Predicting Body Composition Change from Change in Body Shape

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Background

- Monitoring body composition change is a critical aspect for lifestyle changes and intervention studies[1]
- Statistical shape models using 3D optical (3DO) body shape have been used to predict body composition (BC) with accuracy and precision[2]
- Previous work has shown that these 3DO shape models can detect change in respects to DXA[3]
- Here, we explore this further with a larger sample and with different study interventions including diet and physical activity
- ***Objective:*** To evaluate how accurate change in shape can predict a change in body composition in respects to DXA.

Methods

- Participants were recruited from 3 intervention studies: Shape Up! Adults TREAT (time-restrictive diet), FB4 (energy-restrictive diet), and REALPA (physical activity).
- Participants received an optical scans on a Fit3D ProScanner and a DXA scans on a Hologic Discovery/A system during baseline and follow-up (Figure 1)
- Optical scans from both visits were reposed (Figure 2), body composition values were predicted from existing models[2], and optical change was compared to DXA change
- Change in body shape by principal components (PCs) were used to build additional models to predict change with stepwise linear regression and 5-fold cross-validation

Results

- 106 participants (67 male) completed the study at the time of analysis
- The best model for females was the previously derived cross-sectional model[2] (R^2 = 0.88, RMSE = 1.3 kg), while males was the newly derived model using the first 20 delta PCs with the first 20 baseline PCs as possible covariates (R^2 = 0.88, RMSE = 1.8 kg). This was consistent with total fat-free mass and percent fat.
- Best model for VAT used the first 20 delta PCs with the first 20 baseline PCs for both males and females (R^2; 0.57 and 0.49, RMSE; 0.09 and 0.08 kg, respectively)

Conclusion

- This study builds upon the previous work with a larger sample size and showed that the change in body shape was associated and predictive of body composition change
- New models were needed to capture this change variance and need to be validated on an external dataset
- A larger sample size with more diversity may be needed to capture biases associated with ethnicity, BMI, age, or other demographic factors

Change in Body Shape Accurately Predicts Change in Body Composition

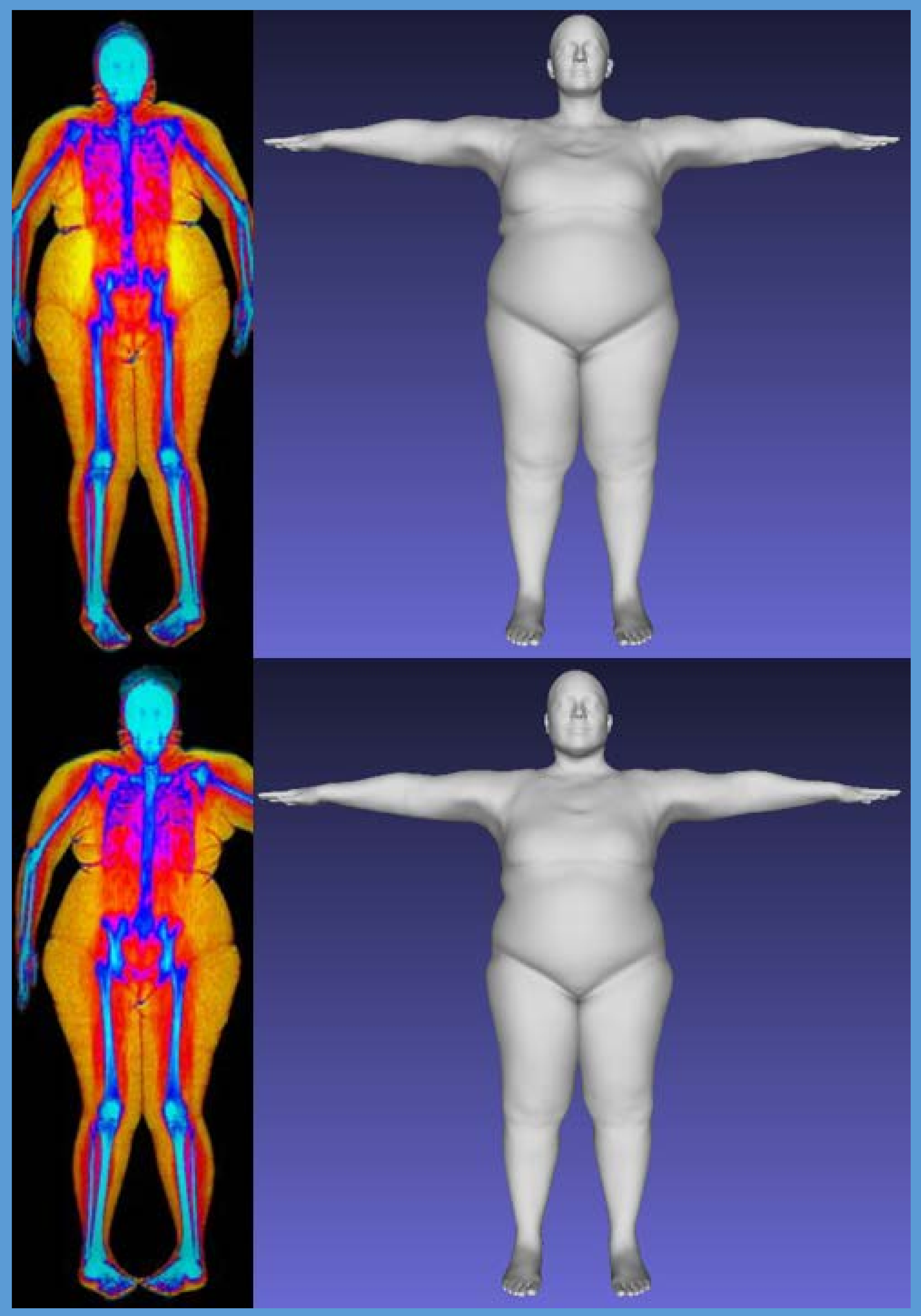

Figure 1. (Top) Baseline DXA (left) and 3D optical (right) scans before intervention. (Bottom) Follow-up DXA and 3D optical scans after intervention. Participant lost 14 kg of total fat mass and 2 kg of total lean mass.

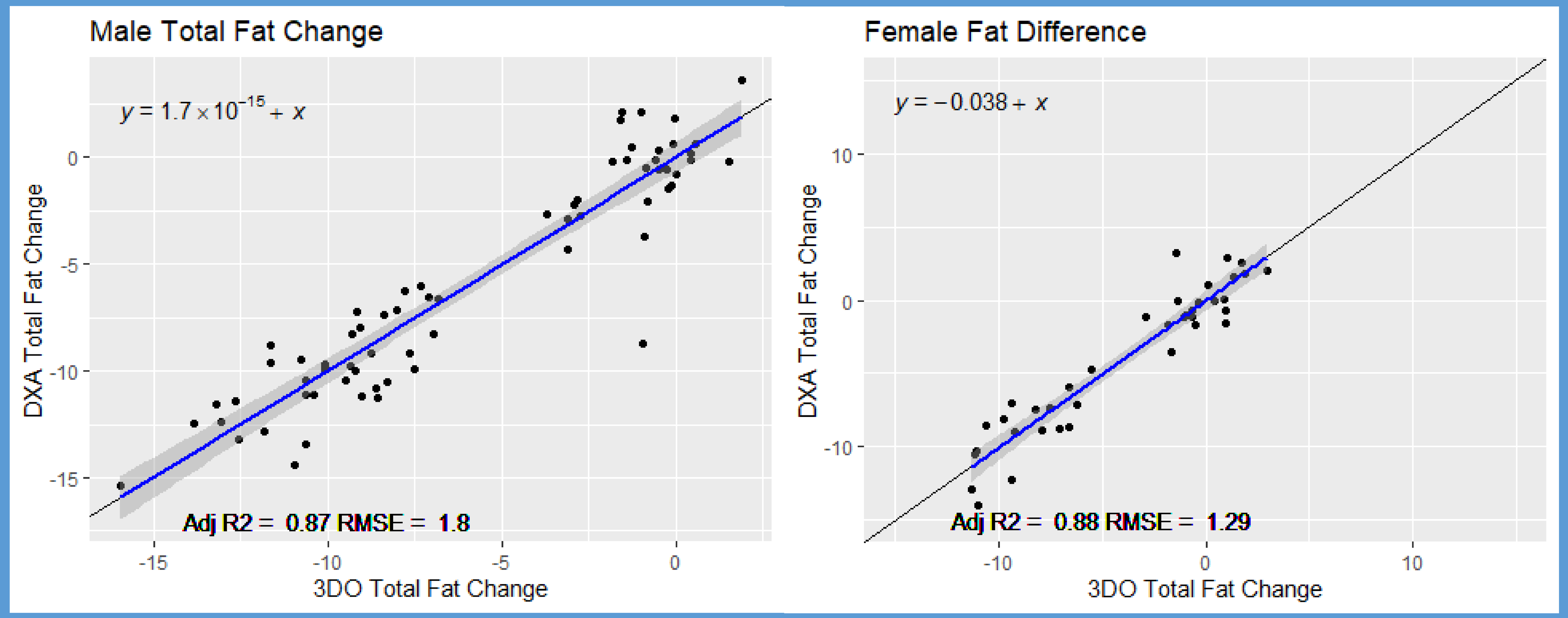

Figure 2. Scatter plots of best DXA vs 3DO Total Fat Change models

Feel free to contact me if there are any questions. Email: mcwong3@Hawaii.edu

Table 1. Demographic characteristics of sample

	Visit 1		Visit 2	
	Female (N=39)	Male (N=67)	Female (N=39)	Male (N=67)
Age				
Mean (SD)	46.2 (13.8)	37.5 (12.4)	46.4 (13.8)	37.7 (12.4)
Median [Min, Max]	45.9 [24.0, 76.7]	34.8 [19.0, 70.5]	46.2 [24.4, 77.1]	35.1 [19.3, 70.9]
Ethnicity		10 (14.9%)		
Asian	3 (7.7%)	2 (3.0%)	3 (7.7%)	10 (14.9%)
Black	7 (17.9%)	5 (7.5%)	7 (17.9%)	2 (3.0%)
Hispanic	6 (15.4%)	0 (0%)	6 (15.4%)	5 (7.5%)
White	23 (59.0%)	50 (74.6%)	23 (59.0%)	50 (74.6%)
Height (cm)				
Mean (SD)	165 (7.24)	177 (6.86)	165 (7.22)	177 (6.97)
Median [Min, Max]	164 [149, 185]	177 [162, 194]	164 [149, 185]	177 [162, 194]
Weight (kg)				
Mean (SD)	88.8 (15.9)	103 (17.8)	82.5 (12.8)	93.0 (17.6)
Median [Min, Max]	83.5 [64.0, 134]	100 [70.2, 169]	81.7 [63.0, 116]	88.5 [64.8, 175]
Body Mass Index				
Mean (SD)	32.5 (5.52)	33.6 (8.42)	30.3 (4.49)	29.8 (5.57)
Median [Min, Max]	31.4 [24.2, 50.3]	31.2 [23.7, 82.1]	30.0 [23.8, 43.7]	28.8 [22.2, 57.3]

Table 2. Results from the best model

	Female		Male	
	R^2	RMSE	R^2	RMSE
Total Fat	0.88	1.29	0.88	1.8
Total Lean	0.75	1.82	0.76	1.77
Percent Fat	0.4	1.31	0.54	1.93
VAT	0.49	0.08	0.57	0.09

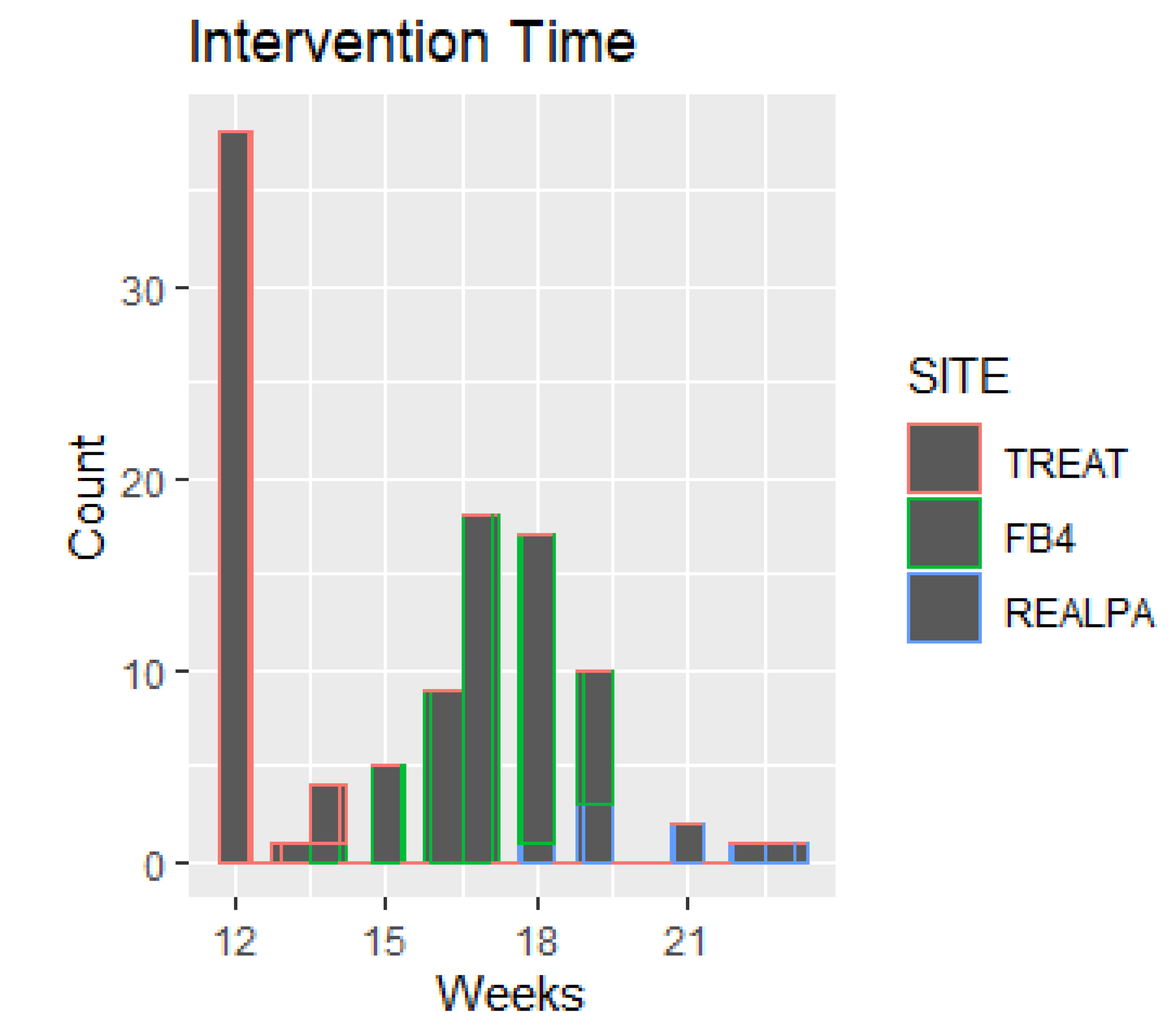

Figure 3. Histogram of intervention time by study for both males and females.

Abbreviations: R^2 (coefficient of determination; RMSE (root mean square error); kg (kilogram); DXA (dual energy X-ray absorptiometry); SD (standard deviation); N (number of participants); PCs (principal components)

References

1. Wells et al. Measuring Body Composition. Archives of disease in childhood. 2006.
2. Wong MC, et al. A pose-independent method for accurate and precise body composition from 3D optical scans. Obesity. 2021 Sep 21.
3. Wong M, et al. Detecting Significant Body Composition Change With Reposed Three-Dimensional Optical Surface Scans. OBESITY 2020 Nov 1 (Vol. 28, pp. 75-75).

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