Ca-GPCA	Causality-aware Genotype intermediate Phenotype Correlation Approach
AD	Alzheimer's disease
LD	Linkage disequilibrium
SNP	Single nucleotide polymorphism
SCAD	Smoothly clipped absolute deviation
MCP	Minimax concave penalty
CCC	Canonical correlation coefficient
ADNI	Alzheimer's Disease Neuroimaging Initiative
HCs	Healthy controls
MCIs	Mild cognition impairments
VBM	Voxel-based morphometry
SNR	Signal-to-noise ratio
MRI	Magnetic resonance imaging
PET	Positron emission tomography
QTs	Quantitative traits
ROIs	Regions of interest
AAL	Automated Anatomical Labeling
RBM	Rules Based Medicine
QC	Quality control
FUMA	Functional Mapping and Annotation
ROI	Region of interest
CCC	Canonical correlation coefficient
ACC	Classification accuracy
$\mathbf{X}$	Genetic variations
$\mathbf{Y}_f$	f-th brain endophenotypes
$\mathbf{z}$	Diagnostic status
n	Number of subjects
p	Number of SNPs
q_f	Number of f-th endophenotypes features
$\mathbf{U}$	Canonical weight carrying the effects of SNPs
$\mathbf{V}$	Carrying weights of endophenotypes
$\mathbf{Q}$	Sample weight vector
$\Omega(\mathbf{U})$	Penalty terms for biomarkers detection
$\Omega(\mathbf{V})$	Penalty terms for biomarkers detection
$\psi(\mathbf{v}_f;\mathbf{Y}_f, \mathbf{z})$	Disease diagnosis module based on a metric function

Supplementary appendix 1 symbol description