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# Modified length board is effectively detecting stunted children at Posyandu: A precision and accuracy test

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## Abstract

**Background.** Currently, anthropometry measurement is considered as an important tool to detect stunted children. Manual measurements of anthropometric tools are commonly used due to their simplicity. However, manual anthropometric techniques produce issues related to human measurement errors.

**Objectives.** The purpose of the study was to perform a precision and accuracy test for a manually modified length board and to assess the prevalence of stunting.

**Methods.** This study was an observational study to assess the precision and accuracy of 360 children's height measurements taken by caders and facilitators as the gold standard. A total of 60 Posyandu caders and 180 children under five year were recruited from three locations of studies; Bakaran Batu in Deli Serdang District, Sidorame Barat in Medan City, and Sidagal in Tapanuli Utara District. The formula for precision and accuracy tests was provided to run automatically calculation.

**Results.** A total of 83.3% of caders had good precision and accuracy in using the length board as a height measurement tool. Regular trainings resulted in more caders having better accuracy and precision skills.

**Conclusion.** A modified length board can be an alternative manual height measurement at the community level and to be used for door-to-door survey.

**Keywords:** Anthropometry; Length board; Precision; Accuracy

## 1. Introduction

Anthropometry is the science that deals with physical body measurements: size, shape, strength, and functional and working capacities (1) (2). Currently, anthropometry measurement is considered an important tool to detect stunted children (3) and obesity (4).

The World Health Organization (WHO) states that around 178 million children under five in the world are stunted (5). WHO through the World Health Assembly Resolution 65.6 (WHAS) has a target to reduce the prevalence of stunting by 40% from 162 million in 2012 to around 100 million in 2025 (6) (7). The prevalence of stunting in developing countries such as Nigeria, Pakistan, and Bangladesh is still high (8). Indonesia is one of the developing countries in Asia that has a high prevalence of stunting 30-37% (9) (10) and decrease to 24.4% in 2021 (11) and 21.6% in 2022 (12). However, this figure is still relatively high considering to WHO target of 20% (6).

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Nutritional anthropometric researchers confirmed that growth monitoring should be regularly conducted because this activity will be able to find out children's growth problems (13) (14). The researchers also emphasized that taking anthropometric measurements regularly such as measuring height is a good way to effective for detecting the tendency of a person's nutritional status (15) (16) (17).

To avoid the internal measures variability and decrease measurement error, the World Health Organization proposed several quality assurance measures ; (i) standardized data collection methodology, (ii) rigorous training and monitoring of data collection personnel, (iii) frequent and effective equipment calibration and maintenance, and (iv) periodic assessment of anthropometric measurement reliability (18).

Manual measurements of anthropometric tools are commonly used due to their simplicities: relatively low cost compared to more automated equipment like 3D scans. However, manual anthropometric techniques produce issues related to human measurement errors (3) (19) (3) (20) .

Another study proved that all anthropometric measurements might be not difficult except height measurement (21). The present review shows that even though anthropometric measurements is not complicated but it needs to present direct indicators of observer errors (3) (22) and low precision and accuracy (23)(24).

Currently, the activity of measuring children's height at the weighing post (Posyandu) is to detect stunted children (25) (26)(27)(28). Most Posyandus use various types of manual height measurement tools such as infantometers, microtoises, wooden rulers, measuring mats, and tape. However, researchers found that the diversity of measuring instruments and the difficulty of using them causes errors in measurement due to the lack of skills of measurers that need consistent training (25)(28)(29)(30).

Therefore it is necessary to modify a simple and practical body length measuring instrument that provides information on stunting. In this study, we developed a modified length board to be used at Posyandu. The profile of this length board is simple, colorful, and communicative. In the middle part, it has meter lines and on the left and right sides, there is a nutritional status table. Children are measured in a recumbent position. The measurements are carried out by two measurers or caders, in which the first cader is to hold the head and the second cader is to press the knee and take the height plotting. This modified length board is not similar to other modified length boards (27) (31) (32).

Before recommending that this tool be used by posyandu cadres, precision and accuracy tests must first be carried out. In this study, accuracy refers to the closeness of caders' measurement to researchers' measurement. While precision is the ability to measure the same subject repeatedly with the smallest error. According to Pederson and Gore, precision is the most basic indicator of measurement skill. If the levels of precision are meant for a technical report, the readers should be given both the results and the acceptable standards in order to determine the precision of each variable (33).

Therefore, this study aimed to assess precision and accuracy of caders in using modified length board at community level

## 2. Material and Methods

Study design: This study was a observational study with descriptive approach. This study was conducted in three locations from November 2021 until April 2022

Location of study: The study was conducted in three villages in different districts in North Sumatera Province; 1) Bakaran Batu village in Deli Serdang District, 2) Sidorame Barat in Medan city, and 3) Sidagal village in North Tapanuli District.

Sidagal Village is in North Tapanuli Regency. The position of the village is on Siatas Barita hill. The population of Sidagal is only 675 people with a total of 160 households and around 90% of parents work as farmers. Among 675 people in the village, 60 are children aged 0-5 years. The distance of this location to the main campus is around 340 km or about 8 hours drive.

Sidorame Barat is located in Medan City. It is a sub-urban area with a total population is 11,229 people. About 500 are children under five years old. The distance from the main campus is around 40 km.

Bakaran Batu is located in Lubuk Pakam District, Deli Serdang Regency. The total population is 2880 persons and among this population, 220 are children under five years old. The distance of this location to the main campus is only 6 km.

### 2.1. Developing modified length board

The rationale in developing a modified length board is because currently caders use conventional and low precision tool. In designing modified length board we concern on ease of use, cultural approriateness and adaptibility local settings. The process of developing involves the community healt workers, community midwives and nutrition workers. Modified Length Board is made from an outdoor colorful plastic and attached to the plywood board. The size is 120.0 cm in length x 35.0 cm wide. This spesification is fit to body of children aged from 0 till 60 months.

### 2.2. The length board has three components

The first component is in the middle part for the meter line. The meter tape length is 0-115cm with an accuracy of 1.0 millimeters.

The second component is left and right side for tables. There are two tables; one is a normal height threshold (length for-age >-2SD) and stunting threshold (length for-age<-2SD)

The third component on the lower part is the instructions to use length board The measuring board is equipped with a headboard on the top. See figure 1


**Figure 1** Modified length board

### 2.3. Population and sample of study

In this study there were two group of population, first is all caders (community health workers) and seond is mothers who have children under five years old. In each location of study two posyandu and ten caders were selected. Therefore number of posyandu caders involved was 30 caders. While number of mothers involved was thirty made the total sample of children mother became 180 persons.

### 2.4. Pre-data collection

Prior to data collection, a three days training for posyandu cadres was conducted. The objective of training was to improve cadres skill in using the modified length board. A total of thirty posyandu cadres involved in the training. The training was implemented in the three session, first session was explanation on the important of growth monitoring, second, how to use the modified length board and the third session is practice. Ten children with mothers were involved as the samples. Three researchers and four enumerators prepared guidance book and took apart in two days training. The materials on second session are definition of length board, how to position a child, how determine normal height, stunting, how to determine the lag of height against the median standard.

### 2.5. Data collection

There are two main data was collected; characteristics of respondents and height of children.

In this study the respondents were posyandu caders. They were interviewed using questionnaires. The characteristics covered age, education, the length work in Posyandu or first started joining posyandu, skill in using anthropomteric tools. The present study considered children age 0-59 months and children height were collected by caders and researchers. The anthropometry data to be used to analyze nutrition status. Data collection was conducted in six weighing posts in three location od study.

Steps for carrying the measurements of children height:

- Prepare the list of children to be measured ( in each session 10 children were measured)
- Prepare standardized modified length board
- Posyandu caders do the first measurement for the first ten children and then continued by the researchers to measure the same children.
- After the first measurement finished then take a 30 minutes break.
- And then the second measurement conducted as the process in first measurement.
- At the end there are two data of children height from caders and researchers fill into form. See the table 1.

**Table 1** Children height of first and second measurement in three locations of study.

| **Researchers** | | | **Kader Posyandu Bakaran Batu** | | **Kader Posyandu Sidagal** | | **Kader Posyandu Sidorame Barat** | |
|---|---|---|---|---|---|---|---|---|
| **Child height (measurement)** | | | **Child height (measurement** | | **Child height (measurement** | | **Child height (measurement** | |
| I (a) | | II (b) | I (a) | II (b) | I (a) | II (b) | I (a) | II (b) |
| 1 | 103.2 | 103 | 103 | 102.8 | 103.5 | 103.4 | 103.1 | 103.2 |
| 2 | 98.4 | 98.5 | 98.6 | 99.3 | 98.1 | 98.6 | 98.4 | 98.9 |

### 2.6. Performing precision and accuracy test

Precision is the ability to measure the same subject repeatedly with the smallest error, while accuracy is the ability to get results as close as possible to the results made by the researchers which are used as the Gold Standard.

We conducted two measurements per dimension, however additional measurements were need until the difference between two measurements was > 5 mm, then, the average of each pair of measurements was implemented (34)

To get the precision and accuracy number, a formula has been provided in an Excel table. It is started by entering the children's height in column 1st and column 2nd of a child that conducted by researchers and caders. Then other columns (ds, ds2, s, S, D, D2) will be automatically calculated. See Table 2.

**Table 2** Formula for precision and accuracy test

| **Results of facilitators measurements** | | | | |
|---|---|---|---|---|
| 1st | 2nd | ds | ds2* | D |
| 102.8 | 102.8 | 0.0 | 0.0 | 205.6 |
| 73.5 | 72.5 | 1.0 | 1.0 | 146.0 |
| Total (∑ds2) | | 2.4 | 2.46 | |

*ds2 = the square of the difference between the first and second measures by researchers of the same children; **de2 = the square of the difference between the first and second measures by cadres of the same children; ***D2 = the square of the difference between the sum of the first and second measurements by the cader and the sum of the first and second measurements by the researcher

### 2.7. Determine the stunting children

Stunting is defined if a child whose height for age Z-score is lower than minus 2 standard deviations (height/age <-2SD) from the median of the reference population based on the WHO standard (35). To calculate the stunting prevalence, data in table 2 were summarized to get the average of children's height and applied to determine stunting prevalence.

### 2.8. Statistical analysis

The data was extracted, edited, and analyzed by using SPSS version 22 for Windows. Descriptive statistics such as frequencies and proportion were used to summarize the distribution of selected respondents' characteristics and the prevalence of children stunting

To perform the precision and accuracy test, the data was extracted, edited, and analyzed using the formula ;

Good Precision, if ds2 caders < 2ds2 facilitator

Good Accuracy if D2 < 3ds2 facilitator (16) (15)

## 3. Results

### 3.1. Characteristics of Posyandu caders

Our population in this study were community health workers that used to be called Posyandu caders. A total of 30 caders and 180 children were involved in this study presented in Table 3.

**Table 3** Characteristics of Posyandu caders

| **Characteristics** | **Bakaran Batu N=10** | | **Sidorame Barat N=10** | | **Sidagal N=10** | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Age (yrs) | | | | | | |
| 20-35 | 4 | 40.0 | 0 | 0.0 | 3 | 30.0 |
| 36-50 | 5 | 50.0 | 4 | 40.0 | 7 | 70.0 |
| >50 | 1 | 10.0 | 6 | 60.0 | 0 | 0.0 |
| Occupation | | | | | | |
| Household works | 8 | 80.0 | 7 | 70.0 | 0 | 0.0 |
| Teachers/Nurses | 2 | 20.0 | 1 | 10.0 | 2 | 20.0 |
| Merchants | 0 | 0.0 | 2 | 20.0 | 0 | 0.0 |
| Farmers | 0 | 0.0 | 0 | 0.0 | 6 | 60.0 |
| Students | 0 | 0.0 | 0 | 0.0 | 2 | 20.0 |
| Education | | | | | | |
| Primary school | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Secondary school | 1 | 10.0 | 2 | 20.0 | 1 | 10.0 |
| Senior school | 8 | 80.0 | 6 | 60.0 | 8 | 80.0 |
| College | 1 | 10.0 | 2 | 20.0 | 1 | 10.0 |
| Length as cader (yrs) | | | | | | |
| < 1 | 1 | 10.0 | 1 | 10.0 | 2 | 20.0 |
| 1-5 | 4 | 40.0 | 0 | 0.0 | 8 | 80.0 |
| 5-10 | 5 | 50.0 | 1 | 10.0 | 0 | 0.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10-15 | 1 | 10.0 | 4 | 40.0 | 0 | 0.0 |
| >15 | 0 | 0.0 | 4 | 40.0 | 0 | 0.0 |

Table 3 explained that younger caders can be found in Bakaran Batu and Sidagal, while older caders (aged >50 years) in Sidorame Barat. In Sidagal, most caders worked as farmers. While in Bakaran Batu and Sidorame, almost all caders were household mothers. Most caders in study locations finished their senior high school, only 10-20% graduated from secondary school. In terms of experience as volunteers in Posyandu, 80% of caders in Sidorame Barat had been working for more than ten years, while in other locations of study, most caders had been working for five years.

On average, 73.3% of caders had good skill in using the length board. A total of 70-80% of caders in Bakaran Batu and Sidorame Barat had good skills. The lowest percentage was in Sidagal, 50%.

### 3.2. Results of precision and accuracy test

**Table 4** The results of precision and accuracy test in twelve group of measurements

| | | **Gold standar (Facilitator)** | **Formula** | | **Cader** | | **Status** |
|---|---|---|---|---|---|---|---|
| Group | Name of Posyandu | | | | | | |
| | | **Precision** | **2xds2** | **3xD2** | **Precision** | **Accuracy** | |
| a | b | c | d | e | f | G | h |
| 1 | Wijaya Kesuma4a | 2.46 | 4.92 | 7.98 | 3.28 | 6.54 | Good Precision Good Accuracy |
| 2 | Wijaya Kesuma4b | 1.92 | 3.84 | 5.76 | 2.77 | 4.87 | Good Precision Good Accuracy |
| 3 | Wijaya Kesuma5a | 3.34 | 7.08 | 10.62 | 4.39 | 5.53 | Good Precision Good Accuracy |
| 4 | Wijaya Kesuma5b | 2.84 | 5.68 | 8.52 | 3.16 | 7.16 | Good Precision Good Accuracy |
| 5 | Bunga Tanjung1a | 2.62 | 5.24 | 7.86 | 4.75 | 7.07 | Good Precision Good Accuracy |
| 6 | Bunga Tanjung1b | 3.60 | 7.201 | 10.8 | 3.86 | 6.57 | Good Precision Good Accuracy |
| 7 | Mawar1a Medan | 3.38 | 6,56 | 9.84 | 4.51 | 5.03 | Good Precision Good Accuracy |
| 8 | Mawar1b Medan | 2.11 | 4.22 | 6.33 | 3.77 | 5.96 | Good Precision Good Accuracy |
| 9 | Rose1a Sidagal | 4.77 | 9.54 | 14.31 | 3.56 | 6.29 | Good Precision Good Accuracy |
| 10 | Rose1b 2/ Sidagal | 4.18 | 8.36 | 12.54 | 4.57 | 8.61 | **Low Precision Low Accuracy** |
| 11 | Rose2a 3/ Sidagal | 2.07 | 4.14 | 6.21 | 3.15 | 5.36 | Good Precision Good Accuracy |
| 12 | Rose2b 4/ Sidagal | 1.95 | 3.90 | 5.85 | 5.51 | 9.40 | **Low Precision Low Accuracy** |

Table 4 showed the results of precision and accuracy test conducted by twelve groups. To determine the results, these formula were used; (2xds2 for precision and 3xD2 for accuracy). Each group had responsible to measure fifteen children. The groups were formed from six posyandu and from different places. The location of Wijaya Kesuma Bakaran Batu is categorized as outskirt, Sidorame Medan is city and Sidagal is village. Of that among twelve groups of measurement, ten groups (83.3%) have a good precision and accuracy. Only two groups (16.7%), Posyandu Rose 1b and Rose 2b from Sidagal that had low precision and accuracy. Bad precision in Posyandu Rose2b (5,51) it is because the measurement of caders were more than two times the researchers' precision (1.95/3.90) and the accuracy of caders (9.40) is more than three times of researchers' precision (1.95/8.85). Such condition also happen in Posyandu Rose1b Sidagal. While in other ten posyandu the result of precision test are not more than two times the researchers' precision and result of accuracy test are also not more than three times of researchers' precision. For example, in Wijaya Kesuma4a, precision test is 3.28 which is not more that two times the researchers' precision, 4.92 and the accuracy is 6.54 not more than three times researchers' precision, 7.98.

**Table 5** Prevalence of stunting in three location of study

| **Location of study** | | **Nutrition status (height/age)** | | | | | |
|---|---|---|---|---|---|---|---|
| | | Severe stunted | | Stunted | | Normal | |
| | N | n | % | n | % | n | % |
| Bakaran Batu | 60 | 6 | 10.0 | 12 | 20.0 | 42 | 70.0 |
| Sidorame Barat | 60 | 0 | 0.0 | 6 | 11.7 | 53 | 88.3 |
| Sidagal | 60 | 3 | 5.0 | 16 | 26.7 | 41 | 68.3 |
| **Total** | **180** | **9** | **5.0** | **34** | **18.9** | **137** | **76.1** |

Table 5 showed the prevalence of stunting. The prevalence was taken by calculating of children whose height is <-2 SD of height for age. Of a total 180 children, about a quater (23.9%) is categorized into severe stunted and stunted. in Bakaran Batu, number of severe stunted children was double than Sidagal ( 10.0% vs 5.0%). Sidorame Barat has more normal height children than other location.

## 4. Discussion

The objective of the present study was to assess caders' skill in using modified length boards. In assessing caders' skills, a precision and accuracy test was conducted. The objective of the precision and accuracy test was to determine whether posyandu caders can use the modified measurement tool at posyandu.

This study found that 83.3% of posyandu cadres had good precision and accuracy. This finding was relatively high because only 16.7% had low precision and accuracy tests. It can be assumed that most caders have no difficulties in using the modified length board to measure children's height. Low precision and accuracy for caders were affected by occupation and experience, as in this study most caders work as farmers, and have experience in measuring height, and children's activities[24].

The effect of low precision and accuracy in taking a height measurement is resulting in determining the prevalence nutrition status (36). However, activities in determining nutrition status is part of national nutrition program.

Reliability of manual anthropometric measurement is an important issue in this study. According to Calcagnotto, it was the reliable results that can be considered to determine the application of the new tool at the community level [36]. This finding was higher than previous studies conducted in Posyandu[14,17-18].

Precision is the ability to measure the same subject repeatedly with the smallest error. However, to get better precision, it needs to concern the extent to which an effect replicates. Even though the mean differences between facilitator and measurements are often smaller[36]

However, several considerations should be taken when applying this modified length board in posyandu. The space for placing the length board, accuracy in reading measurement even the characteristics of caders should be taken into account such as knowledge, education, occupation, and experiences in height measurements activities [37] [38]

This can be a big challenge for government to recruit caders with higher education and better occupation, eager to run anthropometric assessments. Therefore, to support the existing caders, conducting regular training is the solution [8][17][18][21].

The difference between this modified length board with other height measurement tools is the availability of an anthropometric table for determining stunting which can be read immediately after the child's height is taken. While other measurements are just to get the height. Caders can be easier to refer the result to the table, no need to look for references. This study detected that 23.9% of children suffered from stunting. These findings were quite similar to several nutritional surveys across districts in North Sumatra and provinces in Indonesia. In 2022, the national nutritional survey found 24.4% stunting in North Sumatra and 25.8% in Indonesia [7,22]. Even in several developing countries. However, in comparing similar findings, it needs to consider the method and sample selection. This study only confirmed that the height measurements using the new length board were eligible for assessing stunting children.

Currently, obtaining stunting rates has become a routine program for growth monitoring activity, however, it must be accurate and fast. The Indonesian government determine stunting prevalence to be decreased to 14% in 2024. Therefore, the implication of this study is before doing measurement activities at the posyandu, it should be started with precision and accuracy tests to ensure the skill of cadres in using the new measuring instruments and more training for less experience caders.

### 4.1. Strength and limitation

Even though this study found a high percentage of caders had better skill in measuring children with modified length boards and can detect stunted children, however, the weakness of this study was no specific analysis of the factors that affected the precision and accuracy. Therefore the next study needs to identify the specific factors of community health workers that have affected the level of precision and accuracy in implementing the anthropometric assessment.

## 5. Conclusion

Currently, manual anthropometric tools were commonly used to detect stunting children at the community level, therefore to have better skill caders and community health workers in using measurement tools should be put in concern. The implementation of this length board might help those who work as children height measurers and door-to-door study. This study suggested that precision and accuracy test was urgent for the new tools and method. To have good precision and accuracy, selected backgrounds of caders and more pieces of training were needly required.

## Compliance and Ethical standards

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### *Disclosure of conflict of interest*

No conflict of interest to be disclosed in this study.

## References

[1] Taifa IW, Desai DA. Anthropometric measurements for ergonomic design of students' furniture in India. Eng Sci Technol an Int J [Internet]. 2017;20 (1):232–9. Available from: http://dx.doi.org/10.1016/j.jestch.2016.08.004

[2] Dawal SZM, Zadry HR, Syed Azmi SN, Rohim SR, Sartika SJ. Anthropometric database for the learning environment of high school and university students. Int J Occup Saf Ergon. 2012;18 (4):461–72.

[3] Ulijaszek SJ, Kerr DA. Anthropometric measurement error and the assessment of nutritional status. Br J Nutr. 1999;82 (3):165–77.

[4] Sommer I, Teufer B, Szelag M, Nussbaumer-Streit B, Titscher V, Klerings I, et al. The performance of anthropometric tools to determine obesity: a systematic review and meta- analysis. Sci Rep [Internet]. 2020;10 (1):1–12. Available from: https://doi.org/10.1038/s41598-020-69498-7

[5] World Health Organization. Childhood Stunting: Challenges and opportunities. Report of a Promoting Healthy Growth and Preventing Childhood Stunting colloquium. WHO Geneva. 2014;34.

[6] World Health Organization (WHO). Global Nutrition Targets 2025. Stunting Policy Brief. Dep Nutr Heal Dev [Internet]. 2014; (Geneva, Switzerland). Available from: file:///C:/Users/LENOVO/Downloads/WHO_NMH_NHD_14.3_eng (1).pdf

[7] WHO, UNICEF. Global Nutrition monitoring framework. Operational guidance for tracking progress in meeting targets for 2025 [Internet]. World Health Organization. 2017. 77 p. Available from: http://apps.who.int/iris/bitstream/handle/10665/259904/9789241513609-eng.pdf;jsessionid=82B08433379C3E3E69B3F8D4F2690C34?sequence=1%0Awww.who.in t/nutrition

[8] Budiastutik I, Rahfiludin MZ. Faktor Risiko Stunting pada anak di Negara Berkembang Risk Factors of Child Stunting in Developing Countries. Amerta Nutr. 2019;

[9] Riskesdas 2018. HASIL UTAMA RISKESDAS 2018 Kesehatan. 2018;20–1. Available from: http://www.depkes.go.id/resources/download/info- terkini/materi_rakorpop_2018/Hasil Riskesdas 2018.pdf

[10] Badan Penelitian dan Pengembangan Kesehatan. Riset Kesehatan Dasar 2013. Ris Kesehat Dasar 2013. 2013;

[11] Kemenkes RI I 2021. buku saku hasil studi status gizi indonesia (SSGI) tingkat nasional, provinsi, dan kabupaten/kota tahun 2021. 2021;2013–5.

[12] Kemenkes. Hasil Survei Status Gizi Indonesia (SSGI) 2022. 2023;1–7.

[13] Bégin F, Elder L, Griffiths M, Holschneider S, Piwoz E, Ruel-Bergeron J, et al. Promoting child growth and development in the sustainable development goals era: Is it time for new thinking? J Nutr. 2020;150 (2):192–4.

[14] Sohal H, Wilkinson D, Morley D. Growth-monitoring teaching aid to improve mother's understanding [3]. Lancet. 1997;

[15] Rosalind S. Gibson. Principles of Nutritional Assessment . Editor Rosalind S Gibson . Oxford University Press Inc . 2nd. 2005;2005.

[16] Supariasa, Penilaian Status Gizi JBKE. Supariasa, Penilaian Status Gizi, Jakarta: Buku Kedokteran EGC. Supariasa, Penilai Status Gizi, Jakarta Buku Kedokt EGC. 2019;

[17] Netty Thamaria. Bahan Ajar Gizi : Penilaian Status Gizi. 2017;11 (3):55. Available from: https://www.m-culture.go.th/mculture_th/download/king9/Glossary_about_HM_King_Bhumibol_Ad ulyadej's_Funeral.pdf

[18] Viviani C, Arezes PM, Bragança S, Molenbroek J, Dianat I, Castellucci HI. Accuracy, precision and reliability in anthropometric surveys for ergonomics purposes in adult working populations: A literature review. Int J Ind Ergon [Internet]. 2018;65:1–16. Available from: https://doi.org/10.1016/j.ergon.2018.01.012

[19] Sicotte M, Ledoux M, Zunzunegui MV, Ag Aboubacrine S, Nguyen VK. Reliability of anthropometric measures in a longitudinal cohort of patients initiating ART in West Africa. BMC Med Res Methodol [Internet]. 2010;10 (1):102. Available from: http://www.biomedcentral.com/1471-2288/10/102

[20] Sulistyawati S. Pengembangan Stadiometer sebagai Alat Ukur Tinggi Badan dan Tinggi Lutut. J Pengelolaan Lab Pendidik. 2019;1 (1):7.

[21] Sebo P, Haller DM, Pechère-Bertschi A, Bovier P, Herrmann FR. Accuracy of doctors' anthropometric measurements in general practice. Swiss Med Wkly.2015;145 (February):1–14.

[22] Simmonds M, Llewellyn A, Owen CG, Woolacott N. Predicting adult obesity from childhood obesity: A systematic review and meta-analysis. Obes Rev. 2016;17 (2):95–107.

[23] Hardiyanti R, Jus'at I, Angkasa D. Hubungan lama kerja menjadi kader, pengetahuan, pendidikan, pelatihan dengan presisi dan akurasi hasil penimbangan berat badan balita oleh kader Posyandu. AcTion Aceh Nutr J. 2018;3 (1):74.

[24] Utama aditia edy. Gambaran Presisi dan Akurasi Penimbangan Balita. 2017;1–14.

[25] Rohmah FN, Siti Arifah. Optimalisasi Peran Kader Kesehatan Dalam Deteksi Dini Stunting. BEMAS J Bermasyarakat. 2021;1 (2):95–102.

[26] Amareta DI, Arum P, Hikmah F. Peningkatan Keterampilan Kader Dalam Pengukuran Panjang Badan Bayi Sebagai Upaya Deteksi Dini Stunting di Wilayah Kerja Puskesmas Sumbersari. J-Dinamika J Pengabdi Masy. 2016;1 (1):9–13.

[27] Nurlita AN, Wigati M, Hasanbasri M, Jumarko J, Helmyati S. Development of Stunting Early Detection Kit for Children under Two Years: Validity and Reliability. J Gizi dan Pangan. 2021;16 (1):39–46.

[28] Simbolon D, Soi B, Ratu Ludji ID. Peningkatan Kemampuan Kader Kesehatan dalam Deteksi Stunting pada Anak Usia 6-24 Bulan melalui Pelatihan Penggunaan Meteran Deteksi Risiko Stunting. Media Karya Kesehat. 2021;4 (2):194–205.

[29] Fuada N, Salimar, Irawati A. Kemampuan Kader Posyandu dalam Melakukan Pengukuran Panjang/Tinggi Badan Balita. Ekol Kesehat. 2014;13 (3):229–39.

[30] Megawati G, Wiramihardja S. Peningkatan Kapasitas Kader Posyandu Dalam Mendeteksi Dan Mencegah Stunting. Dharmakarya. 2019;8 (3):154.

[31] Sinaga HT, Mahdiah, Manalu M. Using modified growth chart in posyandu effectively improved child weight gain in Deli Serdang District, Indonesia. Pakistan J Nutr. 2015;14 (9):547–52.

[32] Hendayana GP. Modifikasi pengukur tinggi badan berbasis mikrokontroler atmega.pdf. 2018.

[33] Norton, K., Olds T (Eds). Anthropomometrica.pdf. University of New South Wales Press. Sidney; 1996.

[34] Lee W, Jung K, Jeong J, Park J, Cho J, Kim H, et al. An anthropometric analysis of Korean male helicopter pilots for helicopter cockpit design. Ergonomics. 2013;56 (5):879–87.

[35] Kebede D, Prasad RPCJ, Asres DT, Aragaw H, Worku E. Prevalence and associated factors of stunting and thinness among adolescent students in Finote Selam Town, Northwest Ethiopia. J Heal Popul Nutr [Internet]. 2021;40 (1):1–12. Available from: https://doi.org/10.1186/s41043-021-00269-4

[36] Indriaty C. Hubungan Karakteristik Kader Penimbang dengan Presisi dan Akurasi Penimbangannya di Kabupaten Sukabumi, Bogor, Demak, dan Semarang Tahun 2002. 2002;