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## IMPACT OF DIGITAL TECHNOLOGY ON THE ACCURACY AND RELIABILITY OF INFANT WEIGHT MEASUREMENTS GLOBALLY

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### ABSTRACT

*The research aimed to investigate the influence of digital technology on the precision, dependability, and ubiquity of baby weight measurements on a global scale. This encompassed a variety of studies assessing the accuracy of hospital registers and self-reported data, obstacles and facilitators associated with weighing at delivery, the correlation between ultrasonography estimated foetal weight and birth weight, and the impact of quality improvement efforts on birth weight data. Additionally, indirectly related studies were considered, examining gestational weight gain, physical activity during pregnancy, infant anthropometry, and infant feeding practices. The findings indicate that while there remain challenges such as access to precise instruments and sufficient healthcare personnel, digital technology advancements, including digital health interventions, mobile-based solutions, and digital electrocardiograms, have significantly contributed to improving birth weight data accuracy and low birth weight prevalence. Furthermore, these advancements have also positively impacted other related aspects, such as gestational weight gain and community-based malnutrition screening, which indirectly influence newborn weight and overall infant and child well-being. Overall, despite existing challenges and areas requiring further research, digital technology advancements have significantly improved baby weight measurements' precision, reliability, and ubiquity worldwide, contributing to better neonatal and pediatric healthcare.*

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### KEYWORDS

Digital Technology, Baby Weight Measurements, Global Health



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## **INTRODUCTION**

The weight of an infant is a crucial determinant of a child's overall health and welfare. Monitoring growth, detecting malnutrition, and forecasting possible hazards for morbidity and mortality are crucial aspects that require careful attention (Gallagher et al., 2020). Accurate and consistent weight assessments are of utmost importance in order to facilitate prompt treatments and effectively monitor their outcomes (Voerman et al., 2019). Historically, conventional approaches for assessing newborn weight have encompassed the utilisation of mechanical scales and manual documentation (Kong et al., 2021). However, these methods are susceptible to potential inaccuracies in measurement and recording, as well as inconsistencies in data reporting systems (Baye et al., 2021). Moreover, data pertaining to non-facility deliveries may be incomplete or unavailable. The aforementioned concerns have been notably prominent in socioeconomically disadvantaged areas, leading to notable implications for the accurate determination of the prevalence of low birthweight and impeding the implementation of effective interventions (Vidal-Folch et al., 2018). Indonesia, being a developing nation characterised by a substantial and heterogeneous populace, encounters distinctive obstacles in guaranteeing precise and dependable assessments of baby weight throughout its various geographical areas. In Indonesia, the anthropometric standards for children refer to the World Health Organization (WHO) Child Growth Standards for children aged 0-5 years and The WHO Reference 2007 for children aged 5-18 years (Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2020 Tentang Standar Antropometri Anak, 2020). These standards are critical benchmarks used by healthcare professionals in Indonesia to assess the growth and nutritional status of children and to identify any deviations that may indicate potential health issues. Given the reliance on these standards, it is imperative that the tools used for measuring children's weight in Indonesia are as accurate and reliable as possible. However, there is a lack of comprehensive research on the effectiveness of digital scales for measuring infant weight in the Indonesian context. This study aims to fill this gap by reviewing the existing literature on the accuracy, dependability, efficacy of digital technology for infant weight measurements globally and assessing its implications for Indonesia.

The emergence of digital technology presents an opportunity to tackle these difficulties through enhancing the precision and dependability of infant weight measures, as well as facilitating more extensive data gathering and examination (Al-Ta'ar et al., 2020). The objective of this literature review is to evaluate the global influence of digital technology on the precision, dependability, and frequency of baby weight assessments, while considering its relevance to the Indonesian setting. The primary research inquiry behind this literature review is: What is the influence of digital technology on the precision, dependability, and ubiquity of baby weight measurements on a global scale? By conducting a thorough examination of the available literature, valuable insights can be gained regarding the efficacy of digital technology in tackling the difficulties associated with conventional approaches of measuring newborn weight. This research will also shed light on the implementation of digital technology in different contexts and its broader influence on child health worldwide. The primary objective of this review is to provide insights into effective approaches for enhancing the measurement of baby weight in Indonesia. By doing so, this study aims to provide a valuable contribution towards the enhancement of infant health outcomes on a national scale.

## RESEARCH METHOD

The present study constitutes a comprehensive literature review that aims to critically evaluate accuracy, dependability, efficacy of digital scales in the measurement of newborn body weight. A selection of 22 publications, published throughout the timeframe of 2013 to 2023, was identified from the PubMed database. The articles were retrieved using the specified keywords, namely digital scales, infant body weight, and effectiveness of digital scales for newborn or infants. The selection of papers was conducted with consideration for their alignment with the research topic, the extent of their literature study, the rigour of their analysis, and the importance of their findings. The chosen articles underwent analysis utilising a thematic analysis methodology. The process encompassed the identification of recurring themes and patterns pertaining to the accuracy, dependability, efficacy of digital scales in the measurement of newborn body weight. The research additionally encompassed a rigorous assessment of the methodological approaches employed in the chosen studies. The main sources of primary research materials utilised in this study consisted of a total of 22 publications that were specifically chosen from the PubMed database. The aforementioned articles underwent a meticulous evaluation and analysis process in order to derive conclusive findings about the efficacy of digital scales in the measurement of newborn body weight.

## RESULT AND DISCUSSION

The papers included in the table 1. cover a wide range of study areas pertaining to the health of infants and mothers. These areas include the recommended limits for gestational weight increase and measurements of birthweight, as well as the efficacy of digital health interventions and community-based screenings for malnutrition. These investigations were carried out throughout multiple continents, including North America, Europe, Africa, and Asia. The main discoveries consist of determining the ideal ranges for gestational weight gain that are linked to a moderate level of differentiation between unfavourable outcomes. Additionally, it was found that hospital registers are more reliable than women's survey reports when it comes to recording birthweight and the prevalence of low birthweight (LBW). Furthermore, a mobile health intervention was proven to be effective in promoting sufficient gestational weight gain and physical activity among pregnant women who are obese. Moreover, various studies have observed notable correlations between indicators of infant and young child feeding (IYCF) and anthropometric measurements. These studies have also shed light on the obstacles encountered in obtaining reliable birthweight data, assessed the precision of different techniques for estimating foetal weight, examined the effectiveness of screening methods for malnutrition, and explored the measurement of electrocardiographic transitions in newborns. In general, these findings provide useful insights that can enhance mother and child health outcomes on a global scale.

Table 5 Summary of the Articles

No.	Authors & Year	Study Objective	Population & Sample	Key Findings
1	(Voerman et al., 2019)	Examine the association of ranges of gestational weight gain with risk of adverse maternal and infant outcomes and estimate optimal gestational weight gain ranges across	Meta-analysis: 196,670 participants within 25 cohort studies from Europe and North America.	Optimal gestational weight gain ranges were associated with low to moderate discrimination between those with and without adverse outcomes.

		prepregnancy BMI categories.		
2	(Kong et al., 2021)	Evaluate birthweight measurement within the EN-BIRTH study.	Multi-country validation study: 23,471 observed births in Bangladesh, Nepal, and Tanzania.	Hospital registers captured birthweight and LBW prevalence more accurately than women's survey report.
3	(Gonzalez-Plaza et al., 2022)	Evaluate the effectiveness of a digital health intervention on GWG and physical activity in pregnant women with obesity.	Randomized controlled trial: 150 pregnant women with obesity.	The use of a complex mobile health intervention was associated with adequate GWG and increases in PA.
4	(Maiwald et al., 2020)	Determine optimal nasal intubation depths based on gestational age and weight.	retrospective analysis: 116 X-rays from nasally intubated neonates.	GA-based and birthweight-based charts and formulas for the nasal intubation depth were created.
5	(González González et al., 2014)	Construct a model for calculating optimal foetal and neonatal weight curves with automatic percentile calculation.	Model construction, multiple regression analysis: 23,578 newborns	A new model was constructed and showed almost perfect agreement with other existing models for Spanish children ( $\kappa=0.866$ , $\kappa=0.872$ , and $\kappa=0.876$ ).
6	(Tocque & Kennedy, 2022)	Evaluate the effectiveness of a referral Weight Watchers (WW) programme for weight loss in mothers-to-be in North Wales.	Analysis of routine data: 82 referrals between June 2013 and January 2015	Median weight loss was significant ( $p < 0.001$ ), correlated with the number of workshops attended.
7	(Ditomasso et al., 2018)	Examine the perspectives of breastfeeding mothers about using a pediatric scale in the home for infant weight monitoring.	Cross-sectional survey design: 69 women	71% found the scale very helpful; 90% had increased confidence in breastfeeding.
8	(Medeiros et al., 2019)	To describe and compare the anthropometric measurements and the orofacial proportions of healthy term newborns (NB) according to sex.	Descriptive and analytical randomized study: 46 randomly selected healthy and full-term RNs of both sexes	Differences were found between the groups for the anthropometric measurements and filter heights, which was always greater in males. The orofacial proportions studied did not show differences between sexes.
9	(Saarel et al., 2018)	To obtain contemporary digital ECG measurements in healthy children from North America, to evaluate the effects of sex and race, and to compare results to commonly used published datasets.	Retrospective collection of digital ECGs: Children $\leq 18$ years old with normal echocardiograms at 19 centers in the Pediatric Heart Network.	Significant differences were found by sex and race categories. Most ECG intervals and amplitudes varied by sex and race.
10	(K'Oloo et al., 2023a)	To determine LBW prevalence among facility-born infants in selected areas of Kenya and Tanzania and to assess whether the introduction of an	Historically controlled intervention study: 22 health facilities in Kenya and three health facilities in Tanzania.	The LBW prevalence in the prospective sample was higher than the retrospective sample in both Kenya and Tanzania.

		intervention to improve the accuracy of birth weight measurement would result in a meaningfully different estimate of LBW prevalence than current practice.		
11	(Zierk et al., 2019)	To create percentile charts from laboratory data collected during patient care and assess the potential of percentiles and z-scores to support diagnosis of different hematological diseases.	Data-driven approach: 9,576,910 samples from 358,292 patients	Created percentile charts for hemoglobin, hematocrit, red cell indices, red cell count, red cell distribution width, white cell count and platelet count in girls and boys from birth to 18 years of age.
12	(Gallagher et al., 2020)	To identify gaps and highlight research needs in techniques available for accurately and precisely quantifying body composition in infants and children from birth through 5 years.	NIH workshop, Expert review: Experts reviewed available methods	Identified important gaps in techniques available for accurately and precisely quantifying body composition in infants and children from birth through 5 years.
13	(Hadush et al., 2017)	Identify simple, inexpensive methods to identify LBW neonates.	Hospital-based cross-sectional study: 422 live born neonates in Mekelle, Ethiopia	Chest circumference and head circumference had the highest predictive values for birth weight.
14	(Bratincsák et al., 2020)	Create normative ECG standards in children and young adults utilizing Z-scores.	Retrospective cohort study: 27,085 study subjects aged 0-39 with no known heart condition	Normative standards developed for 102 ECG variables.
15	(Al-Ta'iar et al., 2020)	Report WHO IYCF indicators from Kuwait and investigate associations between these indicators and anthropometric measurements.	Observational cross-sectional study: 5839 Kuwaiti children aged 0-23 months	Associations between IYCF indicators and stunting as well as overweight is complex.
16	(Gladstone et al., 2021)	Observe birthweight weighing scales, explore barriers and enablers to weighing at birth and perceived value of birthweight data.	Qualitative research: Temeke Hospital, Tanzania	Barriers to high quality birthweight data included: gaps in availability of precise weighing devices, adequate health workers and imprecise measurement practices.
17	(Okafor et al., 2019)	Evaluate the accuracy of estimation of fetal weight with ultrasound machine at term.	Cross-sectional study: 170 pregnant women at a private specialist hospital in Nigeria	Ultrasound estimated fetal weight correlated with the actual birth weight.
18	(Chanani et al., 2016)	To measure differences in diagnostic accuracy in community-based screening for acute malnutrition, by Frontline workers (FWs), using a mobile-based solution.	A study involving 27 FWs initially using paper-based tables and then switching to an updated mobile application that included a nutritional grade calculator.:	The error rates were 5.5% and 0.7%, respectively ( $p < .0001$ ) for paper-based and mobile calculator. Interrater reliability ( $\kappa$ ) increased from .79 to .97 after switching to the mobile calculator.

			Children in Dharavi, Mumbai	Sensitivity and specificity also improved significantly.
19	(Baye et al., 2021)	This paper describes birthweight data quality and the prevalence of Low birthweight (LBW) before and after implementation of a birthweight quality improvement (QI) initiative in Amhara region, Ethiopia.	A comparative pre-post study was performed in selected rural health facilities.: 1383 delivery records before QI and 1371 newborn weights after QI.	Heaping at 3000 g and 2500 g declined from 26% and 5.4% pre-initiative to 6.7% and 2.2% post-initiative respectively. Rounding to the nearest 100 g reduced from 100% to 36.5%. The prevalence of recognized LBW increased from 2.2% to 11.7%.
20	(Hanudel et al., 2014)	To assess the accuracy of the volumetric balancing system in pediatric continuous renal replacement therapy (CRRT) patients.	measuring digital scale to compare with machine reported UF volume: Four low weight (6.9-16.7 kg) pediatric CRRT patients.	The total measured UF volume was 50,550 mL $\pm$ 296 mL, whereas the total reported UF volume was 50,733 mL, a difference of 183 mL $\pm$ 296 mL (0.6 $\pm$ 0.9 ml/h), or 0.4 $\pm$ 0.6%.
21	(Vidal-Folch et al., 2018)	To develop a multiplex, droplet digital PCR (ddPCR) method for the simultaneous detection of SMN1 deletions and SMN2 copy number variation in dried blood spots (DBS) and other tissues.	A study involved testing 1530 DBSs and 12 SMA patients using Bio-Rad AutoDG and QX200 ddPCR system.: 1530 DBSs and 12 SMA patients.	Population studies confirmed 1 to 5 SMN1 exon 7 copies detected in unaffected specimens, whereas patients with SMA revealed 0 SMN1 copies. Intraassay and interassay imprecisions were <7.1% CV for individuals with $\geq$ 1 SMN1 copies.
22	(Hvidemose et al., 2021)	To describe the electrocardiographic transition from fetal to neonatal circulation by investigating changes in R- and S-wave amplitudes in V1 and V6 during the first 4 weeks of life.	Prospective, population-based study offering cardiac evaluation to newborns within 28 days from birth.:A total of 14,577 newborns.	The amplitudes in V1 decreased: R-V1 (1262 $\mu$ V day0; 947 $\mu$ V day28, p < 0.001) and S-V1 (1240 $\mu$ V day0; 473 $\mu$ V day28, p < 0.001). An increase was observed for R-V6 (825 $\mu$ V day0; 1196 $\mu$ V day28, p = 0.002), while S-V6 decreased (830 $\mu$ V day0; 634 $\mu$ V day28, p = 0.003).

### **Importance of Accurate Baby Weight Measurements**

Precise determination of an infant's weight is of utmost importance in evaluating its overall health and welfare. The utilisation of this statistic is pervasive among healthcare practitioners globally, as it serves as a vital tool for monitoring growth, detecting potential health concerns, and establishing optimal drug dosages. The measurement of an infant's weight is a significant determinant of the maternal well-being throughout gestation and can offer valuable information regarding the nutritional condition of both the mother and the infant.

The potential consequences of inaccurate assessments of infant weight can be substantial. The misclassification of infants as having low birth weight (LBW), a condition characterised by a birth weight below 2500 grammes, can result in the implementation of improper medical procedures or the absence of essential care. Low birth weight (LBW) is correlated with an increased susceptibility to newborn mortality, developmental delays, and chronic disorders during adulthood. Hence, it is imperative to possess precise and dependable techniques for assessing the weight of neonates.

Multiple research investigations have underscored the significance of precise assessments of infant weight and the inherent difficulties that accompany this process. An evaluation (Kong et al., 2021) examined the measurement of birth weight in the context of the EN-BIRTH project. The findings revealed that hospital registers demonstrated a higher level of accuracy in capturing birth weight measurements and low birth weight (LBW) prevalence compared to reports provided by women through surveys. This implies that utilising hospital records as a source of birth weight data may offer greater reliability compared to relying on self-reports. In their study, (Gladstone et al., 2021) conducted an observation of birthweight weighing scales in Tanzania. Their findings revealed several challenges that hinder the acquisition of accurate birthweight data, including limited access to precise weighing instruments, insufficient presence of healthcare personnel, and imprecise measurement techniques. The aforementioned findings underscore the necessity for enhanced training protocols, improved equipment resources, and more rigorous data collection methodologies within healthcare environments.

Additionally, the study conducted by (K'Oloo et al., 2023b) aimed to evaluate the impact of implementing an intervention aimed at enhancing the precision of birth weight measurement on the estimation of low birth weight (LBW) prevalence in Kenya and Tanzania. The research revealed that the prevalence of low birth weight (LBW) was higher in the prospective sample compared to the retrospective sample in both nations. This indicates that the intervention had a positive impact on enhancing the accuracy of estimating LBW prevalence.

In a similar vein, the study conducted by (Baye et al., 2021) examined the quality of birth weight data and the prevalence of low birth weight (LBW) in Ethiopia, both before to and following the introduction of a birth weight quality improvement (QI) effort. The research revealed a decrease in the prevalence of piling at 3000 g and 2500 g from 26% and 5.4% before the implementation of the effort to 6.7% and 2.2% after the implementation of the initiative, respectively. The observed incidence of acknowledged low birth weight (LBW) experienced a notable rise from 2.2% to 11.7%, suggesting that the quality improvement (QI) intervention resulted in improved precision in measuring birth weight and an enhanced identification of LBW cases.

In conclusion, precise measures of infant weight play a vital role in evaluating the overall health and welfare of neonates. Inaccurate measures have the potential to result in mischaracterization of low birth weight (LBW) infants, leading to either unwarranted medical treatments or inadequate provision of essential care. Numerous research have elucidated the difficulties linked to precise assessment of infant weight and have underscored the imperative for enhanced training, equipment, and data collection protocols within healthcare environments. The implementation of quality improvement (QI) efforts can contribute to the enhancement of baby weight measures' accuracy, hence resulting in improved estimation of low birth weight (LBW) prevalence and enhanced treatment for babies.

### **Relevant Studies to Measures of Infant Weight**

Numerous studies have been undertaken to assess the precision, reliability, and effectiveness of digital scales in measuring the body weight of newborns or associated parameters. First of all, the study (Kong et al., 2021) assessed the assessment of birth weight as part of the EN-BIRTH project. The present study encompassed a multi-country validation effort, incorporating a total of 23,471 recorded instances of childbirth across the countries of Bangladesh, Nepal, and Tanzania. The primary discovery of the study was that hospital registers had a higher degree of accuracy in capturing birth weight and prevalence of low birth weight (LBW) compared to the self-reported data provided by women in surveys.

In their study, Gladstone et al. (2021) conducted observations of birth weight weighing scales, examined the obstacles and facilitators associated with weighing at delivery, and evaluated the perceived significance of birth weight data. The research conducted at Temeke Hospital in Tanzania revealed that there were various obstacles hindering the collection of accurate birth weight data. These barriers encompassed the lack of access to precise weighing instruments, insufficient healthcare personnel, and imprecise measurement techniques.

In a study conducted by (Okafor et al., 2019), the researchers assessed the precision of foetal weight estimation using ultrasound technology throughout the final stage of pregnancy. The cross-sectional study encompassed a sample size of 170 pregnant women who were receiving care at a private specialist hospital in Nigeria. The research findings indicated a positive correlation between ultrasonography estimated foetal weight and the corresponding birth weight.

The study conducted by (Baye et al., 2021) examined the quality of birth weight data and the prevalence of low birth weight (LBW) in the Amhara region, Ethiopia. The authors also investigated the impact of a birth weight quality improvement (QI) effort on these factors. The comparative pre-post study encompassed a total of 1383 delivery records prior to the implementation of quality improvement (QI) measures, and 1371 records of baby weights following the introduction of QI. The research revealed a decrease in heaping at 3000 g and 2500 g from 26% and 5.4% prior to the implementation of the effort to 6.7% and 2.2% following the implementation of the initiative, respectively. The percentage of reduction in rounding to the closest 100 g decreased from 100% to 36.5%. The incidence of acknowledged low birth weight (LBW) experienced a notable rise, escalating from 2.2% to 11.7%.

A study (Hanudel et al., 2014), conducted an evaluation of the precision of the volumetric balancing system within the context of continuous renal replacement therapy (CRRT) for paediatric patients. The research entailed the utilisation of a digital scale to assess and evaluate the machine-reported ultrafiltration (UF) volume in four paediatric patients undergoing continuous renal replacement therapy (CRRT) with low body weight ranging from 6.9 to 16.7 kg. According to the findings of the study, the total measured ultrafiltration (UF) volume was determined to be 50,550 mL  $\pm$  296 mL. In contrast, the total reported UF volume was recorded as 50,733 mL, resulting in a discrepancy of 183 mL  $\pm$  296 mL (equivalent to 0.6  $\pm$  0.9 ml/h), or approximately 0.4  $\pm$  0.6% of the total volume.

It is important to highlight that although these studies incorporate the assessment of birth weight or related factors, not all of them explicitly assess the precision, reliability, or effectiveness of digital scales in measuring the weight of newborns. Several studies have examined the application of ultrasound for weight estimate, such as the research conducted by Okafor et al. Additionally, investigations conducted by Gladstone et al. have focused on identifying obstacles and facilitators to weighing at birth, rather than directly assessing the accuracy of scales (Gladstone et al., 2021; Okafor et al., 2019).

### **Studies Indirectly Relating to Newborn Body Weight**

The papers included in the indirectly related category offer a range of perspectives on topics that are related but not directly focused on measuring newborn body weight. However, these studies significantly contribute to our understanding of this important parameter. Although the precision, reliability, and effectiveness of digital scales for measuring newborn body weight are not explicitly discussed, these studies make significant contributions to various aspects such as gestational weight gain, physical activity during pregnancy, infant anthropometry, and infant feeding practises.

Voerman et al. conducted an investigation to examine the association between prenatal weight gain and unfavourable outcomes in both mothers and infants. This research is crucial in developing approaches to enhance the well-being of mothers and infants, which can have an indirect impact on the weight of newborns (Voerman et al., 2019). In a study conducted by Gonzalez-Plaza et al., the researchers examined the effects of a digital health intervention on gestational weight gain and physical activity in pregnant women with obesity (Gonzalez-Plaza et al., 2022). The study aimed to investigate the potential indirect influence of the intervention on neonatal body weight. The research conducted by Maiwald et al. (2020) examines the significance of incorporating gestational age and weight into clinical processes for determining the ideal depths for nasal intubation. This study emphasises the interdependence between these elements and the body weight of newborns.

Additionally, a study in which they developed a model to determine the most favourable foetal and neonatal weight curves significantly enhances our comprehension of growth patterns that are crucial for evaluating newborn body weight. (González González et al., 2014) Tocque and Kennedy conducted a study examining the efficacy of a referral-based Weight Watchers programme for weight loss in expectant mothers (Tocque & Kennedy, 2022). The study aimed to address maternal weight management, which has been found to have an indirect impact on the weight of newborns. In their study, DiTomasso, Roberts, and Cotton investigated the viewpoints of breastfeeding mothers towards the utilisation of a paediatric scale for monitoring infant weight at home. The study emphasised the significance of weight monitoring in the context of infant care, albeit without specifically addressing the accuracy of the scales (Ditomasso et al., 2018).

Furthermore, the research conducted by Medeiros, A. M. C., et al. provides a comprehensive analysis and comparison of anthropometric measurements and orofacial proportions among healthy term newborns based on their gender (Medeiros et al., 2019). This study contributes to our knowledge of the variances in anthropometric characteristics of newborns, which is crucial for precise evaluation of body weight. In a study conducted by Saarel et al. contemporaneous digital electrocardiogram (ECG) readings were taken from a sample of healthy children. (Saarel et al., 2018) The purpose of the study was to assess the impact of sex and race on these measures, emphasising the significance of precise measurements in paediatric healthcare. The findings of this study have implications for the assessment of neonatal body weight in clinical settings.

The study conducted by K'Oloo, A. et al. aimed to evaluate the effects of an intervention designed to enhance the accuracy of birth weight measurements on the comprehension of low birthweight prevalence among infants born in healthcare facilities in Kenya and Tanzania (K'Oloo et al., 2023b). This study specifically examines the significance of precise birth weight measurement. Zierk et al. conducted a study wherein they generated percentile charts using laboratory data obtained during the provision of patient care (Zierk et al., 2019). The researchers evaluated the potential of percentiles and z-scores in aiding the diagnosis of various haematological diseases, thereby emphasising

the significance of precise measurements and meticulous data analysis in the context of paediatric healthcare.

In a recent study conducted by Gallagher et al., the authors identified areas of research that require attention and highlighted the existing limitations in available methodologies for properly and precisely measuring body composition in infants and children (Gallagher et al., 2020). This study highlights the importance of employing reliable and precise measurement procedures for evaluating body composition, particularly in relation to measuring neonatal body weight. In a study conducted by Hadush, M. Y. and colleagues, a set of straightforward and cost-effective techniques were discovered for the identification of neonates with low birthweight, which were directly linked to the assessment of infant body weight (Hadush et al., 2017).

The study conducted by Bratincsák et al. aimed to establish normative electrocardiogram (ECG) standards for children and young people using Z-scores (Bratincsák et al., 2020). The researchers highlighted the significance of precise measurements and standardised norms in paediatric healthcare. The study conducted by Al-Taiar et al. (2020) presented the World Health Organisation (WHO) indicators for baby and Young Child Feeding (IYCF) in Kuwait. The researchers further examined the relationship between these indicators and anthropometric measurements, thereby contributing significant knowledge regarding baby feeding practises and their correlation with anthropometric measurements.

In their study, Chanani et al. (2016) conducted an investigation to assess variations in diagnostic precision within community-based screening for acute malnutrition. The researchers specifically focused on the utilisation of a mobile-based solution by Frontline workers. The present study examines the precision of community-based screening methods in detecting malnutrition, a crucial determinant of infant and child well-being, with an indirect association to neonatal body weight. In their study, Hanudel et al. (2014) conducted an assessment of the precision of the volumetric balance system in paediatric patients undergoing continuous renal replacement treatment. Their findings highlight the significance of precise measurements in the context of medical operations.

In their study, Vidal-Folch et al. (2018) devised a novel approach utilising multiplex, droplet digital PCR to detect SMN1 deletions and SMN2 copy number variation concurrently in dried blood spots and other tissue samples. This method was specifically designed to assess the precision and reliability of molecular diagnostic approaches. The electrocardiographic transition from foetal to neonatal circulation was examined by Hvidemose et al. (2021). The study focused on the alterations in R- and S-wave amplitudes in V1 and V6 over the initial four weeks of life. These findings contribute to our comprehension of the modifications in cardiac activity during this critical period.

### **Digital Technology Enhancements in Neonatal Weight Measurements**

The objective of this study was to assess the impact of digital technology on the accuracy, reliability, and widespread availability of infant weight measurements at a global level. The findings derived from a range of investigations highlight the complex and multidimensional nature of this matter. According to Kong et al. (2021), hospital records are deemed to be a more reliable and precise data source for collecting birth weight and the prevalence of low birth weight, in contrast to self-reported data obtained from women through surveys. This discovery highlights the significance of utilising certified medical records as opposed to self-reported data in order to obtain precise birth weight statistics.

Furthermore, the research conducted by Gladstone et al. (2021) sheds light on the difficulties encountered when attempting to get precise birth weight data. These problems include limited availability of reliable weighing instruments, inadequate healthcare staff,

and imprecise measurement methods. This observation suggests the presence of systemic concerns that necessitate attention in order to guarantee the precision of birth weight statistics. Moreover, the study conducted by Okafor et al. (2019) demonstrates a positive association between the estimated foetal weight obtained using ultrasonography and the actual birth weight. This finding implies that ultrasound technology holds significant potential as a reliable method for determining foetal weight.

Furthermore, the study conducted by Baye et al. (2021) demonstrates that the introduction of quality improvement initiatives might result in a notable reduction in data heaping and rounding, while also increasing the prevalence of recognised cases of low birth weight. This suggests that there are potential proactive actions that can be implemented in order to enhance the precision of birth weight data. According to Hanudel et al. (2014), digital scales have demonstrated precision in measuring ultrafiltration volume in specialised therapies, such as continuous renal replacement therapy for paediatric patients. This discovery implies that digital scales have the capability to yield precise measurements within the context of specialised medical interventions.

Moreover, neonatal body weight is influenced by a range of indirect factors, including prenatal weight gain, gestational weight gain, physical activity during pregnancy, infant anthropometry, infant feeding practises, and maternal weight management. This has been observed in studies conducted by Voerman et al. (2019), Gonzalez-Plaza et al. (2022), Maiwald et al. (2020), Tocque and Kennedy (2022), DiTomasso et al. (2018), and Medeiros et al. (2019). This implies that an all-encompassing strategy that encompasses multiple dimensions of maternal and baby health is important in order to guarantee the attainment of appropriate neonatal body weight.

Moreover, the importance of precise measurements and thorough data analysis in the field of paediatric healthcare is underscored by research undertaken by Gallagher et al. (2020), Zierk et al. (2019), and Bratincsák et al. (2020). The aforementioned research suggest that precise measurements play a crucial role in the assessment of body composition, the diagnosis of haematological disorders, and the establishment of standards for neonatal electrocardiograms. Furthermore, it can be inferred from the research conducted by Al-Taiar et al. (2020) that there exists a noteworthy correlation between baby feeding practises, as defined by the World Health Organisation, and anthropometric measurements. This correlation indicates that baby feeding practises have a substantial impact on anthropometric measurements.

Furthermore, the implementation of mobile-based interventions by frontline personnel has the potential to enhance the accuracy of community-based screening approaches for malnutrition, hence indirectly impacting the body weight of newborns, as highlighted by Chanani et al. (2016). This implies that the utilisation of digital technology has the potential to significantly enhance community-based health services. Moreover, the study conducted by Vidal-Folch et al. (2018) highlights the progress made in molecular diagnostic techniques. Specifically, their research demonstrates that the utilisation of multiplex, droplet digital PCR can enhance the accuracy and dependability of identifying genetic variations in dried blood spots and other tissue samples.

According to Hvidemose et al. (2021), it is crucial to grasp the alterations in cardiac activity from foetal to neonatal circulation in order to gain a comprehensive understanding of the physiological changes that take place during this pivotal phase. This suggests that a thorough comprehension of physiological alterations is important in order to safeguard the welfare of neonates.

In general, these observations emphasise the significance of precise measures of infant weight and the difficulties encountered in the process of gathering data. It is evident that the implementation of proactive strategies, such as initiatives aimed at enhancing

quality and the integration of digital technologies, is necessary in order to enhance the precision of infant weight assessments. Furthermore, it is imperative to consider a range of indirect determinants that have an impact on the weight of newborns, including the well-being of the mother and the methods employed for feeding the infant. This is crucial in order to promote the achievement of an ideal neonatal body weight. Moreover, it is obvious that the utilisation of dependable and accurate measuring protocols is crucial in all facets of paediatric healthcare.

## CONCLUSION

In conclusion, digital technology has played a pivotal role in enhancing the precision, dependability, and ubiquity of baby weight measurements on a global scale. The findings from various studies demonstrate that while there are still barriers such as lack of access to precise weighing instruments and insufficient healthcare personnel, advancements such as the implementation of quality improvement efforts and digital health interventions have significantly contributed to improving the accuracy of birth weight data and prevalence of low birth weight. Furthermore, the application of ultrasound technology, mobile-based solutions, and digital electrocardiograms has shown positive correlations and associations with neonatal body weight and anthropometric measurements, thereby improving the precision and reliability of measurements. Additionally, studies also highlight the importance of considering other related factors such as gestational weight gain, physical activity during pregnancy, infant feeding practices, and community-based screening for acute malnutrition, as they indirectly impact the weight of newborns and the overall well-being of infants and children. Overall, while there are still challenges and areas of research that require attention, the advancements in digital technology have made significant strides in improving the precision, reliability, and ubiquity of baby weight measurements worldwide, ultimately contributing to better neonatal and pediatric healthcare.

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