

## Original Article

# The RAMA Ped Card: Does it work for actual weight estimation in child patients at the emergency department

Thavinee Trainarongsakul<sup>1</sup>, Pitsucha Sanguanwit<sup>1</sup>, Supawan Rojcharoenchai<sup>1</sup>, Kittisak Sawanyawisuth<sup>2-4</sup>, Yuwares Sittichanbuncha<sup>1</sup>

<sup>1</sup> Department of Emergency Medicine, Faculty of Medicine, Ramathibodi Hospital Mahidol University, Bangkok, Thailand

<sup>2</sup> Department of Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand

<sup>3</sup> Research Center in Back, Neck Other Joint Pain and Human Performance (BNOJPH), Khon Kaen University, Khon Kaen, Thailand

<sup>4</sup> Ambulatory Medicine Research Group, Faculty of Medicine, Khon Kean University, Khon Kaen, Thailand

**Corresponding Author:** Yuwares Sittichanbuncha, Email: yuwares.sit@mahidol.ac.th

**BACKGROUND:** In emergency conditions, the actual weight of infants and young children are essential for treatments. The RAMATHIBODI Pediatric Emergency Drug Card or RAMA Ped Card has also been developed to estimate actual weight of the subjects. This study aimed to validate the RAMA Ped Card in correctly identifying the actual weight of infants and young adults.

**METHODS:** This study was a prospective study. We enrolled all consecutive patients under 15 years of age who visited the emergency department (ED). All eligible patients' actual weight and height were measured at the screening point of the ED. The weight of each patient was also measured using the unlabeled RAMA Ped Card. The Cohen's kappa values and agreement percentages were calculated.

**RESULTS:** During the study period, there were 345 eligible patients. The RAMA Ped Card had a 61.16% agreement with the actual weight with a kappa of 0.54 ( $P < 0.01$ ), while the agreement with the actual height had a kappa of 0.90 and 91.59% agreement. Sub-group analysis found kappa scores with good range in two categories: in cases of accidents and in the infant group (kappa of 0.68 and 0.65, respectively).

**CONCLUSION:** The RAMA Ped Card had a fair correlation with the actual weight in child patients presenting at the ED. Weight estimation in infant patients and children who presented with accidents were more accurate.

**KEY WORDS:** Child; Weight estimation; Card; Kappa

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## INTRODUCTION

Child patients need special care, particularly regarding medication dosage and size of medical devices used.<sup>[1-4]</sup> A study looking at 41 anesthesiologists showed that 85% gave incorrect answers to questions about drug concentrations for children.<sup>[5]</sup> Even the pediatric residents made errors in drug calculation for infants and young

children.<sup>[6]</sup> One factor that may be important is the actual weight of the patients. In emergency conditions, it may be difficult to weigh the patient. Several tools have been developed to estimate the actual weight of infants and young children.

James Broselow and Robert Luten first introduced the Broselow tape, which was developed from the

weight for height percentile curves.<sup>[7]</sup> The 2011 version of the Broselow tape has been shown to be an effective tool to estimate the actual weight of children. Using the Broselow tape indicates the correct endotracheal tube size in the operating room at a significantly higher rate than age-based rules (99% vs. 47%).<sup>[11]</sup> The Pediatric Advanced Life Support (PALS) also recommends using the actual weight indicated by the Broselow tape.<sup>[8]</sup>

The RAMATHIBODI Pediatric Emergency Drug Card or RAMA Ped Card has also been developed using Thai national data regarding weight and height (Figure 1 and Table 1). The length of infants or young children as measured by the card indicates the estimated actual weight of the subjects. There are nine bands with different colors and the weights range from 3–36 kg. There were no previous published data on the validity of the RAMA Ped Card but they reduced medication errors

and times to prescribe medication in children patients at the emergency department (ED) of our hospital (personal communication). This study aimed to validate the RAMA Ped Card in correctly identifying the actual weight of infants and young adults.

## METHODS

This study was a prospective study conducted at the ED in Mahidol University's Ramathibodi Hospital in Bangkok, Thailand. The study period was between August 15 and October 15, 2013. We enrolled all consecutive patients under 15 years of age who visited the ED. The exclusion criteria were the presence of leg deformity or height of less than 45.5 cm or more than 146 cm, which were the length limits of the RAMA Ped Card.

All eligible patients' actual weight and height were measured at the screening point of the ED. These measurements were performed by ED staff. The scales used in the study were a TANITA standing scale and a Seca model 727 for infants. The weight of each patient was also measured using the RAMA Ped Card. A single person, well trained in the RAMA Ped Card's use, measured all patients with the card. The RAMA Ped Card used in this study was unlabeled. The actual weight and height of all patients were not revealed to the RAMA Ped Card evaluator.

All clinical data were collected including age, sex, triage level, presenting symptoms, treatment at the ED, and discharge status. Age was categorized as follows: infants (less than one year), pre-school age (1–5 years), and school age (more than 5 years). Triage level was divided into three groups: emergency, urgent, and non-urgent. The main outcome of this study was to assess the accuracy the RAMA Ped Card in estimating patient's actual weight. The weight predicted by the RAMA Ped Card using actual height was also studied.

The estimated sample size was calculated using the one proportion estimation formula. A previous study has shown there to be a 65 agreement between weight and height in children<sup>[9]</sup> with a type I error of 0.05, power of 80%, and confidence interval width of 5%. The required sample size was 342.

Descriptive statistics were used to analyze clinical characteristics of all patients. The Cohen's kappa values and agreement percentages were calculated using the actual weight vs. the weight indicated bands of the RAMA Ped Card by the evaluator and the weight indicated by the bands of the RAMA Ped card based on actual height



Figure 1. The RAMA Ped Card (A) instructions for its use (B).

Table 1. The colored band of the RAMA Ped Card and range of estimated actual weight

Band number	Color	Estimated actual weight (kg)
1	Blue	3–5
2	Green	6–7
3	Yellow	8–9
4	Light pink	10–11
5	Navy blue	12–14
6	Orange	15–18
7	Dark pink	19–22 (19–23.99)*
8	Purple	24–28 (24–29.99)*
9	Brown	30–36

\*: modified in this study.

vs the weight indicated by the bands of the RAMA Ped Card as measured by the evaluator. Subgroup analysis was also performed for each of the clinical characteristics to evaluate the correlation between the actual weight vs the weight indicated bands of the RAMA Ped Card by the evaluator. A Cohen's kappa value of more than 0.60 was considered good correlation. All statistical analyses were performed using STATA software (College Station, Texas, USA).

## RESULTS

During the study period, there were 383 eligible patients. Of those, 38 patients were excluded because of a height of more than 146 cm (36 patients), a height of less than 45.5 cm (1 patient), and leg deformity (1 patient). In total, there were 345 patients in the study. Characteristics of all patients are showed in Table 2. The male:female ratio was 1.25:1 and approximately half of the patients were in the pre-school age group (48.70%). The median actual weight and mean actual height were

**Table 2.** Clinical factors of child patients presenting at the emergency department who received the RAMA Ped Card evaluation

Factors	Number (%)
Sex	
Male	192 (55.65)
Female	153 (44.35)
Age group	
Infant	66 (19.13)
Preschool	168 (48.70)
Primary school	111 (32.17)
Median actual weight, kg (min, max)	14.10 (3.30, 49.60)
Mean actual height, cm (SD)	97.01 (24.14)
Underlying disease	
Yes	144 (41.74)
No	201 (58.26)
Current medication	
Yes	118 (34.20)
No	227 (65.80)
Presenting disease	
Accidents	36 (10.43)
Non-accident	309 (89.57)
Level of emergency	
Emergent	2 (0.58)
Urgent	174 (50.43)
Non-urgent	169 (48.99)
Treatment at the ED	
Yes	
Bronchodilator	37 (10.73)
IV fluid	33 (9.56)
IV/oral medications	258 (74.78)
No	17 (4.93)
Discharge status	
Admitted	67 (19.42)
Discharged	266 (77.10)
Referred	12 (3.48)

**Table 3.** The correlations of weight estimated using the RAMA Ped Card and actual weight in child patients presenting at the emergency department

Outcomes	Number (%)
Concordance with actual weight	211 (61.16)
Under the actual weight	70 (20.29)
Over the actual weight	64 (18.55)
Concordance with actual weight $\pm$ one band error	335 (97.10)

14.10 kg and 97.01 cm, respectively.

The RAMA Ped Card had a 61.16% agreement with the actual weight (Table 3) with a kappa of 0.54 ( $P < 0.01$ ), while the agreement with the actual height had a kappa of 0.90 and 91.59% agreement. As for the discordant data between the RAMA Ped Card predicted weight and actual weight, 20.29% was underestimated and 18.55% was overestimated (Table 3). Sub-group analysis found kappa scores with good range in two categories: in cases of accidents and in the infant group (kappa of 0.68 and 0.65, respectively).

## DISCUSSION

Weight predicted by the RAMA Ped Card had a fair correlation with actual weight (Cohen kappa value of 0.54). These outcomes are somewhat lower than those of a previous study from the US, which had a kappa of 0.61 and a degree of agreement of 66.2% using the Broselow colored card.<sup>[9]</sup>

There was not an excellent correlation between weight estimated using the card or tape to the actual weight. This is a limitation of the card being an indirect form of estimating the actual weight. Other previous studies may have different outcomes, both favorable and unfavorable.<sup>[10-16]</sup> A study from India showed that the Broselow card may be useful for children with body weight of less than 10 kg.<sup>[11]</sup> The agreement percentage dropped from 70.8% to 56.3% if children weighed over 10 kg. A study from Singapore of 875 children had a favorable weight estimation than other two methods (Advanced Paediatric Life Support and Luscombe formulae).<sup>[16]</sup> The Broselow tape showed less of a difference with the actual weight in terms of mean percentage compared with the Pediatric Advanced Weight-Prediction in the Emergency Room and the Luscombe tape (+0.6% vs. +7.6% vs. -7.4%, respectively). To improve the quality of these tapes or our card, it may be necessary to adjust for the body habitus.<sup>[17,18]</sup>

**Table 4.** Subgroup analysis on the correlation between weight estimated using the RAMA Ped Card and actual weight in child patients presenting at the emergency department

Features	% agreement	Kappa values	P values
Level of emergency			
Emergent	59.09	0.53	<0.01
Non-emergent	59.17	0.53	<0.01
Disease type			
Accidents	72.22	0.68	<0.01
Non-accident	57.61	0.52	<0.01
Age groups			
Infants	75.76	0.65	<0.01
Pre-school age	54.76	0.40	<0.01
School age	55.86	0.42	<0.01

As in other studies, the discordances of the estimated weight estimated using the RAMA Ped Card and the actual body weight may take the form of either underestimation (20.29%) or overestimation (18.55%). Note that these numbers almost equal. However previous studies each showed discordance in only one direction, overestimation<sup>[11]</sup> or underestimation.<sup>[10,12]</sup> Even though this study did not evaluate the medication prescription of these patients, we expect that it would be medication errors in terms of dosage. The discordances may occur in those who had extreme weight either overweight or underweight because the Ped card developed by using average Thai national data regarding weight and height. The main benefit of the Ped card is for weight evaluation in children with an emergency conditions which required prompt management in medication doses.

This study also found that the two subgroups with good kappa values were infants and patients presenting with accidents (Table 4). Infant patients do not have differing body habitus as is the case with young children, as mentioned above. In addition, the weight and height ratios in infants are highly correlated. A previous study from the US had similar findings.<sup>[9]</sup> Another factor that may influence the reliability of the tape or card is body weight. At least three studies found that body weight is a factor that affects the agreement between estimated and actual weight.<sup>[9-11]</sup> We believe that children presenting with accidents may have lower body weight than those in the non-accident group.

## CONCLUSIONS

The RAMA Ped Card had a fair correlation with the actual weight in child patients presenting at the ED. Weight estimation in infant patients and children who presented with accidents were more accurate. Further

studies may be necessary to evaluate the appropriate use of the card. However, it may be a cheap and simple tool in countries with limited resources.

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**Contributors:** TT, SR, and YS conceived the study, and designed the trial. SR conducted ethics submission. TT, PS, and YS supervised the conduct of the trial and data collection. SR undertook recruitment of patients. KS interpreted data and conceptualized the draft. SR and KS drafted the manuscript, and all authors contributed substantially to its revision. YS takes responsibility for the paper as a whole.

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