ORIGINAL ARTICLE

Acceptability of A Stuntingmeter Digital Ultrasonic: A Mixed Methods Approach

Tri Siswati[1,2], Bunga Astria Paramashanti[3], Lukman Waris[4], Nanik Setiyawati[2,5], Agus Wijanarka[1,2], Muhammad Primiaji Rialihanto[1,2]

[1] Nutrition Department, Politeknik Kesehatan Kementerian Kesehatan Yogyakarta, 55293 Yogyakarta, Indonesia
[2] Center of Excellence for Applied Technology Innovation in the Field of Public Health, Poltekkes Kemenkes Yogyakarta, 55293 Yogyakarta, Indonesia
[3] Research Center for Public Health and Nutrition, National Research and Innovation Agency (BRIN), 16914 West Java, Indonesia
[4] Stikes Husada Jombang, Mancar, Peterongan (Veteran), Jombang, 61481 Eastjava, Indonesia
[5] Midwifery Department, Politeknik Kesehatan Kementerian Kesehatan, 55143 Yogyakarta, , Indonesia

ABSTRACT

Introduction: New innovation acceptance must be monitored promptly to ensure a continuing and broadened user range. Objective: the study aims to analyze the acceptability of a stuntingmeter digital ultrasonic. **Materials and methods:** We used mixed-methods research to assess the user acceptability of the digital ultrasonic tool of stuntingmeter. The qualitative approach applied a rapid assessment procedure to obtain users' responses on stuntingmeter. Our participants were 120 health workers from different backgrounds, including nutritionists, midwives, health promotors, general practitioners, nurses, and community health workers. We used the diffusion innovation theory to assess user acceptability, including relative advantages, compatibility, complexity, triability, and observability. A structured questionnaire consisting of 23 questions was delivered for self-filling. Score from 1 (strongly disagree) to 10 (strongly agree). Calculating the average invention acceptability value score was the analysis. Performance themes, how to use, innovation functions, and invention improvement recommendations are assessed qualitatively. **Results:** Our findings showed that the five items provided a rating for each attribute of at least 8 and the total mean rating was >8. the mean score of RA was 8.53±1.71, compatibility was 8.60±1.56, complexity was 8.57±1.64, triability was 8.56±1.70 and observability was 8.87±1.64, while the overall mean was 8.62±1.65. The findings of the evaluation also indicated that the stuntingmeter should be scaled up to enhance the comfort level of users, socialization, and support regulation for broad implementation. **Conclusion:** In general, the five facets of the stuntingmeter diffusion assessment were positively received by the participants. However, further development, extensive public awareness, and built-in policy regulations are required to facilitate the instrument's broader adoption.
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Keywords: Acceptability, Anthropometry, Children, Diffusion innovation, Stuntingmeter digital

Corresponding Author:
Muhammad Primiaji Rialihanto, SST,M.Kes
Email: primiaji@gmail.com
Tel: +62 816-688-683

INTRODUCTION

The Indonesian government, particularly the Ministry of Health, is currently facing several challenges, including the double burden of malnutrition. Among these nutritional problems, stunting remains a priority. The stunting prevalence target in 2024 set by the government as stated in the 2020-2024 National Medium-Term Development Plan (RPJMN) follows the Sustainable Development Goals (SDGs) which is 14%(1). Despite stunting reduction from 30.8% in 2018(2) to 21.6% in 2023 (3), Indonesia is still working hard to reduce the stunting prevalence until it reaches the specified target.

Anthropometric tools are an important piece of infrastructure that can provide information on whether a child is categorized as stunting or not(4). In Indonesia, height measurement is uniformly carried out using a microtoise, while body length is measured with an infantometer. This measuring tool has been determined by the Indonesian Minister of Health in the Republic of Indonesia Minister of Health Decree No HK.01.07-MENKES-1919-2022 concerning Standards for Anthropometric Tools and Early Detection Tools for Child Development(5).

Community health workers in the integrated health post (Posyandu) are field officers who play a critical role in measuring children's nutritional status. This measurement activity is carried out during monthly growth monitoring. However, several studies found several limitations on community health workers'

performance, including non-compliance with measurement standard procedure, lack of motivation, unstandardized skills, varied educational levels from elementary to tertiary level, diverse infrastructures, and inadequate incentives which might have impacted results measurement(6)(7)(8).

Currently, an innovation in the form of an ultrasonic digital Stuntingmeter has been developed (9) and its novelty has been tested through a narrative review that has been carried out previously(10). The Stuntingmeter provides output measurements that determine the nutritional status of children based on height or length in cm, height-for-age or length-for-age Z-score, and the categorization of severe stunting, stunting, or normal height according to WHO standards(11) and the Ministry of Health of Indonesia(12). This tool offers various benefits since it is fast, accurate, and portable measuring results, overcoming the problem of limited officer resources, as well as saving training costs (9). Still, health workers have a key role in providing an assessment of whether the invention is acceptable or not. Research showed that several factors were related to the acceptance of new inventions, including social demographics, previous habits, awareness of innovations, opinions of participants regarding the program, and willingness to change(13). This acceptance test was also carried out by previous research when developing new education kits to prevent malnutrition(14). This study aims to find out how people felt about the Stuntingmeter ultrasound digital as a new anthropometry tool.

MATERIALS AND METHODS

Design

The present study used mixed-methods approaches, combining quantitative and qualitative research. For the quantitative approach, we used a cross-sectional survey to examine the acceptability of Stuntingmeter. For the qualitative approach, qualitative research was conducted using rapid assessment procedures to understand user responses toward Stuntingmeter. The use of mixed methods research enabled us to improve the development of new instruments, understand the meaningfulness of outcomes from different participant viewpoints, and inform health care policy(15).Thus, we carried out mixed methods research to understand the acceptance of a new device or invention called the ultrasonic digital stunting meter both on the score assessment scale and on the qualitative evaluation of the invention by considering the benefits, feasibility, ease of use, and contribution to solving nutritional problems as well as the potential for long-term implementation in the field.

Time and place

This study was done in Sleman District, Yogyakarta Special Region, Indonesia from May-August 2023.

Participants

Participants were health workers in charge of anthropometric measurements in the communities. For the quantitative study, we recruited 120 participants representing nutritionists, midwives, health promotors, general practitioners, nurses, and community health workers. A total of 120 participants were obtained based on the minimum sample size calculated using Lemeshow formula(16). For the qualitative evaluation, we selected a total of 15 informants from the quantitative respondents based on their willingness to participate, the representativeness of their characteristics, such as variations of health professions, and data saturation.

Variables

The outcome of the quantitative approach was the acceptability of the Stuntingmeter using Diffusion and Innovation Theory. For the qualitative approach, we assessed five aspects of the new invention acceptability included relative advantages, compatibility, complexity, triability, and observability based on Everett M. Rogers' Theory(17).

Data Collection Procedures and Instruments

Prior to data collection, we explained about our study, the aim of the study, including information on Stuntingmeter. Each participant provided consent by signing the informed consent form. Overall, data collection procedures included the research team explanation about the study, observations by the panelists, the formation of groups consisting of 5-8 participants, participants practising using Stunting meter, and participants reporting individual scores.

For the cross-sectional survey, we used a structured questionnaire consisting of 23 items by applying 1-10 scales, with score 1 as the lowest score and score 10 as the highest score. Participats tried using the tool twice before fulfilling the questionnaire. We separated different sessions for health professionals and community health workers.

For qualitative research, we explored the performance of the Stuntingmeter utilization, invention functions, and general feedback by using a standardized instrument of a new invention following the Roger's Theory (15). We also used a recorder to capture the opinions of informants.

Data Analysis

For quantitative analysis, the average and standard deviation of each of the five things are found, and then the average of all of them in Microsoft Excel. The minimum score for acceptable innovation was 80. Thematic analysis was used to analyse qualitative data. Following verbatim transcription, the first author read the transcripts multiple times or familiarization. A list of codes was developed and grouped into themes

and subthemes manually using Microsoft Excel. Trustworthiness of the qualitative data was obtained by peer debriefing and member checks, in addition to the triangulation of different sources of participants.

Ethical clearance

This study was ethically approved by the Institutional Review Board of Universitas Gadjah Mada (No: KE/FK/0671/EC/2023) on 27 April 2023.

RESULTS

Table I presents the demographic characteristics of 120 participants who utilized Stuntingmeter. Most participants were aged 21-40 years (75.5%) and women (90.0%). Thirty percent of the participants were community health workers, while 70% of them were health professionals. Most of them completed university degrees (60.0%).

Table I: Characteristics of study participants

Variables	n	%
Age (years)		
20-30	33	27.5
31-40	87	75.5
Gender		
Male	12	10.0
Female	108	90.0
Occupation		
Nutritionist	24	20.0
Health promotor	24	20.0
Midwifery	27	22.5
General practitioner	9	7.5
Community health worker	36	30.0
Education		
University degree	84	60.0
Senior high school	36	40.0

User acceptance was evaluated based on the following five criteria: relative advantages, compatibility, complexity, triability, and observability. Five indicators comprised relative advantages with an average of 8.53. Four indicators comprised compatibility with an average of 8.60. Five indicators comprised complexity with an average of 8.57. Five indicators comprised triability with an average of 8.56. Four indicators comprised observability with an average of 8.87. In conclusion, each object has a mean of 8.63, so Stuntingmeter was generally accepted by users. As detailed depicted in Table II.

Table II: The mean acceptance rate based on sub-items

Sub-item	x±SD
Relative advantage	
Tools to improve health worker and cadre exam performance	8.72±1.28
Tools for inspection are superior.	8.32±2.23
Tools can increase exam accuracy.	8.51±1.43
Tools aid exam outcome observation.	8.70±1.47
Inspection tool satisfaction	8.38± 2.11
Mean relative advantages	8.53±1.71
Compatibility	
Toddler nutrition services tools for health workers and cadres	8.55±1.87
The tool according to patient needs in stunting screening	8.66±1.78
The tool according to values in society	8.55±1.66
The tool is proportional to the current level of children's nutritional status	8.64±1.58
Mean of compatibility	8.60±1.56
Complexity	
Instructions for using the tool are understandable	8.64±1.34
Easy to assemble	8.32±1.44
Easy to use	8.74±2.12
Observation results are understandable	8.34±1.46
Easy maintenance	8.83±1.84
Mean of complexity	8.57±1.64
Trialability	
Tools can be used by health workers and health cadres	8.66±2.10
Tools can be used well	8.53±1.98
The tool is suitable for anthropometric measurements of toddlers	8.55±1.45
Tools have many advantages	8.53±1.49
We plan to use this tool	8.55±1.48
Mean of Trialibility	8.56±1.70
Observability	
The tool is an innovation in the nutrition field	8.98±1.89
The tool is a solution to make it easier to screen for child stunting	8.81±1.72
The tool makes it easier to interpret examination results	8.66±1.53
The tool can be used to document the results of child stunting screening	9.02±1.42
Mean of Observability	8.87±1.64
Overall mean	8.62±1.65

Table III presents the results from the regression analysis. Of all five aspects, aspects of relative advantages,

compatibility, triability contributed significantly to the acceptability of Stuntingmeter.

Table III: Results from regression analysis

Independent variables	B	SE	T	p-value	Collinearity statistics	
					Tolerance	VIF
Relative advantages	0.17	0.056	3.989	0.001*	0.545	1.453
Compatibility	0.23	0.066	3.786	0.000*	0.501	1.675
Complexity	-0.34	0.043	-0.879	0.123	0.627	1.654
Trialability	0.28	0.059	3.799	0.002*	0.523	1.543
Observability	-0.23	0.061	-3.102	0.324	0.643	1.534

*significant (p<0.05)

Findings from the qualitative analysis using in-depth interviews, we found four themes of Stuntingmeter acceptability as detailed in Figure 1.

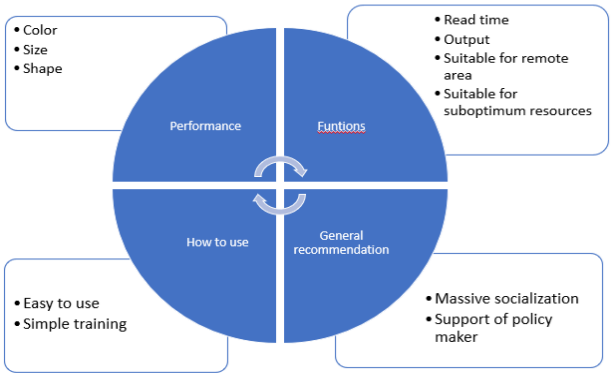

Figure 1: Theme Overview.

Even though users received the Stuntingmeter with a good assessment score, the evaluation results stated the need for scale-up so that respondents were more comfortable when using the tool. As stated by a community health worker as follows:

"One of the users of Stuntingmeter was community health workers. The age range of community health workers was very diverse, from adults to the elderly, so the display size of the tool needs to be enlarged, making the results easier to read." (P1)

In Indonesia, the use of anthropometric tools is determined based on the Health Ministry Decree Number HK.01.07-MENKES-1919-2022 about Standards for Anthropometric Tools and Early Detection Tools for Child Development. In these regulations, the tool used is a manual tool with a single index output. So, to reach a wider range of users and make greater use of the digital ultrasonic stunting meter invention, it is necessary to disseminate information primarily to the private sector, such as general practitioners/midwives/nurses in mother and child clinics, mother and child units in hospitals, as well as academic or research groups. This is as stated by the informant as follows:

"This tool has many benefits and provides fast measurement results in a very short time. Minimum human resources and anyone can use with very short training. It seems that more massive and continuous outreach is needed so that this tool can be utilized by the public." (P2)

Another informant added:
"Advocacy is needed by the government so that this tool can be adopted as an anthropometric tool recommended by the government." (P3)

In terms of using this tool, it was very easy compared to manual tools that were often used in the field, as said by the informant:
"This tool is very easy to use by anyone, but familiarization with the tool and procedures for using the tool are still required." (P4)

This invention had the advantage of sufficient size and comprehensive function to determine whether a toddler was suffering from stunting or not as stated by the informant:

"Portable, adequate size, enough to hold but its function is very good. It can determine whether a toddler is stunted or not within 3.9 seconds. If I may suggest, it would be better if this tool provides comprehensive information on wasting and underweight so that it can provide a broad picture of the types of malnutrition suffered by toddlers." (P5)

DISCUSSION

Our findings showed that the five items provided a rating for each attribute of at least 8 and the total mean rating was >8. This fact proved that Stuntingmeter was accepted by many groups, including those with secondary education and who worked as community health workers. Cadre with a high school level, an individual is considered to have attained an adequate education that enables them to comprehend novel concepts, as well as to implement positive behavior modification and innovation. Higher levels of education are often associated with openness to change, curiosity, open-mindedness, and acceptance of novel innovation(18). In addition, previous studies found that the acceptance of new inventions by potential users can be influenced by many factors, such as value, ability to drive innovation and change in behavior(19)(20)(21).

It has been suggested by Rogers (2003) that five perceived attributes have the potential to influence user acceptance and utilization of the service. Relative advantages, compatibility, complexity, observability, and trialability are the characteristics that make

up these. Specifically, Stuntingmeter provides fast, accurate measurement results, and saves staff resources. Stuntingmeter was developed by taking into account the needs of health workers related to the issue of a limited number of human resources, wide variations in skills and compliance of community health workers in carrying out measurements, and high burden (9). Besides, the Stuntingmeter was easy to carry or portable so it can be used in remote areas. Another issue that contributes to the advancement of RA is the absence of comparable tools(10). In Indonesia, a digital stunting measurement tool was previously developed, but the measurement output was height or body length in cm (22), so determining whether a child experienced stunting or not still required calculations according to a formula and then interpretation. Of course, the calculation and interpretation require special expertise, for example, a nutritionist, midwife, or doctor. Previous studies also indicate that non-contact ultrasonic sensor measurements primarily focused on adult subjects, although several investigations incorporated expectant women for fetal size assessment(10).

Complexity, translated as the attribute defeats usability. According to respondents, this tool is very easy to use even with very short training, the implication being that it reduces officer training costs. Stuntingmeter even decreases the burden on officers, usually community health workers in posyandu who are in charge of child anthropometric measurements and also play a role in other social activities. Another reason is that the Stuntingmeter follows the measurement standard procedure and is easy to use and maintain after use. Research stated that ease of equipment maintenance would support the long-term function of the equipment(23). The research results clearly stated that perceived simplicity of use significantly affects technology adoption. Ease of use is a key factor in determining the adoption of technology, as it creates the opportunity for successful intention to use. Therefore, the simpler a technology is perceived to be, the more likely it is to be adopted(24).

In contrast to complexity, compatibility is defined as the extent to which a service is seen to be consistent with the values, views, beliefs, habits, and experiences that users already have, both in the present and the past(25). Added by Rogers(17), compatibility is an essential characteristic of innovation since conformity with the lifestyle of the user can significantly accelerate the pace of adoption. It has also been discovered that compatibility plays a significant role in the acceptance of new programs or technology(25). In this case, the reason for accepting the Stuntingmeter is that anthropometric measurements are essential, especially because the government is currently concerned with accelerating the reduction of stunting. Stunting convergence is the responsibility of all local government organizations, both in the health and non-health sectors, so the existence of the Stuntingmeter is very suitable for current needs to achieve the health and welfare of children under five. It has also been discovered that compatibility plays a significant role in the implementation of electronic commerce(26), m-Health(27), and new vaccines (28). As a result, when it comes to the adoption of inventions, compatibility will have a favorable impact.

In terms of trialability, research has indicated that potential adopters who are given the option to experiment with an innovation will feel more at ease with it, increasing the likelihood of adopting it. Gharaibeh (2020) proved that the acceptability of mobile health applications is positively impacted by the trialability of these applications (29). A study also demonstrated the application of artificial intelligence in the healthcare sector (30).

As a result of Stuntingmeter's provision of help and demonstrations on the utilization of anthropometry tools during the trial period, concerns regarding output measurement can be reduced, which will also encourage potential adopters to make use of Stuntingmeter. A favorable impact on the adoption of Stuntingmeter will be brought about via trialability.

Ultimately, an innovation's observability describes how its advantages can be recognized and disseminated by the people inside a social system. The observability score is directly proportional to acceptance, the higher the observability score, the more the invention is accepted. By splitting observability into two concepts—visibleness and result demonstrability—Rogers(17) was able to simplify the original concept. This allowed the original construct to be simplified. The term observability is used in the context of Stuntingmeter to refer to the capability of accessing the nutritional status of children quickly and accurately. Additionally, it refers to the ability to quickly observe the impact of the Stuntingmeter to provide information on whether toddlers experience stunting or not based on the z score output produced according to the reference. Finally, we provide a compilation of these five attributes so that we get a mean score of more than 8, meaning that as a truly original invention, this invention can be well received by potential users. The results of the user evaluation will be followed up as a scale-up of the invention so that Stuntingmeter becomes a better tool and has better acceptance.

The study suggests that targeting individuals with higher education levels can increase the acceptance and adoption of new technologies or innovations. However, it also highlights the need for educational initiatives to promote technological literacy and awareness among broader populations. Other factors like socio-economic status, cultural background, and individual preferences should also be considered.

Limitations

This research has limitations in the aspect of convenience

sample selection, which covers relatively young respondents aged <40 years. In reality, health workers are of various ages or older. The age factor is one of the demographic factors related to the acceptance of innovation.

CONCLUSION

Even though Stuntingmeter is acceptable, this invention needs to be scaled up throughout future research to ensure that it is compatible with numerous current user requirements, previous experiences, behavior patterns, and beliefs to fulfill the expectations of clients.

The greater the range of services offered and the improved support for Stuntingmeter, the more customers will find the anthropometry digital instrument beneficial, which will increase its adoption rate. Additionally, several stakeholders should concentrate on disseminating information that highlights the relative benefits and utility of Stuntingmeter in comparison to other anthropometry tools, such as its affordability, simplicity, and ability to preserve human assets and finances. The realization of these findings is feasible via rigorous strategic foresight, robust user and stakeholder collaboration, and periodic evaluation cycles that guarantee the success and sustainability of innovation acceptance.

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