



Original Article

## Effectiveness of Screening and Growth and Development Stimulation Methods in Toddlers in Central Sulawesi, Indonesia: a quasi-experimental study

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### ABSTRACT

**Background:** Stunting is a significant health problem both globally and nationally. According to the 2023 Indonesian Health Survey, Central Sulawesi has a relatively high stunting prevalence of 27.2%, which is higher than the national average of 21.5%. Stunting can negatively impact early childhood development. Parents are unaware that their children are experiencing developmental delays because they do not receive information from health workers. Growth screening is carried out at integrated health posts (Posyandu), but developmental screening is rarely carried out due to limited equipment and the lack of training for health workers. The purpose of this study was to evaluate the effectiveness of screening and stimulation methods using the DDST and KPSP tools. **Methods:** *quasi-experimental* design with a *pre-post test non-equivalent control group* approach. The instruments used are z-score to measure nutritional status based on anthropometric standards, the Developmental Pre-Screening Questionnaire and the Denver Development Screening Test to screen child development. The population of this study is all toddler-aged children with a total sample size of 34 people. Exclusion criteria are children who are sick, have physical disabilities, or have developmental disorders. Data analysis uses the Mann-Whitney test, the Wilcoxon test, and the Pearson chi-square test. **Results:** Pearson's Chi-Square test showed a p-value of 0.036 ( $p < 0.05$ ), indicating a significant difference in the proportion of nutritional status between groups of children based on anthropometric screening results. The Mann-Whitney test results showed a significant difference in developmental screening scores between DDST and KPSP in toddlers of 0.001 ( $p < 0.05$ ). KPSP had a higher mean rank, indicating that KPSP scores tended to be higher than DDST. Wilcoxon test analysis showed a significant change between KPSP scores before and after stimulation with a p-value of 0.009 ( $p < 0.05$ ). These results explain that stimulation has an impact on improving children's developmental status. **Conclusion:** There is a significant difference between the developmental stage scores in the DDST group and KPSP before and after screening and stimulation.



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## INTRODUCTION

Optimal brain development occurs in the first 1,000 days of a child's life, as well as growth disorders often begin in the womb and continue for at least the first 2 years of postnatal life, but also continue to develop significantly until the age of 3 years (Choo, Yeleswarapu, How, & Agarwal,

2019; Mustakim, Irwanto, Irawan, Irmawati, & Setyoboedi, 2022) . Therefore, the critical period for treatment for developmental delays is before the child reaches the age of 3 years. The toddler period (preschool) is a very sensitive period because in addition to changes in language, social and motor development, developmental disabilities and stunted growth are found during this period (Fernald, Prado, Kariger, & Raikes, 2017; Kim, 2022) . Various causes, both internal (genetic) (Marchamah & Arum, 2022) and external (environment and parenting) (Black et al., 2017) inhibit children's growth and development. Parents are unaware that their children are experiencing developmental delays because they do not receive information from health workers (Hastoety, Rachmalina, Irawan, & Febriani, 2020) . Risk factors for stunted growth and development in children can pose a significant burden on families and communities, both physically, psychologically, and economically (Zablotsky et al., 2017) .

Global data shows that developmental disabilities in children under 5 years old are 52.9% and approximately 22% or 149.2 million children worldwide suffer from stunting, with more than a fifth (21.8%) of them in Asia (Olusanya et al., 2018) . Based on the 2023 Indonesian Health Survey (SKI), the prevalence of stunting in Central Sulawesi reached 27.2%, while the national figure is 21.5%. This indicates that Central Sulawesi still has a higher stunting rate compared to the national average. Based on data from the Central Sulawesi Health Office in 2022, the percentage of toddlers whose growth and development is monitored is still below the Ministry of Health's target, which is 74.14% of the target of 75%. Several districts above the target are Morowali (120.11%), Palu City (98.83%), Sigi (98.75%), Banggai Laut (83.82%), and Toli-toli (79.27%). Meanwhile, the districts with the lowest percentages were North Morowali (33.78%), Tojo Una-Una (54.39%), Banggai Islands (61.4%), Parigi Moutong (61.42%), Buol (61.98%), Poso (69.19%), Donggala (71.25%), and Banggai (71.47%).

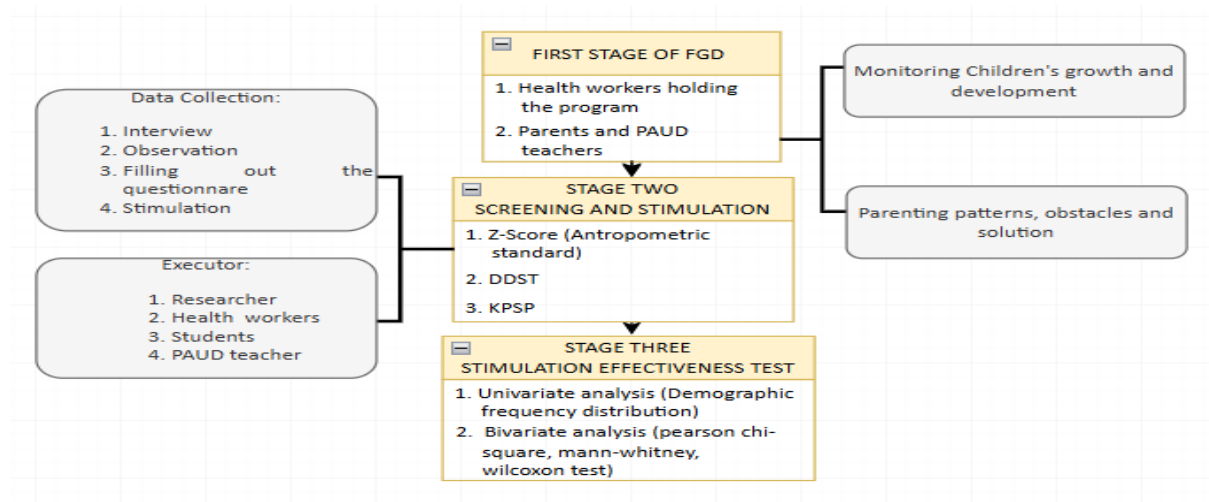
Community service conducted by a team of lecturers from the Palu Ministry of Health Polytechnic emphasized that the low level of implementation of preschool child growth and development screening remains a challenge. Many early childhood education centers (PAUD) do not conduct routine monitoring, resulting in early detection of developmental disorders. Limited knowledge of teachers and parents, as well as a lack of measuring tools and screening formats, are major obstacles. Collaboration between PAUD and health workers is also needed to support the screening process and follow-up on screening results (Kolomboy, Syamsu, & Kunci, 2025).

The first step of a comprehensive diagnostic procedure, namely early detection and appropriate intervention, can reduce the risk of future growth and developmental disorders and prevent the occurrence of more severe sequelae (Choo, Agarwal, How, & Yeleswarapu, 2019; Choo, Yeleswarapu, et al., 2019; Chung et al., 2020) . Early detection and intervention are crucial because child development has a significant long-term impact on disease prevention and improving health, learning ability, and well-being throughout life (Bishwokarma et al., 2022; Kim, 2022) . To implement effective early intervention, an important first step is to understand the estimated prevalence of developmental disorders and the characteristics of various types of developmental delays. Thus, interventions can be tailored to the child's specific needs (Sim, Thompson, Marryat, Ramparsad, & Wilson, 2019; Valla, Wentzel-Larsen, Hofoss, & Slinning, 2015). Standardized screening methods include growth tests (KMS, Z-Score) (Scherzer, Chhagan, Kauchali, & Susser, 2013) and developmental tests (DDST, KPSP) (Choo, Agarwal, et al., 2019; Sices, 2007) .

Based on research data in Central Sulawesi, the focus is still on screening using the KPSP. The KPSP is determined based on observations by parents or caregivers, where openness and honesty from parents or caregivers of toddlers are very important in answering questions asked by the examiner because it will affect the results of the developmental examination of the toddler. Therefore, it is deemed necessary to conduct research to evaluate the effectiveness of screening and stimulation methods using the DDST and KPSP tools, in addition to the fact that screening with the DDST based on the examiner's observations is still rare in Central Sulawesi, so that it can directly see the development of the toddler during the examination.

## METHODS

Study A quasi-experimental pre-post test non-equivalent control group approach was conducted at the Integrated Health Post (Posyandu) in the working area of the Mabelopura Health Center, including the Teratai Posyandu, Masomba Posyandu, Kembang Joyo Posyandu, Bougenville Posyandu, and Nasanapura Posyandu from June to July 2025 and has obtained ethical approval from the Palu Ministry of Health Polytechnic with ethical number No. 002140/KEPK POLTEKKES KEMENKES PALU/2025. Data collection used standardized instruments based on PMK no. 2 of 2020 concerning anthropometric standards and the 2022 Ministry of Health guidelines concerning guidelines for stimulation and early detection of child growth and development (Ministry of Health of the Republic of Indonesia, 2022; Regulation of the Minister of Health of the Republic of Indonesia, 2020) . The DDST questionnaire assesses four aspects of development, namely gross motor skills, language, fine motor skills, and personal social skills. The KPSP questionnaire consists of 10 questions covering four aspects of gross motor skills, language, fine motor skills, and personal social skills. The final results of the DDST screening are categorized as normal, abnormal, and suspect, while the KPSP includes the categories of appropriate development (S), doubtful (M), and deviation (P). Stimulation will be carried out on children with doubtful and deviation categories for 2 weeks, then a re-assessment will be carried out using the KPSP according to the child's age . The research stages consist of three stages described in the following flowchart:



**Figure 1. Research Stage Flowchart**

The population is all children aged toddler. The sample was determined by using *non-probability sampling technique with purposive sampling approach*. The formula for determining the sample using the difference of 2 means (two groups, the same variance) is the *level of significance* ( $\alpha$ ) of 0.05, *the power of the test* is 80%, the mean score of the control group (DDST) and the intervention group (KPSP) is  $11-9 = 2$ , the variance of the two groups is 4, the number of samples is 15 people plus a reserve for *drop out of 10%*, namely 2 people, then the sample required for each group consists of 17 people, so the total sample required is 34 people with inclusion criteria of child age (1-3 years), mother's education, mother's occupation and exclusion criteria of children who are experiencing acute or chronic medical conditions, children who have physical limitations and children who have complex developmental conditions.

## RESULTS

The number of respondents in this study was 34 toddler-aged children. This study observed the demographic characteristics of respondents based on age, gender, maternal occupation and maternal education (table 1). Furthermore, this study also looked at the results of the growth and development screening of toddler-aged children (table 2), the effectiveness of anthropometric

screening on the growth of toddler-aged children (table 3), the effectiveness of Development Screening with the DDST and KPSP Methods for Toddler-aged Children (table 4) and the level of Development of Toddler-aged Children with the KPSP Method Before and After Stimulation (table 6).

**Table 1. Frequency Distribution of Respondents Based on Demographic Characteristics**

Demographics	n	%
<b>Gender</b>		
Man	18	52.9
Woman	16	47.1
<b>Age</b>		
12-23 Months	17	50
24-36 Months	10	29.4
37-47 Months	7	20.6
<b>Mother's Job</b>		
Working (ASN, private)	12	35.3
Housewife (IRT)	22	64.7
<b>Mother's Education</b>		
Junior High School (SLTP)	11	32.4
Senior High School (SLTA)	13	38.2
Higher Education (Diploma, S1)	10	29.4

This study involved 34 children aged 12-46 months, table 1 shows that the majority of children were boys (52.9%) and aged 12-23 months (50%), with mothers who were mostly high school graduates (38.2%) and did not work 64.7%.

**Table 2. Frequency Distribution Based on Growth and Development Screening of Toddlers**

Growth Screening	n	%
<b>PB/U</b>		
Normal	25	73.5
Stunting	3	8.8
Tall	6	17.7
<b>BB/U</b>		
Good Nutrition	27	79.4
Malnutrition	3	8.8
Overnutrition	4	11.8
<b>DDST</b>		
Normal	10	58.8
Abnormal	4	23.5
Suspect	3	17.7
<b>KPSP</b>		
In accordance	12	70.5
Doubtful	2	11.8
Deviation	3	17.7

Based on Table 2, it was found that of the 34 respondents, based on growth screening according to height/age, the majority (73.5%) showed normal growth, while 8.8% showed stunting. Furthermore, growth screening according to weight/age showed that 79.4% were well-nourished and 8.8% were malnourished. The analysis also showed that the majority (58.8%) had normal development based on the DDST, while 17.7% were suspected. Furthermore, based on the KPSP, 70.5% showed appropriate development, while 11.8% were doubtful.

**Table 3. Effectiveness of Anthropometric Screening on the Growth of Toddlers**

Anthropometric Screening	Good Nutrition	Malnutrition	Overnutrition	<i>p-value</i>
Normal	25 (73.5%)	2 (5.9%)	3 (8.8%)	
Stunting	2 (5.9%)	1 (2.9%)	0 (0.0%)	*0.036
Tall	0 (0.0%)	0 (0.0%)	1 (2.9%)	

\*Pearson Chi-Square Test

Based on Table 3, the Pearson Chi-Square test shows a *p*-value of 0.036 ( $p < 0.05$ ), indicating a significant difference in the proportion of nutritional status between child groups based on anthropometric screening results. Therefore, it can be concluded that children's anthropometric status is significantly related to nutritional status.

Based on Table 4, the Mann-Whitney test results show a significant difference in developmental screening scores between the DDST and the KPSP in toddlers of 0.001 ( $p < 0.05$ ). The KPSP has a higher mean rating, indicating that the KPSP scores tend to be higher than the DDST. Thus, the two instruments provide different developmental assessment results and show significantly different results.

**Table 4. Effectiveness of Developmental Screening with the DDST and KPSP Methods for Toddlers**

Developmental Screening	Mean	Standard Deviation (SD)	<i>p-value</i>
DDST	8.47	1.419	*0.001
KPSP	13.82	2.099	

\*Mann-Whitney test

**Table 5. Development Level of Toddler-Aged Children Using the KPSP Method Before and After Stimulation**

		KPSP POST		Total	<i>p-value</i>
		In accordance	Doubtful		
KPSP	In accordance	12(70.5)	0(0.0)	12(70.6)	*0.009
PRE	Doubtful	2(11.8)	0(0.0)	2(11.8)	
	Deviation	0(0.0)	3(17.7)	3(17.6)	
	Total	14(82.3)	3(17.7)	17(100)	

\*Wilcoxon test

Table 6, a Wilcoxon test analysis, shows a significant change between KPSP scores before and after stimulation with a *p*-value of 0.009 ( $p < 0.05$ ). This indicates that stimulation has an impact on improving children's developmental status.

## DISCUSSION

Statistical test results indicate a link between malnutrition and stunting. Malnutrition is linked to stunting because chronic deficiencies in energy, protein, and micronutrient intake inhibit a child's linear growth. When nutrition is inadequate, the body prioritizes basic survival functions, resulting in suboptimal bone and tissue growth. Malnutrition also weakens the immune system,

making children susceptible to repeated infections, which further reduces nutrient absorption and suppresses growth hormone. This combination of malnutrition and long-term infection causes stunted growth and ultimately leads to stunting. This finding, in line with research by Thurstans et al. (2022) , shows a significant relationship between stunting and malnutrition, with malnutrition exacerbating stunting. Children with concurrent wasting and stunting have a significant risk of death. (Myatt, Khara, Dolan, Garenne, & Briend, 2019) . In addition to a balanced diet, adequate health services, employment, and good parental education are important factors in achieving optimal child nutrition (Alam et al., 2020; Black et al., 2017; Mertens et al., 2023; Woldehanna, Behrman, & Araya, 2018) . Therefore, routine reporting on the prevalence of wasting and stunting is necessary through anthropometric surveys, health surveys, and other nutrition information systems to monitor children's nutritional status (Myatt et al., 2018).

This study shows that there are significant differences between the Denver Developmental Screening Test (DDST) and the Developmental Pre-Screening Questionnaire (KPSP) in detecting developmental disorders in children. The KPSP is considered more effective for screening child development because this instrument is simpler, faster, and easier to use by health workers and parents. The KPSP is based on observations and reports from parents or caregivers, so it does not require special testing tools like the DDST, which requires stimulation equipment and trained examiner skills. In the DDST, some items require direct demonstration and tool manipulation, making it more time-consuming, prone to administrative errors, and creating bias among examiners. In line with the research findings of Apriani & Febrianti (2020) that The use of the Denver and KPSP instruments showed significant differences in detecting developmental disorders in children. According to Hamdanesti & Oresti (2021; Padila et al., (2019) KPSP and DDST have good compatibility because both are adapted from the Prescreening Developmental Questionnaire (PDQ). However, DDST is more widely used by health workers, while KPSP can be used by the general public, including cadres, so it is more easily accessed and used in health services at community health centers and integrated health posts.

The results of the study indicate that stimulation or intervention has a positive effect on improving children's developmental outcomes. Children's brains at an early age are highly responsive to repeated practice and stimulating experiences, so that previously undeveloped skills can be improved through targeted interventions. Age-appropriate stimulation in both motor, language, and personal-social aspects encourages the strengthening of neural connections, the maturation of neuromuscular function, and an increase in children's ability to adapt to the environment . In line with the results of the study by Padila et al., (2019) , there was a significant influence between developmental stage scores in the group using the DDST and the SDIDTK group before and after the intervention, indicating the effectiveness of the intervention in improving development. Developmental screening is the initial step in a comprehensive diagnostic procedure to prevent and detect early developmental delays (Faruk et al., 2020) . Children who are detected with developmental deviations after screening are then given periodic stimulation (2 weeks) tailored to their developmental needs, then will be retested using the same method as before, namely the KPSP method (Ministry of Health of the Republic of Indonesia, 2022) .

The results of the FGD with the head of administration at the Community Health Center (Puskesmas) during the initial data collection revealed that no health workers had received training. Cadres at the integrated health post (Posyandu) only performed anthropometric measurements due to time and energy constraints. Cadres, early childhood education (PAUD) teachers, and parents play complementary roles in detecting children's growth and development. Cadres monitor growth at the Posyandu through simple weighing, measuring, and screening, and connect families with health workers. PAUD teachers observe children's abilities daily in the learning environment to quickly recognize any delays compared to their peers. Meanwhile, parents monitor their children's development at home, provide daily stimulation, and ensure regular visits to health services. In line with research by Ngestiningrum & Qomaruddin (2024), child development detection is usually only carried out if there are complaints from parents during SDIDTK examinations at Posyandu, due to limited time and resources. Furthermore, teachers and cadres said they had never received material or training, when there were health workers' visits to schools only related to the provision of vitamins, supplementary food, counseling on MTBS,

cadres at Posyandu only helped with data collection and anthropometric measurements (Susanti & Sustini, 2017) . In accordance with the results of the study which stated that teachers need training and assistance to detect child developmental disorders early and provide appropriate stimulation, so that children can achieve optimal development and get referrals to experts if needed (Rispoli, Norman, & Nelson, 2024) . Parents also need to increase their knowledge about the importance of early detection of child development so they can participate during screening, cooperate in receiving screening results, follow up on referral programs if deviations or delays are found and can provide appropriate stimulation to help children grow and develop optimally, by understanding the needs and abilities of children at each stage of their development (Krisdiantini, Setyo-boedi, & Krisnana, 2021; Shahidullah et al., 2020).

## Limitations and Recommendations

Limitations in this study include time and respondents. Researchers need time to conduct growth and development screening, while the study was conducted when there was a Posyandu schedule. In the scheduled Posyandu activities, there was a lack of community participation in the area to bring their children, which affected the number of respondents. There are several weaknesses that need to be addressed, such as the lack of human resources, including health workers, cadres, and early childhood education teachers who have participated in child growth and development screening training, limited supporting facilities, and a lack of information for parents about the importance of early detection and how to stimulate if they find signs of delayed child growth and development. It is hoped that the Mabelopura Palu Community Health Center will provide opportunities for related officers and cadres to participate in training, so that they can then provide training to parents and teachers in assessing child growth and development.

## CONCLUSION

Regular screening and stimulation interventions are effective strategies for preventing and improving developmental delays in toddlers. These findings can inform public health strategies for integrated Posyandu programs.

**Author's Contribution Statement:** **Freny Ravika Mbaloto:** conceptualization, methodology development/design, software, investigation, project administration. **Estelle Lilian Mua:** resources, investigation, writing - preparation of the original draft. **Robi Adikari Sekeon:** supervision. **Alfrida Samuel Ra'bung:** writing - review and editing.

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