Media Kesehatan Masyarakat Indonesia
Volume 21 Issue 4 2025
DOI : 10.30597/mkmi.v21i4.43510
Website : http://journal.unhas.ac.id/index.php/mkmi


# Evaluation of Anthropometric Data Quality for Children from Electronic-Based Nutrition Surveillance: A Case Study in Magelang Regency, Central Java, Indonesia

**Slamet Riyanto[1*], Digna Niken Purwaningrum[2], Lutfan Lazuardi[3]**
[1]Research Center for Public Health and Nutrition, National Research and Innovation Agency (BRIN), Cibinong Science Center, Bogor, Indonesia
[2]Department of Biostatistics, Epidemiology and Population Health, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
[3]Department of Health Policy Management, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
[*]Authors Correspondence: slam026@brin.go.id/+6281316958558

**ARTICLE INFO**

***Article History:***
Received Jun, 26th, 2025
Accepted Dec, 3rd, 2025
Published online Dec, 17th, 2025

**Keywords:**
Anthropometric;
EPPGBM;
Data Quality;
Nutritional Status;
Surveillance;

**ABSTRACT**
Data quality regarding the nutritional status of children under five is crucial for developing strategies to address nutritional issues. This study aims to develop indicators and assess the quality of anthropometric data from community-based nutrition surveillance using the EPPGBM application in Magelang Regency. The research employed an observational design with a quantitative approach. Data quality indicators were defined based on expert consensus using the Delphi method. These indicators were also used to construct an anthropometric data quality index (IKDA). The WPS Office spreadsheet was utilized to assess data quality and perform IKDA calculations. Nine data quality indicators were identified, categorized into four domains: representation, completeness, accuracy, and external consistency. Evaluation of the EPPGBM data revealed that indicators for representation and completeness were categorized as good quality. In contrast, within the accuracy domain, only the z-score accuracy indicator met the "good" standard, while the digit preference indicator showed poor quality. Specifically, digit preference accounted for 24.2% of weight measurements and 62.8% of height measurements, with clustering around digits 0 and 5. In the external consistency domain, the stunting prevalence from the EPPGBM results was lower than the 2022 SSGI results. The IKDA score for the data was 85.8. Overall, the evaluation identified that the EPPGBM data quality in Magelang Regency demonstrated strong representation and completeness but exhibited limitations in accuracy and external consistency. To improve data accuracy, relevant stakeholders should implement targeted interventions, including capacity-building through training of cadres, standardization of measurement procedures and instruments, and reinforcement of supervisory mechanisms.

## INTRODUCTION

Overcoming the chronic malnutrition (stunting) problem is one of the focuses of Indonesia's 2020-2024 National Medium-Term Development Plan (RPJMN), which targets reducing stunting by up to 14% in 2024.[1] Stunting prevention efforts require routine data on children under five nutritional status. These data can be used for situation analysis, determining the intervention locus, and achievement indicators at all levels. To ensure routine data availability, the Government has established a strategy in Presidential Decree No. 72, 2021, to strengthen and develop systems, data, information, research, and innovation.[2] The availability of good quality nutritional status data for children under five at the village level is a serious challenge in tackling stunting.[3] Stakeholders need good quality and sustainable data to develop strategies and assess program achievements.[4,5]

Annual data on the nutritional status of children under five at the national, regency/city levels are available through various routine surveys conducted by the Ministry of Health, including the Basic Health Research/*Riset Kesehatan Dasar (Riskesdas)* and the Indonesian Nutritional Status Study/*Survei Status Gizi Indonesia (SSGI)*. These surveys are performed by trained health workers and use standardized tools, protocols, and strict controls to ensure the quality of the anthropometric measurement data obtained. However, these activities require funding support, are limited in producing macro-level data, and cannot provide village and individual level – by name and by address – data.[6]

Data sources that potentially describe the nutritional status of children under five at the village and individual levels – by name by address – are nutrition surveillance data. The Government has assigned regencies/cities to use nutrition surveillance data and is targeting 100% of regions to implement electronic-based nutrition surveillance by 2023.[2] In addition, nutrition surveillance activities are regulated in tby Ministry of Health (MoH) Regulation No. 14, 2019, concon Technical Implementation of Nutrition Surveillance, which inclcoversa collection, processing, and dissemination. The MoH has also developed an Electronic Community-Based Nutrition Recording and Reporting/*Elektronik-Pencatatan dan Pelaporan Gizi Berbasis Masyarakat (EPPGBM)* application to support nutrition surveillance activities. One of the indicators obtained is nutritional status based on routine anthropometric measurements of children under five (height/length and weight).

A health informatics system aims to produce quality health data to support evidence-based policies.[7,8] However, poor data quality can influence situational analysis results and inappropriate follow-up.[9] The data quality from the EPPGBM apps is a major concern because most anthropometric measurement data are generated from community-based activities such as integrated service posts/*Pos Pelayanan Terpadu (Posyandu)*. This condition may lead to poor data quality due to limited available resources. A study by the Center for Indonesia's Strategic Development Initiatives (CISDI) states that Posyandu is an ideal platform for monitoring growth. However, limited measuring instruments, especially for height/length, and skilled staff remain a bottleneck.[10]

Magelang is one of the regencies in Central Java that is making serious efforts to reduce the number of nutritional problems among children under five. The 2021 SSGI data show that the prevalence of stunted under-five children in Magelang was 22.3%.[11] The Magelang District Health Office has also used the EPPGBM apps to report monthly nutritional surveillance results of children under five. Therefore, researchers are interested in analyzing the quality of anthropometric data from nutrition surveillance based on EPPGBM apps in Magelang Regency. This study will also identify and develop anthropometric data quality indicators into a data quality index that matches the EPPBM data characteristics.

## MATERIAL AND METHOD

### Data Source

Data quality evaluation incorporating secondary data from anthropometric measurements of children under five (0-59 months) in Magelang Regency from the February 2023 nutrition surveillance report via the EPPGBM apps.

### Data Quality Indicator

The indicator selection was based on expert consensus, using a modified Delphi method

across two rounds. This method was a structured approach to answering research questions by bringing together experts' opinions in various fields related to the problem. The Delphi method used in this study generally refers to Trevelyan and Robinson (2015) and Zinab et al. (2019).[12,13] Respondents consist of experts in the field; 20 were invited in the first round to meet the minimum number of experts recommended for each round (n = 8 experts).[8] The inclusion criteria for the experts in this study included having a minimum master's degree in nutrition, public health, epidemiology, biostatistics, or medicine. Practitioners were required to hold an undergraduate degree and at least 5 years of experience in nutrition surveillance.

The questionnaire in the first round consisted of 15 initial indicators for assessing the quality of EPPGM-based anthropometric data. These indicators include data representation domain (indicators: target coverage, data entry duplicate, age distribution), data completeness domain (indicators: data completeness of date of birth, measurement date, gender, measurement position (length/height), body length/height data, body weight data), data accuracy domain (indicators: digit preference of body weight and length/height data, z-score outlier values height-for-age index), timeliness domain (indicator: timeliness of data entry time), and external consistency of data (indicator: stunting prevalence comparison with national standard survey).

The first and second rounds of questionnaires were emailed to experts, with a maximum completion time of 10 days for each round. Each expert was requested to assess the feasibility of each indicator on a 0-5 scale, justify their assessment based on their expertise and experience, and provide input or suggestions for other indicators, if any. The second-round questionnaire contains the same indicators, followed by the previous expert's score, the average score of all experts, and a summary of the justification. The experts were asked to reassess this information and recommend a cut-off point for each indicator of good-quality data. Expert agreement for each indicator was obtained if at least 60% of experts in the second (final) round rated the same range; "0 = inadequate indicator", "1-3= low-quality indicator, low-moderate score", or "4-5 = good indicator, high score". The standard deviation of the average value of each indicator cannot be more than 1 (one) SD.

The final indicator used was the indicator agreed upon by the expert in the final round and adapted to the EPPGBM application's characteristics. The EPPGBM application characteristics were obtained by the observation method facilitated by the manager/person in charge of the EPPGBM apps at the Magelang District Health Office. The final indicator will be used to assess data quality and to construct the EPPGM-based anthropometric data quality index/*Indeks Kualitas Data Antropometri (IKDA)*. Steps for index development were adopted steps for special index development for stunting prevention efforts.[14]

**Analysis**

Data on expert respondents' characteristics and assessment results were presented descriptively in tabular form. The assessment results for each data quality indicator were shown in tables, along with the frequency of Public Health Centres/*Pusat Kesehatan Masyarakat (Puskesmas)* that achieved the minimum score. Additionally, the data was visualized as a regency-level histogram to clarify the digit preference indicator for the measurement results. The data quality index was displayed in a diagram and sorted by the IKDA rating for all Puskesmas in Magelang Regency. All descriptive analyses were conducted using the WPS Office Spreadsheet. A Chi-Square Goodness-of-Fit test was used to evaluate the distribution of the final digit in weight and height measurements. The observed digits (0–9) were compared to the expected uniform distribution using SPSS version 16 at a 5% significance level.

**Ethics Approval and Consent to Participate**

This study received ethical approval from the Medical and Health Ethics Commission, Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University, under the approval number KE-FK-0307-EC-2023, dated February 24, 2023. All expert respondents provided informed consent to participate in the research before the study commenced.

## RESULTS

### The Quality of the Anthropometric Data Indicator from EPPGBM Results

Table 1 shows the expert respondents' characteristics involved in the first and second rounds of Delphi. The response rate in the first round was 70%, with 14 experts participating out of 20 invited. In the second round, 11 of the 14 experts from the previous round were involved.

Figure 1 shows the results of expert assessments in the first and second rounds. The indicators assessed by experts in the first round were reassessed by the same expert in the second round. In the second round, experts suggested the addition of z-score outlier value (weight-for-age) indicators that fall into the data accuracy domain. The second round results showed an increase in the percentage of experts who agreed on most indicators compared to the first round. The timeliness indicator and the stunting prevalence comparison, which did not meet the agreed criteria in the first round, were fulfilled in the second round. Meanwhile, the age distribution and z-score outlier value (weight-for-age) were not agreed-upon indicators. The final results of the expert recommendations, after two rounds, agreed on 14 of the 16 indicators.

After adjustments were made based on the the EPPGBM application's characteristics, researchers concluded that five indicators were either unnecessary or unsuitable for assessing the quality of anthropometric data from the app. These indicators include completeness of data on birth, measurement date, and gender. These three indicators did not require evaluation because of standardized data entry formats and mandatory input requirements that ensure the completeness of the resulting data output.

Although measurement position data also follows a standardized format and is required, this indicator could not be used because length/height measurement position data is unavailable in the output recap used for quality assessment. Additionally, the absence of data entry dates and times prevented the use of timeliness indicators to assess the quality of EPPGBM-based anthropometric data. The final indicators, aligned with operational definitions, indicator weights, and cut-off points, are presented in Supplement 1.

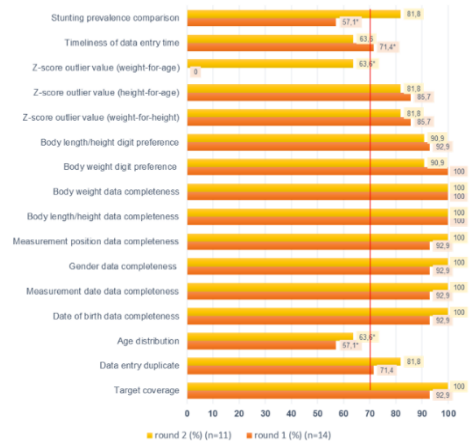
**Table 1. Expert Respondent's Characteristics**

| Indicators | Round 1 (n=14) n (%) | Round 2 (n=11) n (%) |
|---|---|---|
| Experts invited (response rate) | 20 (70) | 14 (78.6) |
| **Gender** | | |
| Male | 7(50) | 6 (54.5) |
| Female | 7(50) | 5 (45.5) |
| **Highest Education** | | |
| Bachelor | 2 (14.3) | 1 (9.1) |
| Master | 8 (57.1) | 7 (63.6) |
| Doctoral | 4 (28.6) | 3 (27.3) |
| **Field of Expertise** | | |
| Public Health Nutrition | 7 (50) | 5 (45.4) |
| Nutrition Survaillance | 2 (14.3) | 1 (9) |
| Epidemiology | 2 (14.3) | 2 (18.1) |
| Biostatistic | 2 (14.3) | 2 (18.1) |
| Public Health | 1 (7.1) | 1 (9) |
| **Profession** | | |
| Lecture | 2 (14.3) | 1 (9.1) |
| Researcher | 8 (57.1) | 8 (72.7) |
| Public Health Nutritionist | 2 (14.3) | 1 (9.1) |
| Health Policy Analyst | 2 (14.3) | 1 (9.1) |
| **Institution** | | |
| University | 3 (21.4) | 2 (18.2) |
| Ministries | 9 (64.3) | 8 (72.7) |
| Puskesmas | 2 (14.3) | 1 (9.1) |
| **Years of Experience** | | |
| 5-10 | 1 (7.1) | 1 (9.1) |
| 11-20 | 7 (50) | 5 (45.5) |
| 21-30 | 5 (35.8) | 4 (36.3) |
| > 30 | 1 (7.1) | 1 (9.1) |

Source: Primary Data, 2023

### Anthropometric Data Quality Index (IKDA) Calculation from EPPGBM Results

Table 2 provides an overview of the stages of compiling the IKDA calculation formula, which was obtained from the total indicator values after being multiplied by each weight, divided by the total potential value, and multiplied by 100%. The IKDA score should not be used as the sole parameter for assessing data quality. Data were considered of good quality if IKDA >85% and all single indicators met the minimum limit of a good data category (Table 2).




*Standar deviation of the average score>1

Source: Primary Data, 2023

**Figure 1. Expert Assessment Results in the First and Second Rounds**

**Table 2. The Indicators for Constructing the EPPGBM-Based Anthropometric Data Quality Index**

| Indicators (I) | Maxi-mum Score (%) | Indicator Weight (B) | Maximum Score After Adjusting the Indicator's Weight |
|---|---|---|---|
| **Data Representation** | | | |
| Target coverage | 100 | 4.5 | 450 |
| No duplicated data | 100 | 4,2 | 420 |
| **Data Completeness** | | | |
| Body length/ height data completeness | 100 | 4.8 | 480 |
| Body weight data completeness | 100 | 4.8 | 480 |
| **Data Accuracy** | | | |
| Body weight digit preference | 100 | 4.4 | 440 |
| Body length/height digit preference | 100 | 4.5 | 450 |
| Z-score accuracy (weight-for-height/ WFH) | 100 | 4.2 | 420 |
| Z-score accuracy (height-for-age/ HFA) | 100 | 4.2 | 420 |
| **External Consistency** | | | |
| Stunting prevalence comparison | 100 | 2.8 | 280 |
| **Total Score** | | | **3840** |
| EPPGBM-Based Anthropometric Data Quality Index **(IKDA)** | $\frac{\sum_{i=1}^{9}(actual\ score\ Ii\ xBi)}{3840}\ x\ 100\%$ | | |

Source: Primary Data, 2023

## EPPGBM Data Characteristics in Magelang Regency, February 2023

Magelang is one of the regencies in Central Java Province, with 29 Puskesmas. This study evaluates nutrition surveillance reporting data for children under five in the EPPGBM apps for February 2023. The target for children under five recorded in the apps was 80,552 data with an entry coverage of 97.1% or around 78,235. Data for that period recorded that most children under five were male (53%) and aged 24-59 months (63.8%).

## The Anthropometric Data Quality from the EPPGBM Results

The anthropometric data quality for the EPPGBM-based nutrition surveillance in Magelang Regency for the February 2023 reporting period is shown in Table 3. All Puskesmas in Magelang Regency have representative data on data coverage and minimum duplicate data. The coverage of children under-five who have been measured and have data entry has reached 97.2% of the total targets in the February 2023 period – around 80,552 children under-five. Based on the data completeness indicators, all Puskesmas have good completeness for weight and length/height measurements.

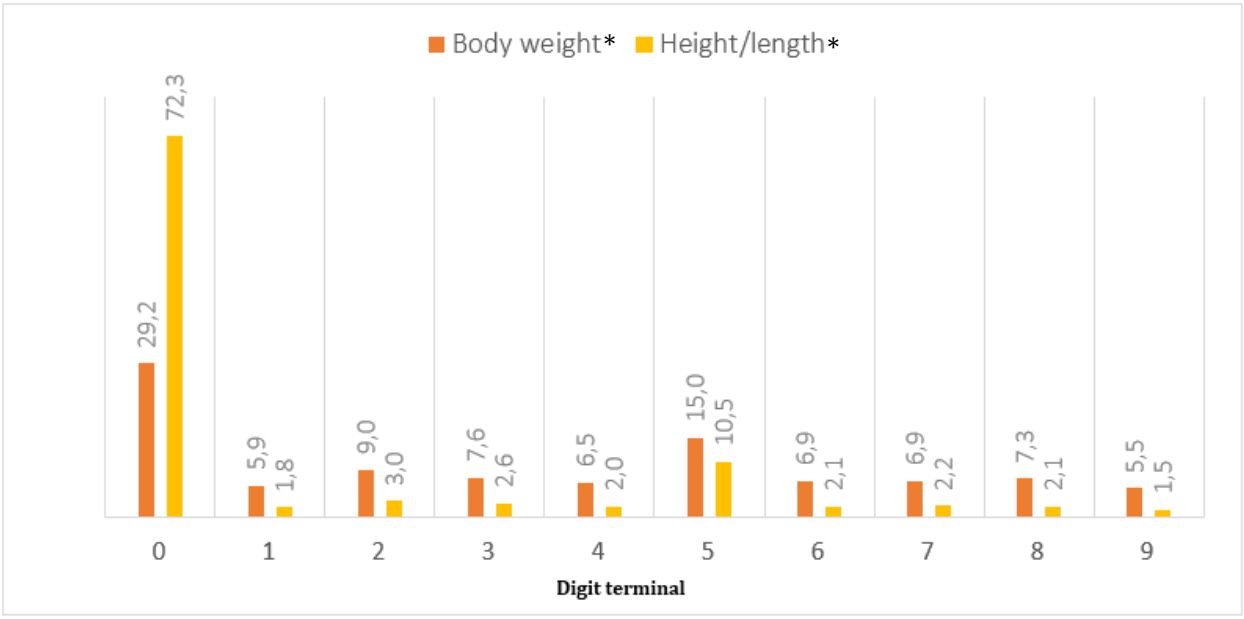
In the domain of data accuracy, the digit preference indicator for weight and length/height remained low, at below 82.5%. For body weight measurement results, only about 75.8% of the data have the last decimal digit properly distributed between 0 and 9. Worse conditions were observed in the digit preference of length/height measurement results, where 62.3% of the results entered into the EPPGBM application were integers, as shown in Figure 2. Regarding the accuracy indicators for height-for-age and weight-for-height z-score values, more than 99% of the data from all Puskesmas were within the expected range (not outliers). The 2022 Indonesian Nutritional Status Study (SSGI) found that the prevalence of stunting among toddlers in Magelang Regency was 28.1%. If this number were used as the gold standard, the EPPGBM results for the particular Regency could detect only around 50% of stunted cases in the region.

Figure 3 shows the IKDA scores for 29 Puskesmas in Magelang Regency. More than half of the Puskesmas have IKDA scores higher than the regency average of 85.8%. However, none of the Puskesmas can be categorized as having good data quality because not all constituent data quality indicators have met the established minimum thresholds, as shown in Table 3. The data accuracy indicated by the digit preference in anthropometric measurement results still requires serious attention from all Puskesmas in the Magelang Regency.

**Table 3. Summary of the Quality of Anthropometric Data from The EPPGBM Results of Puskesmas in Magelang Regency Based on a Single Indicator (n=29 Puskesmas)**

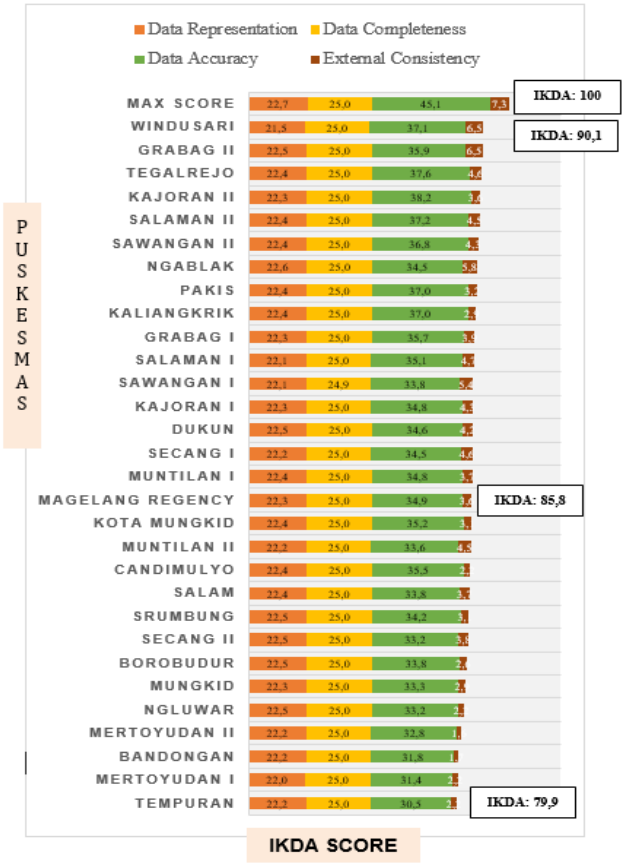
| Indicators | Data Quality Score | | | | Puskesmas with Good Data Quality Category* | |
|---|---|---|---|---|---|---|
| | Mean | SD | Min | Max | n | % |
| **Data Representation** | | | | | | |
| Target coverage | 97.2 | 1.7 | 90.2 | 99.4 | 29 | 100 |
| No duplicated data | 99.8 | 0.3 | 98.7 | 100 | 29 | 100 |
| **Data Completeness** | | | | | | |
| Body length/height data completeness | 99.9 | 0.1 | 99.5 | 100 | 29 | 100 |
| Body weight data completeness | 100 | 0.0 | 99.9 | 100 | 29 | 100 |
| **Data Accuracy** | | | | | | |
| Body weight digit preference | 75.1 | 7.2 | 54.6 | 88.6 | 1 | 3.7 |
| Body length/height digit preference | 36.4 | 11.2 | 18.5 | 57.0 | 0 | 0 |
| Z-score accuracy (weight-for-height/ WFH) | 99.9 | 0.2 | 99.4 | 100 | 29 | 100 |
| Z-score accuracy (height-for-age/ HFA) | 99.8 | 0.1 | 99.5 | 100 | 29 | 100 |
| **External Consistency** | | | | | | |
| Stunting prevalence comparison | 51.3 | 18.0 | 22.6 | 89.8 | 2 | 7.4 |

Source: Primary Data, 2023
*cut off (%): indicator 1=85; indicator 2=87,5; indicator 3-4=92,5; indicator 5-6=82,5; indicator 7-9=80




Source: Primary Data, 2023
*Chi-square goodness-of-fit test indicates significant digit preference ($p < 0.001$). Digits 0 and 5 appeared more frequently than expected

**Figure 2. Distribution of Body Weight and Length/Height Data Terminal Digits**




Source: Primary Data, 2023

**Figure 3. EPPGBM-Based Anthropometric Data Quality Index (IKDA) Based on The Puskesmas Area in Magelang Regency (Reporting Period February 2023)**

## DISCUSSION

The data quality is multidimensional, depending on the characteristics and the purpose of data usage.[15,16,17] A systematic review stated that data quality assessment needs to be performed comprehensively, not only from one dimension or one indicator.[18] The same systematic review also states that at least three quality aspects need to be assessed; the quality of the data collection process, the data, and data usage. In this study, the indicator's development will focus solely on the quality of the data produced. Assessment of quality indicators in the data collection process and data use aspects tends to be more complex because it requires involving organizations and actors in nutrition surveillance.[18] This method will require more time and resources, which may be difficult for the nutrition surveillance manager to implement.

This study concludes that nine main indicators in four domain groups could be used to assess the quality of EPPGBM-based anthropometric data. The first domain was data representation, with target coverage and non-duplicated data indicators; the data completeness domain, with measurement completeness indicators; the accuracy domain, with digit preference of measurement results and accuracy of z-score values indicators; and the external consistency domain, with stunting prevalence comparison with other data sources indicators. WHO and the Centers for Disease Control and Prevention (CDC) state that there are three basic characteristics of high-quality public health data; data completeness, accuracy, and timeliness.[19] Among the three important components of data quality mentioned by WHO and CDC, this study uses at least two components; data completeness and accuracy. Because the evaluation in this study focuses on each data unit, the timeliness dimension cannot be used due to the unavailability of entry date data in the EPPBM data output.

Most of the indicators produced in this study follow the recommendations of the WHO/ UNICEF Anthropometry Data Quality Working Group.[20,21] The distinguishing indicator was the external consistency indicator, produced by comparing the EPPGBM results with the SSGI data source. The consideration of using the SSGI was that all stages of activities were standardized and controlled by experts. In general, this indicator remained related to the data accuracy dimension and described the external validity of the data. Validity is also an important domain of public health surveillance.[22]

The assessment results concluded that the anthropometric data based on EPPGBM in Magelang Regency were representative in quantity and had good data completeness. However, the data has lower accuracy and consistency than the SSGI 2022 results. The accuracy indicator that was not met was the digit preference for body weight and length or height measurement results. Meanwhile, more than 99% of the height-for-age and weight-for-height z-score indexes were in the correct range value. This result was in line with research in Indonesia, which evaluated the quality of anthropometric data from Posyandu and reported findings through an electronic application devel-

oped across several areas of the study.[23] Compatibility was mainly demonstrated by the data completeness indicator and the accuracy of the z-score values, indicating good data quality. Even when compared with the children's anthropometric data quality research in healthcare facilities,[24] the EPPGBM data was considered not worse based on data completeness and the accuracy of the z-score value.

As a result of community-based surveillance, the digit preference values for weight and length/height measurements in the EPPGBM data were lower than those in organized surveys such as the Demographic and Health Surveys (DHS) and several others.[25,26] In those surveys, the percentage of data that needed to be redistributed was only 3-10% for body weight and 3-36% for body length/height. Meanwhile, the EPPGBM data found that around 20% of body weight and 60% of body length/height measurements had terminal digits of 0 and 5.

Community-based surveillance is a widely applied surveillance model in low-middle-income countries, such as Indonesia and Ethiopia.[27,28] Community-based surveillance can potentially become a solution for conducting surveillance in limited resources conditions.[29] However, this study showed that the accuracy of the data produced needs to be considered and improved.

Various factors may have contributed to the lack of accuracy in the EPPGBM data, including unstandardized measuring instruments, varying capabilities of measurement personnel, failure to implement standardized measurement and data recording procedures, and a lack of supervision.[30,31] There was a note in the EPPGBM apps that might influence the result, namely the example of measurement results in the length/height column as an integer (70 cm). This condition can lead to data entry personnel with low literacy entering measurement results as rounded numbers. These potential causes were confirmed by the statement of the nutrition surveillance manager at the Health Office and Puskesmas levels during the observation of the EPPBM apps. Several indicators that have been achieved have received support from program managers and implementers in the form of policies and commitments, as well as the use of electronic-based reporting applications that support completeness and minimize errors in data entry.

Almost all of the anthropometric data for children under five reported through the EPPGBM apps was derived from Posyandu activities. Posyandu activities have been carried out since the 1980s, and now there are 213,670 Posyandu units with more than 1 million active health cadres throughout Indonesia.[32] Several studies have concluded that Posyandu effectively increased community participation in regularly monitoring the growth of under-five children and optimizing the target nutritional status.[33,34] Therefore, the routine data obtained from Posyandu can be utilized, given its national coverage and monthly conduct. However, aligned with the current study, several studies stated that Posyandu management still has much to improve to produce quality data. A study from CISDI found several obstacles in Posyandu implementation, including limited standardized measuring instruments, a lack of skilled cadres in anthropometric measurements, not all Posyandu measure length/height, and around 46.8% of children under five had not had their length/height measured in the last 12 months.[10]

One of the performance indicators of a routine data information system is data quality, including the consistency of the data obtained compared to other data sources.[35] This study found a discrepancy in stunting cases of around 50% lower when compared to the 2022 SSGI data as the gold standard. If the number of cases was considered equal across all Puskesmas, then only two Puskesmas had stunting rates close to the SSGI. This result showed that the EPPGBM data has been unable to capture and find the real nutritional problem conditions in the field. Data accuracy with the digit preference indicator still piling up at 0 could be one of the potential causes. The 0.1 cm or kg difference in the measurement results during z-score calculation in determining nutritional status affects the overall conclusion of the nutritional status category.

In addition, one of the results of this study was the compilation of the anthropometric data quality index (IKDA) from the EPPGBM results. The index with four domains and nine indicators sorted the Puskesmas areas in Magelang Regency based on its data quality value. Regions with the lowest IKDA scores were regions where most of the single indicators had low scores compared to other regions. However, in this

study, IKDA was suggested not to stand alone and should be accompanied by the value of each indicator. A high IKDA value (> 85%) does not represent good data quality in a region. Data were considered of good quality if IKDA > 85% and all single indicators met the minimum threshold for a good data category (Table 2). By comparing the IKDA with a single indicator, specific data-quality issues in a region can be identified, facilitating the implementation of monitoring and assistance activities.

IKDA is expected to improve the quality of anthropometric data from community-based nutrition surveillance conducted at Posyandu, in a comprehensive manner based on the key issues identified. The District Health Office can use IKDA to prioritize which Puskesmas require support based on indicators that remain low. Similarly, Puskesmas can apply the same approach at the village or Posyandu level, targeting health cadres and relevant stakeholders. The support provided should not be limited to training but tailored to the specific problems encountered. For example, advocacy to local governments may be needed in areas lacking internet access, which contributes to low data entry coverage. In subsequent periods, IKDA can serve as an indicator to assess whether improvements have occurred following the support activities.

There were technical and substantive limitations or weaknesses in this research. Technically, the Delphi process would be optimal in three rounds due to the potential for new indicator suggestions in the first round. If the Delphi process is conducted in only two rounds, as was done in this study, additional indicators will receive agreement to be assessed only once. However, if no new indicators are proposed and consensus criteria have been met, two rounds are sufficient, aligning with the core purpose of the Delphi method.[36] In this study, the data quality assessment was only performed by one person, which could induce subjectivity bias, such as when determining data duplicates. Data quality assessment by two assessors can also be used to test the consistency and operationality of each indicator definition. The final results of the indicators and indexes should also be presented to the experts for input and to justify their feasibility of use. In addition, this study has focused solely on the quality of the final data and has not yet developed indicators for the data collection and utilization process.

Another substantive limitation of this study is the unavailability of data on the measurement position of infant length/height and the timeliness of data entry in the EPPGBM application output. As a result, these two aspects cannot serve as data quality indicators, even though they were recommended by the experts in this study. Information on the measurement position is important for assessing data completeness and the correctness of measurement procedures based on the child's age. Meanwhile, the timeliness of data entry is a critical indicator because EPPGBM aims to enable prompt detection and management of children with nutrition problems at Posyandu. Delays in data entry may hinder timely response from health workers. These findings provide input for the Ministry of Health to consider adding these two indicators to the EPPGBM data output.

## CONCLUSION AND RECOMMENDATION

Based on a single indicator, this study concluded that the quality of the EPPGBM-based anthropometric data in Magelang Regency has fulfilled the data representation and completeness aspects, but still lacks data accuracy and external consistency. Although the data quality in Magelang Regency has an IKDA score above 85, it does not meet the criteria for good quality data because some constituent indicators fall below the minimum required values. Nevertheless, IKDA can be used to map data quality across regions and prioritize support based on unmet indicators in each area. Based on the results of this study, it is possible to develop an information system for assessing data quality that can be integrated with the EPPGBM application in health information systems. Moreover, efforts are needed to improve data quality, especially in data accuracy in Magelang Regency, by increasing cadres' measurement skills, standardizing measuring instruments and measurement and reporting procedures, and increasing monitoring and assistance efforts, especially in Puskesmas with IKDA values below the overall Regency value.

## ACKNOWLEDGMENTS

The author would like to thank all the experts

involved in this research and the Magelang District Health Service, who have permitted the use of the February 2023 EPPGBM data.

## AUTHOR CONTRIBUTIONS

SR contributed to conceptualizing the study, conducting research, analyzing data, and drafting the manuscript. DNP and LL provided input and corrections throughout the research process, from implementation to manuscript preparation. SR = Slamet Riyanto; DNP = Digna Niken Purwaningrum; LL = Lutfan Lazuardi.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest in this study.

## REFERENCES

1. Presiden Republik Indonesia. Presidential Regulation of The Republic of Indonesia No. 18 of 2020 Concerning The National Medium Term Development System 2020-2024. Jakarta: Indonesian Government; 2020. https://peraturan.bpk.go.id/Download/122195/Perpres%20Nomor%2018%20Tahun%202020.pdf
2. Indonesian Government. Presidential Decree of Republic Indonesia No 72/2021 About Accelerating Stunting Reduction. Jakarta: Indonesian Government; 2021. https://peraturan.bpk.go.id/Details/174964/perpres-no-72-tahun-2021
3. Bhutta ZA, Akseer N, Keats EC, Vaivada T, Baker S, Horton SE, Et Al. How Countries Can Reduce Child Stunting at Scale: Lessons from Exemplar Countries. *The American Journal of Clinical Nutrition*. 2020;112(2): 894S-904S. Https://Doi.Org/10.1093/Ajcn/Nqaa153
4. Buckland AJ, Thorne-Lyman AL, Aung T, King SE, Manorat R, Becker L, et al. Nutrition Data Use and Needs: Findings from An Online Survey of Global Nutrition Stakeholders. *Journal of Global Health*. 2020;10(2):1–10. Https://Doi.Org/10.7189/Jogh.10.020403
5. Weldon I, Parkhurst J. Governing Evidence Use in The Nutrition Policy Process: Evidence and Lessons from The 2020 Canada Food Guide. *Nutrition Reviews.* 2022;80(3):467–478. Https://Doi.Org/10.1093/Nutrit/Nuab105
6. Ministry of National Development Planning of The Republic of Indonesia. Guidelines for Implementing Integrated Stunting Reduction in Districts/Cities. Ministry of National Development Planning of The Republic of Indonesia. Jakarta: Ministry of National Development Planning of The Republic of Indonesia; 2018. https://stunting.go.id/?sdm_process_download=1&download_id=4714
7. Shama AT, Roba HS, Abaerei AA, Gebremeskel TG, Baraki N. Assessment of Quality of Routine Health Information System Data and Associated Factors Among Departments in Public Health Facilities of Harari Region, Ethiopia. *BMC Medical Informatics and Decision Making.* 2021; 21(1):1–12. Https://Link.Springer.Com/Article/10.1186/S12911-021-01651-2
8. Chanyalew MA, Yitayal M, Atnafu A, Tilahun B. Routine Health Information System Utilization for Evidence-Based Decision Making in Amhara National Regional State, Northwest Ethiopia: A Multi-Level Analysis. *BMC Medical Informatics And Decision Making.* 2021;21(1):1–10. Https://Doi.Org/10.1186/S12911-021-01400-5
9. Zerfu TA, Genye T, Tareke AA. Quality of Routine Health and Nutrition Data in Ethiopia: A Systematic Review. *Plos One*. 2025;20:1–16. Https://Doi.Org/10.1371/Journal.Pone.0316498
10. CISDI. Implementation of Toddler Height Measurement Activities and Integrated Stunting Data Management in Indonesia. Jakarta: Center for Indonesia's Strategic Development Initiatives; 2019. https://cisdi.org/riset-dan-publikasi/publikasi/dokumen/Implementasi-Kegiatan-Pengukuran-Tinggi-Badan-Balita-dan-Manajemen-Data-Stunting-Terintegrasi-di-Indonesia
11. Ministry of Health of Indonesia. Handbook of The Results of The Indonesian Nutritional Status Study (SSGI) at National, Provincial and District/City Levels in 2021. Jakarta: Ministry of Health of Indonesia; 2021.

https://www.badankebijakan.kemkes.go.id/buku-saku-hasil-studi-status-gizi-indonesia-ssgi-tahun-2021/

12. Trevelyan EG, Robinson N. Delphi Methodology In Health Research: How to Do It?. European Journal of Integrative Medicine. 2015;7(4):423–428. Https://Doi.Org/10.1016/J.Eujim.2015.07.002
13. Zinab HE, Kalantari N, Ostadrahimi A, Tabrizi JS, Pourmoradian S. A Delphi Study for Exploring Nutritional Policy Priorities to Reduce Prevalence of Non-Communicable Diseases in Islamic Republic of Iran. *Health Promotion Perspectives.* 2019;9(3):241–247. Https://Doi.Org/10.15171/Hpp.2019.33
14. Statistics Indonesia. Special Index Report For Handling Stunting 2019-2020. Jakarta; 2021. https://www.badankebijakan.kemkes.go.id/buku-saku-hasil-studi-status-gizi-indonesia-ssgi-tahun-2021/
15. Juddoo S, George C. Discovering Most Important Data Quality Dimensions Using Latent Semantic Analysis. *International Conference on Advances in Big Data, Computing and Data Communication System (icABCD) 2018*. 2018;0–5. https://doi.org/10.1109/ICABCD.2018.8465129
16. Ridzuan F, Zainon WMNW. A Review on Data Quality Dimensions for Big Data. *Procedia Computer Science.* 2024;234:341–348. Https://Doi.Org/10.1016/J.Procs.2024.03.008
17. Wang J, Liu Y, Li P, Lin Z, Sindakis S, Aggarwal S. Overview of Data Quality: Examining The Dimensions, Antecedents, and Impacts of Data Quality. *Journal of The Knowledge Economy.* 2024;15(1):1159–1178. Https://Doi.Org/10.1007/S13132-022-01096-6
18. Chen H, Hailey D, Wang N, Yu P. A Review of Data Quality Assessment Methods for Public Health Information Systems. *International Journal of Environmental Research and Public Health.* 2014;11(5):5170–5207. Https://Doi.Org/10.3390/Ijerph11050517 0
19. WHO. Birth Defects Surveillance: A Manual For Programme Managers, Second Edition. Second. Geneva: World Health Organization; 2020. https://www.who.int/publications/i/item/9789240015395
20. WHO, UNICEF. Recommendations for Data Collection, Analysis and Reporting on Anthropometric Indicators in Children Under 5 Years Old. Geneva: World Health Organization and The United Nations Children's Fund; 2019. https://www.who.int/publications/i/item/9789241515559
21. Harkare HV, Corsi DJ, Kim R, Vollmer S, Subramanian S V. The Impact of Improved Data Quality on The Prevalence Estimates of Anthropometric Measures Using DHS Datasets in India. *Science Reports.* 2021;11(1):1–13. Https://Doi.Org/10.1038/S41598-021-89319-9
22. Shah HA, Househ M. Concepts, Objectives and Analysis of Public Health Surveillance Systems. *Computer Methods And Programs Biomedicine Update.* 2024;5:100136. Https://Doi.Org/10.1016/J.Cmpbup.2024.100136
23. Rinawan FR, Faza A, Susanti AI, Purnama WG, Indraswari N, Didah, Et Al. Posyandu Application for Monitoring Children Under-Five: A 3-Year Data Quality Map in Indonesia. *ISPRS International Journal of Geo-Information.* 2022;11(7):399. Https://Doi.Org/10.3390/Ijgi11070399
24. Carsley S, Parkin PC, Tu K. Completeness and Accuracy of Anthropometric Measurements in Electronic Medical Records for Children Attending Primary Care. *Journal of Innovation in Health Informatics.* 2018;25(1):19–26. Https://Doi.Org/10.14236/Jhi.V25i1.963
25. Perumal N, Namaste S, Qamar H, Aimone A, Bassani DG, Roth DE. Anthropometric Data Quality Assessment In Multisurvey Studies of Child Growth. *The American Journal of Clinical Nutrition.* 2020;112(2):806S-815S. Https://Doi.Org/10.1093/Ajcn/Nqaa162
26. Corsi DJ, Perkins JM, Subramanian S V. Child

Anthropometry Data Quality from Demographic and Health Surveys, Multiple Indicator Cluster Surveys, and National Nutrition Surveys in The West Central Africa Region: Are We Comparing Apples And Oranges?. *Global Health Action.* 2017;10(1): 1328185. Https://Doi.Org/10.1080/16549716.2017.1328185

27. Guerra J, Pratikshya A, Barnadas C. Community-Based Surveillance : A Scoping Review. *Plos One.* 2019;14(4):E0215278. Https://Doi.Org/10.1371/Journal.Pone.0215278
28. Demis Nimani T, Muluneh E, Asrade G, Zemene T, Shasho Bayisa F, Debebe Jimma S. Process Evaluation of Community-Based Nutrition Service for Under 2 Years Children in Degadamot District Using Qualitative Approach, Western Ethiopia, 2023. *Inquiry (United States).* 2024;61: 00469580241273244. Https://Doi.Org/10.1177/00469580241273244
29. Nieves CI, Dannefer R, Zamula A, Fonseca A, Myers C, Brown-Dudley L, Et Al. A Qualitative Evaluation of A Community-Based Nutrition and Health Promotion Program. *Journal of Hunger & Environmental Nutrition.* 2022;17(3):318–332. Https://Doi.Org/10.1080/19320248.2021.1898514
30. Syagata AS, Rohmah FN, Khairani K, Arifah S. Evaluation of Height Measurements Implemented by Posyandu Cadre in Yogyakarta. *Jurnal Kebidanan dan Keperawatan Aisyiyah.* 2021;17(2):195–203. Https://Doi.Org/10.31101/Jkk.2311
31. Asmara R, Astuti SP, Nasytha SR, Petersen Z. A Quality Improvement Model for Stunting Prevention Through Community Healthcare Workers Training and Home-Based Growth Monitoring. P*aediatrica Indonesiana.* 2024; 64(6):536–545. Https://Doi.Org/10.14238/Pi64.6.2024.536-45
32. Ministry of Home Affairs. Posyandu Development Data-2022. Dashboard Data Desa Direktorat Jenderal Bina Pemerintahan Desa; 2022. https://id.scribd.com/document/649233348/DATA-PERKEMBANGAN-POSYANDU-TAHUN-2022
33. Anwar F, Khomsan A, Sukandar D, Riyadi H, Mudjajanto ES. High Participation in The Posyandu Nutrition Program Improved Children Nutritional Status. *Nutrition Research and Practice*. 2010;4(3):208-214. https://doi.org/10.4162/nrp.2010.4.3.208
34. Nazri C, Yamazaki C, Kameo S, Herawati DMD, Sekarwana N, Raksanagara A, et al. Factors Influencing Mother's Participation in Posyandu for Improving Nutritional Status of Children Under-Five in Aceh Utara District, Aceh Province, Indonesia. *BMC Public Health.* 2016;16(1):1–9. https://doi.org/10.1186/s12889-016-2732-7
35. Aqil A, Lippeveld T, Hozumi D. PRISM Framework: A Paradigm Shift for Designing, Strengthening and Evaluating Routine Health Information Systems. *Health Policy and Planning.* 2009;24(3):217–228. https://doi.org/10.1093/heapol/czp010
36. Schmalz U, Spinler S, Ringbeck J. Lessons Learned from a Two-Round Delphi-based Scenario Study. *MethodsX*. 2021;8:101179. https://doi.org/10.1016/j.mex.2020.101179

**Supplement 1**

## Final Anthropometric Data Quality Indicators

| No | Indicators* | Operational Definition | Indicators Potential Score(%) | | Weight** | Median *Cut-off* (%)** |
|---|---|---|---|---|---|---|
| | | | Minimum | Maximum | | |
| | **Data Representation** | | | | | |
| 1 | Target coverage | Comparison between the under-fives measured and their data entry on the EPPGBM application for a certain period with the total number of under-fives targeted for that period | 0 | 100 | 4.5 | 85.0 |
| 2 | No duplicated data | Comparison of the number of targets whose data is not duplicated compared to all targets. Identification of duplicates is made by checking duplication of names, NIK (The Customs Identification Number), and parent's names, and confirmed by date of birth and gender. | 0 | 100 | 4.2 | 87.5 |
| | **Data Completeness** | | | | | |
| 3 | Body length/height data completeness | The number of children under five who have length/height data compared to all children under five whose data was entered during that period | 0 | 100 | 4.8 | 92.5 |
| 4 | Body weight data completeness | The number of children under five who have body weight data compared to all children under five whose data was entered during that period | 0 | 100 | 4.8 | 92.5 |
| | **Data Accuracy** | | | | | |
| 5 | Body weight digit preference | Comparison of body weight data with terminal digits distributed in numbers as expected (10% in each digit (0-9)) compared to the entire data. | 10 | 100 | 4.4 | 82.5 |
| 6 | Body length/height digit preference | Comparison of body length/height data with terminal digits distributed in numbers as expected (10% in each digit (0-9)) compared to the entire data. | 10 | 100 | 4.5 | 82.5 |
| 7 | Z-score accuracy (weight-for-height/ WFH) | The z-score for WFH is within the range determined by WHO (-5, +5 SD). It is calculated | 0 | 100 | 4.2 | 80.0 |

| No | Indicators* | Operational Definition | Indicators Potential Score(%) | | Weight** | Median *Cut-off* (%)** |
|---|---|---|---|---|---|---|
| | | | Minimum | Maximum | | |
| | | by comparing the data in the proper range divided by the total data. | | | | |
| 8 | Z-score accuracy (height-for-age/ HFA) | The z-score for HFA is within the range determined by WHO (-6, +6 SD). It is calculated by comparing the data in the proper range divided by the total data. | 0 | 100 | 4.2 | 80.0 |
| | **External Consistency** | | | | | |
| 9 | Stunting prevalence comparison | Standardized national survey data such as SSGI or Riskesdas are the gold standard. The results of the EPPGBM are expected to be closer to the survey results. This indicator is assessed by comparing the prevalence of stunting between the EPPGBM and the nearest standardized survey (SSGI/Riskesdas/Others), with the higher prevalence between the two as the denominator. | 0 | 100 | 2.8 | 80.0 |

Source: Primary Data, 2023

*The indicator names have been adjusted so that all indicators have one-way values (the higher the value, the better the quality)

**The indicator weights are taken from the average of the expert scores in the second round.

***The minimum score for data indicators is categorized as good (the expert respondents' recommendation