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ORIGINAL RESEARCH

Accuracy of parental estimate of child's weight in a paediatric emergency department

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Abstract

Objectives: To determine the accuracy of using parental estimate of a child's weight compared to actual weight in a paediatric emergency setting.
Methods: Prospective, observational study. Age, weight and height data were collected from children aged 1 month up to 11 years with an Australian Triage score of 3 or higher. This was compared with a parent weight estimate. Analysis is descriptive.
Results: A total of 450 children were studied with a mean age of 4 years 4 months. A total of 85.3% of parents were willing to provide a weight estimate (n = 384). The mean difference between the parent estimate (where provided) and the actual weight was 0.33 kg (measured weight > estimated; 95% confidence interval [CI] −6.9 kg to +7.6 kg). There was 75% agreement within 10% of the measured weight (95% CI 71–79%) and 92% agreement within 20% of the measured weight (95% CI 89–95%). Weight was more commonly underestimated than overestimated. Children of Polynesian/Pacific ethnicity were less likely to have an accurate parental weight estimation.
Conclusions: Parent estimate is an accurate weight estimation method when parents are willing to give an estimate. There is ethnic variation in accuracy that should be taken into account when applying this method.

Key words: *children, emergency, weight estimation.*

Introduction

When a weight cannot be measured during a paediatric emergency, an estimate is used to calculate drug dosage, equipment size and counter shock voltage.[1] Without an accurate weight, children could be over- or under-treated. This might negatively impact outcome.[2] To date, age-based formulae have been used. In these, all children of the same age are considered to weigh the same, regardless of gender, ethnicity or body habitus.[3] Previous studies have shown these formulae to be inaccurate.[4,5] A number of methods for weight estimation have been proposed including a height-based tape,[6] body habitus adjustments[7–9] and technology-based solutions.[10–12] One low-technology method of estimating weight is to ask the parents.[13] Previous studies have shown that parents can accurately estimate their child's weight[13–19] when willing to do so. These studies are now over a decade old and may not reflect the current situation.

The parent estimate solution has significant benefits. Pre-hospital providers can communicate this information to destination hospitals so drugs and equipment can be prepared in advance.[20] Minimal staff training is required to obtain it.[21]

Key findings

- Parental estimate is an accurate weight estimation method for children in the ED.
- The majority (85.3%) of parents in this study were willing to provide a weight estimate.
- There is ethnic variation in accuracy of parental estimate, with children of Polynesian/Pacific ethnicity less likely to have an accurate weight estimate.
- Further research is required to see if this method is still accurate when children are critically ill.

However, recent Australian studies show parents do not accurately perceive obesity in their own children,[22] and overweight parents are less reliable in identifying the weight status of their children.[23–25] With childhood obesity rates rising globally,[26] it is important to ensure that any chosen method remains reliable.

The present study aims to determine the accuracy of using parental estimate to approximate a child's weight compared to measured weight in a paediatric emergency setting.

Method

This was a prospective, observational study. Data were collected over a 3 month period from September to November 2018 in the paediatric ED of Sunshine Hospital, Melbourne, Australia. This ED has an annual paediatric census of approximately 25 000 presentations. Data were collected from children aged 1 month up to (but not

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including) 11 years with an Australian Triage score of 3–5. This age range was selected as the original APLS formula (which at present is the status quo for paediatric weight estimation in Victoria[1]) is restricted to the same age range.[5]

Study participants were collected by convenience sampling by the principal investigator who was not blinded to the study hypothesis. Data collected included age, gender, height (cm), weight (kg), ethnicity and parent weight estimate. Parent weight estimate was collected prior to the recording of the child's weight. Weight was measured using National Weighing and Instruments standing scales, the Wedderburn electronic chair scale (model WM401), or the Tanita digital baby weight scale (model BD586). Infants less than 12 months old were measured naked, while older children were weighed without shoes or heavy clothing. Height was measured using a stadiometer or a SECA baby measuring mat (model SECA201). Shoes were removed to measure height. In the case of an uncooperative child, weight was measured indirectly by weighing the parent and child together then subtracting the parent's weight. The data form used can be found in Appendix S1.

Outcomes of interest were agreement between parental estimate of a child's weight and measured weight. Secondary outcomes of interest were agreement within 10% and 20% by age group, ethnicity and body mass index (BMI) for children aged 2 years or older (n = 258). Data were analysed by descriptive statistics, chi-squared/Fisher's exact for comparison of proportions and Bland–Altman analyses for calculation of mean difference and 95% limits of agreement.

Ethical approval was granted by the Western Health Low Risk Ethics Panel. All parents verbally consented to participate in the study.

Results

A total of 450 children were enrolled into the study. The mean age was 4 years 4 months and the median age was 3 years 7 months. This is consistent with the average age of presentation to the Sunshine Hospital paediatric ED over the preceding 4 year period. In total, 54.6% of children were male. Over half (53.3%) were of non-Caucasian/European ethnicity. BMI was available for 258 children. The demographic of the sample are summarised in Table 1.

The majority (85.3%) of parents were willing provide a weight estimate. Willingness did not appear to be related to the age of the child (P = 0.6), ethnicity (P = 0.33) or gender of the child (P = 0.17). Full data can be found in Appendix S2.

The mean difference between the parent estimate (where provided) and the actual weight was 0.33 kg (measured weight > estimated weight; 95% confidence interval [CI] −6.9 kg to +7.6 kg). The mean percent difference was 1.1% (95% CI −0.5% to +2.7%). There was 75% agreement within 10% of the actual weight (95% CI 71–79%) and 92% agreement within 20% of the actual weight (95% CI 89–95%). Weight was more commonly underestimated than overestimated. No significant difference was found between age groups, as shown in Table 2. The distribution of parental estimate compared to actual weight can be seen in Figure 1.

On multivariate analysis, agreement of the parent estimate within 10% and 20% of the actual weight differed by ethnicity (agreement within 10%, P = 0.065; agreement within 20%, P = 0.01) (Fig. 2). Children of Polynesian/Pacific ethnicity were less likely to have agreement of parental weight estimate within 10% or 20%.

There was a trend towards accuracy of parental estimate varying with BMI category, as shown in Figure 3. However, this did not reach statistical significance (Appendix S3).

TABLE 1. *Demographic data*

Total	450 candidates, *n* (%)
Gender (n = 450)	
Male	246 (54.6)
Female	197 (43.8)
Not recorded	7 (1.6)
Age (n = 450)	
<1 year	52 (11.6)
1–4 years	223 (49.6)
5–10 years	175 (38.9)
Ethnicity (n = 450)	
Caucasian/European	211 (46.9)
African	38 (8.4)
Asian	81 (18)
Polynesian/Pacific Islander	22 (4.9)
Indian subcontinent	65 (14.4)
Other	13 (2.9)
Not recorded	20 (4.4)
Body mass index (only children aged 2 and above, n = 258)	
<14 kg/m^2	22 (8.6)
14–17 kg/m^2	126 (48.8)
17–20 kg/m^2	77 (29.8)
>20 kg/m^2	33 (12.8)

TABLE 2. *Accuracy of the parent estimate compared to actual weight by age*

	Mean difference (kg)	95% limits of agreement (kg)	Mean percent difference	Agreement within 10%	Agreement within 20%
Overall	0.33 (measured weight > estimated)	−6.9 to +7.6	1.1% [−0.5 to +2.7%]	75% [71–79%]	92% [89–95%]
Age <1 year	0.18 (measured weight > estimated)	−1.12 to +0.76	2.4% [−0.8 to +4.1%]	42/47; 89% [77–95%]	47/47; 100% [92–100%]
Age 1–4 years	0.23 (measured weight > estimated)	−1.75 to +2.21	1.4% [−0.4 to +2.4%]	148/189; 78% [72–84%]	173/189; 92% [86–95%]
Age 5–10 years	0.8 (measured weight > estimated)	−8.54 to +10.1	2.3% [−0.1 to 4.8%]	107/147; 71% [64–78%]	135/147; 91% [85–95%]

Square brackets enclose 95% confidence interval.

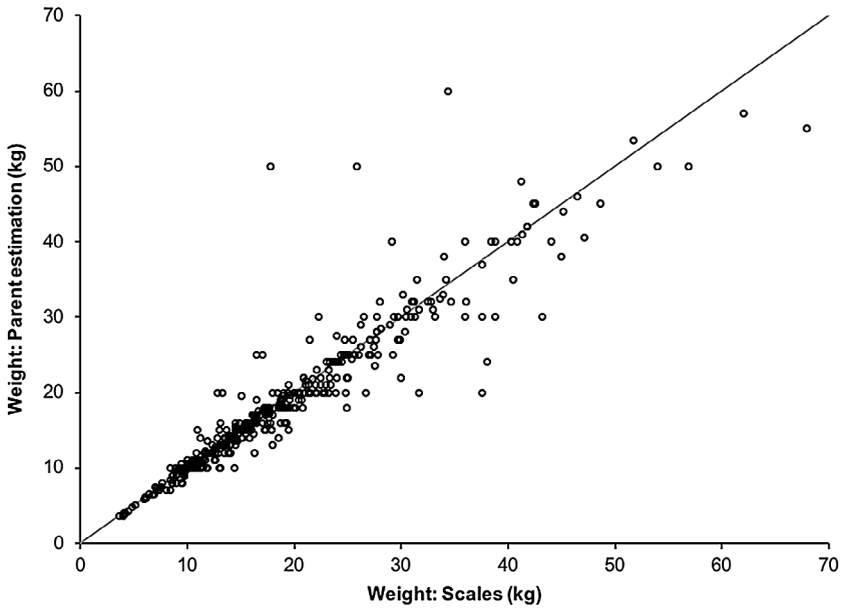

Figure 1. *Scatter plot showing accuracy of parent weight estimate (kg) compared to measured weight (kg). A total of 385 out of 450 (85.6%) parents were willing to provide a weight estimate. The graph shows parental weight estimates are closely aligned with actual weight, but this is less congruent with increasing weight.*

Discussion

The present study suggests that parental estimate of their child's weight remains an accurate method of weight estimation. This is consistent with findings from previous studies.[13–19] The benchmark for sufficient accuracy of weight estimation is not yet known. Previous authors have suggested an estimation method should have 70% of weight estimates fall within 10% of actual weight, and 95% of weight estimates fall within 20% of actual weight.[5,27] Our data show that the parental estimation method is close to this, with 75% of weight estimates falling within 10% of actual weight, and 92% of weight estimates falling within 20% of actual weight.

However, what the present study suggests is that the accuracy of parental weight estimates varies with ethnicity and possibly that they become less accurate with increasing BMI. A possible explanation for the ethnic variation is that children of Polynesian and Pacific Islander background tend to have higher BMI, compared to other ethnic groups.[28] This finding is consistent with previous research, which suggests that parents of overweight or obese children are less able to discriminate the weight status of their children.[22–25] This could suggest that using parent estimate to estimate children's weight in ED may be less reliable in overweight or obese children.

Research has found that other weight estimation methods, such as age-based formulae or the Broselow tape, also become less accurate with increasing BMI.[5,29] Methods that account for body habitus such as the PAWPER XL tape are more reliable in overweight and obese patients.[30] These methods may be more labour-intensive and time-consuming. Future guidelines could suggest that parental estimate be used in the first instance with the majority of patients, but if a patient is overweight or obese, or if the parent is unwilling to give an estimate, other methods such as the PAWPER XL tape could be implemented.

There are a number of limitations to the present study. First, many children presenting to the ED with non-life threatening illnesses had recently visited a general practitioner where they had been weighed. Some children were weighed regularly at home. Resuscitation scenarios, such as those because of trauma, are often unpredictable and therefore it may be less likely that the child has been weighed recently. Further research in critically ill children is required to see

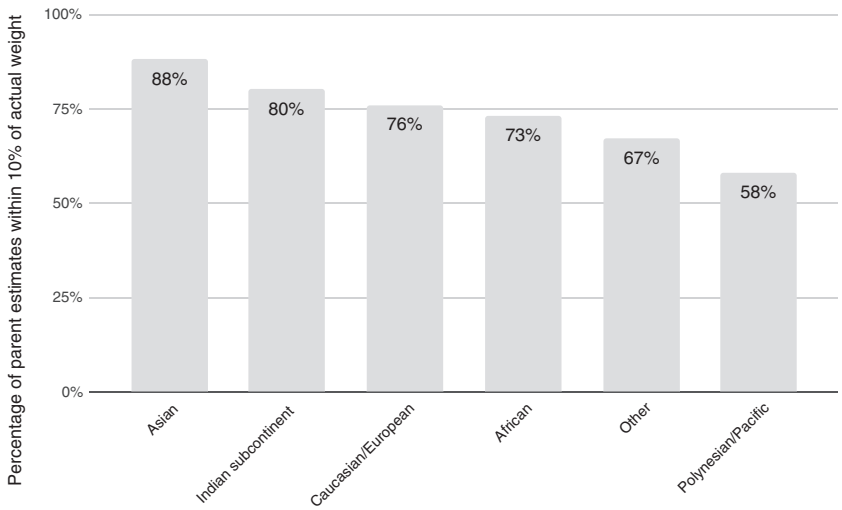

Figure 2. *Column graph showing percentage of parent estimates that were within 10% of actual weight by ethnicity* (n = *430). Data show that those of Asian ethnicity were most accurate, and those of Polynesian/Pacific ancestry were least accurate. Full data can be found in the Supporting Information.*

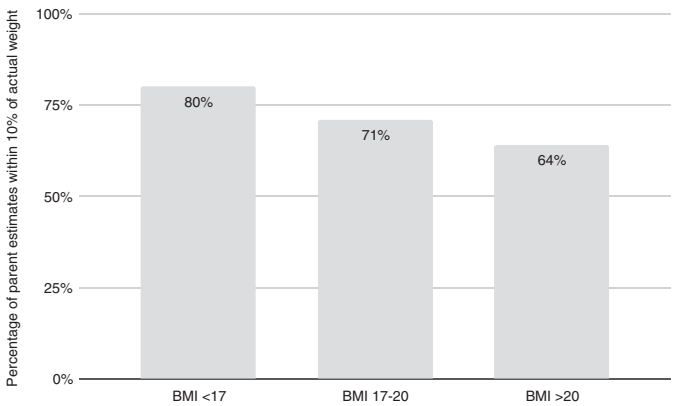

Figure 3. *Column graph showing the percentage of parent estimates that were within 10% of the actual weight by body mass index (BMI)* (n = *258). Data show that those of lower BMI were most accurate, and those of higher BMI were least accurate. Full data can be found in the Supporting Information.*

if this changes the accuracy of the parental estimate method. Equally, parents presenting with children to the ED in a non-emergent situation may be less stressed and have better recall of a recent measured weight. Further research in Australasian Triage Scale categories 1 and 2, children are also required to see if parental stress has an impact on the accuracy of weight estimates. In our study, 85.3% of parents were willing to estimate their child's weight. It would be important to see if parents are more or less willing to estimate their child's weight in a critical emergency scenario, and to determine what the best solution is to use as a backup should a parent be unwilling to guess. This research does not provide guidance on the accuracy of parental estimate as a weight estimation method for children aged 11 and above.

Conclusion

In conclusion, this research adds to the growing body of evidence that suggests that parental estimate is an accurate weight estimation method for children in ED. It raises questions about whether this method would remain accurate in the future should childhood obesity continue to rise. Further research on children in critical scenarios is required to see if this method is fit-for-purpose in those scenarios where it would be required.

Author contributions

MF came up with the original study design, collected the data and wrote the initial draft. AT assisted with data collection and writing of the document. SK assisted with ethics approval and data collection. AMK provided core oversight, helped with the ethics approval and data analysis.

Competing interests

None declared.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Appendix S1. Data collection form.
Appendix S2. Demographics of parents that gave an estimate.
Appendix S3. Agreement within 10% and 20% of parent estimate to actual weight by BMI and ethnicity.