Application of Weight Estimation Formula in Emergency for Pakistani Pediatric Polulation: Advanced Pediatric Life Support or Luscombe

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ABSTRACT

Objectives: To compare original Advanced Pediatric Life Support (APLS) and Luscombe & Owen (LO) formula with weight on scale in Pakistani pediatric population.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: Pediatric Unit, Pak Emirates Military Hospital Rawalpindi Pakistan, from Jan to Jun 2018.

Methodology: A total of 1059 patients were subjected to weight scale and different formulas for weight estimation i.e., original APLS and LO. A pre-designed Performa was used to extract the data. SPSS v.25.0 was used as statistical analysis, where t-test was used to measure the significant difference.

Results: The mean age of 1059 children was 4.55 ± 2.96 years with 55.1% males and 44.9% females. A total of 683 (64.4%) children were below or of 5 years of age. The mean scale weight was recorded as 16.71 ± 6.34 kg while for APLS and LO estimation mean was 17.13 ± 5.935 kg and 20.62 ± 8.88 kg respectively. The difference in means of scale weight with APLS and LO estimation was -0.42 kg and -3.92 kg respectively. Independent sample t-test was used for comparison of scale weight with original APLS and LO, *p*-value of 0.115 and <0.001 were recorded for both respectively, revealing that no difference in means of scale weight and APLS.

Conclusion: Pakistani pediatric population of young age utilizing age-based estimation methods, APLS weight estimation tool is much better than LO estimation.

Keywords: Advanced paediatric life support (APLS), Luscombe & Owen (LO), Weight estimation, Scale weight.

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INTRODUCTION

A medical cannot be completed without proper weighing measures among children.[1] This resuscitation involves many intervention, all of which are mostly based on the physique of the child particularly weight. Additionally, the role of weight in medications prescription, fluid requirement and other aspects is also irrefutable.[2] It is mostly difficult to weigh the child for many unavoidable reasons in emergency, in all such scenarios different weight estimation techniques are used. Worldwide different means are proposed and then applied to estimate weight in emergency conditions which involves age of the child or the length based.[3] However, this weight estimation is a complex process depending upon user, tool and patients factor.[4] These include inherent limitation of the age estimation measures in which age based weight estimation measures are found to be inaccurate.[5] Among all, the most well-known and being used at Europe, New Zealand, Australia and South Africa with other countries too is APLS.[6] Broselow tape measurement was another famous weight estimation tool but it was mostly applicable in overweight and obese children.[7] While this APLS weight estimation being an aged-based toolis found to be more accurate in normal children but with time it has become more apparent that the margin of error gets increased in this formula with age.[3] Another popular age based method which was introduced in later half of the century was proposed by Luscombe and Owen (LO), which was found to be more close with actual findings in various setting particularly for older ages.[8] The utilization of APLS for 1-5 years and then LO upto 12 years has shown good results. In addition, few others formulas are also established but this study will focus more towards use of APLS and LO formula in this setting. The evidence of length based weight estimation is also getting popularity for its accurate results; however till yet mostly age-based formulas for estimation are in practice while validation for length based formulas are ongoing.[9] In Pakistan, literature regarding comparison of weight estimation tool on local population is rare, though a study has utilized data from 6 nutritional surveys and presented the same in

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research, which hasn't given any definite or actual findings for Pakistani Population.[10]

This study was planned to compare original APLS and LO method of weight estimation with scale weight to know the better estimation tool in Pakistani pediatric population. This study will fill the gap of comparison weight estimation results in our setting and will help the pediatric community to adopt a better and accurate estimation method for weight.

METHODOLOGY

This comparative cross-sectional study was conducted in the Out-Patient Department of Paediatric Unit, Pak Emirates Military Hospital Rawalpindi Pakistan, from January to June 2018. All patients reporting to this (OPD), after following proper inclusion and exclusion were enrolled and a total of 1059 patients were analyzed for comparison using non-probability convenience sampling. The sample size was calculated using WHO formula through online website of Epitool in which mean of scale weight was taken 20.09 years while for APLS age was taken as 19.85 years at a confidence interval of 95%, power 80% and variance 3.885.[11]

Inclusion Criteria: Children between 1-12 years and of any gender were included in the study.

Exclusion Criteria: Any child having any congenital structural/bony malformation or nutritional diseases of any type was excluded.

After taking informed written consent and approval from Ethical Committee of Pak Emirates Military Hospital, Rawalpindi Pakistan dated 28/10/ 2018, the study was initiated. Scale method was used for normal weight in lightest clothing possible, for original APLS, weight was measured by adding age with 4 and multiplying the whole with 2 (Weight = (Age + 4) x 2), while for LO weight was estimated by multiplying age with 3 and then adding 7 to the whole (Weight = (Age x 3) + 7). SPSS version 25.0 was used to evaluate the data statistically, in which mean ± S.D was calculated for numerical variables while frequency and percentages for categorical variables. Independent sample t-test was used to test the hypothesis for difference in the means of the two (either APLS estimation or Scale weight or LO estimation and Scale weight) variables. The *p*-value ≤0.05 was used to reject the hypothesis stated.

RESULTS

This study analyzed a total of 1059 children for a comparative result evaluation between different weight estimation tools with scale weight. The means age of the sample was 4.55 ± 2.96 years, having 584 (55.1%) males and 475 (44.9%) females. The age of the sample was stratified in groups in which age group between 1-4 years had maximum frequency 584 (55.1%), followed by 5-9 years group with 372 (35.1%) and the 10+ age group only had 103 (9.7%) children. A total of 683 (64.4%) samples were below or of 5 years. The mean of scale weight was 16.71 ± 6.34 kg while mean of APLS and LO estimation was 17.13 ± 5.935 kg 20.62 ± 8.88 kg respectively. The difference in mean of scale weight with APLS and LO estimation was recorded to be as -0.42 kg and -3.92 kg respectively, showing results of APLS formula being closer to scale weight.

The mean comparison according to age groups and gender were shown in the Table-I & II.

Table-I: Mean comparisons according to Age Groups.

Age Group	Sca Weight (kg)	APLS Estimation (kg)	Luscombe and Owen Estimation kg)
	Mean ± SD	Mean ± SD	Mean ± SD
0-4 Years	12.36 ± 2.549	12.58 ± 2.485	13.78 ± 3.494
5-9 Years	20.16 ± 3.837	21.23 ± 2.778	26.78 ± 4.176
10 + Years	28.92 ± 4.828	28.12 ± .615	37.17 ± .923

Table-II: Mean comparisons according to gender.

Gender	Scale Weight (kg)	APLS Estimation (kg)	Luscombe and Owen Estimation (kg)
	Mean	Mean	Mean
Male	17.13 ± 6.524	17.44 ± 5.965	21.09 ± 8.881
Female	16.19 ± 6.066	16.74 ± 5.882	20.04 ± 8.846

Independent t-test was applied between two groups. The *p*-value 0.115 between scale weight and original APLS that there was no difference in means of these two, while *p*-value of <0.001 showed that LO estimation resultswere different from scale weight, (Table-III).

Table- III: Comparison between APLS & LO Estimation with scale weight.

Estimation Tools	Scale Weight		
	Total	Mean ± SD	*p*-value
APLS	1059	17.13 ± 5.935	0.115
LO	1059	20.62 ± 8.88	<0.001

DISCUSSION

A sample of 1059 children was used to compare in which results of original APLS were much closer to the scale weight. The study meant to compare two formulas with scale weight and there by contributing towards better intervening tool for the management results. This study has tested the same formulas on Pakistani pediatric population for which the discussion is given as under.

The weight of the child increases with age and development, concurrently abnormal development leads to obesity which is getting more common among children of United States and Europe. In contrast opposite was observed in malnourished children of Africa and other under-developed countries as shown in a study where mean percentage difference (MPD) calculated using true and estimated weight is +1.12 (9.63) in Africa and +3.71 (8.62) in America.[12,13] Such a drastic in appropriate weight in consistency with age may lead to the under estimation or over estimation of the weight using these formulas; hence, optimal resuscitation gets failed leading to high morbidity and mortality.[14,15] All formulas must be validated for such inconsistent rise and fall of weight in different regions of the world. The search of pediatric literature showed a good bit of books with respect to mean weight compared to age however authenticity of formula estimation with age is still under debate.[3]

The result extracted from data of this study showed that the mean of scale weight was 16.71 ± 6.34 kg, while APLS and LO estimation mean weight was 17.13 ± 5.935 kg 20.62 ± 8.88 kg respectively. In addition, the difference in mean of weight was calculated and it was found that the difference between scales weight and APLS estimation was quite less than that of scale weight and LO estimation with -0.42 kg and -3.92 kg respectively. The study further revealed that APL Sestimation of mean weight was closer to the scale weight as compared to the LO. To compare, a study conducted at Trinidad and Tobago on 1784 children between 1-5 years contradicts findings of this study and the study revealed weight nearer to the LO estimation.[16] In contrast to the study on Caribbean population a study from South Africa revealed the authenticity of APLS up to 5 years in comparison with LO and other length based weight estimation measures as demonstrated in this study.[6] The accuracy of these estimation formulas is not only based on the age-group but also varies in different population having separate ethnicity. A study at India by Varghese, *et al*,[17] in 2003-2004 revealed that APLS formula overestimates the weight by about 2-3 kg, while evidence shows that APLS mostly under estimates the weight as established in this study.[3] This contrast from Indian population to the recorded evidence may be due to variance of age and selection criteria. In the same way the formula derived by Mark Luscombe and Ben Owens overes-timates the weight as shown in review of various studies published, while this study has underestimated the weight which is in accordance with the results of the Australian population.[3,11] Here again the difference in LO estimation with respect to age group and population is diverse, however, the literature has shown that above 5 years LO has much better results than APLS which is also proved by Graves *et al*,[18] in his study conducted on 49565 children at Australia. The results of this study proving APLS much better mean of estimation for weight may be due to the reason that maximum about 64.4% of the patients were under 5 years giving edge to APLS method as proved in literature.

APLS and LO are being adopted as different methods of weight estimation throughout the world. This study being unique and exceptional for this region of the world revealed APLS as better weight estimation method; however the adequate division between age group may be taken as a limitation in this study. So, it is recommended that a study on larger sample with adequate age group categorization must be conducted to validate these results and also weight estimation methods. The trends of length-based weight estimation must also be kept in mind before validation a single weight estimation method for this region in future.

CONCLUSION

In Pakistani pediatric population of young age utilizing age-based estimation methods, APLS weight estimation tool was much better than LO estimation. The trends however are shifting towards length-based weight estimation but till a comparative study with other means, APLS method can be used for early ages in children.

Conflict of Interest: None.

Authors' Contribution

SA: Article Writing and Data Collection, FB:, FI: Data Analysis

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