Associations of Recreational Physical Activity and Body Mass Index with Breast Tissue Composition in a Cohort of African American and Hispanic Women in New York City

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Background

- Physical activity and body mass index (BMI) are independently associated with breast cancer risk,[1,2] but less is known about associations with breast tissue composition over the lifecourse.
- We previously examined associations of recreational physical activity with breast tissue composition in adolescent girls from a family-based cohort, and found that physical activity was associated with decreased levels of collagen and total hemoglobin in breast tissue.[3]

In this study, we examined if recreational physical activity and BMI are independently associated with breast tissue composition in mothers from the family-based cohort.

Study Population and Data Collection

- Black and Dominican non-smoking pregnant women, aged 18-35 years, were enrolled from 1998-2006 from a low income area of New York City.[4]
- In 2016, mother-daughter dyads were recruited from the Columbia Center for Children's Environmental Health (CCCEH) cohort to participate in a follow-up study through the Breast Cancer and the Environment Research Program consortia (N=216; data available for 167).
- Breast tissue composition was measured using optical spectroscopy (OS), and height and weight were measured by trained staff.
- Women self-reported by questionnaire past year average strenuous and moderate physical activity levels (hours per week).
- We calculated total metabolic equivalents (METs) per week: 1 hour strenuous = 7 METs and 1 hour moderate = 4 METs.[5]

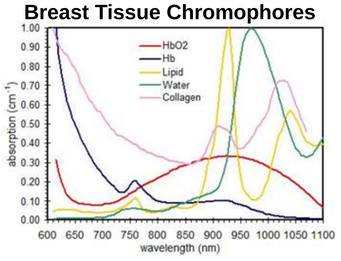
Characteristics of Mothers from the CCCEH Cohort by Average METs per Week in the Past Year (N=167)

Characteristic	< 6 METs per week	6-22 METs per week	>22 METs per week
Age, years	43.3 (4.9)	41.5 (4.9)	39.5 (5.0)
Black	30 (30.0%)	25 (25.0%)	22 (22.0%)
Dominican	9 (17.3%)	9 (17.3%)	17 (32.7%)
BMI, kg/m^2	31.2 (8.0)	29.9 (6.0)	31.4 (7.2)

Optical Spectroscopy Device

- OS is a non-imaging and non-invasive method for providing information about bulk tissue properties that does not involve ionizing radiation or breast compression.[6,7]
- In addition to breast density (largely determined by relative amounts of **water** and **lipid**), OS also provides information on metabolic activity of by capturing data on **total hemoglobin** (Hb), **saturated hemoglobin** (HbO_2), and **collagen**.

Optical Absorption Spectra of Breast Tissue Chromophores



Correlations between Principal Component (PC) Loading Vectors and Chromophore Spectra† and % Variance Captured by PCs

PC Score	Collagen	Hb	HbO_2	Lipid	Water	Optical Index	% Variance Captured
PC1	-0.08	-0.44*	0.14	0.42*	-0.54*	-0.40*	94.34
PC2	-0.11	-0.03	-0.36*	-0.10	0.43*	0.11	3.84
PC3	-0.09	-0.12	-0.37*	0.04	0.15	-0.06	0.97
PC4	-0.21*	-0.25*	0.14	0.65*	-0.73*	-0.49*	0.43
PC5	-0.06	0.10	-0.22*	0.37*	-0.24*	-0.38*	0.08

†Preliminary results based on sub-cohort with chromophore data available (n=66).

- We used OS to measure red and near-infrared light transmission of wavelengths in the range of 650-1060 nm) for up to 12 overlapping tissue volumes per breast.
- We took a two-step approach to analyzing the OS data averaged over both breasts:
  1. **Principal component (PC) scores** generated to reduce spectral data
  2. **Chromophore concentrations** estimated with Monte-Carlo light propagation simulation.
- We used multivariable linear regression to examine associations of BMI and physical activity with standardized OS PC scores (N=167). We also conducted preliminary analyses of chromophore concentrations in a subset of women with data available (N=51).

Results

Associations of BMI with Standardized OS PC Scores from Multivariable Linear Regression Models (N=167)

OS PC	Continuous BMI per 5 kg/m^2 β (95% CI)	Categorical BMI 25-30 vs. < 25 kg/m^2 β (95% CI)	Categorical BMI ≥30 vs. <25 kg/m^2 β (95% CI)
PC1	0.08 (-0.03, 0.19)	0.25 (-0.16, 0.66)	0.29 (-0.12, 0.69)
PC2	-0.13 (-0.25, -0.02)**	-0.37 (-0.78, 0.06)*	-0.60 (-1.01, -0.18)***
PC3	0.15 (0.03, 0.28)**	0.06 (-0.40, 0.52)	0.45 (0.00, 0.91)**
PC4	-0.09 (-0.21, 0.03)	-0.20 (-0.64, 0.24)	-0.28 (-0.71, 0.15)
PC5	0.07 (-0.05, 0.19)	0.29 (-0.15, 0.74)	0.45 (0.03, 0.88)**

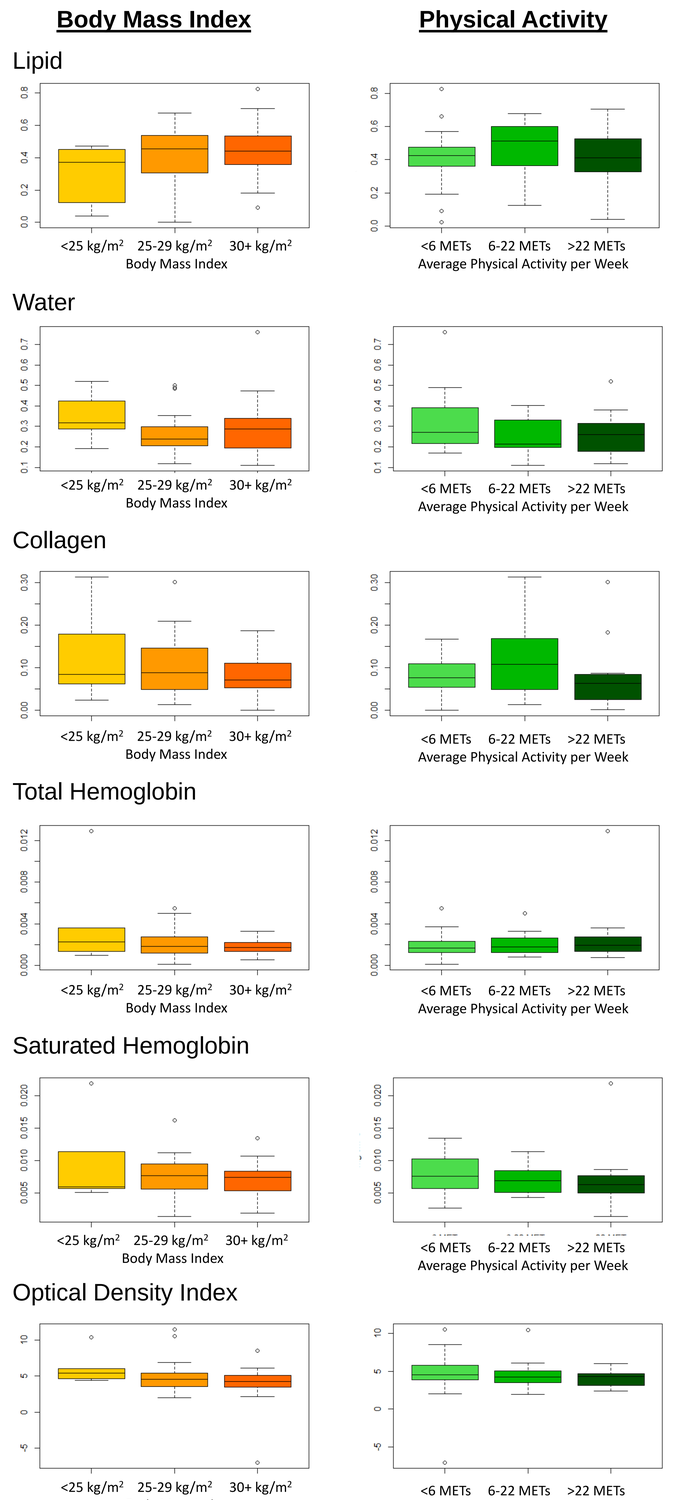
Models adjusted for age at OS measurement ,ethnicity and physical activity; ***p<0.01, **p<0.05, *p<0.10

Associations of Past Year Physical Activity with Standardized OS PC Scores from Multivariable Linear Regression Models (N=167)

OS PC	Continuous METs per 10 units β (95% CI)	Categorical METs 25-30 vs. < 25 kg/m^2 β (95% CI)	Categorical METs ≥30 vs. <25 kg/m^2 β (95% CI)
PC1	0.002 (-0.06, 0.05)	-0.15 (-0.51, 0.20)	0.04 (-0.32, 0.39)
PC2	0.03 (-0.03, 0.08)	-0.06 (-0.43, 0.31)	0.07 (-0.29, 0.44)
PC3	-0.02 (-0.08, 0.04)	0.06 (-0.34, 0.46)	0.03 (-0.37, 0.42)
PC4	0.01 (-0.05, 0.06)	0.04 (-0.34, 0.42)	0.13 (-0.25, 0.51)
PC5	0.01 (-0.05, 0.07)	0.32 (-0.06, 0.71)*	0.08 (-0.30, 0.47)

Models adjusted for age at OS measurement, ethnicity and BMI; ***p<0.01, **p<0.05, *p<0.10

Preliminary Analysis of Chromophore Concentration Fractions in the Breast Tissue of Mothers from the CCCEH Cohort (N=51)



Key Findings and Next Steps

- BMI was associated with different breast tissue composition profiles in mothers from the CCCEH cohort, as indicated by significant associations with PCs 2, 3, and 5.
- Recreational physical activity did not significantly confound or modify the association of BMI with breast tissue composition in mothers from the CCCEH cohort.
- In preliminary analyses, BMI was positively correlated with lipid (Pearson ρ: 0.31) and negatively correlated with collagen (ρ: -0.31) and total hemoglobin (ρ: -0.32) concentrations in the breast tissue of mothers. BMI was also negatively correlated with optical density index (ρ: -0.39), which captures the proportion of water and collagen compared to lipid in the breast tissue.[8]
- Recreational physical activity was not associated with OS PC scores in mothers from the CCCEH cohort. However, preliminary data suggest a negative correlation with saturated hemoglobin levels in the breast tissue (ρ: -0.25).

The next step with this analysis is to generate and evaluate data on chromophore concentrations in the full cohort (N=216).

References

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