Supplementary Materials

Table S1. Regions identified by NBS in network component associated with cardiorespiratory fitness independent of MVPA

Network	Region of Interest (ROI) label	Description of anatomical region	MNI coordinates (x,y,z)
DMN	PHG	Parahippocampal/hippocampal gyrus	*L(-24,-26,-20)
DMN	MTG	Middle temporal gyrus	*L(-52,-18,-18), R(62,-10,-16)
DMN	IPL	Inferior parietal lobule	L(-46,-64,32), R(50,-62,34)
DMN	PCC	Posterior cingulate cortex	L(-6,-54,32), R(6, -60, 32)
DMN	mPFC	Medial prefrontal cortex	L(-6,62,-4), R(6,62,-4)
DMN	dmPFC	Dorsal medial prefrontal cortex	R(6,50,20)
DMN	SFG	Superior frontal gyrus	L(-24,24,42), R(22,28,44)
DAN	pIPS	Posterior intraparietal sulcus	L(-28,-68,48)
DAN	aIPS	Anterior intraparietal sulcus	L(-40,-46,46), R(38,-46,46)
DAN	MT	Middle temporal/visual cortex (V5)	L(-52,-60,-8), R(58,-52,-10)
DAN	MOT	Premotor motor cortex	R(48,10,28)
DAN	FEF	Frontal eye field	L(-26,2,54)
DAN	MFG	Middle frontal gyrus	R(46,34,22)
MOT	MOT	Primary motor cortex	L(-6,-28,58), R(6,-26,58)
SAL	IPL	Inferior parietal lobule	R(60,-38,38)
SAL	aINS	Anterior insula/cingulo-operculum	L(-38,16,2), R(42,16,2)
SAL	dACC	Dorsal anterior cingulate cortex	L(6,32,30), R(-6,26,32)
SAL	aPFC	Anterior prefrontal cortex	L(-30,48,26), R(32,48,26)
ECN	SFG	Superior frontal gyrus	L(-6,42,44)
ECN	alPFC	Anterior lateral prefrontal cortex	L(-46,42,-6), R(48,36,-10)
ECN	MTG	Middle temporal gyrus	L(-58,-38,0)
ECN	STG	Superior temporal gyrus	R(52,-32,0)

Table S1 caption: Network regions of interest (ROIs) empirically derived from the study sample using independent components analysis (ICA) based decomposition of resting state fMRI signal. Networks were identified from ICA with all older and younger adults, based on knowledge of spatial activation patterns for canonical brain networks of interest. Network acronyms refer to: DMN (Default Mode Network), DAN (dorsal attention network), MOT (Somato-motor network), SAL (Salience network), and ECN (Executive Control Network). Regions were identified based on peak Z-scores for functionally distinct regions within networks. *Regions identified as part of network based on a previous study from our group (Voss et al., 2010a,b) finding age- and fitness-related individual differences in network membership. Refer to Figure 7 for the illustration of positive and negative associations between fitness and links between these nodes as derived from NBS.

Figure S1.

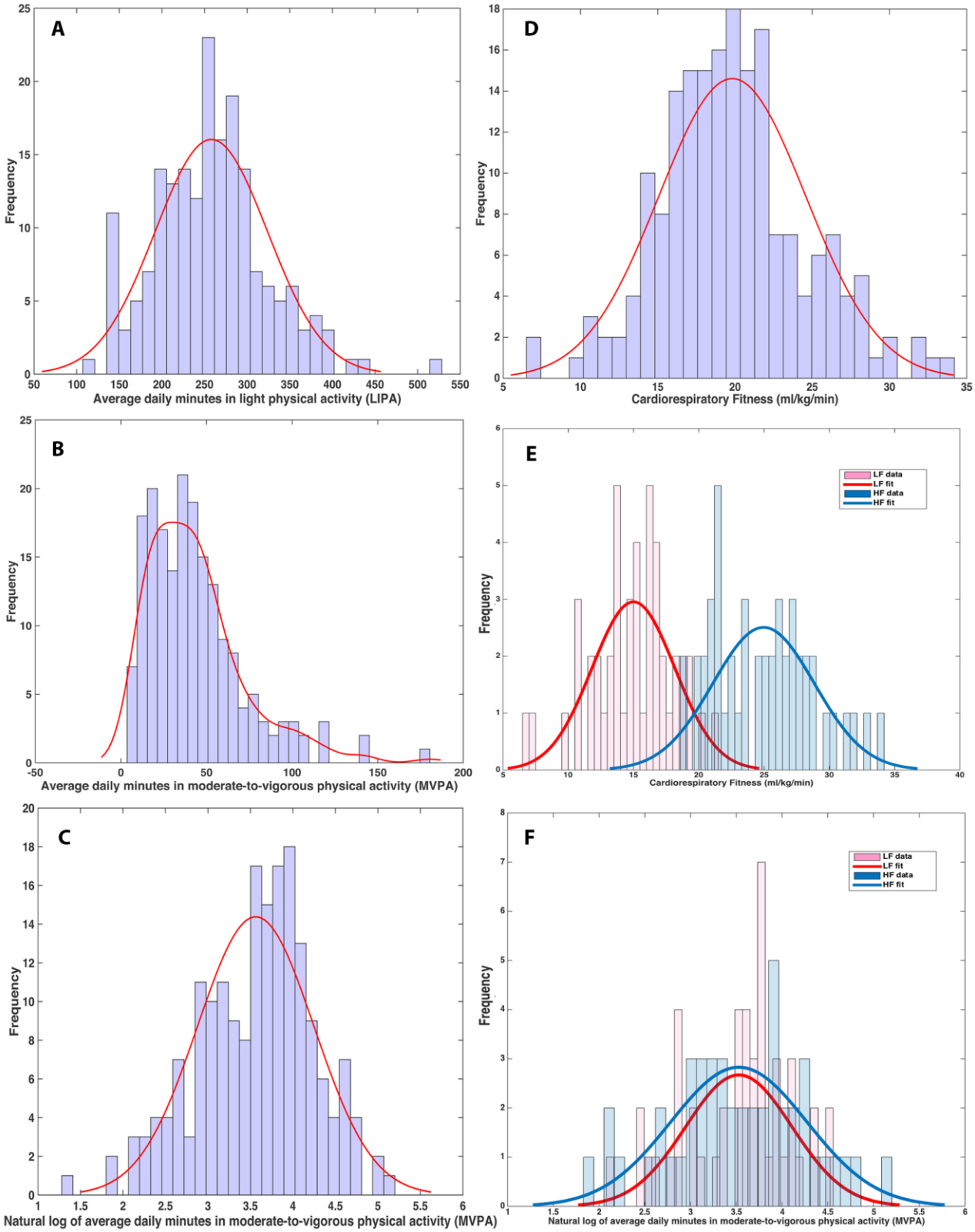
A
Frequency
Average daily minutes in light physical activity (LIPA)
D
Frequency
Cardiorespiratory Fitness (ml/kg/min)
B
Frequency
Average daily minutes in moderate-to-vigorous physical activity (MVPA)
E
LF data
LF fit
HF data
HF fit
Frequency
Cardiorespiratory Fitness (ml/kg/min)
C
Frequency
Natural log of average daily minutes in moderate-to-vigorous physical activity (MVPA)
F
LF data
LF fit
HF data
HF fit
Frequency
Natural log of average daily minutes in moderate-to-vigorous physical activity (MVPA)

Figure S1 caption: Histograms of (A) average light physical activity (LIPA), (B) average daily minutes spent in moderate-to-vigorous physical activity (MVPA) and (C) MVPA natural log transformed, (D) cardiorespiratory fitness, (E) cardiorespiratory fitness broken down by fitness group, and (E) MVPA (natural log transformed) broken down by fitness group. The curve for the raw MVPA (B) variable is non-parametric, whereas the curve for the natural log transformed MVPA variable is a normal curve. The natural log transformed variable was used in all analyses for the current study. Curves for A, C, D, E, and F depict a normal curve fit to the data.

Age effects on ROI-ROI links

In this link-wise analysis we did not correct for multiple comparisons at the level of individual ROI-ROI links because the goal was to emphasize exploration and to evaluate whether there was a systematic pattern of weaker or stronger FC for older adults as a function ROI pairs within or between networks. Here the ROI-ROI Fisher's Z(r) correlations were compared for each pair using a two-tailed independent-samples t-test with a *p*-value criterion of $p < .01$. Based on this approach and with uncorrected thresholds for individual ROI-ROI links, we found network structure in systematic age differences that were strongest within the ECN and DMN regions (see Figure S2).

All wheel plots of age group contrasts or correlations between fitness or physical activity and these bivariate cross-correlations of ROI pairs were created using MATLAB code provided publicly by researchers from the Harvard Aging Brain project (http://mrtools.mgh.harvard.edu/index.php/Downloads).

Figure S2.

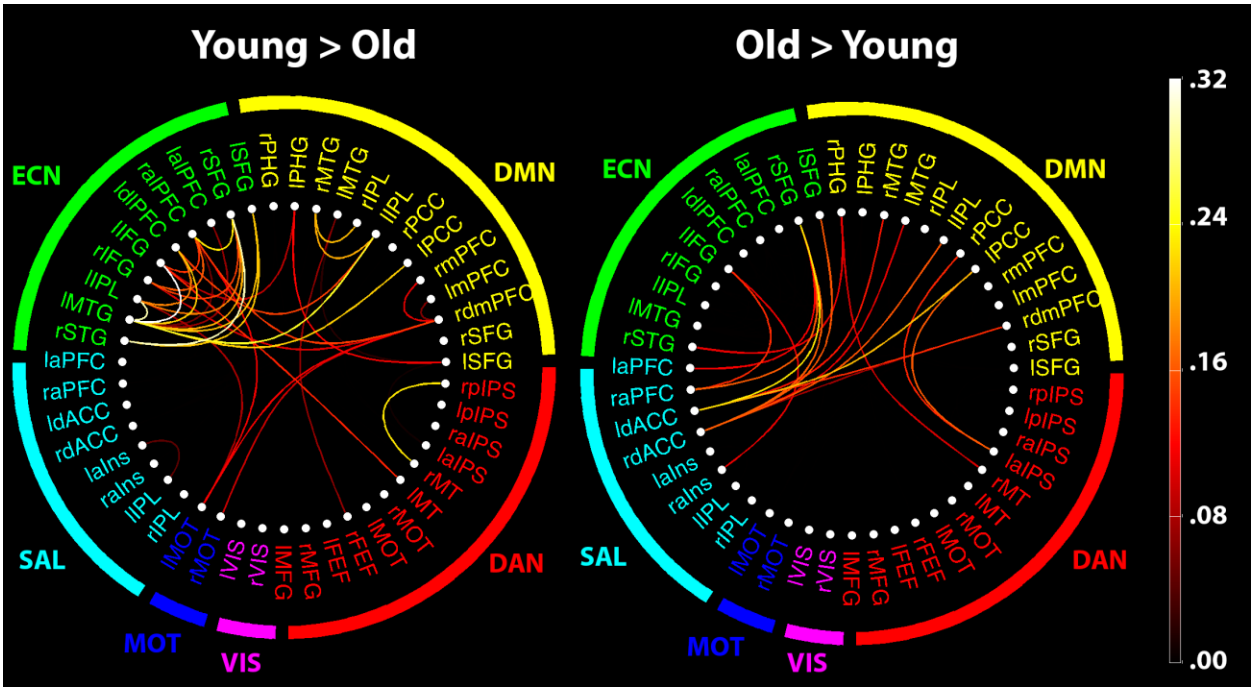

Figure S2 caption: Visualization of age differences in ROI-ROI functional connectivity within and between networks. Colors denote different networks including the Default Mode Network (DMN), Dorsal Attention Network (DAN), Executive Control Network (ECN), Salience Network (SAL), Motor Network (MOT), and Visual Network (VIS). Each white node represents an ROI and each line between ROI-ROI pairs demonstrates there is a statistically significant difference ($p<.01$, uncorrected, two-tailed tests) between the functional connectivity of the young and older adults for that ROI pair, in the direction indicated by the contrast of Young>Old or Old>Young. The color of the line represents the absolute difference between groups in the Fisher's *Z*(r) correlation between the ROI pair, corresponding to the color bar on the right.

Relationship with fitness on ROI-ROI links

These uncorrected pair-wise results suggest the positive correlations with cardiorespiratory fitness have network structure and that positive associations are present primarily within the DMN, SAL, and DAN.

Figure S3.

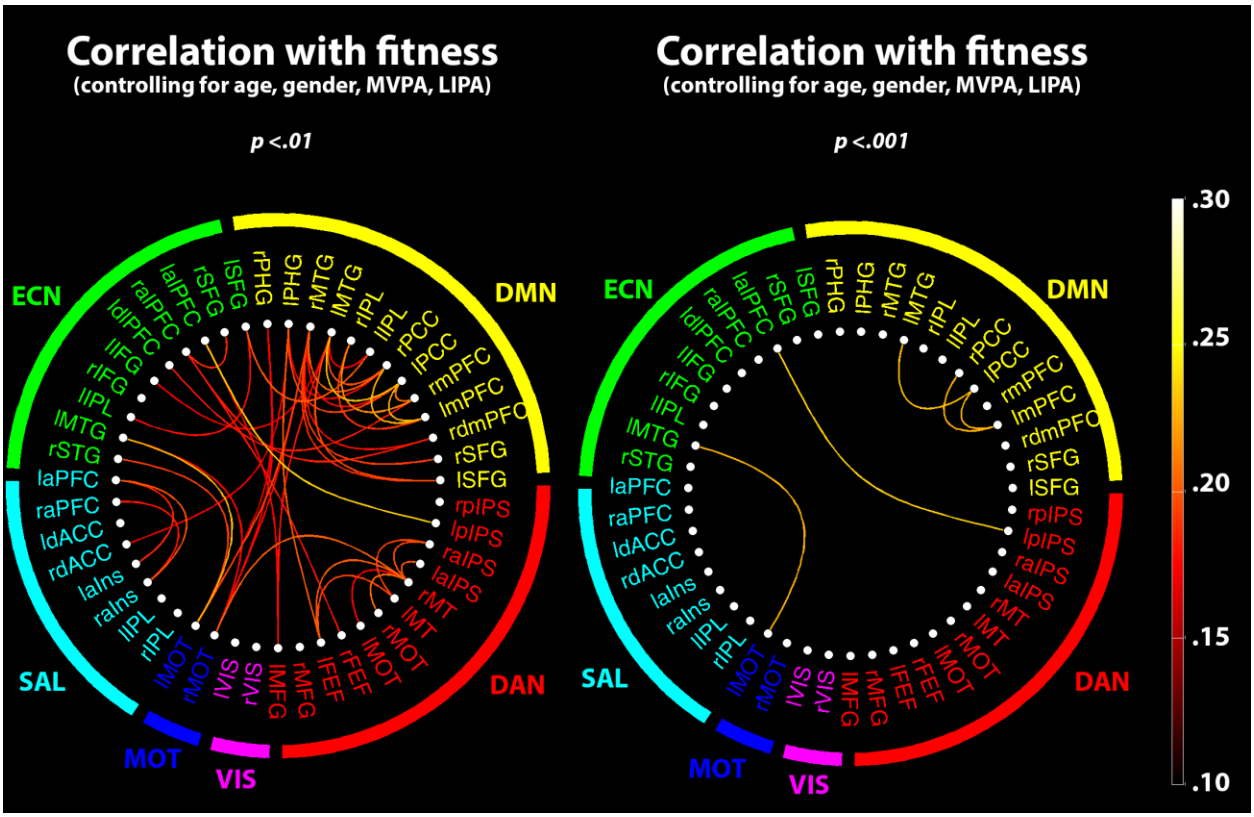

Figure S3 caption: Visualization of the correlation of ROI-ROI functional connectivity within and between networks with cardiorespiratory fitness. Colors denote different networks including the Default Mode Network (DMN), Dorsal Attention Network (DAN), Executive Control Network (ECN), Salience Network (SAL), Somato-motor Network (MOT), and Visual Network (VIS). Each white node represents an ROI and each line between ROI-ROI pairs demonstrates there is a statistically significant correlation between functional connectivity for that ROI pair and cardiorespiratory fitness, after controlling for variance associated with variables as indicated in sub-titles. The color of the line represents the Fisher's Z(r) correlation between the ROI pair. For reference, the associations between fitness and functional connectivity after controlling for only age and gender at both p<.01 and p<.001 thresholds are shown below in supplementary materials.

Figure S4.

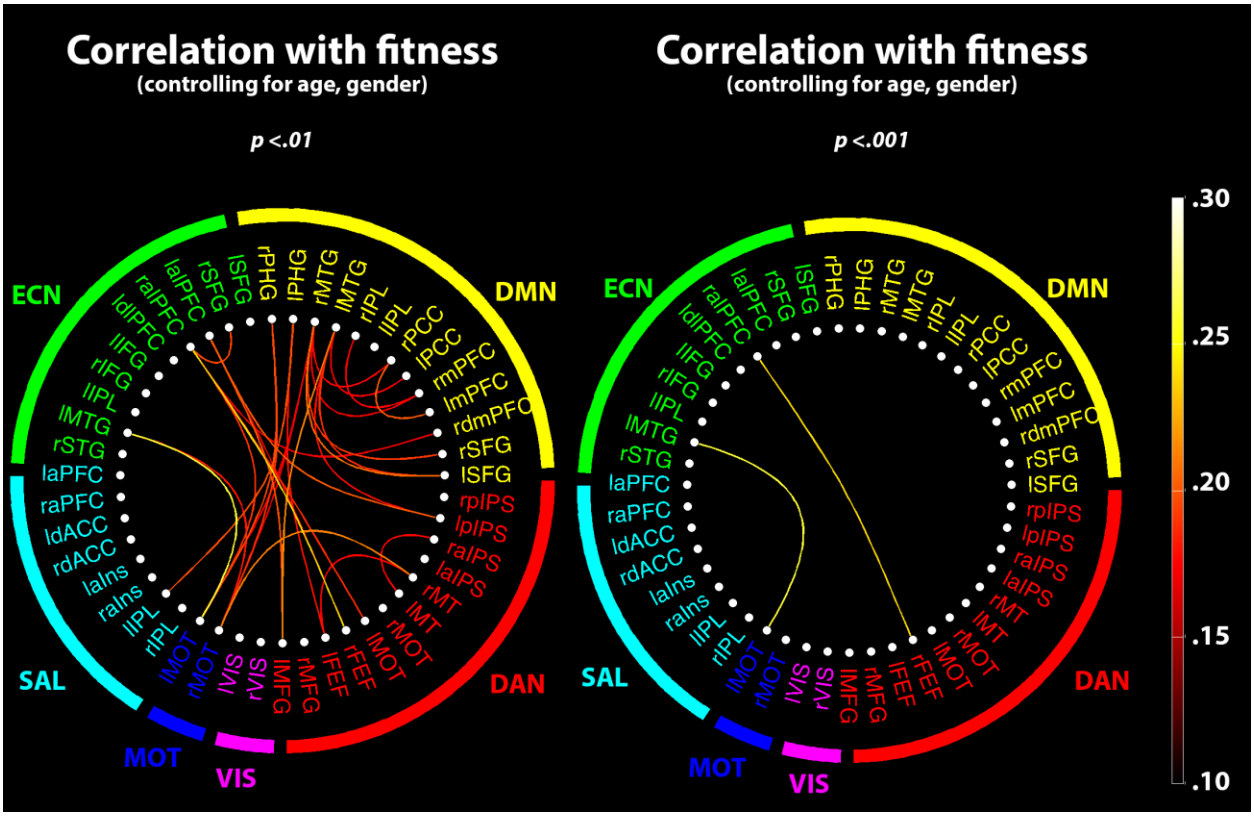

Figure S4 caption: Visualization of the correlation of ROI-ROI functional connectivity within and between networks with cardiorespiratory fitness. Colors denote different networks including the Default Mode Network (DMN), Dorsal Attention Network (DAN), Executive Control Network (ECN), Salience Network (SAL), Somato-motor Network (MOT), and Visual Network (VIS). Each white node represents an ROI and each line between ROI-ROI pairs demonstrates there is a statistically significant correlation between functional connectivity for that ROI pair and cardiorespiratory fitness, after controlling for variance associated with variables as indicated in sub-titles. The color of the line represents the Fisher's Z(r) correlation between the ROI pair.

Figure S5.

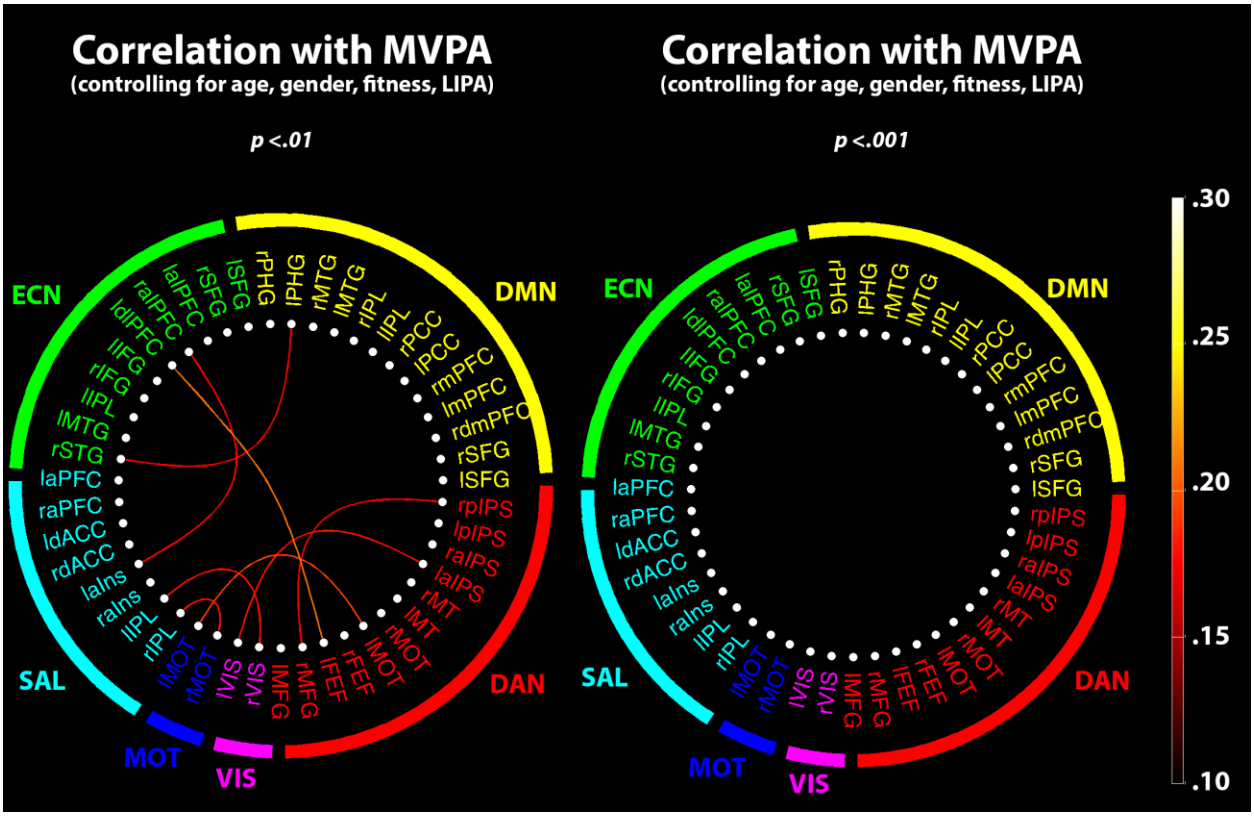

Figure S5 caption: Visualization of the correlation of ROI-ROI functional connectivity within and between networks with MVPA. Colors denote different networks including the Default Mode Network (DMN), Dorsal Attention Network (DAN), Executive Control Network (ECN), Salience Network (SAL), Somato-motor Network (MOT), and Visual Network (VIS). Each white node represents an ROI and each line between ROI-ROI pairs demonstrates there is a statistically significant correlation between functional connectivity for that ROI pair and cardiorespiratory fitness, after controlling for variance associated with variables as indicated in sub-titles. The color of the line represents the Fisher's *Z*(r) correlation between the ROI pair.

Figure S6.

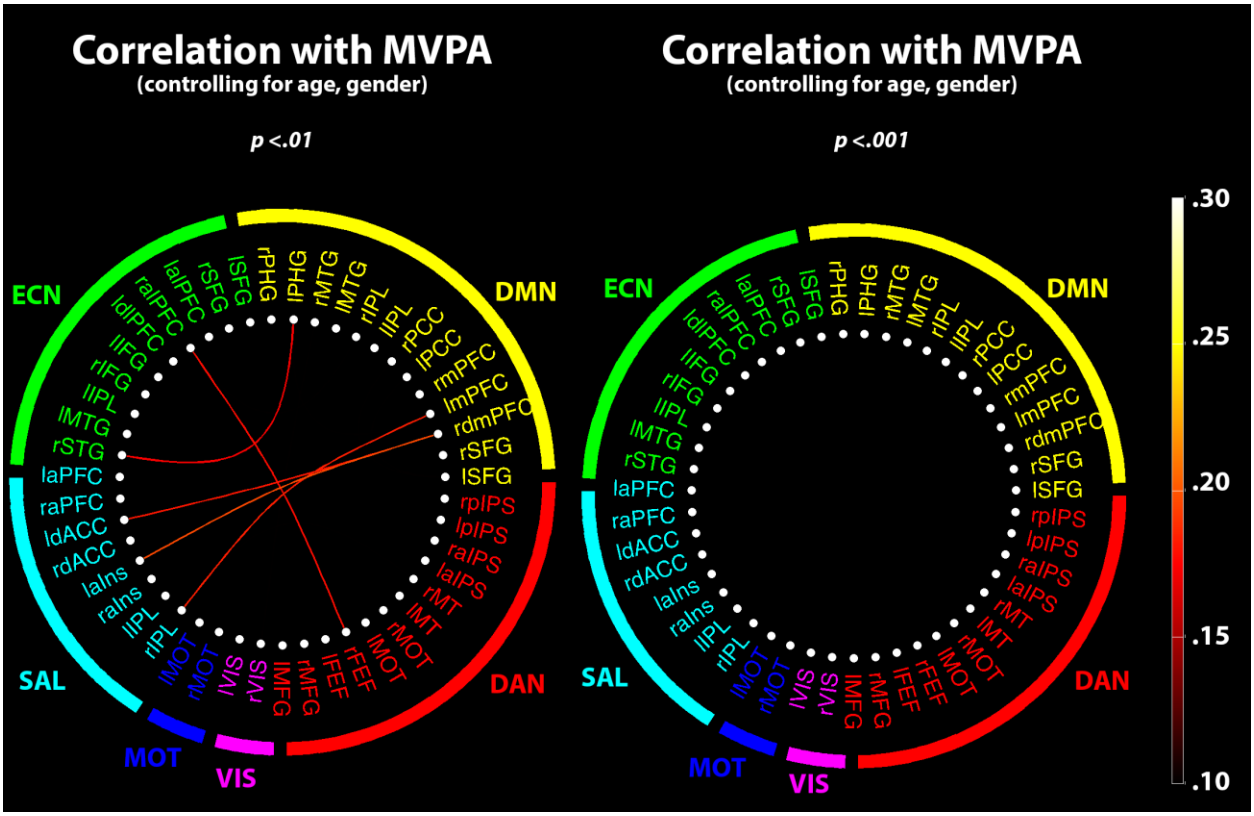

Figure S6 caption: Visualization of the correlation of ROI-ROI functional connectivity within and between networks with MVPA. Colors denote different networks including the Default Mode Network (DMN), Dorsal Attention Network (DAN), Executive Control Network (ECN), Salience Network (SAL), Somato-motor Network (MOT), and Visual Network (VIS). Each white node represents an ROI and each line between ROI-ROI pairs demonstrates there is a statistically significant correlation between functional connectivity for that ROI pair and cardiorespiratory fitness, after controlling for variance associated with variables as indicated in sub-titles. The color of the line represents the Fisher's Z(r) correlation between the ROI pair.

Figure S7.

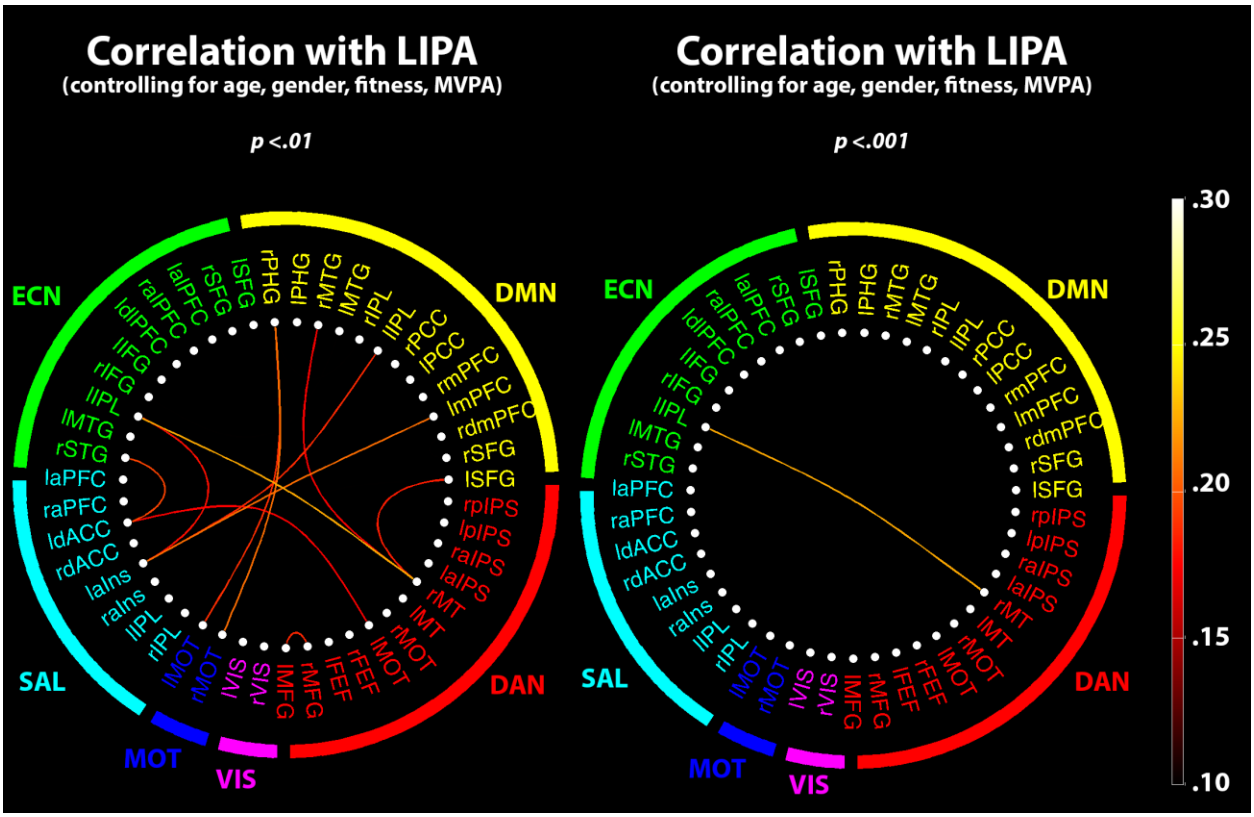

Figure S7 caption: Visualization of the correlation of ROI-ROI functional connectivity within and between networks with LIPA. Colors denote different networks including the Default Mode Network (DMN), Dorsal Attention Network (DAN), Executive Control Network (ECN), Salience Network (SAL), Somato-motor Network (MOT), and Visual Network (VIS). Each white node represents an ROI and each line between ROI-ROI pairs demonstrates there is a statistically significant correlation between functional connectivity for that ROI pair and cardiorespiratory fitness, after controlling for variance associated with variables as indicated in sub-titles. The color of the line represents the Fisher's Z(r) correlation between the ROI pair.

Figure S8

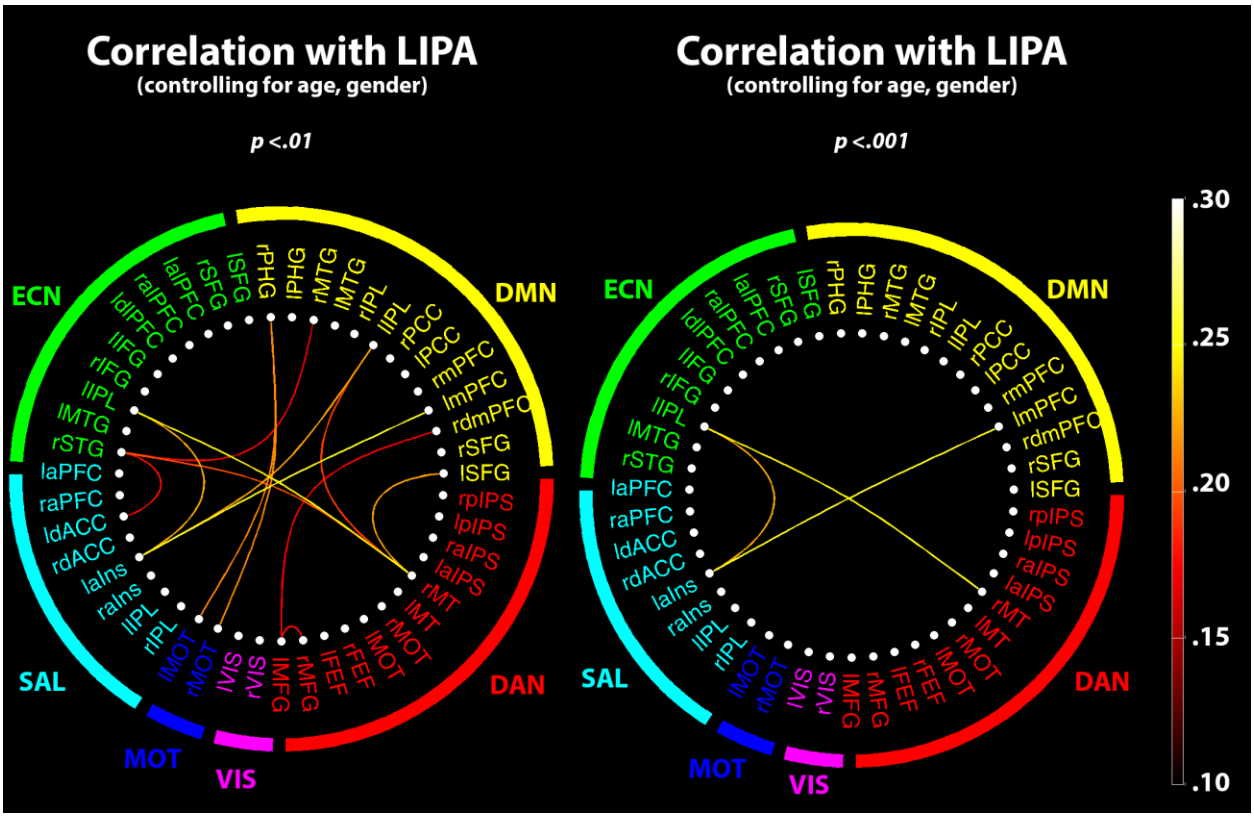

Figure S8 caption: Visualization of the correlation of ROI-ROI functional connectivity within and between networks with LIPA. Colors denote different networks including the Default Mode Network (DMN), Dorsal Attention Network (DAN), Executive Control Network (ECN), Salience Network (SAL), Somato-motor Network (MOT), and Visual Network (VIS). Each white node represents an ROI and each line between ROI-ROI pairs demonstrates there is a statistically significant correlation between functional connectivity for that ROI pair and cardiorespiratory fitness, after controlling for variance associated with variables as indicated in sub-titles. The color of the line represents the Fisher's Z(r) correlation between the ROI pair.