

Estimating maximum local anesthetic dose using body mass index (BMI)

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Background

- Clinical obesity with altered pharmacokinetics in local anesthetic dosing
- Necessitating adjustments in local anesthetic dosage using lean body weight (LBW) instead of total body weight (TBW)
- Hypothesis
 - For males, estimate LBW using only BMI with simplified equations $[(100 - \text{BMI})\% \times \text{TBW}]$.
 - Since studies have shown that the percentage fat of females was about 10% higher than that of the males[1], we further hypothesize that the LBW in females is directly related to $(90 - \text{BMI})\%$ of TBW.
- Objective
 - Demonstrate that doing rapid calculations using body mass index (BMI-M and BMI-F) can offer a practical approach for measuring lean body weight (LBW) and determining the maximal dosage of local anesthetic.

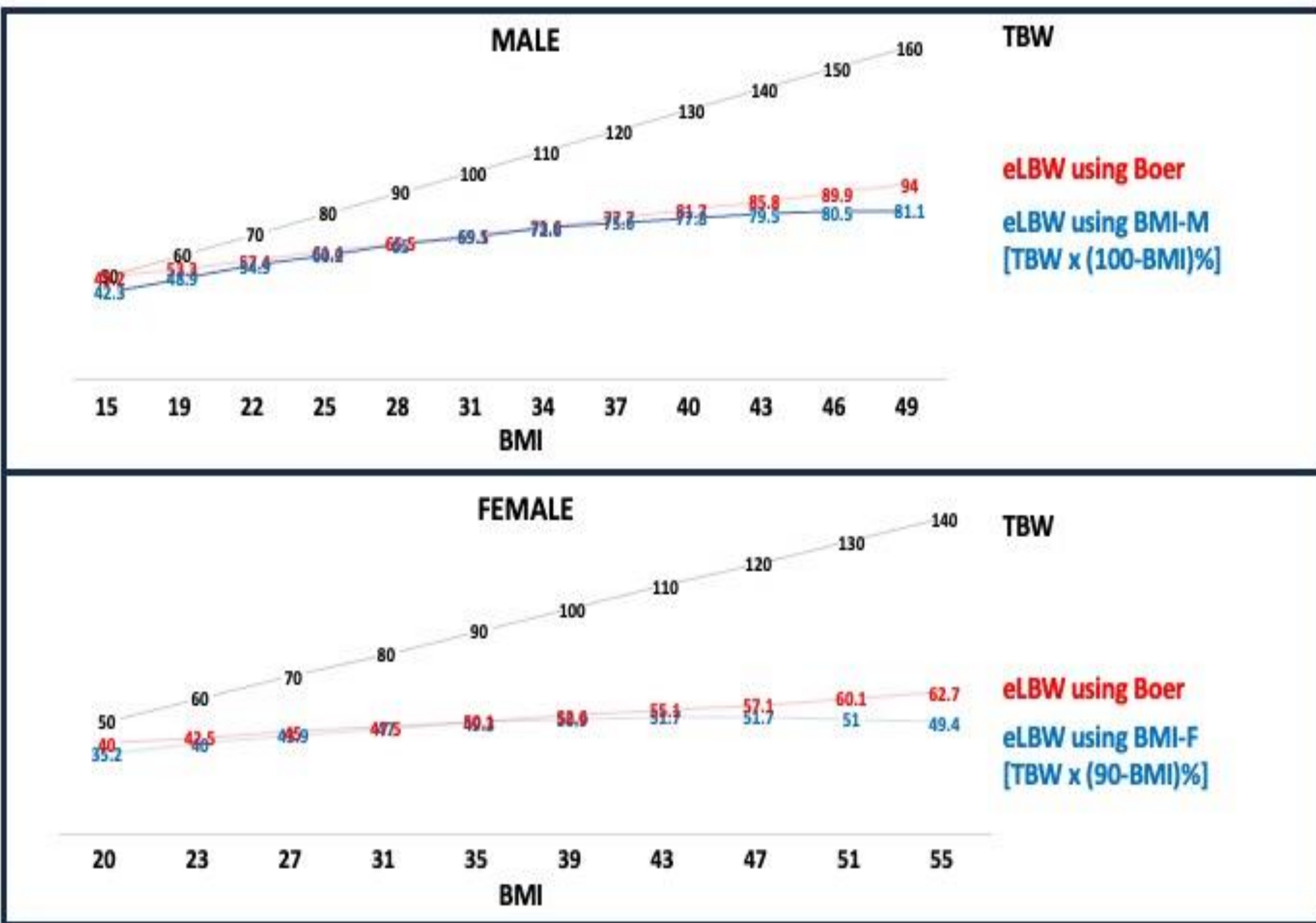
Methods

Key study details: (IRB approval was waived for this in-vitro study)

- Using published clinical data (weight and height) from Hume's study [2], a series of linear regression analyses were performed to examine the agreement and relationship of the estimated LBWs derived from the four commonly used LBW equations (i.e. Hume[2], Boer[3], James[4], and Janmahasatian formulas[5]) with the LBWs derived from the above proposed simplified equations
- Using Bland–Altman plots. We defined the acceptable difference limit between equations as less than 10%. All statistical analysis was performed using SPSS v20 (IBM Corp, USA).
- Simulate 1.8 m male and 1.6 m female with varied BMI.
- Comparing calculated LBM with Boer vs new formula

Results

	Formulas	% Mean	SD	Line of Agreement		
Male				%Mean + 1.96*SD	%Mean - 1.96*SD	Magnitude between the upper and lower
<i>Proposed Simplified Formula</i>	$LBW = \frac{(100 - \text{BMI}) \times \text{weight(kg)}}{100}$					
Hume	$LBW = (0.32810 \times W) + (0.33929 \times H) - 29.5336$	-3.54	3.20	2.7	-9.92	12.65
Boer	$LBW = 0.407 \times \text{weight(kg)} + 0.267 \times \text{height(cm)} - 19.2$	3.86	2.67	9.09	-1.37	10.46
James	$LBW = 1.1 \times \text{weight(kg)} - 128 \times (\text{weight(kg)} / \text{height(cm)})^2$	3.31	2.29	7.79	-1.17	8.90
Janmahasatian	$LBW = 0.32810 \times \text{weight(kg)} + 0.33929 \times \text{height(cm)} - 29.5336$	2.61	1.70	5.91	-0.66	6.57
Female		% Mean	SD	%Mean + 1.96*SD	%Mean - 1.96*SD	Magnitude between the upper and lower
<i>Proposed Simplified Formula</i>	$LBW = \frac{(90 - \text{BMI}) \times \text{weight(kg)}}{100}$					
Hume	$LBW = (0.29569 \times W) + (0.41813 \times H) - 43.2933$	-2.27	1.40	0.47	-5.01	5.48
Boer	$LBW = 0.252 \times \text{weight(kg)} + 0.473 \times \text{height(cm)} - 48.3$	1.92	1.31	4.48	-0.65	5.13
James	$LBW = 1.07 \times \text{weight(kg)} - 148 \times (\text{weight(kg)} / \text{height(cm)})^2$	1.69	1.38	4.39	-1.01	5.40
Janmahasatian	$LBW = 0.29569 \times \text{weight(kg)} + 0.41813 \times \text{height(cm)} - 43.2933$	1.29	0.731	2.72	-0.15	3.47



Discussion

- Our study demonstrates that the proposed simplified equations
- Male: $(100 - \text{BMI})\% \times \text{TBW}$; Female $(90 - \text{BMI})\% \times \text{TBW}$**
 - provide estimations of LBW comparable to commonly used formulas with a wide range of BMI
- Limitations:
 - Given the prevalence of medical calculators and smartphone apps that can calculate LBW with a few inputs, this simplified equation may have limited merit.
 - However, inadvertently inputting incorrect data can lead to medication errors.

Conclusion

- Bedside clinicians can use the simplified equation to calculate LBW and mentally verify that local anesthetic dosing is within the maximum dose.

References

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