two decades.[13] The ECDI was also conducted in Indonesia as part of the 2018 Indonesian Basic Health Research (IBHR). This study utilized the Composite Index of Anthropometric Failure (CIAF) to investigate the association between nutritional status and undernutrition with early childhood cognitive development (ECCD) in Indonesia. This study aimed to determine the association between CIAF and ECCD in Indonesian children aged 36-59 months and to identify the presence of confounding variables and modifying effects of the association between CIAF and ECCD.

Method

The data utilized in this study were sourced from the 2018 IBHR. It is a national survey performed in Indonesia every five to six years using a cross-sectional study design. This survey offers insights into various health parameters in the country. A multistage sampling technique was adopted for random selection, representing the entire population in the country, provinces, and district/city areas.

Of 24,926 children aged 36-59 months, 18,072 (72.5%) were eligible for this study. The inclusion criteria were children aged 36-59 months who were successfully interviewed, had records of growth and development monitoring (measured height and weight), and had a record of antenatal care (ANC) visits handled by health providers. The exclusion criteria were children with missing data on variables and at risk of disability.

The ECDI comprises four domains: learning, physical, social, emotional, and literacy-numeracy. The literacy-numeracy and learning domains in IBHR consisted of six criteria to identify children with delayed cognitive development.[14,15] The six items were K50: Can say their name without assistance; K51: Can read at least four simple and popular words; K52: Knows names and recognizes the symbols of all numbers from 1 to 10; K55: Can name at least ten letters of the alphabet, K56: Follows simple directions on how to do something correctly, K57: When given something to do, they can do it independently. All items were reported in a simple binary (yes/no) response. This method was adapted from a previous study to determine cognitive delay, defined by the inability to perform all six tasks.[14]

The field assessment teams of the IBHR calibrated the equipment every morning before data collection.[16] The children's weight was measured using a digital weighing scale, and their height was measured using an adjustable and multifunction measuring tool. The height of children older than 24 months was measured while standing. Children's anthropometric failures are determined by stunting, wasting, and underweight.[17]

The Indonesian Ministry of Health Regulation No. 2 of 2020 concerning child anthropometry standards was used in this study to convert the height and weight measurements into age and sex-specific z-scores.[18] The CIAF formula of multiple and concurrent failures was used to determine the three binary categorizations of anthropometric failures employed in previous study.[11] Subsequently, the results were divided into seven groups, as detailed in Table 1.

There were other independent variables used in this study: vitamin A supplementation, ANC visits, mother's education, occupation, and mental health, and access to drinking water and sanitation. The Indonesian Minister of Health Regulation No. 43 of 2016 stated that registered midwives, nurses, doctors, and pediatricians can prescribe vitamin A supplementation.[19] Vitamin A capsules were provided twice annually in public and private health facilities and it had been done in the last 12 months.

In this study, the data on vitamin A supplementation were recorded based on the information provided by the mother or caregiver of the child, with a recall interval of

Table 1. The Composite Index of Anthropometric Failure Categories

Category	WAZ (z-score < -2 SD)	HAZ (z-score < -2 SD)	WHZ (z-score < -2 SD)
No failure	-	-	-
Underweight	✓	-	-
Wasted	-	-	✓
Stunted	-	✓	-
Underweight and wasted	✓	-	✓
Stunted and underweight	✓	✓	-
Stunted, wasted, and underweight	✓	✓	✓

Notes: WAZ = Weight for Age, HAZ = Height for Age, WHZ = Weight for Height, SD = Standard Deviation

12 months prior to the interview. While, the data on ANC visits referred to the frequency of prenatal examinations for mothers in each trimester by health providers. The Indonesian Minister of Health Regulation No. 97 of 2014 was implemented nationwide when the 2018 IBHR was conducted; thus, the frequency of ANC visits was at least four times during pregnancy.[20]

Mother's education was divided into three categories: low (never attended school, did not complete primary school, completed primary school, and completed junior high school); middle (completed high school); and high (graduated from college). This study adapted the mother's occupation categories from a previous study: civil servant/private employer (civil servants, Indonesia National Armed Forces, Indonesia National Police, state-owned or regionally owned enterprises); entrepreneur (traders of agricultural, plantation, or forestry products); laborer (individuals whose profession involves processing the work of others and do not earn a stable or income); and others (individuals whose profession does not belong to previous categories).[21]

Maternal's mental health referred to mothers with common mental disorder (CMD). The Self-Reporting Questionnaire (SRQ-20) with CMD psychometric classification developed by the World Health Organization was used as a diagnostic and screening tool comprising 20 items (yes/no) to determine the risk of mental disorders among participants. The most common mother's mental health disorders identified as risks in the SRQ-20 were depression, anxiety, and stress.[22] The cutoff score in this study was "yes" answers for at least eight items overall, and the reference category was non-CMD mothers.

The primary source of drinking water referred to the supply through pipes, public taps or standpipes, tube wells or boreholes, protected wells, protected springs, or rainfall shields. Anything beyond these categories was considered "unimproved" for access to drinking water variable. While, access to sanitation referred to facilities that were not shared, complete with piped sewage system or septic tank or pit (latrine), ventilated pit latrines, pit latrines with slabs, or composting toilets. Anything in these categories was considered "unimproved."

The first phase involved the estimation of prevalence for all variables among children aged 36 to 59 months using simple descriptive analyses. Second, the bivariable analyses were performed to identify the odds ratio (OR) and p-value for each independent variable, followed by the Chi-square test to determine the relationship with ECCD. The third analysis stage assessed the variables' interaction between CIAF and ECCD. Finally, multivariate analyses with logistic regression were conducted to estimate the confounding variables, adjusted odds ratio (AOR), and the relationship between CIAF and ECCD by considering other independent variables. Statistical analyses are estimated with a 95% confidence interval (CI) and using the complex samples facility to account for the within-country sampling clusters and the clustering of observations by country.

Result

Table 2 presents the overall descriptive data for 18,072 children in Indonesia. There was a high prevalence of delayed ECCD (61.21%). More than half of the study sample were between 36 and 47 months (52.49%), were boys (51.21%), and were supplemented with vitamin A twice annually (58.06%). Most participants had a record of more than four ANC visits (91.57%), and 64.2% had no failure in CIAF. Furthermore, 71.56% recorded a gestational age of ≥37 weeks, and 54.40% were middle-aged mothers (25 to 34 years). In addition, 54.4% of mothers had low education, 55.49% were un-

Table 2. Participants Characteristics (n = 18,072)

Variable	Category	n	%
Early childhood cognitive development	Normal	7,009	38.79
	Delayed	11,063	61.21
Composite index of anthropometric failure	No Failure	11,603	64.2
	Underweight	339	1.88
	Wasted	493	2.73
	Stunted	2,776	15.36
	Underweight and wasted	574	3.18
	Stunted and underweight	1,893	10.47
	Stunted, wasted, and underweight	394	2.18
Child's age	36–47 months	9,486	52.49
	48–59 months	8,586	47.51
Sex	Male	9,254	51.21
	Female	8,818	48.79
Vitamin A supplementation	Twice	10,494	58.06
	Once	5,125	28.36
	Never	2,454	13.58
Antenatal care visits	<4 sessions	1,523	8.43
	≥4 sessions	16,549	91.57
Gestational age	<37 weeks	5,140	28.44
	≥37 weeks	12,932	71.56
Maternal's age	Young (15–24 years)	2,582	14.29
	Middle (25–34 years)	9,831	54.40
	Late (≥35 years)	5,659	31.31
Maternal's education	Low	9,738	53.89
	Middle	6,090	33.70
	High	2,244	12.42
Maternal's occupation	Civil servant/private employer	4,259	23.57
	Entrepreneur	1,477	8.17
	Laborer	930	5.15
	Other	1,378	7.62
	Unemployed	10,028	55.49
Maternal's mental health	CMD (score ≥8)	859	4.75
	Non-CMD (score <8)	17,213	95.25
Access to drinking water and sanitation	Improved	3,255	18.01
	Poor	14,817	81.99
Type of residence	Urban	10,318	57.09
	Rural	7,754	42.91
Number of household members	<5 people	10,656	58.96
	≥5 people	7,416	41.04

Note: CMD = Common Mental Disorders

employed, and 95.25% were non-CMD. Most respondents had poor access to drinking water and sanitation (81.99%), lived in urban areas (57.09%), and had <5 members in a household (58.96%).

Figure 1 demonstrates the distribution of respondents, where the categories for children's age and sex variables were almost comparable. Children who experienced delayed cognitive development were then classified based on genetic factors (age and sex), which are highly prevalent in boys between 36 and 47 months. Figure 2 illustrates that stunted nutritional status was more prevalent than other anthropometric failures, followed by stunted-underweight and stunted-wasted-underweight. This trend indicated chronic-acute nutritional problems within the study population.

Table 3 demonstrates that children with stunted and wasted nutritional status had a 1.35 times higher risk (95% CI = 1.16–1.56) of experiencing delayed cognitive development, while stunted children faced a 1.17 times

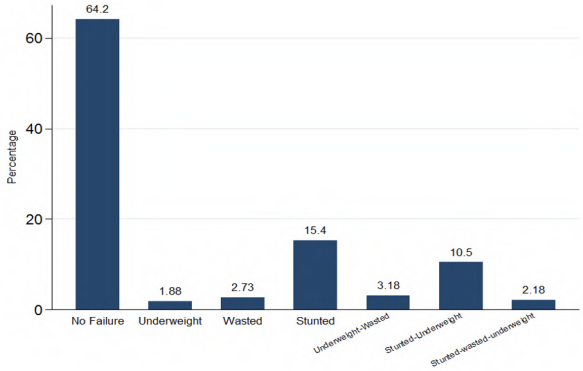
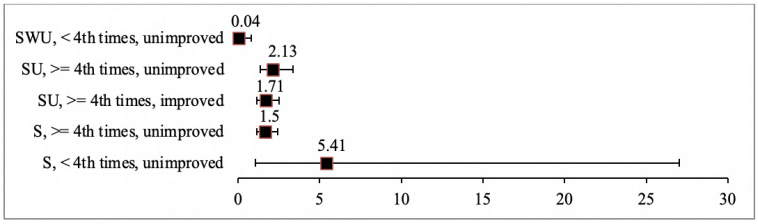


Figure 1. Prevalence of Children's Nutritional Status in Indonesia Based on Composite Index Anthropometric Failure in 2018

Table 3. Bivariate Analysis between Composite Index Anthropometric Failure and Other Independent Variables with Early Childhood Cognitive Development in Indonesia (n = 18,072)

Variable	Category	Early Childhood Cognitive Development				OR	95% CI
		Delayed		Normal			
		n	%	n	%		
Composite Index of Anthropometric Failure	No failure	6,972	60.1	4,630	39.9	1	1
	Underweight	218	64.2	121	35.8	1.19	0.89–1.60
	Wasted	245	49.8	248	50.2	0.66**	0.50–0.87
	Stunted	1,770	63.8	1,006	36.2	1.17*	1.03–1.32
	Underweight and wasted	333	57.9	242	42.1	0.91	0.72–1.16
	Stunted and underweight	1,267	67.0	626	33.1	1.35***	1.16–1.56
	Stunted, wasted, and underweight	257	65.3	137	34.7	1.25	0.92–1.69
Age	36–47 months	6,447	68.0	3,039	32.0	1.82***	1.67–2.00
	48–59 months	4,616	53.8	3,971	46.2	1	1
Sex	Male	5,893	63.7	3,361	36.3	1.24***	1.13–1.35
	Female	5,170	58.6	3,648	41.4	1	1
Vitamin A supplementation	Twice	6,445	61.4	4,048	38.6	1	1
	Once	3,076	60.0	2,048	40.0	0.94	0.85–1.05
	Never	1,541	62.8	913	37.2	1.06	0.93–1.21
Antenatal care visit	<4 sessions	937	61.5	586	38.5	1.01	0.87–1.18
	≥4 sessions	10,126	61.2	6,423	38.8	1	1
Gestational age	<37 weeks	3,243	63.1	1,897	36.9	1.12*	1.01–1.23
	≥37 weeks	7,820	60.5	5,113	39.5	1	1
Maternal's age	Young (15–24 years)	1,596	61.8	986	38.2	1.01	0.86–1.16
	Middle (25–34 years)	5,973	60.8	3,858	39.2	0.95	0.87–1.05
	Late (≥35 years)	3,493	61.7	2,165	38.3	1	1
Maternal's education	Low	6,047	62.1	3,691	37.9	1.22**	1.06–1.40
	Middle	3,730	61.2	2,360	38.8	1.18*	1.02–1.36
	High	1,286	57.3	958	42.7	1	1
Maternal's occupation	Civil servant/private employer	2,464	57.9	1,795	42.1	0.84**	0.75–0.94
	Entrepreneur	976	66.1	502	33.9	1.19*	1.04–1.37
	Laborer	583	62.7	347	37.3	1.03	0.81–1.30
	Other	825	59.9	553	40.2	0.91	0.78–1.07
	Unemployed	6,215	62.0	3,812	38.0	1	1
Maternal's mental health	CMD (score ≥8)	10,444	71.9	242	28.1	1.66***	1.32–2.08
	Non-CMD (score <8)	618	60.7	6,768	39.3	1	1
Access to drinking water and sanitation	Improved	1,902	58.4	1,354	41.6	1	1
	Poor	9,161	61.8	5,656	38.2	1.15*	1.02–1.30
Type of residence	Urban	6,196	60.1	4,122	39.9	1	1
	Rural	4,867	62.8	2,887	37.2	1.12*	1.03–1.23
Number of household members	<5 people	6,350	59.6	4,306	40.4	1	1
	≥5 people	4,712	63.5	2,704	36.5	1.18***	1.08–1.29

Notes: OR = Odds Ratio, CI = Confidence Intervals, CMD = Common Mental Disorders, *p-value<0.05, **p-value<0.01, ***p-value<0.001



Notes: S = Stunted, SU = Stunted-Underweight, SWU = Stunted-Wasted-Underweight

Figure 2. Forest Plot of Odds Ratios for Chronic-Acute Nutritional Status, Antenatal Care, and Access to Drinking Water and Sanitation Concerning the Cognitive Development of Children Aged 36-59 Months in Indonesia (2018)

Table 4. Association Between Composite Index of Anthropometric Failure and Early Childhood Cognitive Development in Indonesia (n = 18,072)

Composite Index of Anthropometric Failure (No Failure as the Reference Group)	Model 1 aOR (95% CI)	Model 2 aOR (95% CI)
No Failure	1	1
Underweight	1.15 (0.85–1.55)	1.15 (0.85–1.58)
Wasted	0.65**(0.50–0.85)	0.65**(0.49–0.85)
Stunted	1.12 (0.98–1.27)	1.09 (0.95–1.23)
Underweight and wasted	0.88 (0.69–1.13)	0.86 (0.68–1.10)
Stunted and underweight	1.33*** (1.15–1.54)	1.31***(1.13–1.52)
Stunted, wasted, and underweight	1.24 (0.90–1.70)	1.16 (0.85–1.58)
n	18,072	18,072
Pseudo R2	0.019	0.027
AIC	23,701.3	23,544.3

Notes: CI = Confidence Interval, aOR = Adjusted Odds Ratio, *p-value<0.05, **p-value<0.01, ***p-value <0.001, AIC: Akaike Information Criteria.
Model 1: Adjusted for child's age. Model 2: Adjusted for child's age, sex, vitamin A supplementation, ANC visits, type of residence, gestational age, access to drinking water and sanitation*mother's education, mother's mental health*mother's occupation, and number of household members. (*) indicates significant combined risk between the interaction variables.

(CI 95% = 1.03–1.32) higher risk of this condition than those with normal nutritional status. While, children with wasted nutritional status had a 44% chance of optimal cognitive development.

Other variables that were significantly related to cognitive development were sex (OR = 1.24; 95% CI = 1.13–1.35), gestational age (OR = 1.12; 95% CI = 1.01–1.23), maternal's education (low and middle) (OR = 1.22; 95% CI = 1.06–1.40 and OR = 1.18; 95% CI =1.02–1.36), maternal's occupation (entrepreneur and civil servant/private employer) (OR = 1.19; 95% CI = 1.04–1.37 and OR = 0.84; 95% CI = 0.75–0.94), maternal's mental health (OR = 1.66; 95% CI = 1.32–2.08), access to drinking water and sanitation (OR = 1.15; 95% CI = 1.02–1.30), type of residence (OR = 1.12; CI 95% = 1.03–1.23), and number of household members (OR = 1.18; 95% CI = 1.08–1.29). Conversely, vitamin A supplementation, ANC visits, and mother's age were not significantly associated with ECCD (p-value>0.05).

Interactions between variables in relation to ECCD were also identified in this study. For instance, stunted children with a record of <4 ANC visits and poor access to drinking water and sanitation were at higher risk of delayed childhood cognitive development (OR = 5.41; CI 95% = 1.08–27.03; p-value = 0.040). The range of CI values from the OR crude interaction of these variables significantly impacted ECCD compared to other interaction categories (Figure 2). Nevertheless, the wide range of OR crude CI values indicates large data variability. Therefore, the OR crude number of the interaction between variables was less accurate as a parameter in the population. However, this finding highlighted the combination of risk factors that should be explored in future studies on cognitive development among children.

Based on Table 4, the parsimony model has a Pseudo R2 value close to 1, and the smallest Akaike Information Criteria value was determined in model 4. The CIAF (wasted and stunted-underweight) had a significant rela-

tionship with ECCD after controlling for variables, which included child's age, sex, vitamin A supplementation, ANC visits, gestational age, access to drinking water and sanitation (combined risk), maternal's education and mental health (combined risk), maternal employment and number of household members (combined risk).

Discussion

This study discovered that a stunted-underweight child was most likely to experience a disruption in ECCD. These results aligned with studies that reported that children's nutritional status at the population level (stunting and underweight-stunting) is the most significant predictor of delays in early childhood development.[11,23] Children are vulnerable to diseases and malnutrition in the early stages of life, reducing their immunological capacity against illnesses that could impact daily cognitive, physical, and mental growth and development.[24]

This study revealed that ECCD of younger children (36-47 months) differed from older children (48-59 months). Cognitive development occurs rapidly at the age of under five years due to brain growth and child neurodevelopment.[25] A child's brain development is in line with age, evident from the multiple intercell connectivity propagations.[26]

Anatomically, younger children experience slower cognitive development than older children. Therefore, nutritional status based on the height for age index could negatively impact children's central nervous system and other functional development that might persist throughout their lifetime.[17] Another study also found that the effect of a stunted nutritional status was not limited to cognitive development deficits but also communication and motor development.[27] These results highlight the importance of integrated interventions that support good nutrition, particularly in children who suffer from nutritional problems, in addition to other anthropometric measurements.[27]

Children with wasted nutrition had a 44% lower chance of experiencing delayed cognitive development. These findings were consistent with a previous study where the z-score for wasted children exhibited a nonlinear relationship with child development deficits.[27] Nonetheless, these results should be reconsidered as this study utilized a cross-sectional design; there was a tendency that the children were not in good health or susceptible to disease due to acute malnutrition (wasted) when cognitive development was measured.

One measure of cognitive development is the child's ability to read and count, which significantly impacts children's short and long-term development.[28] If a child suffers from acute malnutrition, the results of the cognitive development index are biased due to the child's inability to fulfill the criteria of cognitive development.[29] A previous study showed that nutritional status (underweight, stunted, and not wasting) significantly influences ECCD.[17]

A child with wasted nutritional status is highly likely to have poor communication and social skills.[30] While, underweight-wasted and stunted-wasted-underweight nutritional status were not significantly associated with ECCD. This finding may result from the low prevalence of underweight and wasted children in this study and acute or temporary incidence (compared to the cumulative impact/effect of stunting).[31]

Underweight and stunted boys were more susceptible to cognitive development delays than girls. This finding confirms that girls had an advantage in cognitive-motor and socio-emotional development compared to boys.[32] Furthermore, girls are superior to boys in functional brain development related to communication and language development.[33]

Children aged 36-47 months also had the potential to experience cognitive development later than those between 48-59 months. Cognitive development under five years is developing rapidly despite the slight time difference.[25] The first 1,000 days of a child's life were initially deemed the most critical period for brain development and growth,[34] but this study's results demonstrated that the next 1,000 days were equally critical for cognitive development.

No significant relationship between vitamin A supplementation and cognitive development was found in this study. Essential micronutrients are not limited to vitamin A but also include zinc supplementation and deworming in children who are at risk.[35] In addition, children with nutritional deficiencies who received consistent micronutrient supplements exhibited significant improvements in cognitive outcomes.[34]

Children born at a gestational age of <37 weeks had smaller and less mature brains, poor social-emotional development at two years old, poor school readiness and increased special educational needs, and increased respiratory morbidity in infancy and early childhood.[36] Pregnancy is often associated with susceptibility to infection.[37] Furthermore, poor access to drinking water and sanitation results in unsafe and unhealthy food. When mothers do not consume proper nutrition during pregnancy, children born <37 weeks will potentially experience delays in cognitive development at 36-59 months.[38]

Early childhood with highly educated mothers generally contributes to good development in all domains, including literacy-numeration, physical, learning, and social-emotional.[21,39] Mothers with higher education backgrounds tended to be more aware of the importance of maintaining child development, such as cognitive development, and hence are proactive in seeking information and providing suitable interventions to sup-

port optimal child development. While, mother's mental health can predict children's academic achievement, a measure of the human development index in the economic sector.[40] This study found that mothers with mental disorders suffered from emotional turmoil and faced challenges in providing the best care for a child's optimal cognitive development.

Unemployed mothers might not contribute to the family's income. Consequently, providing quality and safe nutrition might be difficult in a family of ≥5 people. Another study also reported that mothers who are civil servants/private employees are a protective factor against delays in cognitive development.[21] Thus, children with mothers who were full-time homemakers and had ≥5 household members were more vulnerable to experiencing delays in cognitive development and stunted-underweight nutritional status.

This study had several limitations. First, the 2018 IBHR offered cross-sectional data; thus, causality relationships could not be identified. Second, the 2018 IBHR utilized multistage sampling within the same cluster, potentially leading to significantly homogenous participants. Data collection at a higher level (population level) for analyses could result in the ecological fallacy, where the conclusion drawn at the group level might not apply to the individuals within the group.

Third, the CIAF only applied to children under the age of five and did not consider obesity. Fourth, the number of covariates obtained in the 2018 IBHR was limited. This study could not explore additional essential variables that reportedly influence a child's growth and development, such as hidden hunger (more variables for micronutrient supplementation), maternal knowledge about vitamin A supplementation, poverty index, and parenting style.

Conclusion

This study's findings demonstrate a significant relationship between numerous anthropometric failures and ECCD. The significant negative relationship between wasted and ECCD after controlling for variables such as child's age, sex, vitamin A supplementation, ANC visits, gestational age, access to drinking water and sanitation (combined risk), maternal's education and maternal's mental health (combined risk), maternal's occupation and number of household members (combined risk). Future studies should perform a multilevel model analysis to account for the clustering and hierarchical structure and manage variations between clusters.

Abbreviations

ECDI: Early Childhood Development Index; IBHR: Indonesian Basic Health Research; CIAF: Composite Index Anthropometric Failure; ECCD: Early Childhood Cognitive Development; ANC: Antenatal Care; CMD: Common Mental Disorder; OR: Odds Ratio; AOR: Adjusted Odds Ratio; CI: Confidence Interval.

Ethics Approval and Consent to Participate

This study received an ethical eligibility letter from the Biomedical Research Ethics Commission on Human, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, on 31 January 2023 No. KE/FK/0148/EC/2023.

Competing Interest

The author declared that no significant competing financial, professional, or personal interest might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The data used in this study were not publicly available. A reasonable request for the dataset can be sent to Badan Kebijakan Pembangunan Kesehatan of the Indonesian Ministry of Health.

Authors' Contribution

SZ was responsible for the entire process, including the analysis, writing, and revision of the manuscript. AW was responsible for the conceptualization, and RKH was responsible for revising the manuscript.

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