# Accuracy of weight estimation methods in adults, adolescents and children: a prospective study

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## ABSTRACT

**Introduction** Weight estimation of both adult and paediatric patients is often necessary in emergency or low-resource settings when it is not possible to weigh the patient. There are many methods for paediatric weight estimation, but no standard methods for adults. PAWPER and Mercy tapes are used in children, but have not been assessed in adults. The primary aim of this study was to assess weight estimation methods in patients of all ages.

**Methods** Patients were prospectively recruited from emergency and outpatient departments in Kigali, Rwanda. Participants (or guardians) were asked to estimate weight. Investigators collected weight, height, mid-arm circumference (MAC) and humeral-length data. In all participants, estimates of weight were calculated from height and MAC (PAWPER methods), MAC and humeral length (Mercy method). In children, Broselow measurements and age-based formulae were also used. The primary outcome measure was the proportion of estimates within 20% of actual weight (p20).

**Results** We recruited 947 participants: 307 children, 309 adolescents and 331 adults. For p20, the best methods were: in children, guardian estimate (90.2%) and PAWPER XL-MAC (89.3%); in adolescents, PAWPER XL-MAC (91.3%) and guardian estimate (90.9%); in adults, participant estimate (98.5%) and PAWPER XL-MAC (83.7%). In all age groups, there was a trend of decreasing weight estimation with increasing actual weight.

**Conclusion** This prospective study of weight estimation methods across all age groups is the first adult study of PAWPER and Mercy methods. In children, age-based rules performed poorly. In patients of all ages, the PAWPER XL-MAC and guardian/participant estimates of weight were the most reliable and we would recommend their use in this setting.

## Key messages

**What is already known on this subject**

- There are many methods of weight estimation in children, but no established methods of weight estimation in adolescents and adults.
- The PAWPER and Mercy tapes, and parental estimation, have been shown to be the best methods of child weight estimation in other settings.
- These have not been assessed and compared in adolescents and adults.

**What this study adds**

- PAWPER tapes are a valid method of weight estimation in adults and adolescents as well as children.
- Guardian/participant estimate is overall the best method of weight estimation across all age groups.

## INTRODUCTION

Paediatric weight is often estimated in emergency situations using methods based on age (eg, the Advanced Paediatric Life Support (APLS) formulae[1]) or height (eg, the Broselow tape[2]) when direct measurement is not possible. Methods based on mid-arm circumference (MAC) have also been developed.[3 4] The Mercy[4] and PAWPER[5] tapes use both length-based and habitus-based body measurements in order to estimate weight. The Mercy tape uses humeral length and MAC; the PAWPER tape uses height and an estimate of overall body habitus. The PAWPER tape has recently been adapted to use MAC instead of the habitus estimate.[6]

Many drug and fluid regimes are weight-dependent in adults too. In our setting, the most frequently prescribed weight-dependent drugs are for rapid sequence intubation or procedural sedation, where it is especially important to ensure we give the appropriate doses. However, there are no accepted standard adult weight-estimation tools. Age-based methods are not appropriate, and the Broselow tape has been shown to be inappropriate for people over 10 years of age, because the large majority are too tall to fit the tape.[7] A MAC-based adult weight estimation formula has been derived and validated using data from the American National Health and Nutrition Examination Survey database,[8] and a height-based formula for adult weight estimation has recently been derived in Nigeria.[9] Neither the PAWPER nor Mercy tapes were designed for adults; however, their body measurement ranges extend to values compatible with adults, and it is unknown whether they might be suitable for use in an adult population.

In resource-limited settings, weight estimation methods for patients of all ages are often helpful even in non-emergency situations, because accurate weighing facilities may not be readily available.[6]

The primary aim of this study was to compare existing methods of weight estimation prospectively in children, adolescents and adults. The secondary aim was to validate the use of the Mercy and PAWPER methods in adults and adolescents.

## METHODS

This was a prospective observational study performed in Rwanda's public tertiary referral hospital, Centre Hospitalier Universitaire de Kigali (CHUK). Data were collected over a 3-month period from December 2016 to February 2017.

Two investigators were trained and supported by the authors to recruit and measure participants. They recruited a convenience sample of patients from the waiting rooms of the adult and paediatric emergency and outpatient departments. Patients were recruited in three groups, aiming for an approximately even spread of ages within each of three categories: children (aged 1–9 years last birthday), adolescents (aged 10–15 years last birthday) and adults (aged 16 years old and above). Pregnant women, patients in extremis and infants were excluded.

Guardians provided an estimate of weight for participants under 16 years of age; adults provided an estimate of their own weight. Investigators used the graphical descriptive scale of body habitus on the PAWPER tape, to allocate children and adolescents to one of seven body habitus categories.[10] Participants were then weighed to 0.1 kg using Omron HN289 scales. Height was measured to the nearest cm using a Rolson 50 565 tape measure with the participant standing against a wall. MAC and humeral length were measured with paper tape measures to the nearest 0.5 cm. Body mass index (BMI) was calculated from height and weight, kg/m$^2$; and BMI z-scores were obtained for children and adolescents from WHO datasets.

Age-based estimates of weight in kg for children included the original and revised APLS formulae,[1] the finger-counting method,[11] and the recently derived 'Rwanda rule'.[12] Broselow, Mercy and PAWPER weight estimates were determined 'virtually'[13]: rather than using the tapes themselves, tables of data for each tape were used to determine appropriate weight estimates in kg for the measured distances in cm. Height was used for four different editions of the Broselow tape: 1993, 1998, 2007, 2011. The Broselow tape extends to approximately 145 cm (depending on the version used), and this method was used only for children. Height and body habitus categories were used for the PAWPER XL tape[10] in children and adolescents; height and MAC for the PAWPER XL-MAC[6] in all participants. The PAWPER tape extends to 180 cm, and those measuring up to 199 cm are assumed to fall in the same weight category as 180 cm. Humeral lengths and MAC were used for the Mercy method,[4] which was assessed in all participants. Two MAC formulae were used in all participants.[3 8] Finally, Kokong's height-based formula was used in adults.[9] Table 1 summarises the different methods used in each age group.

The primary outcome measure for any given method was the percentage of estimates that lay within 20% of actual weight (p20). This cut-off was chosen based on the results of the retrospective study of age-based rules and the Broselow method in CHUK.[12] Percentages of estimates within 10% (p10) and 30% (p30) of actual weight were also calculated.[1 6 8] Secondary outcome measures were the bias (mean percentage error (MPE); a measure of the trueness of the estimate), and limits of agreement (LOA=MPE±1.96 SD; a measure of the precision of the estimate). Bias and LOA were obtained from a modification of Bland-Altman analysis using percentage rather than absolute differences between estimate and actual weights.[14] The MPE was calculated from the estimated weight minus the actual weight; a negative MPE is an underestimate, a positive MPE is an overestimate.

Subgroup analysis was performed according BMI groups. In children and adolescents, underweight and overweight were defined as BMI z-score $\leq -1$ and $\geq 1$, respectively. In adults, as BMI $\leq 18.5$ and $\geq 25$ kg/m$^2$.

**Table 1** Weight estimation methods

| Method | Measurements used | Formula for weight (kg) | Groups included in study |
|---|---|---|---|
| Original APLS | Age (years) | (2×age)+8 | Children |
| Revised APLS | Age (years) | (2×age)+8 (1–6 years of age)<br>(3×age)+7 (from 6 years of age) | Children |
| Finger-counting | Age (years) | (2.5×age)+7.5 | Children |
| Rwanda rule | Age (years) | (1.7×age)+8 | Children |
| Broselow tape | Height (cm) | | Children |
| Kokong | Height (cm) | Height–100 | Adults |
| 2010 MAC formula | MAC (cm) | (MAC–10)×3 | All |
| 2017 MAC formula | MAC (cm) | (4×MAC)–50 | All |
| Mercy tape | Humeral length (cm)<br>MAC (cm) | | All |
| PAWPER XL tape | Height (cm)<br>Body habitus | | Children<br>Adolescents |
| PAWPER XL-MAC tape | Height (cm)<br>MAC (cm) | | All |
| Guardian/participant | | | All |

APLS, Advanced Paediatric Life Support method; MAC, mid-arm circumference.

The p10, p20 and p30 obtained for different methods were compared using the McNemar test for comparison of paired proportions. For comparison of each method between BMI subgroups, the 'N-1' $\chi^2$ test was used.[15] Using Bonferroni correction to adjust for multiple pair-wise comparisons of methods, we considered $p<0.001$ as significant.

A sample size of 300 for each group was identified as pragmatically realistic for the availability of the investigators within the timescale of the study, allowing 15–20 patients to be recruited each weekday. Approximately 30–40 patients attend each of the emergency department, adult outpatient and paediatric outpatient departments daily. Bland-Altman analysis requires a sample size of at least 200.[16] For McNemar's test, 253 participants are required to detect a difference of 5% in proportions (power 80%, 95% CI).

MedCalc Statistical Software V.19.1.6 was used for statistical analysis (MedCalc Software, Ostend, Belgium; https://www.medcalc.org; 2020).

## PATIENT AND PUBLIC INVOLVEMENT

Patients and public were not involved in the design, conduct, reporting or dissemination plans of the research.

## RESULTS

We recruited 947 participants: 307 children (1–9.9 years), 309 adolescents (10–15.9 years) and 331 adults (16.1–90 years). All were Rwandan; 442 (46.7%) were female. No participant had a BMI z-score >2 (children and adolescents) or >30 kg/m$^2$ (adults). Age, weight, height, BMI and MAC data within each age group were not normally distributed, so medians and IQRsare presented in table 2. Required data were obtained in all participants, but two children had MAC below, and four adults had humeral length above, the limits of the Mercy tape. Guardians estimated the weight for five of the 16 year olds.

For the primary outcome, p20, the best methods were guardian/participant estimate and PAWPER XL-MAC across all age groups (table 3, figure 1). The Mercy method also performed

**Table 2** Demographic data for each group

| | Children (n=307) | Adolescents (n=309) | Adults (n=331) |
|---|---|---|---|
| Female, n (%) | 119 (39%) | 126 (41%) | 197 (60%) |
| Median age, years (IQR) | 4.5 (2.6 to 7) | 13.1 (11.3 to 14.6) | 43.1 (29.1 to 56.1) |
| Median weight, kg (IQR) | 15.6 (12 to 21) | 35 (28.9 to 43.8) | 64 (56.2 to 75.3) |
| Median height, cm (IQR) | 100 (89 to 116) | 145 (133 to 155) | 162 (157 to 167.8) |
| Median MAC, cm (IQR) | 15 (14 to 17) | 20 (18 to 21) | 27 (25 to 30) |
| Median BMI, kg/m$^2$ (IQR) | 15.5 (14.1 to 16.6) | 17.1 (15.6 to 18.7) | 24 (21 to 27.9) |
| z ≤3, n (%) | 18 (6%) | 9 (3%) | |
| −3<z≤−2, n (%) | 28 (9%) | 20 (2%) | |
| −2<z≤−1, n (%) | 36 (12%) | 74 (24%) | |
| −1<z<1, n (%) | 165 (54%) | 192 (62%) | |
| z≥1, n (%) | 60 (20%) | 14 (5%) | |
| BMI≤18.5 | | | 20 (6%) |
| 18.5<BMI<25 | | | 166 (50%) |
| 25≤BMI<30 | | | 145 (44%) |

BMI, body mass index; MAC, mid-arm circumference; z, z-score.

well. Results for p10 and p30, and pair-wise comparisons are presented in online supplemental tables 1 and 2.

The original APLS and Rwanda rules were the best of the age-based methods. The 1998 version was the best of the Broselow methods (although the differences were not significant). The 2010 MAC rule was better than the 2017 in children and adolescents, but vice versa in adults. PAWPER XL-MAC was better than the PAWPER XL tape. In children, Broselow methods performed better than Mercy and age-based methods, and the MAC formulae worst. The MAC formulae performed worst in adolescents too, but in adults the 2017 formula was not significantly worse than Mercy or PAWPER XL-MAC. All were outperformed by participant estimate.

**Table 3** Percentage of estimates within 20% of actual weight (p20)

| | Children (n=307) | Adolescents (n=309) | Adults (n=331) |
|---|---|---|---|
| | n (%) | n (%) | n (%) |
| Original APLS | 219 (71.3%) | | |
| Revised APLS | 163 (53.1%) | | |
| Finger-counting | 178 (58%) | | |
| Rwanda rule | 226 (73.6%) | | |
| Broselow 1993 | 254 (82.7%) | | |
| Broselow 1998 | 265 (86.3%) | | |
| Broselow 2007 | 254 (82.7%) | | |
| Broselow 2011 | 249 (81.1%) | | |
| Kokong | | | 223 (67.4%) |
| 2010 MAC | 157 (51.1%) | 134 (43.4%) | 154 (46.5%) |
| 2017 MAC | 79 (25.7%) | 121 (39.2%) | 252 (76.1%) |
| Mercy* | 230 (75.4%) | 243 (78.6%) | 267 (81.7%) |
| PAWPER XL | 252 (82.1%) | 199 (64.4%) | |
| PAWPER XL-MAC | 274 (89.3%) | 282 (91.3%) | 277 (83.7%) |
| G/P estimate† | 277 (90.2%) | 281 (90.9%) | 326 (98.5%) |

*Mercy method could not be used in all participants. For children, n=305. For adults, n=327.
†Guardians estimated weight for five of the 16 year olds.
APLS, Advanced Paediatric Life Support method; G/P, guardian/participant; MAC, mid-arm circumference.

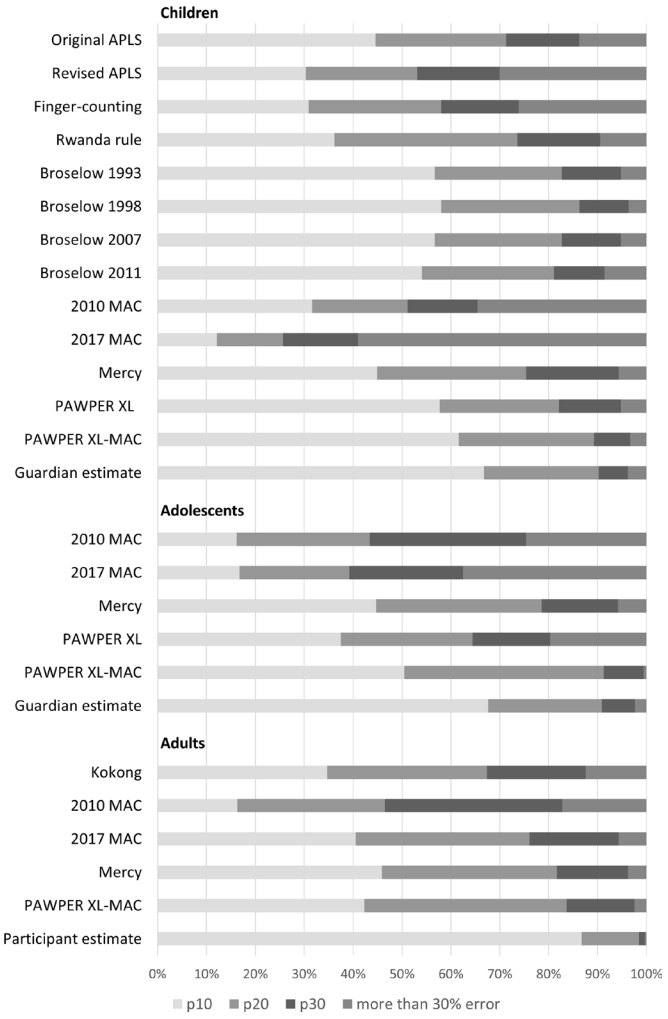


**Figure 1** Accuracy of different weight estimation methods. This figure presents for each method, the proportions of children with weight estimates within 10% (p10), 20% (p20), 30% (p30) of actual weight, and those with an error >30%. For each group of participants, methods are displayed in descending order of error >30%. Full data are presented in table 3 and online supplemental table 1. APLS, Advanced Paediatric Life Support; MAC, mid-arm circumference.

Bland-Altman analysis of the methods that performed best in each age group is presented in table 4 and figure 2. The smallest bias and narrowest LOA are seen with guardian/participant estimates. PAWPER XL-MAC, Broselow 1998 and Mercy have comparable LOA, and age-based rules the widest.

BMI subgroup analysis was performed for the three best performing methods overall (online supplemental table 3). In children, PAWPER XL-MAC performed worse in both underweight and overweight participants compared with normal In adults, both PAWPER XL-MAC and Mercy methods performed worse in overweight participants. A similar but insignificant trend was seen in adolescents. There was no significant difference between BMI subgroups for guardian/participant estimate. Bland-Altman analysis demonstrates a clear trend, in all ages and all methods, of decreasing weight estimation with increasing actual weight (figure 2B–D).

## DISCUSSION

This study has prospectively compared several methods of weight estimation in children, adolescents and adults. The study

**Table 4** Bland-Altman analysis

| | Children (n=307) | | Adolescents (n=309) | | Adults (n=331) | |
|---|---|---|---|---|---|---|
| | Bias, MPE (95% CI) | LLOA to ULOA | Bias, MPE (95% CI) | LLOA to ULOA | Bias, MPE (95% CI) | LLOA to ULOA |
| Original APLS | 4 (1.8 to 6.2) | −33.9 to 41.9 | | | | |
| Rwanda rule | −3.5 (−5.7 to 1.3) | −41.8 to 34.8 | | | | |
| Broselow 1998 | −1.9 (−3.5 to −0.3) | −30.3 to 26.6 | | | | |
| 2017 MAC | | | | | −11.8 (−13.4 to −10.1) | −42 to 18.5 |
| Mercy* | −10.2 (−12.0 to −8.3) | −42.7 to 22.4 | −10.2 (−11.8 to −8.5) | −39.1 to 18.8 | −12.6 (−13.9 to −11.4) | −35.1 to 9.8 |
| PAWPER XL-MAC | −1.8 (−3.2 to 0.3) | −27 to 23.5 | −7.9 (−9.1 to −6.7) | −28.9 to 13.2 | −11.6 (−12.8 to −10.4) | −33.4 to 10.2 |
| G/P estimate† | −0.5 (−0.2 to 1.0) | −26.7 to 25.6 | −4.1 (−5.4 to −2.8) | −27.2 to 19.1 | −0.4 (−1.1 to 0.4) | −13.9 to 13.2 |

Negative or positive biases represent underestimate or overestimate of weight, respectively.
*Mercy method could not be used in all participants. For children, n=305. For adults, n=327.
†Guardians estimated weight for five of the 16 year olds.
APLS, Advanced Paediatric Life Support method; G/P, guardian/participant; U/L LOA, upper/lower limits of agreement; MAC, mid-arm circumference; MPE, mean percentage error.

was well-powered and included large and equally sized age groups. The best methods in children are guardian estimate, the PAWPER XL-MAC and 1998 Broselow. In adolescents, the best methods are the PAWPER XL-MAC, guardian estimate and the Mercy method. In adults, participant estimate is the best method, with the PAWPER XL-MAC, Mercy method and 2017 MAC formula performing less well. Overall, in terms of the proportion of participants whose weight estimate is within 20% of actual weight (p20), guardian or participant estimate was significantly better than any other method. We have demonstrated that although neither was designed for adults, both the Mercy and PAWPER XL-MAC methods could be used in adults and adolescents. For guardian/participant estimate, PAWPER and Mercy methods, there is a clear trend of decreasing weight estimation with increasing actual weight. This was most significant for PAWPER XL-MAC. In children, the Rwanda age-based rule has been shown to perform comparably to the best existing alternative, the original APLS formula.

There is no consensus as to what defines an acceptable degree of accuracy for weight estimation. The original Broselow tape study determined proportions of estimates within 5%, 10%, 15% and 25% but did not argue for one specific cut-off.[2] The MAC formulae papers presented proportions within 10%, 20% and 30%, and suggested that most drugs could safely be given within a margin of error of 30%.[3 8] Lack argued that as the therapeutic ratio (the toxic dose divided by the effective dose) for most drugs is >1.5, an error in weight-dependent dosage of 10%–20% would be reasonable.[17] The creator of the PAWPER tape states that 95% of estimates should lie within 20% of actual weight, and 70% within 10%, for a method to be considered adequate.[5] Using this standard, none of the methods we assessed would be considered adequate in any age group, other than

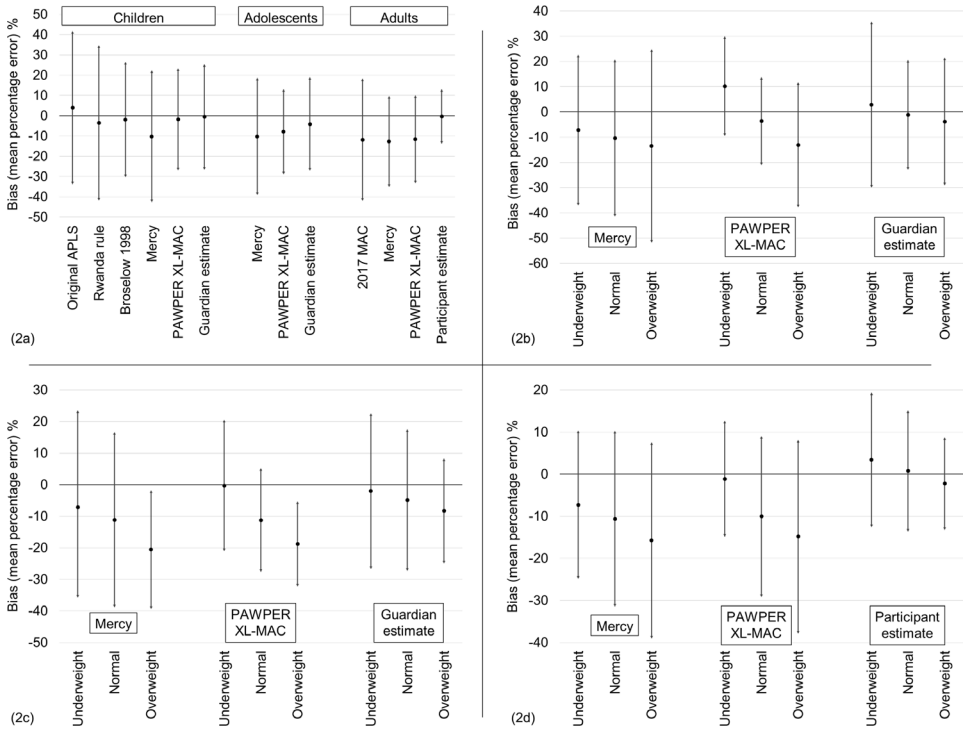


**Figure 2** Bias (mean percentage error) and limits of agreement. (A) According to age groups. (B) Children, according to body mass index (BMI) subgroups. (C) Adolescents, according to BMI subgroups. () Adults, according to BMI subgroups. A negative bias represents an average underestimate of actual weight. Full data are presented in table 4 and online supplemental table 3. MAC, mid-arm circumference.

participant estimation in adults. Other studies consistently show that age-based rules for children would fail that standard, not even reaching a p30 of 90%.[1 5] The original Broselow tape study only found a p10 of 59.7%. If we were to define acceptability as a p20 of 80% (ie, that 80% of estimates lie within 20% of actual weight), then in children we would recommend the PAWPER XL-MAC, the 1998 Broselow tape and guardian estimation. In adolescents we would recommend the PAWPER XL-MAC and guardian estimation. In adults we would recommend the Mercy tape, PAWPER XL-MAC and participant estimation. These recommendations would be unchanged by defining acceptability as a p30 of 95. By any of these definitions, none of the age-based rules would be acceptable in children, nor would Kokong's height-based formula in adults, nor would either of the MAC formulae. If there were no guardian available, and no tape, then we would recommend cautious use of the original APLS formula in children. Although it did not significantly outperform the new Rwanda rule overall, it is much easier to calculate.

In general, our results are consistent with those from other countries: age-based rules perform poorly, and Mercy and PAWPER tapes perform well. However, the p20 or MPE for each method may differ between populations. For example, a recent study has found that the MAC formula did not perform as well in an elderly Dutch population as it did in an American population.[18] It is likely that body habitus and BMI are important reasons for these differences. 'One-dimensional' (1D) methods that use only one body-based measure (eg, height or MAC) are consistently outperformed by 'two-dimensional' (2D) methods that use two different body measurements: a length-based measure and a habitus measure.[6] There are two 2D methods in use, the Mercy and PAWPER tapes. These methods are inherently more precise: for any given height, people could have a wide range of weights. But for any given height together with a given MAC, the range of weights is much narrower. Previous Mercy and PAWPER studies have demonstrated high values of p10 and p20 (78.6% and 98% for Mercy, 79.3% and 96.9% for PAWPER XL-MAC).[4 6] In our study, Bland-Altman analysis confirms that the PAWPER MAC-XL has narrower LOA in children than Broselow, MAC or age-based methods. However, we have not obtained as good overall accuracy (p10, p20) in our study as in the original PAWPER and Mercy studies. This is likely due to differences in body habitus between Rwandan, South African and American populations, and reinforces the need for local studies. Much of the difference in local populations will depend on the distribution of underweight and overweight. Although our results cannot be directly applied to other settings, the relative performance of each method in BMI subgroups might help identify which method might be more appropriate in a population with a particular BMI distribution. PAWPER XL-MAC has recently been shown to underestimate weight in overweight, and overestimate weight in underweight, consistent with the findings presented here.[6] Although the Mali study of the Mercy method found no performance difference between BMI percentile groups,[19] a US study found that the Mercy method overestimated weight in all groups except the overweight, in whom weight was underestimated.[20] In our study, weight was underestimated in all groups, worsening with increasing weight. The PAWPER XL-MAC has narrower LOA than Mercy across all age and BMI groups, and narrower than guardian/participant estimates in children and adolescents in all BMI groups. Adjustment to improve PAWPER bias especially in overweight and underweight, could therefore result in greater overall accuracy than would be achieved by similarly correcting the bias for Mercy. In adults, participant estimate has the lowest LOA, which suggests that improving the bias for other methods, while increasing their accuracy, will not enable them to outperform participant estimate.

Wells has noted that the only method as accurate as 2D methods is parental estimate.[6] We have confirmed that this is true in children and adolescents, and that participant estimate is the best in adults too. There was a trend of decreasing estimate with increasing actual weight, but less pronounced than PAWPER or Mercy methods, and there was no significant difference in p20 between BMI groups. However, in emergency situations patients might not be able to estimate their weight and guardians may not be present, which is why alternative methods of weight estimation are essential. Cultural differences between populations might also limit the generalisability of using guardian/participant estimates in other settings without confirmatory local studies. This study has also not addressed whether clinician estimate is reliable in our context. Previously, clinician estimate has been found to be significantly worse than patient or parent estimates in adults or children.[21 22] For now, it appears that the PAWPER XL-MAC is the overall best method to use in all ages.

One limitation of the study was that it was conducted in a tertiary referral centre. Patients usually attend this hospital only after referral from a district hospital, where they may have already been weighed. It is therefore possible that guardian or self-estimation is not as accurate for patients presenting for the first time at district hospitals. A second potential limitation was the pragmatic recruitment method, aiming for a convenience sample of 15–20 patients each weekday, and a balance of ages across age groups. It is possible that the process of selection might have contributed to the gender imbalance. However, this might simply reflect the balance of patients presenting at our hospital. It is unlikely to skew the results significantly, and none of our weight estimation methods includes an option to adjust for gender. Third, the study was virtual, in that we did not use the actual PAWPER, Mercy or Broselow tapes. However, it has been shown that real and virtual studies produce very similar results, although it is recommended to confirm virtual findings in a real-life study.[13] Fourth, at the time of our study the latest 2017 version of the Broselow tape had not been published. Successive versions of the tape since 1998 have been less accurate in our population, and it is likely that the 2017 version, with similar weight divisions as the 2011 version, would follow that trend. Fifth, we did not measure inter-rater reliability, nor intrarater variability. A recent study of the Mercy method in Mali found very high inter-rater reliability (ICC=0.998) and very good intrarater variability.[19] Finally, BMI subgroup analysis was limited by the relatively few overweight adolescents and underweight adults, making it harder to confirm the significance of the trend.

## Conclusions

Both the PAWPER and Mercy methods can be used in adolescents and adults. In children, the new Rwanda age-based rule performed comparably to the original APLS formula, but neither were considered acceptable. If no other option is available, we would recommend cautious use of the APLS formula. Across all ages, the PAWPER XL-MAC and guardian/participant estimates of weight were the most reliable and we would recommend their use in this setting, with the proviso that the PAWPER XL-MAC (and Mercy) method might benefit from adjustment for local population data, with subsequent real-life validation.

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**Contributors** Both authors meet the requirements for authorship. GNC and AM devised the study and wrote the protocol. AM oversaw the running of the study. GNC analysed the data and wrote the manuscript draft. GNC and AM reviewed and revised the paper.

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**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not required.

**Ethics approval** Ethical approval was obtained from the Institutional Review Board, College of Medicine and Health Sciences, University of Rwanda (reference 406/CMHS IRB/2016) and from the Ethics Committee, CHUK (reference EC/CHUK/214/2016). Written consent in Kinyarwanda was obtained from patients or guardians as appropriate.

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**Data availability statement** Data are available on reasonable request. Deidentified Excel/Medcalc datasets are available on request from the author (ORCID ID 0000-0002-8910-2307).

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