The Association Between Nutritional Status and Risk of Developmental Disorder in Children in Denpasar Bali Indonesia

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Abstract

BACKGROUND: Preschool age is an important period for growth and development. Malnutrition that occurs during this period can have negative impacts on growth, cognitive development, and academic performance in children.

AIM: The objective of the study is to know the association between nutritional status and the risk of developmental disorder in preschool children in Denpasar.

METHODS: An observational analytic study with a cross-sectional design and cluster sampling method was conducted on children under 5 years old who attended Early Childhood Education in Denpasar Bali in 2019.

RESULTS: From 468 samples, the median age was 5 years old (range, 1–5), the majority of children were well-nourished (52.6%), and caretaken by parents (82.9%). Child development was prescreened using an Indonesian child development pre-screening questionnaire/*Kuesioner Pra Skrining Perkembangan* (KPSP) that had 75% sensitivity, 99.16% specificity, 85.71% positive predictive value, and 98.33% negative predictive value compared to Capute Scale test as a gold standard. It showed that the majority of participants had an appropriate developmental stage (91.3%), followed by doubtful (5.3%) and possible deviations (3.4%). The results of the bivariate analysis showed that malnutrition was significantly related to the risk of developmental delay (PR 2; confidence interval [CI] 95%, 1.05-3.97). The result of multivariate analysis for variables that were considered to be significant as a risk for developmental disorder showed that malnutrition was related to the possibility of developmental disorder (PR 2; CI 95%, 1.04–3.95). Caretakers other than parents and lack of physical activity were not significantly related to the risk of developmental disorder.

CONCLUSION: Malnutrition was found to be significantly associated with the risk of developmental disorder in preschool children. Further prospective study by standard assessment tools is required to evaluate the association between nutritional status and developmental level in children.

Introduction

Growth and development are continuous processes that occur from conception to adulthood [1], [2]. Childhood is a critical period in growth and development and is the key stage in the formation of their physical and mental abilities [3], [4]. During this stage, physical growth and brain development that are important for learning, intelligence, motor skills, speech and language, as well as social and independence, occurs rapidly [5], [6].

Preschool age is an important period for children's growth and development to prepare themselves for the next stage [7], [8]. Approximately one-third of 30 million children aged 0-6 years in Indonesia have difficulty accessing the early childhood education program (*Pendidikan Anak Usia Dini* [PAUD]). The Indonesian Ministry of Health reported that 400,000 (16%) Indonesian children under 5 years old have developmental disorders [8]. The incidence of developmental disorders in children under 5 years old can be detected early with a good and effective screening method to prevent overdetection or underdetection.

Nowadays, only very few health workers perform screening for growth and developmental disorders in children due to limited time, knowledge, and skills in using screening instruments. One of the instruments for children developmental screening is the Capute Scale (Cognitive Adaptive Test/Clinical Linguistic Auditory Milestone Scale). Developmental screening using the Capute Scale can accurately determine important aspects of children's development including aspects of language development and visual-motor development by assessing the quantification of the Developmental quotient [9]. Another method that is very easy and fast to detect the possibility of developmental disorder in children is the Indonesian child development pre-screening questionnaire the *Kuesioner Praskrining Perkembangan* (KPSP). This prescreening method can be carried out by nurses, midwives, medical personnel, and trained paramedics

to parents in populations to determine whether a child needs further examination. This instrument has a sensitivity of 75% and a specificity of 99% compared to the Capute scale as the gold standard [9].

Several factors can affect the development of children in developing countries such as poverty, malnutrition, screen time, physical activity, poor sanitation, and lack of stimulation from the environment [6], [10]. Malnutrition which includes undernutrition and overnutrition is caused by inadequate nutritional intake to meet children's basic needs. Based on the results of Indonesian basic health research (*riset kesehatan dasar*/Riskesdas) 2018, the prevalence of children under 5 years old with malnutrition in Indonesia reaches 13.8% [8]. In addition, there is an increased prevalence of other types of malnutrition, which are overnutrition and obesity. Obesity may result in disturbance in children's motor skills, causing them to have decreased endurance and speed in doing physical activities. This will ultimately affect their level of development [10], [11], [12]. Based on this background, the aim of this study is to investigate the relationship between nutritional status and the risk of developmental disorder in preschool children in Denpasar.

Methods

This study was an observational research with a cross-sectional design to determine the relationship between nutritional status and the risk of developmental disorders in preschool-aged children in Denpasar in 2019. Data were collected at 21 PAUD in Denpasar City by conducting interviews in the form of questionnaire data, direct anthropometric examinations, and pre-screening using the KPSP form according to age. Participants were selected using cluster random sampling and a total of 468 preschoolers participated in this study. Participants were excluded if parents refused to give consent to participate in this study. The relationships between variables were analyzed and presented using the Chi-square test.

Nutritional status was determined based on anthropometric data, body weight and body height, which are then classified according to Waterlow's criteria. The risk of developmental disorder was assessed using KPSP according to the child's age. The results were categorized as "appropriate developmental stage" if the score was 9–10 and "inappropriate developmental stage" if the score was below 8 (doubtful and possible deviation). Confounding variables were the primary caregivers consisting of parents or other than parents, screen time, and physical activity. This study was approved by the Research Ethics Committee of School of Medicine, Universitas Udayana/Sanglah Hospital.

Results

A total of 468 children met the inclusion and exclusion criteria during the study period from August to December 2019. The characteristics of the patients were shown in Table 1. Based on the assessment of the KPSP developmental pre-screening questionnaire, we found that the majority of participants had an appropriate developmental stage (91.3%), followed by dubious results (5.3%) and possible deviations (3.4%). Interpretation of developmental pre-screening using KPSP is shown in Table 2.

Table 1: The characteristics of study subjects

Baseline characteristic	n = 468
Gender, n, %	
Male	227 (48.5)
Female	241 (51.5)
Age (years), n, %	
2–3	11 (2.4)
3–6	457 (97.6)
Nutritional status, n, %	
Well nourished	246 (52.6)
Underweight	98 (20.9)
Severe underweight	1 (0.2)
Overweight	62 (13.3)
Obesity	61 (13)
Father's education, n, %	
Uneducated	4 (0.9)
Primary school	14 (3)
Junior high school	32 (6.8)
Senior high school	222 (47.4)
Diploma	7 (1.5)
Bachelor	189 (40.4)
Mother's education, n, %	
Uneducated	3 (0.6)
Primary school	28 (6)
Junior high school	38 (8.1)
Senior high school	200 (42.8)
Diploma	15 (3.2)
Bachelor	184 (39.3)
Family income, n, %	
According to the minimum wage	316 (67.5)
Below minimum wage	152 (32.5)
Caretaker, n, %	
Parents	388 (82.9)
Other than parents	79 (16.9)

Bivariate analysis showed that caregiver, physical activity, and screen time did not show a significant relationship with developmental disorders as shown in Table 3. There was a statistically significant relationship between nutritional status and the risk of developmental delay (confidence interval [CI] 95%, 1.05-3.97). Multivariate analysis for variables that were considered significant (p = 0.25) as shown in Table 4

Table 2: Variables related to KPSP

Variable	KPSP interpretation		
	Possible deviation n = 16	Doubtful n = 25	Appropriate n = 427
Gender, n, %			
Male	9 (1.9)	8 (1.7)	210 (44.9)
Female	7 (1.5)	17 (3.6)	217 (46.4)
Nutritional status, n, %			
Well nourished	9 (1.9)	6 (1.3)	231 (49.4)
Underweight	2 (0.4)	9 (1.9)	87 (18.6)
Severe underweight	0 (0)	0 (0)	1 (0.2)
Overweight	5 (1.1)	7 (1.5)	50 (10.7)
Obesity	0 (0)	3 (0.6)	58 (124)
Caretaker, n, %			
Parents	13 (2.8)	17 (3.6)	359 (76.8)
Other than parents	3 (0.6)	8 (1.7)	68 (14.5)
Physical activity (hour/day), n, %			
<3	4 (0.9)	3 (0.6)	106 (22.6)
≥3	12 (2.6)	22 (4.7)	321 (68,6)
Screen time (hour/day), n, %			
>1	1 (0.2)	6 (1.3)	99 (22.6)
≤1	15 (3.2)	19 (4.1)	328 (70.1)

KPSP: *Kuesioner Pra Skrining Perkembangan.*

showed that malnutrition has a statistically significant relationship with the risk of developmental disorder (PR 2; CI 95%, 1.04–3.95).

Table 3: Bivariate analysis of child development

Nutritional status	KPSP			CI 95%	p-value
	Inappropriate n = 41	Appropriate n=427	PR		
Nutritional status, n, %					
Malnutrition	26 (5.6)	196 (41.9)	2	1.05–3.97	0.03
No malnutrition	15 (3.2)	231 (49.4)			
Caretaker, n, %					
Other than parents	11 (2.4)	68 (14.5)	1.8	0.95–3.45	0.075
Parents	30 (6.4)	359 (76.7)			
Physical activity (h/day), n, %					
<3	7 (1.5)	106 (22.6)	0.65	0.29–1.42	0.27
≥3	34 (7.3)	321 (68.6)			
Screen time (h/day), n, %					
>1	7 (1.5)	99 (21.2)	0.703	0.32–1.54	0.37
≤1	34 (7.26)	328 (70.1)			

CI: Confidence interval, KPSP: *Kuesioner Pra Skrining Perkembangan*.

Discussion

Most of the subjects had appropriate developmental stages according to age and suspicion of developmental disorders occurred in 8.6% of children. This result is in accordance with the theory that early childhood (0–6 years) is an important period in growth and development as it accounts for almost 95% of adult brain development [12], [13]. This period is the most appropriate time to develop the physical ability, language skills, social-emotional skills, self-concept, moral arts, religious values, and independence [14]. This result is lower than the research by Dhamayanti *et al*., involving children aged 15–18 months in the slum area of the *Puskesmas* work area, in which the percentage of children with suspicion of developmental disorders is 15%. [15].

Table 4: Multivariate analysis of developmental disorders based on KPSP

Variable	B	PR	CI 95%	p-value
Malnutrition	0.7	2	1.04–3.95	0.038
Caretaker by other than parents	0.6	1.85	0.88–3.9	0.1

CI: Confidence interval, KPSP: *Kuesioner Pra Skrining Perkembangan*.

Malnutrition refers to deficiencies, excess, or imbalance in energy and/or nutritional intake, which includes undernutrition (stunting, wasting, underweight) and overweight [16]. Overweight and obesity in children have become a global epidemic and one of the health problems in the world that must be addressed seriously. Data from the WHO in 2007 stated that 22 million children under 5 years of age are overweight [17]. Data from Riskesdas in 2013 showed that the prevalence of obese children under 5 years old is 11.9% [18]. This study found that malnutrition increases the likelihood of developmental disorders in children by two times. This result was in accordance with the theoretical review which stated that a person who has a good nutritional status reflects normal growth and developmental level according to age [19]. It is also in accordance with a study by Soetjiningsih *et al*., in 2010 which explained that nutritional status was one of the determinants of child development where malnutrition will inhibit the rate of child development [20]. The development of children including cognitive, motor, language, and skills will be hampered compared to children who have good nutritional status [19]. Mugianti *et al*., stated on their study that the majority of their subjects showed abnormality in gross motoric development [17]. In this study, the malnutrition group which included children with overweight and obese nutritional status showed a significant association with the risk of developmental disorders in children.

Child development depends on the quality of care from the environment. Parents are the primary providers of childcare and their strategies, relationships and interactions will have an impact on aspects of children development. Children who live with their father and mother have better developmental rates than those who live with only their father or mother or caregiver. Parents can immediately recognize abnormalities in the child's development process as early as possible and provide comprehensive stimulation of physical, mental, social, and independency [21].

A study by Glascoe *et al*., found that among children with undiagnosed developmental disorders, 80% had parents who expressed developmental concerns. [22]. In this study, there was no significant difference in the developmental status of children cared by parents, family other than their parents (grandparents), or caregiver. This study is in line with research by Latifah *et al*. who found that good cognitive function and independence were found in children who were cared by their grandmothers [23]. This illustrates a multifactorial process related to parenting and development which can include children's attachment to caregivers, the care system, and the level of education of the caregiver.

The duration of physical activity that affects developmental stimulation is categorized by age and type of physical activity. Children <1 year old should have physical activity for at least 30 min in the form of interactive play on the floor and no restraint for more than 1 h. Children aged 1–2 years are advised to have physical activity for at least 180 min with activity varying from moderate to severe intensity and children aged 3–4 years are also advised to have physical activity for at least 180 min with moderate intensity and 60 min with vigorous intensity [24]. This study found that physical activity in children had no effect on the risk of developmental disorder in children based on KPSP. It may be because this study did not evaluate the type and intensity of the physical activity.

The development of new technology and changes in family routines have raised concerns about the potential unexpected impacts. In response to reports from infants and toddlers watching television, AAP issued a statement in 2016 recommending that

parents should avoid children <2 years of age from watching television [25]. This study found that screen time activity in children had no effect on children's development status based on KPSP. This result was different from the research by Perdana *et al*., which stated that children who are exposed to television for more than 4 h/day have a four times greater risk of experiencing speech delays [26]. This was because, in this study, the screen time activity was evaluated only in the form of the duration of playing gadgets or watching television.

There were several limitations of this study. This study did not describe the general characteristics of the nutritional status of children, as well as the association between nutritional status and the risk of developmental disorders in children in general because the samples were only taken from urban areas. In addition, this study did not evaluate screen time as a confounding variable that may cause bias.

Conclusion

This study concluded that malnourished children had a likelihood of experiencing delay in development based on KPSP. Further prospective study by standard assessment tools is required to evaluate the association between nutritional status and developmental level in children.

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