The impact of physical activity on cognition in men with and without HIV

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Poster 489

BACKGROUND

- HIV-associated neurocognitive disorder (HAND) is a highly prevalent complication of HIV infection, however, the mechanism of its development and its optimal treatments are only partially understood

Objective:

To determine the association between physical activity and cognitive function and the effect of HIV on that association within the Multicenter AIDS Cohort Study (MACS).

HYPOTHESES

- Physical activity will be associated with cognitive function among all men, and there will be an HIV-PA interaction.

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:** Men completing the IPAQ (validated instrument to obtain estimate of PA) at Visit 53 and/or 54 (Apr 2010-Mar 2011) with neuropsychiatric testing completed within 180 days
- **Outcomes:** **Primary independent variable: Physical Activity** Metabolic equivalents (METs) total score was calculated; categorical score (low, moderate, and high) was assigned
- **Dependent variables:** Pyschomotor function assessed by SDMT (Symbol Digit Modalities Test) ; Executive function assessed by Trail Making Test (TMT) Part & B – results were examined both at one time point and with a slope generated from multiple administrations
- Neuropsychological battery: Executive function, Speed of processing, Attention/Working Memory, Learning, Memory, Motor
- **Statistical Analysis:**
  - Adjusted quantile regression

RESULTS

Table 1. Demographic and Clinical Characteristics of Study sample (N=622)

	Total N	N HIV-	HIV- Median	IQR or %	N HIV+	HIV+ Median	IQR or %
Age, years	622	351	55	48, 61	271	51	45, 57
Depression score (CESD)	608	342	6.5	2.0, 14.0	266	10.0	4.0, 20.0
Body Mass Index (kg/m²)	551	315	26.2	23.8, 29.5	236	25.6	23.4, 28.8
MACS Cohort							
Old	622	230		66	103		38
New		121		34	168		62
Educational Attainment	622						
High School		51			68		
Any College		174			181		
Grad School		128			55		
Annual Income	592						
<$20,000		86			132		
20,000-60,000		117			76		
> 60,000		131		37	50		18
Race	582						
White, non-Hispanic		254		72	122		45
Black, non-Hispanic		61		17	89		33
Other		36			60		
Smoking status	622						
Never		104		30	49		18
Former		187		53	142		52
Current		60		17	80		30
Hepatitis C status	620						
Negative		340		97	243		89
Diabetes	622						
No		306		87	224		83
Hypertension	622						
No		122		35	97		36
IPAQ category	622						
Low		68		19	75		28
Moderate		108		31	67		25
High		175		50	129		48

Table 2. HIV-specific variables (N=271)

	Total N	N HIV+	HIV+ Median	IQR or %
AIDS history	271			
Yes		28		10
HAART status	271			
Yes		253		93
CD4+ T cell count (cells/ul)		267	554	415, 753
CD4+ T cell count (cells/ul) nadir		268	267	153, 360
Undetectable HIVRNA	268			
Yes		194		72
HIV RNA (men with detectable virus		268	40	10, 102

Table 3. The association between physical activity and Symbol Digit/Trails A/Trails B/cognitive function domains*

Variable		Symbol Digit (N=598)		Trails A (N=598)		Trails B (N=597)		Speed (N=620)		Working Memory (N=606)		Learning (N=622)		Memory (N=622)		Motor (N=622)		Executive Function (N=621)	
		β	p-value	β	p-value	β	p-value	β	p-value	β	p-value	β	p-value	β	p-value	β	p-value	β	p-value
PA Category	High	0.06	0.80	0.23	0.33	0.35	0.14	-0.13	0.93	4.19	0.02	0.90	0.64	-1.09	0.64	3.61	0.09	1.01	0.62
	Moderate	0.30	0.10	0.23	0.24	0.41	0.06	0.89	0.50	1.95	0.23	1.72	0.29	0.40	0.83	3.35	0.05	1.30	0.50
	Low	Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref		Ref	
HIV negative (vs. positive)		0.06	0.82	0.25	0.28	0.14	0.63	-0.87	0.62	2.98	0.15	-2.50	0.19	-2.87	0.24	0.10	0.97	0.47	0.80
HIV-mod PA interaction		0.13	0.71	-0.28	0.38	-0.06	0.85	3.24	0.15	-4.32	0.09	2.45	0.34	3.57	0.22	0.46	0.88	0.56	0.83
HIV-high PA interaction		-0.11	0.69	-0.21	0.40	-0.02	0.95	1.55	0.43	-0.55	0.82	1.98	0.39	2.84	0.28	-0.11	0.97	0.63	0.80

- HIV status was not associated with psychomotor/executive function assessed by SD/Trails A/Trails B or with any domains in the neuropsychological battery
- High PA was associated with better performance on the working memory domain and moderate PA was associated with the motor domain
- No HIV-PA interaction was observed

Table 4. The association between physical activity and change in Symbol Digit/Trails A/Trails B *

Variable		Symbol Digit (N=600)		Trails A (N=602)		Trails B (N=601)	
		β	p-value	β	p-value	β	p-value
PA Category	High	-0.03	0.54	0.00	0.93	0.03	0.61
	Moderate	-0.07	0.16	-0.00	0.94	0.00	0.98
	Low	Ref		Ref		Ref	
HIV negative (vs. positive)		-0.02	0.78	-0.10	0.07	0.01	0.86
HIV-mod PA interaction		0.05	0.52	0.06	0.41	-0.09	0.23
HIV-high PA interaction		0.05	0.44	0.07	0.27	-0.01	0.93

*Table 3/4: Adjusted for age, BMI category, race, MACS cohort, educational achievement, smoking status, alcohol consumption, marijuana use, amyl nitrate use, stimulant use, HCV status, depression, diabetes, hypertension
*Table 5: Adjusted for same variables listed above, also income

Table 5. The association between physical activity and Results of Symbol Digit, Trails A, and Trails B testing (HIV+ patients only)*

Variable		Symbol digit		Trails A		Trails B	
		β	p-value	β	p-value	β	p-value
Age		-0.04	0.01	-0.06	<.0001	-0.07	<.0001
PA Category	High	0.57	0.01	0.06	0.80	0.45	0.06
	Moderate	0.46	0.07	0.12	0.60	0.36	0.12
	Low	Ref		Ref		Ref	
MACS Cohort	Old	0.58	0.10	0.48	0.05	0.91	0.00
No Diabetes (vs. Diabetes)		-0.03	0.90	-0.20	0.36	-0.09	0.66
No Hypertension (vs. Hypertension)		0.16	0.40	-0.18	0.34	-0.05	0.78
Race	White non-Hispanic	-0.15	0.66	-0.07	0.84	-0.20	0.47
	Black non-Hispanic	-0.08	0.75	0.07	0.81	0.54	0.02
	Others	Ref		Ref		Ref	
No HAART (vs. HAART)		0.02	0.95	-0.33	0.24	-0.22	0.48
CD4 current		0.00	0.43	0.00	0.71	0.00	0.62
HIVRNA not suppressed (vs. suppressed)		0.02	0.93	0.02	0.93	-0.56	0.01
No AIDS history (vs. AIDS history)		-0.37	0.15	-0.02	0.94	0.14	0.67

- PA was not associated with change in SD/Trails A/Trails B over time
- Among HIV-infected men, High PA was associated with better SD performance

CONCLUSIONS AND IMPLICATIONS

- Higher physical activity category was associated with better scores on tests of psychomotor and executive functioning in a cohort of HIV-infected and –uninfected men at baseline but did not affect the change over time.
- The affect of PA on cognition does not vary by HIV status