Measuring Physical Activity and its Impact on Insulin Resistance in MACS Men

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BACKGROUND

- Benefits of Physical Activity (PA):
  - Improved fitness, strength, quality of life, self-efficacy, cognition
  - Decreased insulin resistance and cardiovascular disease risk
  - Potential for improved immunologic function among HIV-infected individuals
- Prior research on PA/ Diabetes Mellitus (DM)/ Insulin resistance (IR) in Pittsburgh MACS participants:
  - DM associated with low physical function, older age and Black race
  - IR associated with HIV, older age, higher BMI, Black race, and physical function/HIV interaction

Objectives:

- To examine the association between HIV status and physical activity (PA) measured by the International Physical Activity Questionnaire (IPAQ)
- To examine the association between PA and insulin resistance and the effect of HIV on that association

HYPOTHESES

- HIV-infected status will be associated with decreased PA
- There will be a weaker association between PA and improved insulin resistance among HIV-infected men compared with HIV-uninfected men

METHODS

- **Study Design:** Cross-sectional analysis of data from the Multicenter AIDS Cohort Study (MACS)
- **Setting:** Four study sites in Baltimore/Washington, DC, Chicago, Los Angeles, and Pittsburgh
- **Population:** All men completing the IPAQ (validated instrument to obtain estimate of PA) at Visit 53 and/or 54 (Apr 2010-Mar 2011)
- **Data Collection:** Standardized semi-annual interview to capture new diagnoses and medications; Blood sample drawn at semi-annual visits
- **Outcomes:**
- **Primary independent variable: Physical Activity** Metabolic equivalents (METs) total score (continuous variable) was calculated by adding MET-minutes/week for all activities performed

Categorical score (low, moderate, and high) also generated

METHODS (continued)

- **Primary dependent variable: Insulin resistance:** Homeostatic model assessment insulin resistance (HOMA-IR) was calculated as: (fasting glucose (mmol/L) x fasting insulin (mU/L)/22.5)
- **Statistical Analysis:**
  - Quantile regression: effect of HIV status on PA (continuous) adjusted for BMI, age, race, and education
  - Linear regression: the effect of PA (categorical) on log-transformed HOMA-IR by HIV status adjusted for BMI, age, race, education, smoking, and HCV

RESULTS

Table 1. Demographic/Clinical Characteristics

	HIV-infected (n=661)	HIV-uninfected (n=768)
Age (years)	51 (46, 57)	55 (48, 62)
Race		
Caucasian (%)	52	72
African-American (%)	18	10
Hispanic/Other (%)	30	17
Education		
High school or less (%)	24	13
College (%)	52	50
Grad school (%)	54	37
Smoking		
Never (%)	23	27
Current (%)	30	19
Former (%)	47	54
Hepatitis C positive (%)	9	3
Diabetes (%)	13	9
Body Mass Index (BMI) (kg/m^2)	25.1 (23.0, 28.1)	26.5 (23.8, 30.0)
HIV RNA <50 copies/mL (%)	74	
CD4$^+$ cell count (cells/mm^3)	557 (407-740)	
CD4$^+$ cell count nadir (cells/mm^3)	245 (144-348)	
On HAART (%)	83	
Duration of HAART (years)	8.7 (5, 12)	
History of clinical AIDS (%)	12	

RESULTS (continued)

Table 2. Physical Activity (METS) and Insulin Resistance by HIV status

		HIV-infected (n=661)	HIV-uninfected (n=768)	P value
Walking METs per week		693 (198 ,1386)	594 (198 ,1386)	0.04
Moderate METs per week		360 (0 ,1500)	480 (0 ,1200)	0.43
Vigorous METs per week		480 (0 ,1920)	480 (0 ,2400)	0.32
Sum of METs per week		2430 (764 ,5184)	2262 (792 ,4755)	0.52
IPAQ category	Low	161(24%)	176(23%)	0.74
	Moderate	177(27%)	217(28%)	
	High	323(49%)	375(49%)	
Log HOMA-IR		3.0 (2.0, 5.0)	3.0 (2.0, 4.0)	<0.001

- **Physical activity was similar by HIV status**
- **Insulin resistance was higher among HIV-infected men**

Table 3. Quantile Regression – Factors Associated with PA*

	Quantile	β	P-value
Intercept	0.10	975.1	
BMI		-13.6	<.0001
HIV-infected		-54.4	0.25
Age (per 10 yrs)		-98.7	0.004
Race - White		REF	
Race – Black		-144.6	0.004
Race – Hispanic/other		-91.2	0.24
Education – high school		REF	
Education – some college		184.6	0.0007
Education - postgrad		327.5	<.0001
Intercept	0.25	1483.4	
BMI		-33.7	<.0001
HIV-infected		-14.1	0.87
Age (per 10 yrs)		-53.9	0.29
Race - White		REF	
Race – Black		-99.6	0.39
Race – Hispanic/other		343.5	0.08
Education – high school		REF	
Education – some college		488.8	<.0001
Education - postgrad		652.4	<.0001
Intercept	0.50	5158.3	
BMI		-88.3	<.0001
HIV-infected		20.0	0.93
Age (per 10 yrs)		-229.1	0.04
Race - White			
Race – Black		-102.1	0.69
Race – Hispanic/other		723.4	0.04
Education – high school		REF	
Education – some college		904.9	0.004
Education - postgrad		662.5	0.04
Intercept	0.75	10079.8	
BMI		-165.3	<.0001
HIV-infected		111.7	0.76
Age (per 10 yrs)		-280.4	0.10
Race – White			
Race – Black		357.0	0.49
Race – Hispanic/other		867.7	0.17
Education – high school		REF	
Education – some college		1039.9	0.02
Education - postgrad		364.6	0.53
Intercept	0.90	10970.7	
BMI		-163.0	0.003
HIV-infected		1125.1	0.06
Age (per 10 yrs)		119.6	0.67
Race - White		REF	
Race – Black		737.8	0.26
Race – Hispanic/other		1604.7	0.05
Education – high school		REF	
Education – some college		862.4	0.37
Education - postgrad		-238.7	0.81

*Adjusted for smoking status

- **Across all quantiles of PA, BMI was inversely associated with PA.**
- **There was a borderline statistically significant association (p=0.06) between HIV and PA in the highest PA level.**

Table 4. Factors Associated with Insulin Resistance*

	β	P-value
Age (q 10 years)	0.07	0.0001
PA		NS
Low	Ref	
High	-0.18	0.0007
HIV	0.29	<.0001
BMI	0.06	<.0001
HCV	0.25	0.0003

*Adjusted for education, smoking status, race

- **Higher PA was associated with less insulin resistance, while HIV infection, BMI, and HCV infection were associated with more insulin resistance**
- **The HIV-PA interaction term was not significantly associated with insulin resistance**

CONCLUSIONS AND IMPLICATIONS

- IR was higher among the HIV-infected men compared with HIV-uninfected men in our sample, although physical activity was similar
- PA may need to be increased to a greater extent among HIV-infected persons to achieve the same metabolic benefit.