

Supplementary Information

Associations between physical activity and brain structure in a large community cohort

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Supplementary Table S1 Differences in the associations between physical activity and brain volumes across body mass index strata

	Total Brain Volume^a	Grey Matter Volume^a	White Matter Volume	Total Hippocampal Volume^a	White Matter Hyperintensity volume^{a,b}
	β -coefficient (p-value)	β -coefficient (p-value)	β -coefficient (p-value)	β -coefficient (p-value)	β -coefficient (p-value)
Model 1 (adjusted for age and sex)					
Body mass index (kg/m ²)					
<20	0.21 (0.41)	0.21 (0.18)	-0.008 (0.96)	0.001 (0.75)	-1×10 ⁻⁶ (0.75)
20-25	Reference	Reference	Reference	Reference	Reference
25-30	0.05 (0.69)	0.05 (0.55)	0.03 (0.72)	0.001 (0.54)	8×10 ⁻⁷ (0.66)
>30	-0.03 (0.87)	0.17 (0.14)	-0.15 (0.22)	-0.004 (0.25)	-2×10 ⁻⁶ (0.59)
Model 2 (fully adjusted)					
Body mass index (kg/m ²)					
<20	0.02 (0.94)	0.15 (0.36)	-0.13 (0.44)	-0.0004 (0.93)	-3×10 ⁻⁶ (0.41)
20-25	Reference	Reference	Reference	Reference	Reference
25-30	0.09 (0.51)	0.09 (0.29)	0.03 (0.72)	0.002 (0.38)	-5×10 ⁻⁷ (0.80)
>30	-0.20 (0.33)	0.04 (0.77)	-0.19 (0.14)	-0.005 (0.17)	-2×10 ⁻⁷ (0.94)

^aModels contain quadratic and cubic physical activity terms; ^bLog-transformed ^cFully adjusted model includes ethnicity + Townsend deprivation index + hypertension + ischaemic heart disease + hypercholesterolaemia + stroke + diabetes + Apolipoprotein E ϵ 4 + smoking + education + sleep + alcohol + mood

Supplementary Table S2 Influence of waist circumference on associations between physical activity and brain volumes

	Total Brain Volume^a	Grey Matter Volume^a	White Matter Volume	Total Hippocampal Volume^a	White Matter Hyperintensity volume^{a,b}
	β -coefficient (95% CI) p-value	β -coefficient (95% CI) p-value	β -coefficient (95% CI) p-value	β -coefficient (95% CI) p-value	β -coefficient (95% CI) p-value
Model 1					
Physical activity	3.67 (2.82 to 4.51) $< 2 \times 10^{-16}$	3.12 (2.57 to 3.67) $< 2 \times 10^{-16}$	0.43 (0.36 to 0.51) $< 2 \times 10^{-16}$	0.05 (0.03 to 0.06) 1×10^{-11}	-4.6×10^{-5} (-6×10^{-5} to -3×10^{-5}) 3×10^{-15}
Model 2					
Physical activity + (age × sex)	1.46 (0.77 to 2.15) 3.4×10^{-5}	1.19 (0.77 to 1.60) 2.0×10^{-8}	0.11 (0.03 to 0.18) 0.004	0.015 (0.002 to 0.03) 0.02	-2.6×10^{-5} (-4×10^{-5} to -2×10^{-5}) 3×10^{-7}
Model 3					
Physical activity + waist + (age × sex)	0.95 (0.25 to 1.65) 0.008	0.71 (0.30 to 1.13) 0.0008	0.10 (0.02 to 0.17) 0.01	0.009 (-0.004 to 0.02) 0.17	-1.6×10^{-5} (-3×10^{-5} to -6×10^{-6}) 0.002
Change in Beta compared with Model 2	↓35%	↓40%	↓9%	↓40%	↓38%

^aModels contain quadratic and cubic physical activity terms; ^bLog-transformed

Supplementary Table S3 Associations between general intensity of physical activity and brain volumes^a

	Total Brain Volume	Grey Matter Volume	White Matter Volume	Total Hippocampal Volume	White Matter Hyperintensity volume^b
	β-coefficient (p-value)	β-coefficient (p-value)	β-coefficient (p-value)	β-coefficient (p-value)	β-coefficient (p-value)
Sedentary (n=16069)	Reference	Reference	Reference	Reference	Reference
Light (n=653)	3.78 (0.11)	2.5 (0.08)	1.26 (0.42)	0.12 (0.003)	-9×10 ⁻⁵ (0.01)
Moderate (n=3)	-6.78 (0.84)	-10.4 (0.61)	3.6 (0.87)	0.64 (0.29)	1.7×10 ⁻⁴ (0.72)

^a All models adjusted for age × sex. ^bLog-transformed

Supplementary Table S4 Objectively measured physical activity and brain volumes by self-reported physical activity

	Low self-reported physical activity	Moderate self-reported physical activity	High self-reported physical activity
	Median (IQR)	Median (IQR)	Median (IQR)
n	2598	5983	5738
Accelerometer (mg)	25.1 (9.09)	27.1 (9.34)	29.6 (11.0)
Brain volumes (cm³)			
Total brain volume	1498 (100)	1495 (103)	1494 (102)
Grey matter volume	795 (64.7)	794 (65.3)	791 (65.4)
White matter volume	702 (55.9)	701 (57.1)	702 (54.7)
Total hippocampal volume	9.99 (1.50)	9.99 (1.48)	9.97 (1.48)
White matter hyperintensities	3.59 (5.15)	3.58 (5.34)	3.70 (5.35)

Supplementary Table S5 Associations between self-reported physical activity and brain volumes

	Total Brain Volume	Grey Matter Volume	White Matter Volume	Total Hippocampal Volume	White Matter Hyperintensity volume^a
	β -coefficient (p-value)	β -coefficient (p-value)	β -coefficient (p-value)	β -coefficient (p-value)	β -coefficient (p-value)
Model 1 (univariable)					
Low	Reference	Reference	Reference	Reference	Reference
Moderate	-3.7 (0.03)	-1.31 (0.25)	-2.42 (0.02)	-0.02 (0.43)	2.5×10^{-6} (0.92)
High	-3.86 (0.03)	-2.75 (0.02)	-1.11 (0.26)	-0.02 (0.47)	9.9×10^{-6} (0.68)
Model 2 (Physical activity + (age $\times$ sex))					
Low	Reference	Reference	Reference	Reference	Reference
Moderate	-0.80 (0.57)	0.2 (0.81)	-1.00 (0.27)	-0.01 (0.61)	-4.0×10^{-5} (0.05)
High	1.22 (0.39)	0.73 (0.39)	0.49 (0.60)	0.02 (0.44)	-5.1×10^{-5} (0.01)

^aLog-transformed