Gizi Indon 2026, 49(1): 9-16
GIZI INDONESIA
Journal of The Indonesian Nutrition Association
p-ISSN: 0436-0265 e-ISSN: 2528-5874

VALIDITY OF E-PPGBM BASED NUTRITIONAL STATUS DATA IN DETERMINING STUNTING PREVALENCE IN NORTH TORAJA REGENCY

Validitas Data Status Gizi Berbasis E-PPGBM dalam Menentukan Prevalensi Stunting di Kabupaten Toraja Utara

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Diterima: 17-11-2025 Direvisi: 12-02-2026 Disetujui terbit: 31-03-2026

ABSTRACT

Accelerating stunting reduction is challenging during planning and budgeting, which requires accurate data. The significant discrepancy between the national survey results and e-PPGBM data raises crucial questions regarding the accuracy and utility of each dataset in the context of policy formulation. This study aimed to assess the differences in stunting prevalence between E-PPGBM and gold standard measurements and to evaluate the diagnostic accuracy and agreement of height-for-age z-scores (HAZ). A cross-sectional study was conducted among 188 children aged 0–59 months, randomly selected from North Toraja Regency. Anthropometric measurements were performed by community health cadres (E-PPGBM) and trained enumerators using standardized instruments (gold standard). Data were analyzed using receiver operating characteristic (ROC) curves, Bland–Altman plots, and descriptive statistics. The AUC value for detecting stunting was 0.925 (95% CI: 0.881–0.970), with a sensitivity of 70.7 persen, specificity of 95.6 percent, PPV of 91.4 percent, and a negative predictive value (NPV) 83.1 percent. The prevalence of stunting based on E-PPGBM (30.9%) was lower than the gold standard (39.9%), indicating underdiagnosis. The mean difference in HAZ values was 0.12, with 95 percent limits of agreement ranging from –1.28 to 1.53. E-PPGBM demonstrated excellent diagnostic accuracy but limited sensitivity, with a tendency to overestimate HAZ values. Strengthening cadre training, supervision, and standardization of anthropometric tools is necessary to enhance the reliability of stunting surveillance data.

Keywords: E-PPGBM, stunting, community health cadres, measurement accuracy

ABSTRAK

Salah satu tantangan dalam percepatan penurunan stunting terletak pada tahap perencanaan dan penganggaran yang membutuhkan data dan informasi yang akurat. Namun, perbedaan signifikan antara hasil survei nasional dan data E-PPGBM menimbulkan pertanyaan krusial tentang keakuratan dan kegunaan masing-masing data dalam konteks kebijakan. Penelitian ini bertujuan untuk menganalisis perbedaan prevalensi stunting antara E-PPGBM dengan gold standard serta menilai akurasi diagnostik dan tingkat kesepakatan pengukuran HAZ. Desain penelitian yang digunakan adalah *cross-sectional* dengan populasi balita usia 0-59 bulan di Kabupaten Toraja utara. Sebanyak 188 balita dipilih menggunakan *simple random sampling*. Pengukuran panjang/tinggi badan dilakukan oleh kader posyandu (E-PPGBM) dan enumerator terlatih sebagai referensi dengan alat terstandar (*gold standard*). Data dianalisis menggunakan uji diagnostik (Kurva ROC), analisis Bland-Altman, dan statistik deskriptif. Hasil penelitian menunjukkan nilai AUC E-PPGBM untuk mendeteksi stunting adalah 0,925 (95% CI: 0,881–0,970), yang mengindikasikan akurasi sangat baik. Sensitivitas sebesar 70,7 persen, spesifisitas 95,6 persen, NPV 83,1 persen, dan PPV 91,4 persen. Rata-rata selisih HAZ adalah 0,12 dengan 95 persen Limits of Agreement (LoA) -1,28 hingga 1,53, menunjukkan variabilitas yang besar. Prevalensi stunting menurut E-PPGBM (30,9%) lebih rendah dibandingkan gold standard (39,9%), mengindikasikan underdiagnosis. Penelitian ini menemukan bahwa perbedaan HAZ antara E-PPGBM dengan *gold standard* menunjukkan kecenderungan HAZ lebih tinggi pada E-PPGBM pada semua kelompok umur. Diperlukan peningkatan kapasitas kader dan standarisasi alat untuk meningkatkan kualitas data E-PPGBM.

Kata kunci: E-PPGBM, stunting, kader posyandu, akurasi diagnostik

Doi: 10.36457/gizindo.v49i1.1196
www.persagi.org/ejournal/index.php/Gizi_Indon

INTRODUCTION

One of the challenges in accelerating stunting reduction lies in the planning and budgeting stages, which require accurate data and information to be effective. However, the significant discrepancy between the national survey results and E-PPGBM data raises crucial questions regarding the accuracy and utility of each dataset in the context of policy formulation.[1] Indonesia continues to face significant challenges in addressing nutritional problems, known as the triple burden of malnutrition, which comprises undernutrition (especially stunting), micronutrient deficiencies, and being overweight. These three issues significantly affect child survival, development, and overall national growth.[2] The prevalence of stunting remains higher than that of other toddler nutritional problems, such as underweight (16.8%), wasting (7.4%), and overweight (3.4%). The Indonesia Health Survey (SKI) 2023 recorded a decrease in the prevalence of stunting among toddlers from 21.5 percent in 2023 to 19.8 percent in 2024 (SSGI, 2024).[3,4] The government is committed to reducing the national stunting rate to 14.2 percent by 2029, according to the National Medium-Term Development Plan (RPJMN) target, and the Long-Term Development Plan (RPJP) stunting prevalence target of 5 percent by 2045.[1]

Based on SKI 2023, North Toraja Regency ranked eleventh out of 24 districts/cities in South Sulawesi Province, with a stunting prevalence of 28.7 percent, which decreased to 27.6 percent in 2024. One specific nutritional intervention effort is the growth monitoring program through anthropometric measurements at Integrated Health Posts (Posyandu) by community health cadres.[5] The World Health Organization (WHO) emphasizes that growth assessment requires accurate anthropometric measurements, and the results should be compared with reference values.[6] Measurement accuracy is a primary indicator for obtaining accurate and high-quality data, and measurement errors can affect the interpretation of nutritional status.[7]

North Toraja Regency, as a priority area for stunting reduction in South Sulawesi, shows progress with a decrease in stunting prevalence from 54.9 percent in 2013 to 27.6 percent in 2024, according to SSGI. However, data from the routine surveillance system E-PPGBM in 2024 reported a much lower figure of only 13.6 percent.[8] This significant discrepancy poses serious challenges for policy planning and budget allocation, as it disrupts the accuracy of evidence-based planning.[9] The stunting prevalence measurements conducted through the SSGI and E-PPGBM applications showed differences in the data collection methodology. The SSGI uses a sampling approach to obtain data, whereas the E-PPGBM uses a routine surveillance mechanism. These methodological differences imply potential variations in the prevalence of stunting between the two systems. Efrizal (2021) also confirmed significant disparities between estimates of nutritional status prevalence for children under two years of age based on E-PPGBM data and results obtained through SSGBI 2019 and Riskesdas 2018.[10]

To address this, the Indonesian Ministry of Health developed an Electronic Community-Based Nutrition Recording and Reporting Information System (E-PPGBM) in 2016. This application was designed to systematically collect data on the nutritional status of toddlers in each region of the country. The E-PPGBM data are expected to serve as a basis for activity planning, policy evaluation, and decision-making by stakeholders.[11] However, significant differences were observed between the stunting prevalence estimates based on the SSGI and E-PPGBM. The SSGI is a national survey with a stratified multistage random sampling methodology representing the population level,[12] whereas the E-PPGBM is an operational recording system based on routine surveillance used by Posyandu cadres and community health center staff to monitor child growth. The significant differences between the SSGI and E-PPGBM results raise crucial questions regarding the accuracy and utility of each data source in the policy context.[9]

The accuracy of anthropometric measurements at Posyandu is crucial because inaccuracies can lead to misclassification of nutritional status and failure in early detection and appropriate intervention.[13] Optimizing growth monitoring requires standardized measuring tools and trained personnel to ensure the validity and reliability of the data.[14] The importance of utilizing quality data to accelerate stunting reduction is also regulated in Presidential Regulation Number 72 of 2021, which emphasizes strengthening systems, data, information, research, and innovation as one of the main pillars. High-quality data are required for accurate problem identification, appropriate solution recommendations, and policy monitoring and evaluation.[15] However, studies comparing E-PPGBM data with standardized anthropometric measurements in Indonesia are limited, particularly at the district level. Therefore, this study aimed to analyze the validity of E-PPGBM-based nutritional status data by comparing it with gold-standard measurements to determine stunting rates in North Toraja Regency.

METHODS

This study used a cross-sectional design to analyze the accuracy of length/height (PB/TB) measurements by posyandu cadres in the E-PPGBM system compared with gold standard measurements. The study was conducted from May to June 2025.

Posyandu cadres were selected purposively based on the inclusion criteria (n=34), whereas children were selected using simple random sampling from the E-PPGBM registry. The toddler sample size was calculated using the Lemeshow formula (1997), and 188 toddlers were obtained, spread across eight posyandu in North Toraja Regency. Toddler subjects were randomly selected from the list of toddlers in each posyandu using Microsoft Excel. These random numbers were used to select participants from the list of toddlers in each posyandu. The integration of E-PPGBM target data with gold standard data was based on toddler identity data, such as name, population identification number, age, and address. The inclusion criteria for the cadres were active posyandu cadres for toddlers, physical and mental health, and willingness to sign an informed consent. The inclusion criteria for toddlers were healthy toddlers registered at the posyandu and residing in the research area. The exclusion criteria for cadres were not being a posyandu cadre for toddlers and being inactive. The exclusion criteria for toddlers were unhealthy conditions during data collection and not being registered at the posyandu. A total of 188 children were selected using simple random sampling from the E-PPGBM registry.

Data were collected through anthropometric PB/TB measurements and interviews with the participants. PB/TB measurements to calculate the Height-for-Age Z-score (HAZ) were conducted by two parties: (1) posyandu cadres using calibrated multifunctional stadiometers with a measuring capacity of two meters and an accuracy of 0.1 cm, MSU MED brand, and (2) trained enumerators (community health center nutrition staff with bachelor's degrees in nutrition and experience in SSGI or Riskesdas/SKI surveys) as the gold standard. The processing of PB/TB indicator data by age was performed using the WHO Anthro application.

Statistical analyses were performed using SPSS (version 29). Descriptive analysis was used to present the distribution of participants' characteristics. Diagnostic test analysis using a Receiver Operating Characteristic (ROC) curve was conducted to evaluate the Area Under the Curve (AUC), sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of E-PPGBM measurements in detecting stunting. The degree of agreement between the E-PPGBM and gold standard HAZ scores was examined using the Bland–Altman method (mean difference and 95% limits of agreement). The agreement of the categorical stunting classification was further tested using Cohen's kappa coefficient.

This study was approved by the Health Research Ethics Committee of UNHAS Makassar (approval number 867/UN4.14.1/TP.01.02/2025).

RESULT

Most toddlers were in the 24-35 month age group (27.1%). The proportion of male toddlers (58.0%) was higher than that females (42.0%) (Table 1). The prevalence of stunting according to the E-PPGBM (30.9%) was lower than the gold standard (39.9%), showing an underdiagnosis of 9 percent. The agreement level between the two measurements was 85.6 percent, with a kappa value of 0.689, indicating substantial agreement. The Kappa value of 0.689 indicates substantial agreement according to the Thrusfield classification (Table 2). The AUC of the E-PPGBM for detecting stunting was 0.925 (95% CI: 0.881-0.970), indicating excellent diagnostic accuracy (Table 3, Figure 1). The sensitivity and specificity were 70.7 percent and 95.6 percent, respectively. PPV values were 91.4 percent and 83.1 percent, respectively (Table 3).

Table 1
Characteristics of Respondents

Characteristics	n	%
Age (months)		
<12	24	12,8
12-23	31	16,5
24-35	51	27,1
36-47	45	23,9
48-59	37	19,7
Sex		
Male	109	58,0
Female	79	42,0

Table 2
Cross-tabulation of Stunting Prevalence E-PPGBM vs Gold Standard

E-PPGBM		Gold standard		Total
		Stunting	Normal	
Stunting	Count	53	5	58
	% within	91.4%	8.6%	100.0%
	% of total	70.7%	4.4%	30.9%
Normal	Count	22	108	130
	% within	16.9%	83.1%	100.0%
	% of total	29.3%	95.6%	69.1%
Total	Count	75	113	188
	% within	39.9%	60.1%	100.0%
	% of total	100.0%	100.0%	100.0%

Table 3
AUC, Sensitivity, Specificity, PPV, and NPV Values

Nutrition status	AUC	95% CI	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Stunting	0.925	0.881-0.970	70.7	95.6	91.4	83.1

Table 4
Difference in HAZ Values between E-PPGBM and Gold Standard by Age Group

Age categories (months)	n	Mean	SD	95% limit of agreement	Concordance correlation
<12	24	0.56	0.72	-0.84-1.97	0.67
12-23	31	0.01	0.61	-1.19-1.22	0.67
24-35	51	0.06	1.07	-2.04-2.17	0.59
35-47	45	0.06	0.29	-0.51-0.64	0.94
48-59	37	0.08	0.41	-0.71-1.87	0.90
Total	188	0.12	0.72	-1.28-1.53	0.73

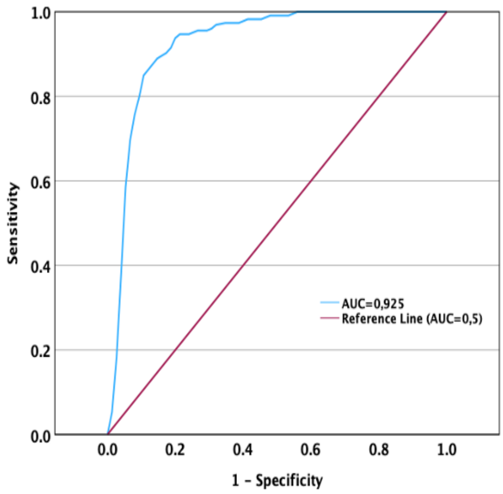

Figure 1
ROC Curve of E-PPGBM for Stunting

The mean HAZ difference between the E-PPGBM and gold standard was 0.12 (95% LoA: -1.28 to 1.53), indicating substantial variability. The largest difference occurred in the <12 month age group (mean=0.56), while the smallest difference was in the 12-23 month group (mean=0.01). Greater variability was observed among children aged <12 months, indicating potential measurement challenges in the younger age groups. The best agreement (Concordance Correlation >0.9) was found in the 36-59 month age group, while younger age groups (<35 months) had lower agreement (CCC<0.8) (Table 4).

DISCUSSION

This study revealed that the prevalence of stunting according to the E-PPGBM (30.9%) was significantly lower than that according to the gold standard measurement (39.9%), indicating an underdiagnosis of 9 percent. A similar phenomenon was reported in a study in Batui Selatan District, where the stunting prevalence based on the E-PPGBM (11.4%) was almost half of the results from trained personnel measurements (22.5%). This reinforces the suspicion that measurements by cadres and community health center staff still have technical limitations.[16,17]

Further diagnostic test analysis showed that the E-PPGBM had an area under the curve (AUC) value of 0.925, indicating an excellent overall diagnostic accuracy.[18,19] However, the relatively low sensitivity value (70.7%) compared to the high specificity (95.6%) reveals a critical weakness where the system can only detect 70.7 percent of children who are truly stunted, while 29.3 percent of truly stunted children were not identified by the E-PPGBM system. Conversely, the E-PPGBM's ability to identify children with normal nutritional status was excellent. This pattern, in which specificity was higher than sensitivity, was consistent with previous research findings.[19,20] This implies that although children detected as stunted by the E-PPGBM are very likely to be truly stunted. Positive predictive value (PPV) of 91.4 percent, there is a considerable proportion of stunted children who are missed and do not receive the necessary interventions.

The Bland-Altman analysis confirmed substantial variability in Height-for-Age Z-score (HAZ) measurements between cadres and the gold standard, with a mean difference of 0.12 and wide 95 percent Limits of Agreement (LoA) (-1.28 to 1.53). This indicates a tendency for the cadres to overestimate HAZ values, which explains why the prevalence of stunting in the E-PPGBM is lower. The lowest measurement agreement was found in the youngest children (age <35 months), while the highest agreement (CCC >0.9) was in the 36-59 month group. This can be caused by several factors, including systematic measurement errors, especially in children under 24 months of age, who are more difficult to measure[21], particularly in measuring the body length of children aged 0-24 months. Studies have shown that untrained individuals often produce less reliable measurements, emphasizing the need for a standardized training program.[22]

These inaccuracies can be caused by multiple factors, including the limitations of measuring tools, noncompliance with standard procedures, and lack of precision in manual measurements.[23,24] The success of the E-PPGBM system depends on the intensity of cadre training, community health center supervision, and the continuity of local funding.[25] Many studies have emphasized the importance of standard protocols and adequate training of personnel involved in data collection.[13,26] Community health workers and cadres who did not receive guidance or regular refresher training tended to produce less accurate and precise data than those who did so. In addition, standard procedures and regular calibration of measuring tools are necessary; however, these protocols are often neglected in the field, further affecting the reliability of the data.[27] Studies by Diyan et al.[20] and Bravo et al.[11] affirmed that the lack of standardization of tools and measurement protocols significantly affects the reliability of anthropometric data. Ergonomic factors, such as child posture and clothing, can also affect the measurement precision and accuracy.[28]

Therefore, efforts to improve the quality of E-PPGBM data should be prioritized and should focus on tiered and continuous training, especially on proper anthropometric measurement techniques for toddlers.[29,30] Standard procedures and regular calibration of measuring tools are necessary; however, these protocols are often neglected. Many health cadres still use uncalibrated equipment and conduct measurements without complying with standard guidelines, which can affect the reliability of results[31], as well as strengthen supervision mechanisms, monitoring, and continuous feedback to ensure the competence of posyandu cadres in anthropometric measurement practices.[32]

This study had several limitations that should be considered. The relatively small sample size may limit the generalizability of our findings. In addition, the condition of the children during the measurement (such as being fussy or crying) may affect the measurement accuracy, although efforts have been made to minimize such biases.

Overall, although the E-PPGBM demonstrated excellent diagnostic accuracy, its sensitivity remained limited owing to field measurement variability. Continuous capacity building, quality assurance, and inter-system data integration are essential to ensure the system's reliability in supporting stunting surveillance and policy decision-making in Indonesia.

CONCLUSION

The E-PPGBM data showed excellent diagnostic accuracy but with limited sensitivity, causing underdiagnosis of stunting in North Toraja Regency. There was a tendency for the overestimation of HAZ values by cadres across all age groups, with the lowest agreement in infants and toddlers, reflecting measurement variability and highlighting weaknesses in the field data quality. These findings emphasize that strengthening cadre competence through structured training, regular equipment calibration, and supervision is essential for improving the reliability of routine anthropometric measurements. Ensuring data validity in the E-PPGBM is crucial for accurate surveillance, targeted intervention planning, and effective monitoring of Indonesia's national stunting reduction program.

RECOMMENDATION

A multilevel approach is required to improve the accuracy and reliability of the stunting surveillance data. The capacity building of posyandu cadres should be strengthened through structured, tiered, and continuous training focused on standardized anthropometric measurement techniques. Regular calibration and maintenance of measuring equipment must be ensured at the puskesmas level to minimize such errors. In addition, the supervision and data validation system within the E-PPGBM should be enhanced through periodic audits and feedback mechanisms supported by district health offices. Integration of the E-PPGBM with national survey systems, such as the SSGI, is also necessary to improve data consistency and policy relevance. These strategies align with Presidential Regulation No. 72 of 2021, which emphasizes data governance and innovation as key pillars of the national stunting reduction framework.

ACKNOWLEDGMENT

We thank all the community health cadres who took the time participated in this study.

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