Novel Methods for Donor and Recipient Size Matching for Heart Transplantation Based on Predicte Lean Body Mass with Validation against Existing Methods

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BACKGROUND

- Donor and recipient size matching during heart transplant can be assessed using weight or predicted heart mass (PHM).
- We developed multiplicative allometeric equations for predicted lean body mass (PLBM) and PHM using the United Kingdom Biobank (UKB)
- We then evaluated their utility in the United Network of Organ Sharing (UNOS) database.

MATERIALS AND METHODS

- The study consists of two parts
  - First: derived sex-specific equations for PLBM and PHM using the UKB.
  - Second: compared the predictive value of donor and recipient size metrics using adult patients in the UNOS database.
- Derived equations from the UKB shown in Table 1 and compared to the MESA PHM and NHANES PLBM equations
- Our primary outcome was post-transplant all-cause mortality within one year
- The additive prognostic value of scaling methods were compared using multivariable Cox proportional hazards analysis, for the primary and secondary outcome, and compared using increase in Chi-square and adjusted hazard ratios
- ROC curves were generated for each scaling metric, separately for under-sizing (ratio≤1) or over-sizing (ratio >1), to determine optimal thresholds using the Youden index
- Subgroup analyses and interaction testing were performed in patient groups which have previously been demonstrated to require closer size matching (pulmonary hypertension, sex mismatch).

Table 1: Comparison of PHM and PLBM Equations

Predicted Heart Mass (PHM)	
MESA	Predicted LV Mass = a * Weight (kg)$^{0.61}$* Height (m)$^{0.54}$ If Male, a=8.25 / If Female, a=6.82
UKB	Male: 5.04 * Weight (kg)$^{0.62}$* Height (m)$^{0.51}$ Female: 6.62 * Weight (kg)$^{0.46}$* Height (m)$^{0.89}$
Predicted Lean Body Mass (PLBM)	
UKB	Male: 3.27 * Weight (kg)$^{0.51}$* Height (m)$^{1.05}$ Female: 4.26 * Weight (kg)$^{0.38}$* Height (m)$^{1.23}$
NHANES	Male: 0.468 * Weight (kg) + 0.210 * Height (m) - 0.071 * Age - 14.729 Female: 0.347 * Weight (kg) + 0.210 * Height (m) - 0.046 * Age - 14.292

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	Weight Ratio	$CPHM_{MESA}$ Ratio	PHM_{MESA} Ratio	PHM_{UKB} Ratio	$PLBM_{NHANES}$ ratio	$PLBM_{UKB}$ ratio
Weight Ratio	1.000	0.764	0.783	0.713	0.810	0.639
$CPHM_{MESA}$ Ratio	0.764	1.000	0.991	0.983	0.992	0.969
PHM_{MESA} Ratio	0.783	0.991	1.000	0.990	0.986	0.968
PHM_{UKB} Ratio	0.713	0.983	0.990	1.000	0.976	0.987
$PLBM_{NHANES}$ ratio	0.810	0.992	0.986	0.976	1.000	0.957
$PLBM_{UKB}$ ratio	0.639	0.969	0.968	0.987	0.957	1.000

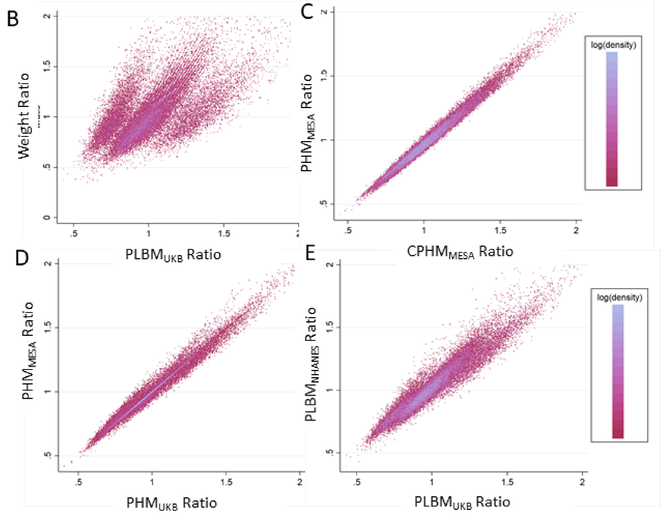

Figure 1. Comparison of scaling metrics. Correlation matrix shown in Panel A. Density scatter plots for (B) weight ratio and $PLBM_{UKB}$ estimation methods demonstrates a higher ratio in male recipients of female donors by weight ratio compared to $PLBM_{UKB}$ with the opposite in female recipients of male donors. Correlation was good between (C) $CPHM_{MESA}$ and PHM_{MESA}, (D) PHM methods, and (E) PLBM methods.

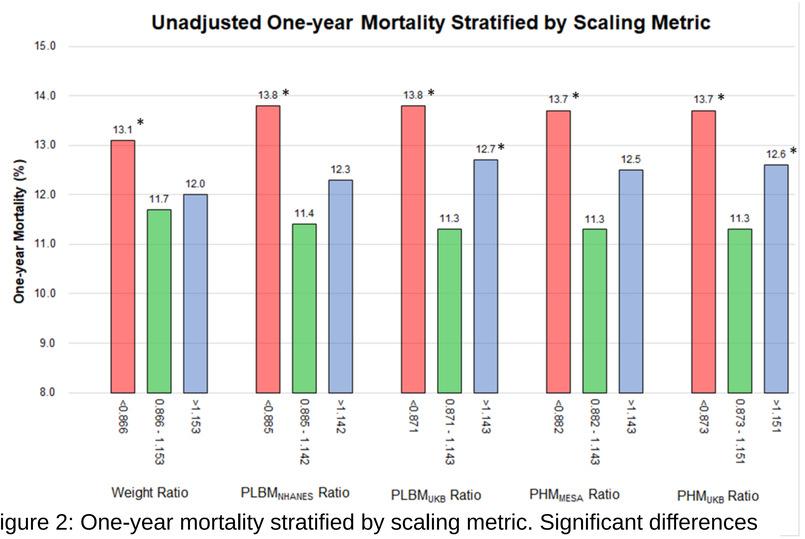

Figure 2: One-year mortality stratified by scaling metric. Significant differences denoted by *.

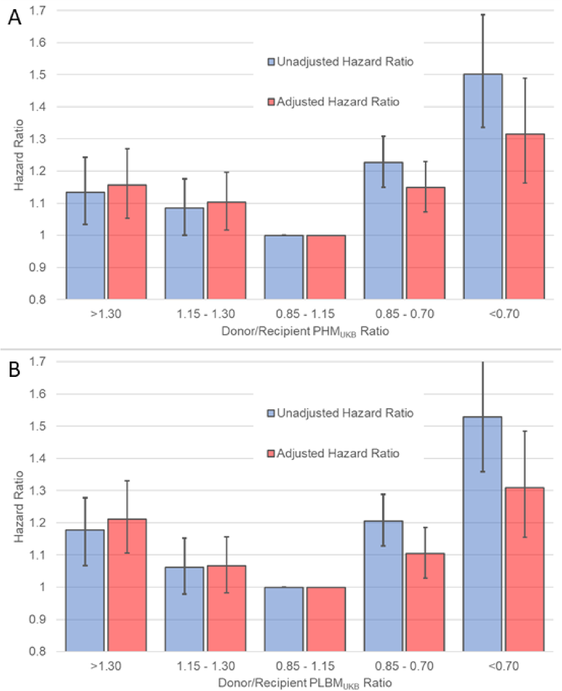

Figure 3. Gradient of risk across groups of oversized (ratio >1.15) or undersized (ratio <0.85) donors according to United Kingdom Biobank (UKB) predicted lean body mass (PLBM) in A and UKB predicted heart mass (PHM) in B.

RESULTS

- In total, 53,648 patients with median follow-up of 4.7 years in the validation cohort, with 6528 (12.2%) dying within the first year.
- Unadjusted associations in **Figure 2**
- Undersized matches associated with increased one-year mortality after multivariable adjustment for all matching methods (all p<0.001).
- Oversized matches by PHM_{MESA} ratio, PHM_{UKB}, $PLBM_{UKB}$ ratio and $PLBM_{NHANES}$ ratio also associated with increased all-cause mortality in the first year
- Size mismatching was more common in sex mismatched recipient-donor pairings.
- There was no significant interaction between donor under-sizing or over-sizing by PHM or PLBM ratios, suggesting they perform similarly in cases of donor and recipient sex mismatch. However, significant interactions were present between oversizing by weight ratio and sex-mismatch

LIMITATIONS

- We are not able to determine how changes to size matching may impact transplant wait-list times or wait-list mortality
- Determined optimal cut-offs for each scaling metric but did not perform external validation for these values
- We did not consider race mismatch in our analysis and there are potentially important differences in body composition to consider in this setting

CONCLUSIONS

- Our results suggest that donor-recipient size matching using any method for PLBM or PHM are superior to total body weight ratio
- Utilizing PHM or PLBM may be particularly important in patients being considered for a sex mismatched donor offers

DISCLOSURES

The authors have no relevant disclosures

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