

Impact of Adverse Childhood Experiences on Overall and Cellular Health in Adults

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INTRODUCTION

Recently, studies have revealed a new and direct relationship between developing health risk behaviors (i.e., smoking, drug abuse) and associated diseases in adulthood to exposure to **emotional, physical, or sexual abuse and household dysfunction**, defined as adverse childhood experiences (ACEs), during childhood. Being exposed to ACEs has been associated with poor adult health outcomes due to chronic stress, which can lead to high levels of cortisol, the body's natural response to stress, especially in impoverished areas like rural Appalachia. The combination of chronic stress and the inflammation associated with this stress can lead to cell damage that can be detected using new devices for measuring body composition, such as bioelectrical impedance analysis (BIA). To measure body composition, BIA uses electrical currents travelling through the body, which can also measure cell membrane integrity, otherwise known as phase angle (PhA). While there is a relationship between ACEs and chronic diseases, there is no evidence of the differences in PhA or cortisol between those who have and those who have not experienced ACEs.

PURPOSE

The goals of this study were:

- **Phase 1:** To determine the prevalence of ACEs and their impact on health and health-risk behaviors in Appalachian College-aged adults (18-35 y) with high, moderate, low, or no exposure to ACEs.
- **Phase 2:** To assess body composition, resting and reactive cortisol levels, and PhA in a subsample of Appalachian College-aged adults (18-35 y) with high, moderate, low, or no exposure to ACEs.

METHODS

Study Design

- Prospective cross-sectional, dual-phase descriptive study

Phase 1

- **Recruitment:** Flyers were distributed across main and regional campuses using email, social media and word of mouth
- **Testing Protocol:** following consent, participants completed the following anonymously:
 - Health History Questionnaire
 - Adverse Childhood Experiences for Adults Questionnaire⁽¹⁾
 - Positive Childhood Experiences Survey⁽²⁾
 - Food Insecurity Questionnaire⁽³⁾
 - Perceived Stress Scale⁽⁴⁾
 - Adult Resilience Measure-Revised Questionnaire⁽⁵⁾
 - Behavioral Risk Factor Surveillance System⁽⁶⁾

Phase 2

- **Recruitment:** Convenient subsample from Phase 1, stratifying by ACEs level (range: 0-17)

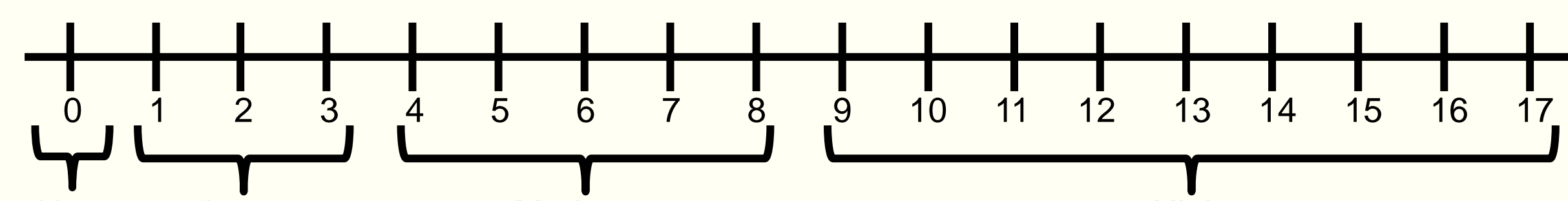


Figure 1. Phase 2 ACEs stratification.

- **Testing Protocol:** 1-hour in-person visit to complete the following

- BIA for measuring body composition and PhA (°)
- Salivary Cortisol levels using the passive drool method
- Baseline: following a 3-hour fast, abstaining from alcohol/caffeine for 12 hours
- Stressed: following a timed mock interview and math challenge

Statistical Analysis:

- 1-way ANOVA comparing outcomes across groups (age, sex, ACEs level, etc.)
- Correlation analyses to assess the relationships among ACEs level and outcome measures
- Using JASP statistical software ($p < 0.05$)

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RESULTS

Table 1. Descriptive Statistics for Phase 1 & 2 (Means±SD)

	N	Phase 1: Anonymous Online Survey							Phase 2: Subsample of In-person Testing							
		Age (y)	ACEs Score (0-17)	Positive Exp (0-28)	Perceived Stress (-16-24)	Resiliency (0-68)	Food Insecurity (0-12)	Measured Health (0-12)	N	Age (y)	ACEs Score (0-17)	Positive Exp (0-28)	Perceived Stress (-16-24)	Resiliency (0-68)	Food Insecurity (0-12)	Measured Health (0-12)
Overall	611	22.47 ± 5.56	7.35 ± 3.57	16.19 ± 5.53	5.93 ± 6.48	47.73 ± 10.45	2.11 ± 3.37	0.78 ± 0.80	42	22.56 ± 3.87	4.95 ± 4.00	17.19 ± 5.99	4.50 ± 7.47	48.93 ± 11.19	2.29 ± 3.50	0.67 ± 0.85
Age Group																
Old (>25 y)	84	33.54 ± 7.64 ^a	7.35 ± 3.96 ^a	14.36 ± 6.26 ^a	5.77 ± 6.87	46.10 ± 11.57	2.83 ± 3.44 ^a	1.14 ± 1.10 ^a	9	28.39 ± 2.94	7.11 ± 3.26	13.67 ± 5.24 ^a	8.00 ± 2.45	45.44 ± 6.82	5.00 ± 3.20 ^a	0.78 ± 0.97
Young (<25 y)	527	20.70 ± 1.98 ^b	6.03 ± 3.47 ^b	16.48 ± 5.35 ^b	5.96 ± 6.42	47.99 ± 10.24	1.99 ± 3.34 ^b	0.72 ± 0.73 ^b	33	20.98 ± 2.21	4.36 ± 4.02	18.15 ± 5.88 ^b	3.55 ± 8.10	49.88 ± 12.02	1.55 ± 3.24 ^b	0.64 ± 0.82
Sex at Birth																
Female	391	22.27 ± 5.30	6.51 ± 3.59 ^a	15.67 ± 5.60 ^a	6.53 ± 5.83 ^a	47.60 ± 10.38	2.13 ± 3.32	0.81 ± 0.84	27	22.24 ± 4.23	5.59 ± 3.91	16.30 ± 5.73	5.70 ± 6.78	47.63 ± 11.01	2.74 ± 3.89	0.78 ± 0.89
Male	148	23.21 ± 6.22	5.52 ± 3.46 ^b	17.27 ± 5.61 ^b	4.24 ± 7.79 ^b	48.17 ± 10.51	2.01 ± 3.36	0.70 ± 0.71	15	23.14 ± 3.19	3.80 ± 4.04	18.80 ± 6.29	2.33 ± 8.39	51.27 ± 11.50	1.47 ± 2.59	0.47 ± 0.74
ACEs Level																
None (0)	22	24.55 ± 8.56	0 ^a	23.55 ± 4.32 ^a	-0.73 ± 7.79 ^a	58.32 ± 11.14 ^a	0.09 ± 0.29 ^a	0.24 ± 0.44 ^a	8	21.36 ± 1.95	0 ^a	22.63 ± 3.89 ^a	-2.25 ± 7.31 ^a	57.50 ± 10.31 ^a	0 ^a	0 ^a
Low (1-3)	136	21.64 ± 5.28	2.17 ± 0.79 ^b	20.82 ± 4.13 ^b	2.63 ± 5.72 ^a	55.28 ± 8.13 ^a	0.34 ± 1.34 ^a	0.49 ± 0.61 ^a	11	21.11 ± 3.06	2.27 ± 0.91 ^b	19.73 ± 5.80 ^a	1.36 ± 4.41 ^{be}	51.73 ± 12.28 ^{ab}	0.27 ± 0.91 ^a	0.64 ± 0.81 ^a
Mod (4-7)	241	22.24 ± 5.07	5.57 ± 1.14 ^d	16.19 ± 4.46 ^c	6.40 ± 5.91 ^b	48.10 ± 8.32 ^b	1.64 ± 2.72 ^{ab}	0.73 ± 0.74 ^b	10	23.04 ± 4.09	5.50 ± 1.18 ^c	16.80 ± 5.16 ^{bc}	5.80 ± 8.18 ^{ce}	49.70 ± 6.38 ^{abc}	1.20 ± 2.49 ^a	0.60 ± 0.70 ^a
High (≥8)	212	23.03 ± 5.81	10.18 ± 2.03 ^e	12.44 ± 4.40 ^d	8.15 ± 6.13 ^c	41.63 ± 9.75 ^c	3.91 ± 4.12 ^c	1.06 ± 0.91 ^c	13	24.17 ± 4.77	9.85 ± 1.95 ^d	12.00 ± 3.27 ^{bc}	10.31 ± 3.99 ^{de}	40.69 ± 8.91 ^c	6.23 ± 3.40 ^b	1.15 ± 0.99 ^b
Positive Experiences																
Low (0-14)	244	23.15 ± 6.03	8.44 ± 3.01 ^a	10.75 ± 2.78 ^a	8.41 ± 5.95	40.17 ± 8.12 ^a	3.37 ± 3.99 ^a	1.03 ± 0.89 ^a	15	24.57 ± 4.68	8.33 ± 2.77 ^a	10.67 ± 2.32 ^a	7.53 ± 7.11 ^a	40.20 ± 7.59 ^a	5.27 ± 4.13 ^a	1.00 ± 0.93 ^a
Mod (15-21)	258	21.75 ± 4.06	5.62 ± 3.02	17.85 ± 1.97	5.75 ± 5.64	49.68 ± 7.27	1.61 ± 2.85	0.72 ± 0.72	14	21.70 ± 3.04	4.64 ± 3.71 ^b	17.64 ± 2.13 ^b	7.57 ± 5.11 ^a	46.43 ± 7.41 ^b	1.21 ± 1.89 ^b	0.93 ± 0.83 ^a
High (≥22)	109	22.62 ± 7.15	2.61 ± 2.18 ^b	24.42 ± 2.06 ^b	0.67 ± 6.31	60.74 ± 5.54 ^b	0.33 ± 0.88 ^b	0.34 ± 0.50 ^b	13	21.19 ± 2.78	1.39 ± 1.61 ^c	24.23 ± 2.01 ^c	-2.31 ± 5.54 ^b	61.69 ± 4.70 ^c	0 ^b	0 ^b
Perceived Stress																
Low (<4)	33	23.63 ± 9.75	4.18 ± 4.59 ^a	20.21 ± 6.31 ^a	-8.21 ± 2.93 ^a	54.72 ± 12.39 ^a	1.50 ± 2.81	0.44 ± 0.56 ^a	5	21.78 ± 2.22	1.20 ± 2.17 ^a	22.80 ± 5.36 ^a	-8.60 ± 2.70 ^a	61.20 ± 8.26 ^a	0 ^a	0.20 ± 0.45
Mod (4 to 4)	191	22.73 ± 5.47	5.00 ± 3.29	18.45 ± 5.20	0.57 ± 2.41	52.77 ± 9.25 ^b	1.44 ± 2.76	0.59 ± 0.61	13	21.22 ± 2.86	2.39 ± 1.94 ^a	20.23 ± 5.75 ^a	-0.15 ± 2.54 ^b	53.92 ± 10.10 ^a	0.23 ± 0.83 ^a	0.39 ± 0.65
High (≥5)	376	22.18 ± 4.91	7.06 ± 3.37 ^b	14.60 ± 5.04 ^b	9.90 ± 3.91 ^b	44.51 ± 9.51 ^c	2.51 ± 3.63	0.90 ± 0.88 ^b	24	23.45 ± 4.43	7.13 ± 3.75 ^b	14.38 ± 4.61 ^b	9.75 ± 4.07 ^c	43.67 ± 9.08 ^b	3.88 ± 3.92 ^b	0.92 ± 0.93
Food Insecurity																
None (0)	323	21.76 ± 5.27	4.84 ± 3.24 ^a	17.77 ± 5.28 ^a	4.73 ± 6.35 ^a	50.82 ± 9.67 ^a	0 ^a	0.63 ± 0.72 ^a	26	21.28 ± 2.63	2.65 ± 2.67 ^a	19.73 ± 5.65 ^a	1.08 ± 6.93 ^a	52.81 ± 10.95 ^a	0 ^a	0.31 ± 0.55 ^a
Low (<8)	220	23.36 ± 5.79	7.65 ± 3.10 ^b	14.51 ± 5.25 ^b	7.19 ± 6.34 ^b	44.57 ± 10.16 ^b	3.61 ± 2.35 ^b	0.90 ± 0.86 ^b	14	25.05 ± 4.85	8.29 ± 2.40 ^b	13.50 ± 3.92 ^b	10.07 ± 4.70 ^b	43.86 ± 8.41 ^b	5.29 ± 2.59 ^b	1.14 ± 0.86 ^b
High (≥9)	38	23.73 ± 5.25	10.32 ± 3.08 ^c	11.03 ± 4.49 ^c	8.42 ± 6.24 ^b	39.90 ± 9.94 ^c	11.34 ± 2.26 ^c	1.31 ± 0.82 ^c	2	21.85 ± 2.19	11.50 ± 4.95 ^b	10.00 ± 2.83 ^b	10.00 ± 0.00 ^{ab}	34.00 ± 4.24 ^b	11.00 ± 1.41 ^c	2.00 ± 1.41 ^b
Risky HIV Behavior																
No	448	22.56 ± 5.81	6.05 ± 3.56 ^a	16.25 ± 5.73	5.65 ± 6.46 ^a	47.78 ± 10.50	1.95 ± 3.21 ^a	0.75 ± 0.80	35	22.70 ± 4.05	4.49 ± 3.53	17.29 ± 6.05	3.89 ± 7.87	49.20 ± 11.35	1.77 ± 3.03 ^a	0.60 ± 0.78
Yes	98	22.26 ± 4.27	7.28 ± 3.62 ^b	15.43 ± 5.19	7.10 ± 6.57 ^b	47.87 ± 10.05	2.82 ± 3.82 ^b	0.90 ± 0.82	7	21.89 ± 2.98	7.29 ± 5.59	16.71 ± 6.10	7.57 ± 4.12	47.57 ± 11.07	4.86 ± 4.74 ^b	1.00 ± 1.16

ACEs, Adverse Childhood Experiences (0-17); Positive Exp, total number of reported positive experiences; Perceived Stress, number of self-reported stressors; Resiliency, reported ability to handle daily activities; Food Insecurity, reported difficulties with acquiring food; Measure health, total number of reported illnesses/diseases (i.e., CVD, cancer, asthma, diabetes, depression, etc.). Significance set at p<0.05; Unlike symbols^(*) within each group are significantly different.

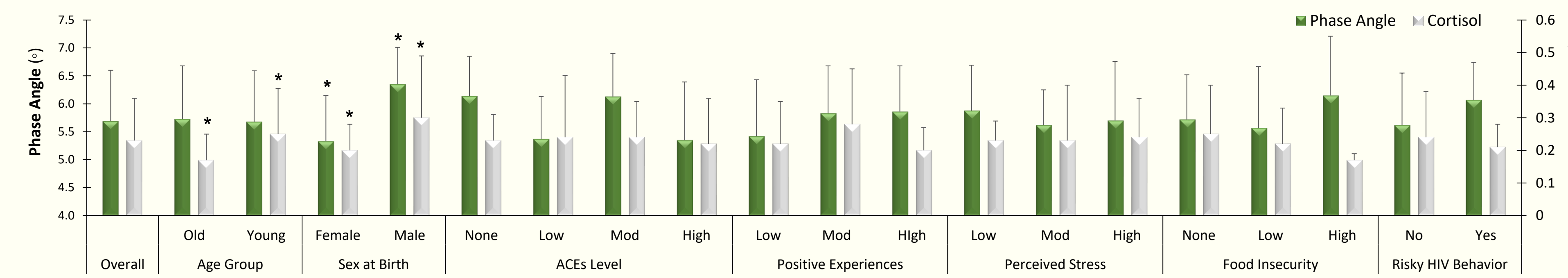


Figure 2. Graphical representation of differences in Phase Angle values and Salivary Cortisol levels between and within groups.

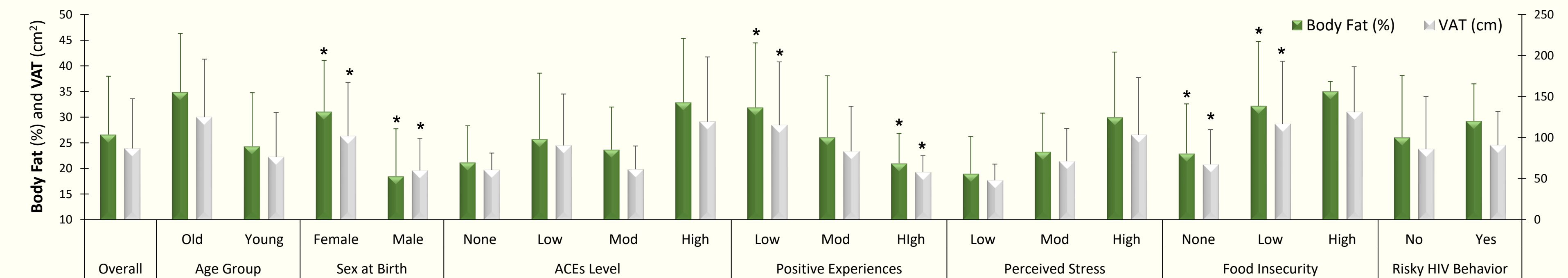


Figure 3. Graphical representation of differences in Body Fat Percentage and Visceral Adipose Tissue area between and within groups.

- **Positive Experiences decreased** with increased ACEs Effect and ACEs Level
- **Perceived Stress increased** and **Resiliency decreased** with increased ACEs Effect
- **Heterosexual orientation** had overall better measured health
 - **Lower ACE scores** (5.3±3.5) than all counterparts (≥7.2±3.2)
 - **Less Perceived Stress** than Bisexual orientation only (5.1±6.8 vs. 7.3±5.7)
 - **Higher Resiliency** compared to all counterparts (50.0±10.3 vs. ≤44.8±9.7),
 - **Lower Food Insecurity** compared to all counterparts (1.6±2.8 vs. ≥2.5±3.6)
- **Caucasian group:** Lower ACEs, Perceived Stress, and Food Insecurity comparatively (5.9±3.5, 5.8±6.4, 1.8±3.2 vs. ≥7.7±3.2, ≥6.1±6.6, ≥2.3±3.0, respectively)

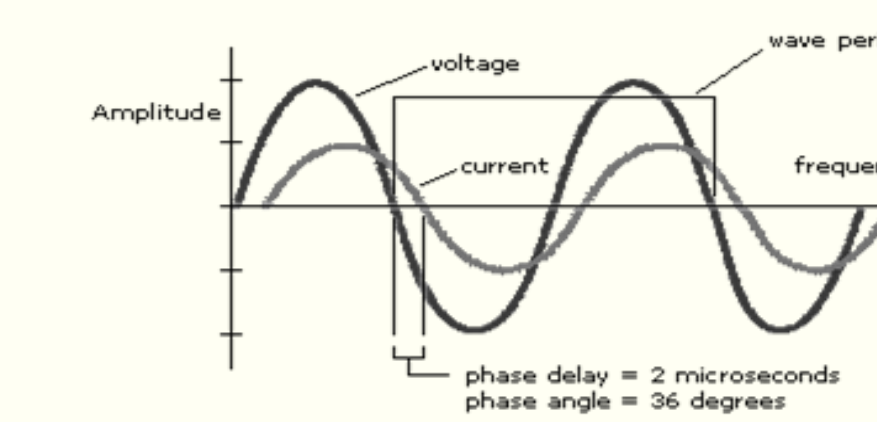


Figure 5. Phase Angle (°) calculation

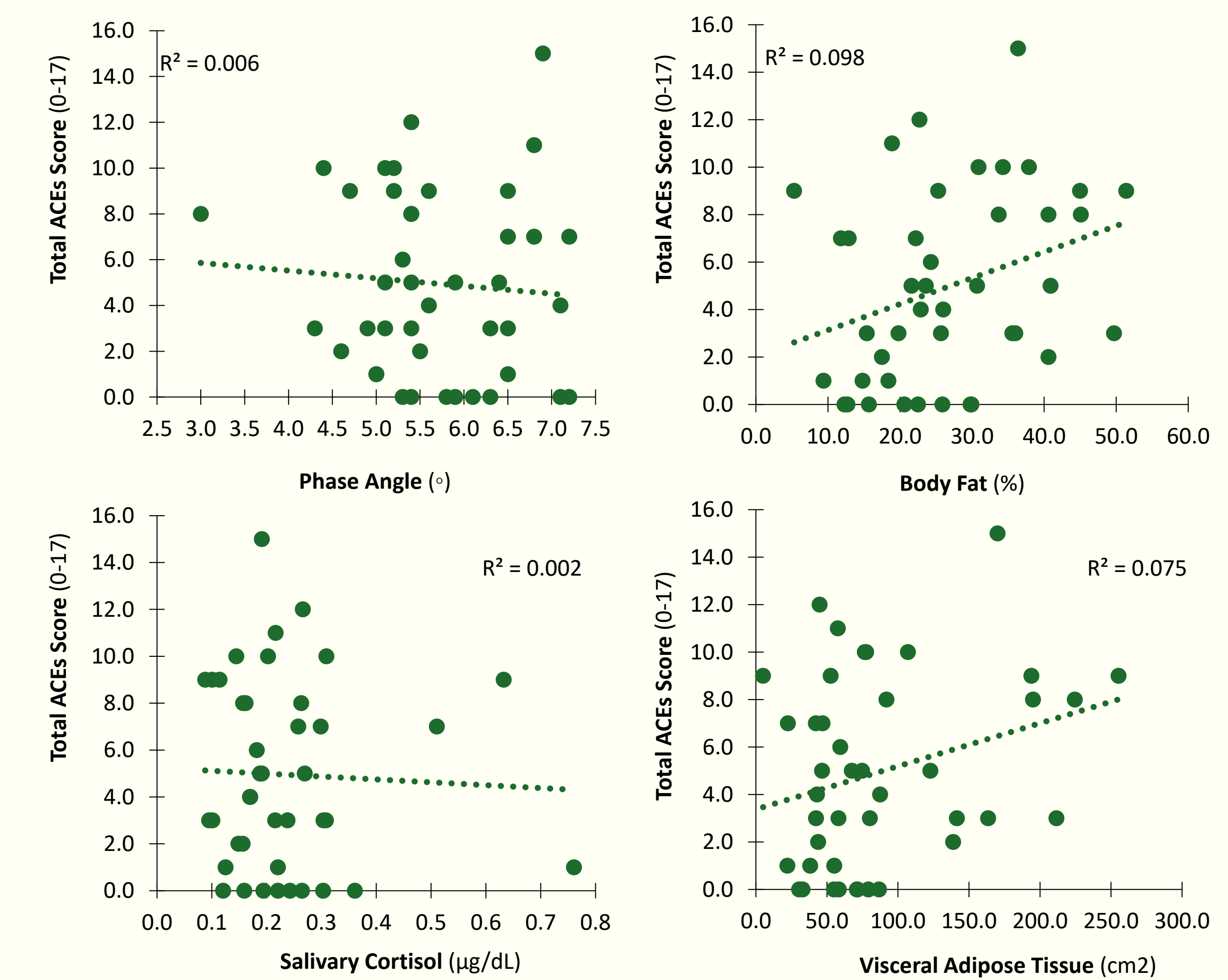


Figure 4. Relationship among Total ACEs Scores and Phase Angle (°), Body Fat (%), Salivary Cortisol (µg/dL), and Visceral Adipose Tissue (cm²)

DISCUSSION

- Health behaviors between groups varied with levels of ACEs, Positive Experiences, and Perceived Stress, influence of these factors on physiology (i.e., phase angle and cortisol) were not observed, but the relationships trend in the direction we would expect.
- Further research should focus on an older age group in order to pinpoint when physiological changes due to adversity in childhood begin to manifest themselves.

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