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Relationship between Growth and Development with Nutritional Status Profile of Children Aged 0-5 Years

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Abstract
Stunting remains a major concern in Indonesia, particularly in Jungkat Village, where early detection is crucial for mitigating its impact on child growth and development. While the Pre-Screening Development Questionnaire (KPSP) is commonly used to assess child development, its relationship with nutritional status remains unclear. This study is aimed to determine the nutritional status, KPSP category, and the relationship between these variables in children aged 0-5 years in Jungkat Village. A cross-sectional quantitative study was conducted from June to August 2023 in Jungkat Village, Mempawah Regency. Ethical approval was obtained from the Health Research Ethics Committee, Faculty of Medicine, Tanjungpura University. A total of 400 children aged 0 to 5 years and 11 months were selected using participatory sampling. Height, weight, and KPSP scores were measured following standardized guidelines, and nutritional status was categorized based on height-for-age, weight-for-age, and BMI-for-age indices. Ordinal logistic regression was performed using R to analyze the relationship between nutritional status and KPSP scores. The prevalence of stunting was 36.3% (10.5% severely stunted, 25.8% stunted), while 5.2% had very low weight and 19.2% were underweight. BMI analysis showed 80% had values within the normal range, while 2.2% were overweight, 0.2% obese, and 2.4% severely wasted. In terms of child development, 77.75% exhibited normal development, 19.75% required reassessment, and 2.5% showed developmental deviations. However, no significant correlation was found between nutritional status and KPSP scores ($p > 0.05$). These findings suggest that factors beyond nutritional status, such as environmental conditions and parenting practices, may have a greater influence on child development. Thus, national nutritional standards should be adapted to local ecological and genetic characteristics to improve the effectiveness of nutritional and health interventions. Further research integrating socio-environmental factors is recommended to gain a more comprehensive understanding of child development determinants.

Keywords: Developmental Pre-screening, Jungkat Village, Nutritional Status, Ordinal Logistic Regression, Stunting.

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1. INTRODUCTION

Nutritional status is influenced by various factors. Multiple methods to assess nutritional status may be used depending on the purpose (Picó et al., 2019). Nutritional status is assessed either through anthropometric measurements or public health indices (de Onis et al., 2013; Kementerian Kesehatan RI, 2018), with weight and height being common indicators in children (Andini et al., 2020). Adequate nutrient intake and quality dietary patterns benefit childhood growth (Chung & Kim, 2020). Although genetic factors influence height, they account for only 3.7% of its variation (Simeone & Alberti, 2014). Height is also shaped by environmental factors, as seen in stunting caused by poor nutrition and infections during early life (Oberg, 2016). In addition, birth history and infant feeding practices significantly affect nutritional outcomes. A study in Nusa Tenggara Timur found that toddlers with a history of low birth weight and those who did not receive exclusive breastfeeding had a significantly higher risk of poor nutritional status (Aty et al., 2021).

One of the critical consequences of poor nutritional status is stunting, a condition that significantly impacts both physical and cognitive development. Stunting, which becomes noticeable by age two, affects not only physical growth but also cognitive abilities, primarily due to prolonged nutrient deficiencies (Arini et al., 2019). Stunting impairs intelligence, increases illness risk, and lowers adult productivity. It can also cause brain disorders, affecting a child's ability to learn (Pratiwi, 2021). Overall, stunting hampers economic growth, increases poverty, and worsens social disparities (Siddiqui et al., 2020). In addition to monitoring growth, early detection of developmental abnormalities is crucial during the critical period. The KPSP (or Pre-Screening Development Questionnaire, used for children aged 0-5, helps identify deviations in fine motor skills, gross motor skills, speech/language, and socialization (Kementerian Kesehatan RI, 2016).

Stunting remains a significant issue in West Kalimantan, where the prevalence reached 29.8%, surpassing the national rate of 24.4% (Dinas Kesehatan Kalimantan Barat, 2021). One major contributing factor is low public awareness, as many parents attribute short stature to genetics, which only affects about 15% of growth. In reality, nutritional intake, hormonal regulation, and recurrent infections have a far greater impact. Prolonged inadequate nutrition can lead to stunting and other growth disorders (Arini et al., 2019). A study in Pontianak Barat found that stunting was significantly associated with multiple risk factors, including high-risk pregnancies, chronic energy deficiency (KEK) during pregnancy, limited exposure to stunting-related education (KIE), overcrowded living conditions, and maternal age at pregnancy (Oktaviani et al., 2023). Recognizing its urgency, Indonesia has set a target to reduce stunting to 14% by 2024, making it a key national health agenda (Aryanti et al., 2022; Kementerian Sekretariat Negara RI, 2021).

At the local level, Jungkat Village in Mempawah District has also faced stunting challenges. In 2019, 22 out of 77 identified malnutrition cases were categorized as stunting. Jungkat Village, located in West Kalimantan, spans 43.39 km² and consists of 10 hamlets (BPS-Statistics Mempawah Regency, 2024). A 2022 interview with a nutrition expert from the local health center indicated a possible increase in stunting prevalence to 20% in 2020. Although malnutrition issues like wasting and obesity also exist (Rokib, 2019), stunting requires urgent attention due to its long-term consequences. Beyond monitoring growth, early detection of developmental abnormalities is equally important. The Pre-Screening Development Questionnaire (KPSP) is a widely used tool for children aged 0-5 years, helping to identify deviations in fine motor skills, gross motor skills, speech/language, and socialization (Kementerian Kesehatan RI, 2016). Understanding the relationship between nutritional status and KPSP categories is crucial, as it can enable early detection of developmental disorders, assist in planning nutrition and child development programs, provide scientific evidence for more effective interventions, and serve as a basis for further research.

This study surveyed children aged 0-5 years in Jungkat Village to profile stunting and child development in 2023. It was conducted as a collaboration between the stunting research team from Tanjungpura University's Biology Education Program and the Jungkat Health Center in Mempawah Regency. The primary aim of this study is to determine the nutritional status, KPSP category, and the relationship between these variables in children aged 0-5 years in Jungkat Village. The findings are expected to provide reliable data on stunting and child development, support public health and nutrition programs, strengthen institutional collaboration, raise awareness among parents and communities, and serve as a foundation for future research and policy development.

2. RESEARCH METHOD

This research utilizes a cross-sectional method with a quantitative approach. The research location is in Jungkat Village, Jongkat Subdistrict, Mempawah Regency, West Kalimantan. The survey was conducted from June to August 2023 in ten hamlets in Jungkat Village.

This study employs participatory sampling with door-to-door techniques due to the dispersed nature of potential subjects across Jungkat Village's ten hamlets. Participants voluntarily joined the study after receiving information on objectives, benefits, risks, and participation expectations (see attached consent form). The participants are infants aged 0 to 5 years and 11 months who are healthy or appear healthy at the time of data collection. Collected data includes height, weight, and KPSP scores. Height and weight were measured using standardized protocols (Kementerian Kesehatan RI, 2016, Kementerian Kesehatan RI, 2020) and appropriate equipment based on the child's ability to stand. The KPSP, completed according to established guidelines (Kementerian Kesehatan RI, 2024), assesses developmental abilities via 9-10 age-specific questions. KPSP usage is supported by references from the Indonesian Ministry of Health (Kementerian Kesehatan RI, 2016, Kementerian Kesehatan RI, 2024) and the Indonesian Pediatrician Association (IDAI) (Digdowirogo et al., 2010).

A cross-sectional study observes variables at a single point in time, allowing researchers to assess relationships and trends without manipulating variables. Nutritional status is assessed through height-for-age, weight-for-age, and BMI-for-age indices, providing standardized measures for comparison. Meanwhile, child development is tracked using age-appropriate developmental pre-screening, in this case developmental pre-screening or KPSP, ensuring that milestones are evaluated systematically. Data analysis is conducted in several stages as follows:

1) Determining the age of the child based on complete months according to the (Kementerian Kesehatan RI, 2024). The determination of the child's age is done by ensuring the date, month, and year of the child's birth based on the respondent's acknowledgment. If the child's age is over 16 days, it is rounded up to 1 month (Kementerian Kesehatan RI, 2020).
2) Calculating the body mass index (BMI) based on height (m) and weight (kg) using the BMI formula = $\frac{\text{body weight (kg)}}{\text{body height (m) x body height (m)}}$ (Kementerian Kesehatan RI, 2020)
3) Determining nutritional status based on height-for-age, weight-for-age, and BMI-for-age indices according to the (Kementerian Kesehatan RI, 2020). Nutritional status based on height-for-age index is categorized as severely stunted, stunted, normal, and tall. Nutritional status based on weight-for-age index is divided into severely underweight, underweight, normal, and possibly at risk of overweight. Nutritional status based on BMI-for-age index is categorized as severely wasted, wasted, normal, possibly at risk of overweight, overweight, and obese.
4) Categorizing KPSP scores into appropriate or normal status, doubtful or in need of reassesment, and deviant according to the (Kementerian Kesehatan RI, 2016).
5) Determining the relationship between each nutritional status indicator (height-for-age index, weight-for-age index, and BMI-for-age index) and KPSP category. Calculations using ordinal logistic regression tests in the R program with the "nnet" package. Ordinal

logistic regression is used to examine the relationship between a dependent variable with more than two ordered categories and one or more predictor variables that can be categorical or continuous (McNulty, 2021).

Ethical clearance was obtained from the Health Research Ethics Committee of the Faculty of Medicine, Tanjungpura University, with decision letter 3479/UN22.9/PG/2023.

3. RESULTS AND DISCUSSION

Figure 1 illustrates that the research location covers ten hamlets within Jungkat Village, located in the Jongkat Subdistrict, Mempawah Regency. This indicates that the study has a relatively broad scope, as it involves several smaller administrative units (hamlets) within a single village. As a result, the research is likely to provide a more comprehensive understanding of the conditions or phenomena being studied in the area.

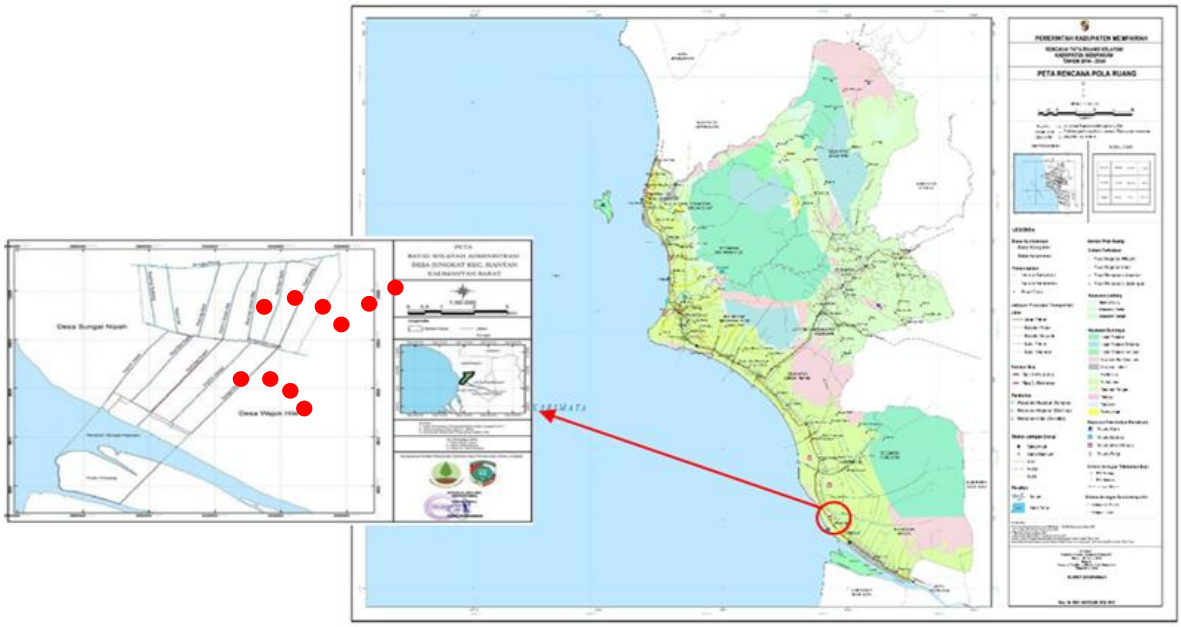

Figure 1. The research location encompasses ten hamlets within Jungkat Village, Jongkat Subdistrict, Mempawah Regency.

A total of 400 children aged 0-5 years in Jungkat Village were sampled in this study, consisting of 187 girls and 213 boys (Table 1). Out of the total subjects, 84.5% of girls and 86.9% of boys experienced normal birth processes. The occurrence of normal birth processes was more common than cesarean births. The average birth weight of girls was 2.98 ± 0.52 kg and boys were 3.08 ± 0.51 kg. On average, boys had slightly higher birth weights than girls.

Table 1. Subjects' number and birth weight.

Parameters	Boys	Girls	Total
Number of individuals (n)	213	187	400
Number of individuals by birth process (%)			
Normal	86.9	84.5	85.7
Caesar	13.1	15.5	14.3
Average birth weight (kg) ± SD	2.98 ± 0.52	3.08 ± 0.51	

Nutritional status of children, as seen from height-for-age, weight-for-age, and BMI-for-age indices, shows variation in occurrence rates (Table 2). Based on the height-for-age index

values as shown in Table 2, the number of children with normal height is 62.75%, severely stunted is 10.50%, stunted is 25.75%, and only 1.0% of children are categorized as tall. Based on the weight-for-age index values, the percentage of children with very low weight is 5.25%, underweight is 19.25%, normal weight is 71.00%, and possibly at risk of overweight is 4.50%. Furthermore, based on the BMI-for-age index, the number of children with normal BMI is 80%, obesity is 0.25%, overweight is 2.25%, possible risk of overweight to obesity is 8.50%, while severely wasted is 2.25% and severely thinnes 0.25%.

Table 2. The number of children in Jungkat Village in each category of nutritional status in percentage.

Variables of Nutritional Status	The number of children in each category (%)		
	Boys	Girls	Total
Height-for-Age Index (%)			
Severely stunted	10.80	10.16	10.50
Stunted	27.23	24.06	25.75
Normal	61.50	64.17	62.75
Tall	0.47	1.61	1.00
Weight-for-Age Index (%)			
Severely underweight	4.69	5.88	5.25
Underweight	18.31	20.32	19.25
Normal	73.71	67.92	71.00
Possible risk of overweight	3.29	5.88	4.50
BMI-for-Age Index (%)			
Obese	0.00	0.53	0.25
Overweight	3.29	1.07	2.25
Possible risk of overweight	7.98	9.09	8.50
Normal	80.75	79.15	80.00
Wasted	4.69	8.56	6.50
Severely wasted	2.82	1.60	2.25
Severely thinness	0.47	0.00	0.25

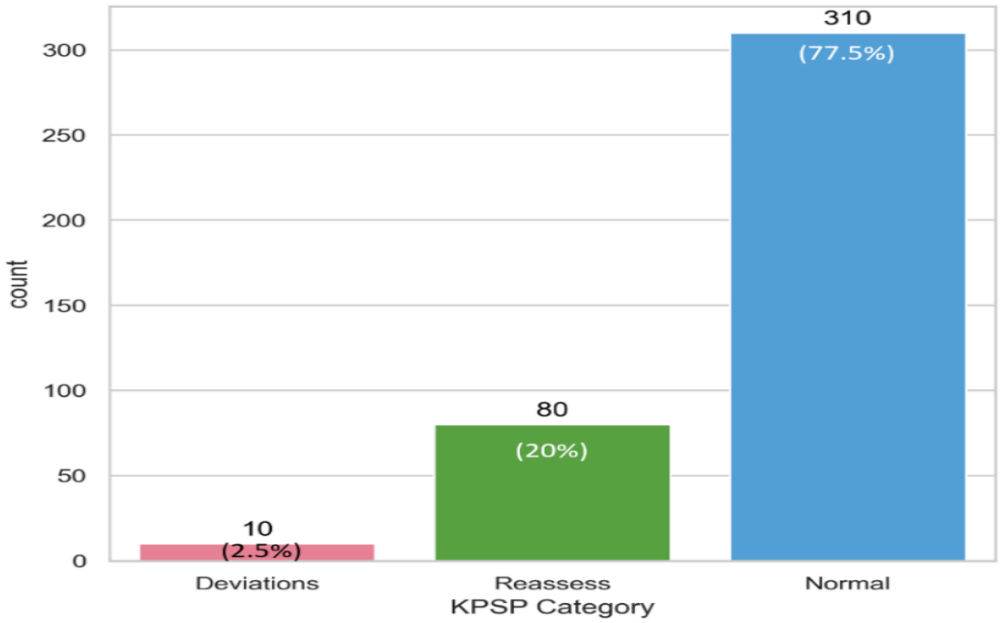

Figure 2. Count plot of KPSP (or Developmental Pre Screening) categories among children aged 0-5 years in Jungkat Village (n_{total}= 400).

Figure 2 shows that all 400 children aged 0-5 in Jungkat Village underwent both anthropometric and developmental pre-screening. Results show that 310 (77.75%) had normal development, 80 (19.75%) required reassessment within 2 weeks (Kementerian Kesehatan RI, 2016), and 10 (2.5%) showed developmental deviations.

The results of the analysis of the relationship between nutritional status and KPSP scores are presented in Table 3. Based on the p-value, none of the nutritional status indices showed a statistically significant relationship with KPSP scores ($p > 0.05$). Among the indices analyzed, the height-for-age index showed a weak positive relationship with KPSP scores, with a coefficient of 0.6706, but this association was not statistically significant. Meanwhile, the BMI-for-age index and the weight-for-age index exhibited negative relationships with KPSP scores, with coefficient values of -1.4988 and -0.2913, respectively, though these relationships were also not significant. The lack of significant associations is further supported by the high residual deviance (480.686) and AIC (508.686) values, suggesting that the model may be missing key explanatory variables or requires further refinement (Creel, 2014). This indicates that factors beyond nutritional status, such as environmental influences, parenting styles, or access to early childhood stimulation, may play a more crucial role in child development in Jungkat Village.

Table 3. The results of the ordinal logistic regression between KPSP (or developmental pre-screening) scores and the nutritional status index (BMI for age, body weight for age, and body height for age) of children aged 0-5 in Jungkat Village.

Coefficients	**Value**	**Std. Error**	**t value**	**p-value**
KPSP with BMI-for-age	-1.4998	149.7127	-0.010018	0.9920
KPSP with BH-for-age	0.6706	0.9965	0.672980	0.5014
KPSP with BW-for-age	-0.2913	0.6551	-0.444700	0.6568
Intercepts:				
Deviants| Reassess	-6.1022	37.7265	-0.1617	
Reassess| Normal	-3.6429	37.7254	-0.0966	
Residual Deviance	480.686			
AIC	508.686			

Description: *KPSP = developmental pre-screening; BMI = body mass index; BH = body height; BW = body weight*

DISCUSSION

Nutritional Status of Children Aged 0-5 in Jungkat Village

In Jungkat Village, the nutritional status of children aged 0–5 years exhibits considerable variation, with the prevalence of stunting, underweight, and potential risks of overweight and obesity. Among the 400 children studied, 36.3% experienced linear growth disorders, with 10.5% categorized as severely stunted and 25.8% as stunted. This indicates that more than one-third of the children face height growth issues, which may be linked to long-term nutritional deficiencies or environmental factors that do not support optimal growth. Meanwhile, 5.2% had very low weight and 19.2% were underweight, highlighting the presence of undernutrition among some children. However, 4.5% were at risk of being overweight, and although the percentage of obesity was low (0.2%), this figure reflects the double burden of malnutrition in Jungkat Village, where both undernutrition and overnutrition coexist.

Both undernutrition and overnutrition in children aged 0–5 years highlight the urgent need for improved nutrition and child development support. Under normal conditions, weight grows proportionally with height, and deviations in this pattern may indicate nutritional problems. Body Mass Index (BMI), which reflects the proportion of weight to height, is commonly used to assess nutritional status in children (Mei et al., 2002). Low z-scores in the weight-for-age or BMI-for-age indices are associated with underweight and indicate chronic or acute malnutrition (Monasor-Ortolá et al., 2021). Undernourished children are more susceptible

to infection and have higher risks of morbidity and mortality (Olofin et al., 2013). However, using BMI alone to assess obesity in children has limitations, as it does not differentiate between fat mass and lean tissue (Flegal, 2023; Messner et al., 2024; Vanderwall et al., 2017), and growth patterns vary between boys and girls, affecting interpretation (Costa et al., 2021; Moestue et al., 2004). Therefore, in Jungkat Village, height-for-age and weight-for-age indices are used alongside BMI to provide a more comprehensive assessment of child nutrition.

A child's height also reflects their nutritional status, which is the result of the relationship between genetic factors and the intake of macro and micronutrients obtained over a long period. Genetic factors play a role in a child's height (Conery & Grant, 2023), and the height of the mother can influence her child's linear growth during the growth period (Addo et al., 2013; Subramanian et al., 2009). However, there are other factors that also influence a child's height, such as nutritional intake, infections, parental caregiving practices, and environmental factors (Floris et al., 2023). Longitudinal height growth occurs through the process of cell proliferation and the addition of new cells in bone growth and hypertrophy. Additionally, growth hormones such as growth hormone and insulin-like growth factor I (IGF-I) also play a crucial role in bone growth processes (Kaur et al., 2021). In Jungkat Village, the high stunting rate suggests that factors such as poor maternal nutrition, inadequate food intake, frequent infections, and limited access to health services may be hindering optimal linear growth in children.

Developmental Pre-Screening Profile of Children Aged 0-5 in Jungkat Village

Early detection of growth and development in children aged 0-5 years in Jungkat Village reveals a significant proportion of children with developmental concerns. Based on KPSP assessments, less than 80% of children exhibit normal development, while 2.5% show clear developmental deviations, and 19.75% require further reassessment. These findings indicate that over 22% of children may face developmental challenges, necessitating closer monitoring and appropriate interventions.

Child development is influenced by the maturation of biological systems, environmental stimulation, and learning experiences. Research indicates that cognitive development is guided by continuous, bidirectional interactions between human biology and the social environment. Given these results, parents are advised to actively provide developmental stimulation to their children while awaiting follow-up assessments. Studies have shown that improved caregiver stimulation practices are likely to enhance children's developmental outcomes. For children in the reassessment category, frequent health check-ups and structured stimulation activities can help track progress and support development. Meanwhile, children with significant developmental delays should be referred to medical professionals for further evaluation and intervention. Following specialist assessment, children can be referred to appropriate therapies, such as speech-language therapy, physiotherapy, occupational therapy, and behavioral interventions (Choo et al., 2019; Okelo et al., 2024).

The substantial proportion of children in Jungkat village experiencing developmental concerns underscores the urgent need for integrated early childhood interventions. Combining regular developmental screening with active parental involvement and timely referrals to appropriate services can significantly improve developmental trajectories. Evidence-based early intervention strategies, when implemented during critical periods of brain development, have been shown to yield long-term cognitive, behavioral, and health benefits (Black & Dewey, 2014; Britto et al., 2017). Therefore, a multisectoral approach involving health, education, and family support systems is essential to ensure that every child in the community reaches their full developmental potential.

Relationship between Nutritional Status and Developmental Pre-Screening Score.

Growth indicators such as height-for-age (H/A), weight-for-age (W/A), and body mass index-for-age (BMI/A) are not always consistent predictors of child development scores based

on the Pre-Screening Developmental Questionnaire (KPSP). While conditions such as stunting, above-average height, underweight, and obesity can influence KPSP scores both positively and negatively, improvements in these growth indicators do not necessarily enhance child development. This suggests that factors beyond height, weight, and BMI may have a stronger influence on a child's development.

Each population possesses distinct environmental and genetic characteristics that can influence growth and developmental patterns. For instance, a study by (Baransano et al., 2016) observed that girls from the Maybrat and Arfak tribes in West Papua exhibit faster BMI growth rates than American children, who are used as a WHO reference, with the Arfak tribe displaying the most rapid growth rate. This variation suggests that global growth standards may not fully capture the growth conditions in every population.

A similar phenomenon may also be observed in the relationship between nutritional status and child development in Jungkat Village. The lack of a significant correlation between KPSP scores and nutritional status in this area may be due to the inaccuracy of nutritional categories in representing the realities of the local population. Environmental factors such as specific dietary patterns, socioeconomic conditions, and genetic adaptations to the local environment may lead to growth patterns that differ from national standards (Sutigno & Pigawati, 2015).

Moreover, child development is a multifactorial process influenced not only by physical growth but also by neurological maturation, emotional well-being, family dynamics, stimulation at home, and access to early education. Standardized tools like the KPSP may not fully capture the nuances of these influences, particularly in diverse rural contexts like Jungkat Village. Additionally, the reliance on global or national growth reference charts can overlook localized patterns of healthy development shaped by long-term adaptations. For instance, children may present with growth indicators that fall below WHO standards but still exhibit age-appropriate cognitive and motor development due to protective cultural practices, nutrient-dense traditional diets, or strong familial support systems (Grantham-McGregor et al., 2007; Yousafzai et al., 2014). Therefore, integrating localized developmental benchmarks and context-specific assessment tools is essential for accurately identifying at-risk children and tailoring appropriate interventions.

In accordance with ecological principles, human communities develop unique growth and development characteristics in response to their specific environments. Therefore, applying national nutritional standards should be approached with caution, especially for populations with distinct ecological and genetic traits. Inappropriate standards may lead to misinterpretations of children's growth and development status, ultimately affecting the effectiveness of nutritional and health intervention strategies. For instance, studies highlighted that current universal growth standards might underestimate stunting in populations with inherently taller growth patterns, suggesting that reliance on such standards can lead to inappropriate cross-population comparisons and misinformed interventions (Flynn et al., 2021; Hackman & Hruschka, 2020; Natale & Rajagopalan, 2014; Tian et al., 2019).

4. CONCLUSION

The nutritional status of children aged 0-5 years in Jungkat Village shows significant variation, with a double burden of malnutrition, including stunting and underweight, as well as risks of overweight and obesity. Additionally, more than 22% of children have the potential for developmental disorders, necessitating more intensive monitoring and intervention. However, the relationship between nutritional status and child development based on KPSP scores is not significant, indicating that other factors such as environment, parenting practices, and developmental stimulation play a greater role in children's growth and development. Therefore, national nutritional standards should be applied with consideration of the local population's

ecological and genetic characteristics to ensure more effective nutritional and health interventions.

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