HOW MUCH IS RIGHT?

Calculating weight from age in children

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INTRODUCTION

Weight-based drug dosing is essential in paediatric anaesthesia. However, childhood obesity is on the rise. The UK National Child Measurement Programme (NCMP) data in 2016-2017 showed 22.6% of 5-year-olds are overweight (BMI >85th centile) and 9.6% are obese (BMI >95th centile)[1]. By the age of 11 years, the figures are 34.2% and 20.0% respectively[1]. This increases inaccuracy in estimating weight using age-based formula in emergency situations. Our audit project aimed to assess accuracy of the formulae amongst paediatric patients in Newcastle.

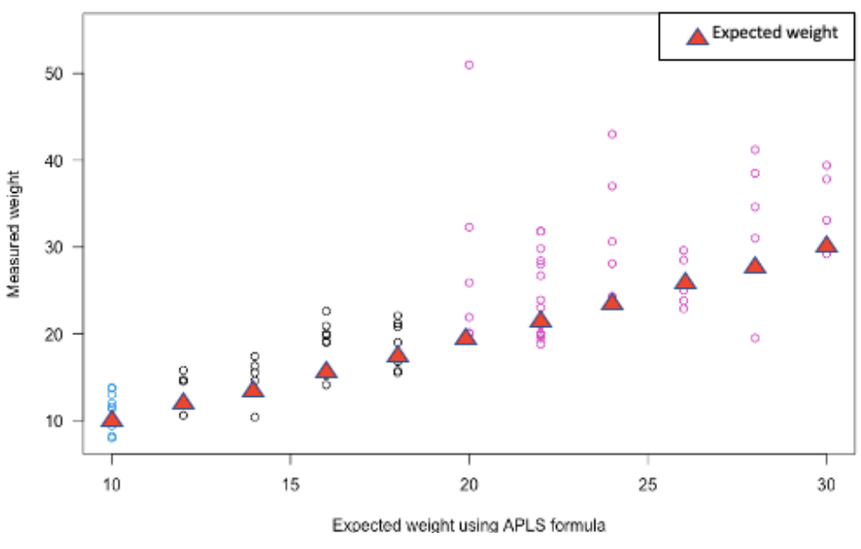
METHOD

Data was collected over 2 weeks in May 2019 in paediatric theatres at The Great North Children's Hospital. Weight for all children, aged Day 1-of-life to 16 years, who came for emergency and elective surgeries was recorded.
Results were split into **male** and **female** arms, grouped into ages <1 year, 1 year, 2-5 years, 5-11 years and >12s. For the groups aged <1, 1 and >12 spread of data was analysed. For the groups aged 2-5 and 6-11, the standard formula (age+4)x2 and the new formula (age x3)+7 were compared for fit by spread of data around the estimated weight and by comparing the estimated and expected weight with a linear model.

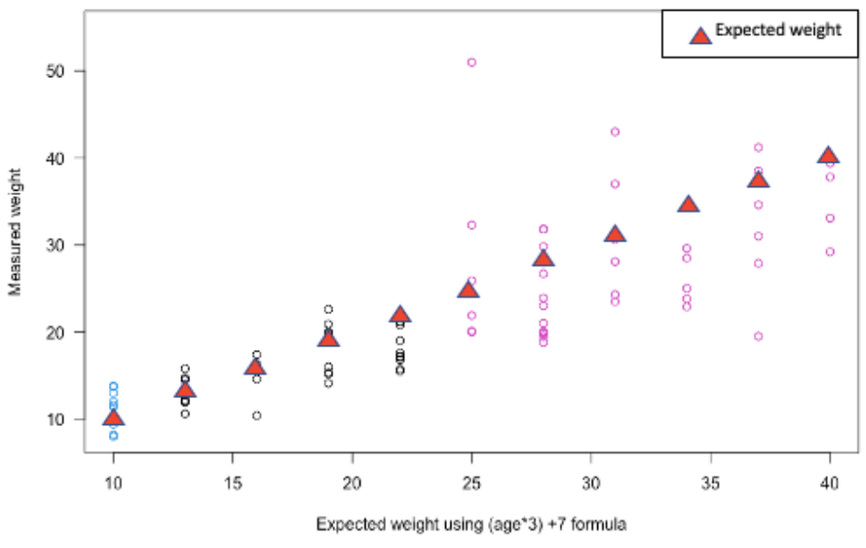
RESULTS

BOYS

Comparison between APLS formula and measured weight for boys age group 1 to 11

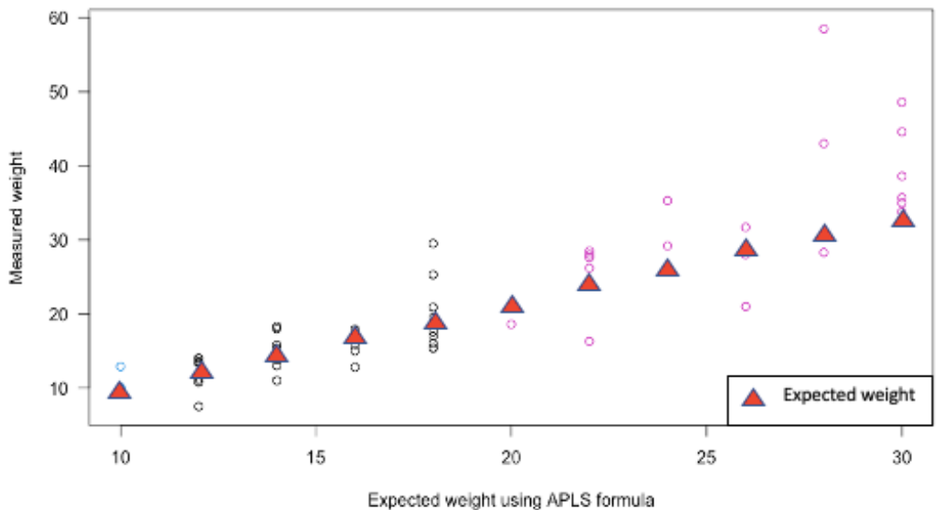


Comparison between (age*3) +7 formula and measured weight for boys age group 1 to 11

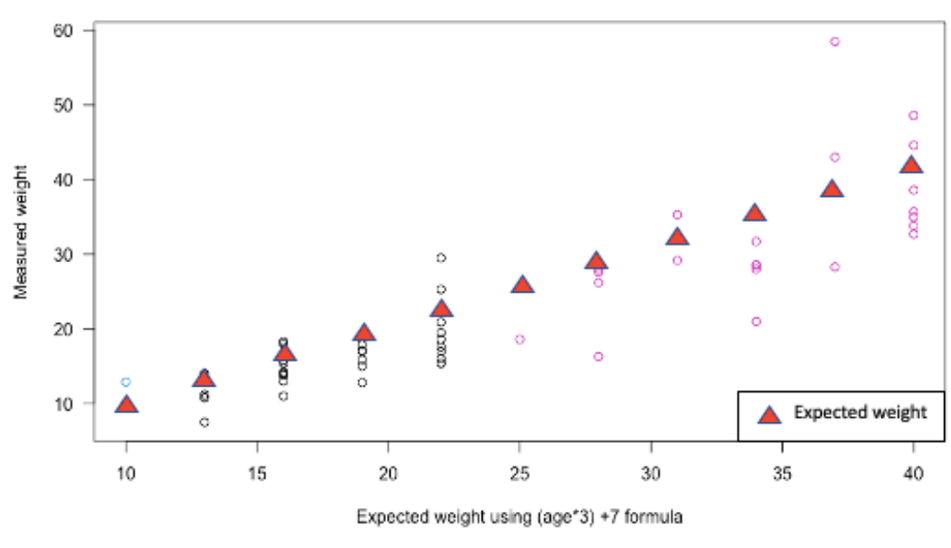


GIRLS

Comparison between APLS formula and measured weight for girls age group 1 to 11



Comparison between (age*3) +7 formula and measured weight for girls age group 1 to 11



For infants the mean values measured were larger than the 3.5kgs predicted. Children aged 1 year were close to the modelled 10kgs in weight (blue circles in graph). For children aged 2-5 years (black circles in graph), the standard APLS formula under-estimates the weight of the child by an average of 0.7kgs for girls and 1.7kgs for boys. The new formula, [(age*3)+7], over-estimates the weight by an average of 2kg and 1.8kg in boys and girls respectively. For children aged 6-11 years (pink circles in graph), the new formula [(age*3)+7] over-estimates the weight of the child by an average of 1.8kgs for girls and 2.8kgs for boys. APLS formula, on the other hand under-estimates the weight by an average of 4kg in boys and 6.8kg in girls. Children over 12 years tended to an average weight near to the estimated 50kgs, but with a broad range of deviation.

DISCUSSION

Rise in prevalence of childhood obesity has led to inaccuracy in estimating weight using age-based formulas[2]. From our study, both formulae were more accurate for their age group than if the counterpart formula had been used instead.

In these age groups the average degree of error is less than 10% of the body weight of the child when respective formulas were used, and so may represent less of an error risk for intra-operative opioids and induction anaesthesia dosing. However, this may represent more of a hazard for antibiotic and paracetamol dosing, where cumulative dose error could result in drug toxicity.

CONCLUSION

In conclusion, age-group specific formulas should be used when estimating child's weight, especially in emergency situations. We are instituting these changes by rolling out an emergency action card, as is shown above.

ACTION CARD

Neonate		**Adrenaline**	
Estimated Weight	3.5kg	**Paediatric Dose**	10mcg/kg IV/IO
ETT size	3.5		0.1ml/kg **1:10 000**
Infant (up to 1 year old)		**Adult Dose**	1mg IV/IO
Estimated weight	10kg		1ml **1:1000** (10ml 1:10 000)
ETT size	4.0	**Anaphylaxis**	10mcg/kg IM
Child (1- 5 years)			0.1ml/kg **1:1000**
Estimated Weight	(Age + 4) x 2		Adult dose + 0.3mg (0.3ml 1:1000) IM
ETT size	(Age/4) + 4 (+/_ 0.5)	**Fluid Bolus**	20ml/kg crystalloid
ETT position at lips (cm)	(Age/2) + 12	**Glucose**	0.5g/kg (5ml/kg 10% Dextrose)
Child (5 – 12 years)		**Benzodiazepine for convulsions/ Status epilepticus**	Lorazepam 0.1mg/kg IV/IO
Estimated weight	(Age x 3) + 7		Midazolam 0.5mg/kg Buccal
ETT size	(Age/4) + 4 (+/_ 0.5)		Diazepam 0.5mg/kg Rectal
Adult (>12 years)			
Estimated Weight	50kg +		
ETT size	7.5		
ETT position at the lips (cm)	21 – 23 cm		

Age (years)	Respiratory Rate	Heart Rate	Systolic Blood Pressure
<1	30 – 40	110 – 160	70 – 90
1 – 2	25 – 35	100 – 150	80 – 95
2 – 5	25 – 30	95 – 140	80 – 100
5 – 12	20 – 25	80 – 120	90 – 110
>12	15 – 20	60 – 100	100 – 120

References

1. Statistics N. National Child Measurement Programme England, 2016/17 school year: NHS Digital, 2017.

2. Luscombe, M., Owens, B. 2007. Weight estimation in resuscitation: is the current formula still valid? Archives of disease in childhood. (2007). May;m 92 (5): 412-41