

Supplementary material

Supplementary tables

Category	Features
Patient History	Patient Sex; Hispanic/Latino ethnicity; Primary language; Years of education; Marital status; Type of residence; Subject’s age at visit; Derived NIH race definitions; Indicator of mother with cognitive impairment; Indicator of father with cognitive impairment; Subject’s height (inches); Subject’s weight (lbs); Subject blood pressure (sitting), systolic; Subject blood pressure (sitting), diastolic; Subject resting heart rate (pulse)
Genetics	Number of APOE e4 alleles
Clinical Dementia Rating (CDR)	Memory; Orientation; Judgment and problem-solving; Community affairs; Home and hobbies; Personal care; CDR sum of boxes; Global CDR
Geriatric Depression Scale (GDS)	Are you basically satisfied with your life?; Have you dropped many of your activities and interests?; Do you feel that your life is empty?; Do you often get bored?; Are you in good spirits most of the time?; Are you afraid that something bad is going to happen to you?; Do you feel happy most of the time?; Do you often feel helpless?; Do you prefer to stay at home, rather than going out and doing new things?; Do you feel you have more problems with memory than most?; Do you think it is wonderful to be alive now?; Do you feel pretty worthless the way you are now?; Do you feel full of energy?; Do you feel that your situation is hopeless?; Do you think that most people are better off than you are?; Total GDS Score
Neuropsychological Battery	Orientation subscale score - Time; Orientation subscale score - Place; Total MMSE score (using D-L-R-O-W); Total number of story units recalled from this current test administration; Logical Memory IIA - Delayed - Total number of story units recalled; WAIS-R Digit Symbol

Table S1: Features available for A4. This table provides the features available for model training in the A4 dataset organized by category, including patient history, genetic markers, Clinical Dementia Rating scores, Geriatric Depression Scale scores, and neuropsychological test scores.

Category	Features
Patient History	Patient Sex; Subject’s age at visit; Smoked more than 100 cigarettes in life
Genetics	Number of APOE e4 alleles
Clinical Dementia Rating (CDR)	Global CDR
Neuropsychological Battery	Total MMSE score (using D-L-R-O-W); Total number of story units recalled from this current test administration; Logical Memory IIA - Delayed - Total number of story units recalled

Table S2: Features available for AIBL. The table provides the features available for model training in the AIBL dataset organized by category, including patient history, genetic markers, Clinical Dementia Rating scores, and neuropsychological test scores.

Category	Features
Patient History	Patient Sex; Hispanic/Latino ethnicity; Primary language; Years of education; Marital status; Is the subject left- or right-handed?; Subject's age at visit; Derived NIH race definitions; Smoked cigarettes in last 30 days; Subject's height (inches); Subject's weight (lbs); body mass index (BMI); Subject blood pressure (sitting), systolic; Subject blood pressure (sitting), diastolic
Medication	Reported current use of lipid lowering medication; Reported current use of a diabetes medication
Genetics	Number of APOE e4 alleles
Clinical Dementia Rating (CDR)	Global CDR
Neuropsychological Battery	Total MMSE score (using D-L-R-O-W); Total number of story units recalled from this current test administration; Logical Memory IIA - Delayed - Total number of story units recalled; Digit span forward length; Digit span backward length; Animals - Total number of animals named in 60 seconds; Trail Making Test Part A - Total number of seconds to complete; Trail Making Test Part b - Total number of seconds to complete; Boston Naming Test (30) - Total score
Blood Tests	Total Tau; AB42/AB40 Ratio

Table S3: Features available for FHS. The table provides the features available for model training in the FHS dataset organized by category, including patient history, medication usage, genetic markers, Clinical Dementia Rating scores, neuropsychological battery test scores, and blood test findings.

Category	Features
Patient History	Patient Sex; Hispanic/Latino ethnicity; Years of education; Marital status; Living situation; Level of independence; Type of residence; Is the subject left- or right-handed?; Subject's age at visit; Derived NIH race definitions; Indicator of mother with cognitive impairment; Indicator of father with cognitive impairment; Smoked cigarettes in last 30 days; Smoked more than 100 cigarettes in life; Total years smoked cigarettes; Average number of packs smoked per day; If the subject quit smoking, age at which he/she last smoked (i.e., quit); Heart attack/cardiac arrest; Atrial fibrillation; Angioplasty/endarterectomy/stent; Cardiac bypass procedure; Congestive heart failure; Other cardiovascular disease; Stroke; Transient ischemic attack (TIA); Parkinson's disease (PD); Other parkinsonian disorder; Seizures; Diabetes; Hypertension; Hypercholesterolemia; Vitamin b12 deficiency; Thyroid disease; Incontinence - urinary; Incontinence - bowel; Alcohol abuse - clinically significant occurring over a 12-month period manifested in one of the following areas: work, driving, legal, or social; Other abused substances - clinically significant impairment occurring over a 12-month period manifested in one of the following areas: work, driving, legal, or social; Other psychiatric disorder; Subject's height (inches); Subject's weight (lbs); Subject blood pressure (sitting), systolic; Subject blood pressure (sitting), diastolic; Subject resting heart rate (pulse); Without corrective lenses, is the subject's vision functionally normal?; Does the subject usually wear corrective lenses?; If the subject usually wears corrective lenses, is the subject's vision functionally normal with corrective lenses?; Without a hearing aid(s), is the subject's hearing functionally normal?; Does the subject usually wear a hearing aid(s)?; If the subject usually wears a hearing aid(s), is the subject's hearing functionally normal with a hearing aid(s)?
Genetics	Number of APOE e4 alleles
Clinical Dementia Rating (CDR)	Memory; Orientation; Judgment and problem-solving; Community affairs; Home and hobbies; Personal care; CDR sum of boxes; Global CDR

Geriatric Depression Scale (GDS)	Are you basically satisfied with your life?; Have you dropped many of your activities and interests?; Do you feel that your life is empty?; Do you often get bored?; Are you in good spirits most of the time?; Are you afraid that something bad is going to happen to you?; Do you feel happy most of the time?; Do you often feel helpless?; Do you prefer to stay at home, rather than going out and doing new things?; Do you feel you have more problems with memory than most?; Do you think it is wonderful to be alive now?; Do you feel pretty worthless the way you are now?; Do you feel full of energy?; Do you feel that your situation is hopeless?; Do you think that most people are better off than you are?; Total GDS Score
Neuropsychological Battery 1/2	Total MMSE score (using D-L-R-O-W); Total number of story units recalled from this current test administration; Logical Memory IIA - Delayed - Total number of story units recalled; Total score for copy of benson figure; Total score for 10- to 15-minute delayed drawing of benson figure; Recognized original stimulus from among four options; Animals - Total number of animals named in 60 seconds; Vegetable - Total number of vegetables named in 60 seconds; Trail Making Test Part A - Total number of seconds to complete; Trail Making Test Part b - Total number of seconds to complete; WAIS-R Digit Symbol; Number of correct F-words generated in 1 minute; Number of F-words repeated in 1 minute; Number of non-F-words and rule violation errors in 1 minute; Number of correct L-words generated in 1 minute; Number of L-words repeated in 1 minute; Number of non-L-words and rule violation errors in 1 minute; Total number of correct F-words and L-words; Total number of F-word and L-word repetition errors; Total number of non-F/L-words and rule violation errors; MoCA Total Score - corrected for education; MoCA: Visuospatial/executive - Trails; MoCA: Visuospatial/executive - Cube; MoCA: Visuospatial/executive - Clock contour; MoCA: Visuospatial/executive - Clock numbers; MoCA: Visuospatial/executive - Clock hands; MoCA: Language - Naming; MoCA: Attention - Digits

Neuropsychological Battery (cont.) 2/2	MoCA: Attention - Letter A; MoCA: Attention - Serial 7s; MoCA: Language - Repetition; MoCA: Language - Fluency; MoCA: Abstraction; MoCA: Delayed recall - No cue; MoCA: Orientation - Date; MoCA: Orientation - Month; MoCA: Orientation - Year; MoCA: Orientation - Day; MoCA: Orientation - Place; MoCA: Orientation - City; Craft Story 21 Recall (Immediate) - Total story units recalled, verbatim scoring; Craft Story 21 Recall (Immediate) - Total story units recalled, paraphrase scoring; Number Span Test: Forward - Number of correct trials; Number Span Test: Forward - Longest span forward; Number Span Test: backward - Number of correct trials; Number Span Test: backward - Longest span backward; Craft Story 21 Recall (Delayed) - Total story units recalled, verbatim scoring; Craft Story 21 Recall (Delayed) - Total story units recalled, paraphrase scoring; Craft Story 21 Recall (Delayed) - Delay time; Craft Story 21 Recall (Delayed) - Cue (boy) needed; Multilingual Naming Test (MINT) - Total score; Multilingual Naming Test (MINT) - Total correct without semantic cue; Multilingual Naming Test (MINT) - Semantic cues: Number given; Multilingual Naming Test (MINT) - Semantic cues: Number correct with cue; Multilingual Naming Test (MINT) - Phonemic cues: Number given; Multilingual Naming Test (MINT) - Phonemic cues: Number correct with cue
Neuropsychiatric Inventory (NPI) Questionnaire	Delusions in the last month; Hallucinations in the last month; Agitation or aggression in the last month; Depression or dysphoria in the last month; Anxiety in the last month; Elation or euphoria in the last month; Apathy or indifference in the last month; Disinhibition in the last month; Irritability or lability in the last month; Motor disturbance in the last month; Nighttime behaviors in the last month; Appetite and eating problems in the last month

Functional Activities Questionnaire (FAQ)	In the past four weeks, did the subject have any difficulty or need help with: Writing checks, paying bills, or balancing a checkbook; In the past four weeks, did the subject have any difficulty or need help with: Assembling tax records, business affairs, or other paper; In the past four weeks, did the subject have any difficulty or need help with: Shopping alone for clothes, household necessities, or groceries; In the past four weeks, did the subject have any difficulty or need help with: Playing a game of skill such as bridge or chess, working on a hobby; In the past four weeks, did the subject have any difficulty or need help with: Heating water, making a cup of coffee, turning off the stove; In the past four weeks, did the subject have any difficulty or need help with: Preparing a balanced meal; In the past four weeks, did the subject have any difficulty or need help with: Keeping track of current events; In the past four weeks, did the subject have any difficulty or need help with: Paying attention to and understanding a TV program, book, or magazine; In the past four weeks, did the subject have any difficulty or need help with: Remembering appointments, family occasions, holidays, medications; In the past four weeks, did the subject have any difficulty or need help with: Traveling out of the neighborhood, driving, or arranging to take public transportation
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Table S4: Features available for OASIS. The table provides the features available for model training in the FHS dataset organized by category, including patient history, genetic markers, Clinical Dementia Rating scores, Geriatric Depression Scale scores, neuropsychological battery test scores, and Functional Activities Questionnaire scores.

Category	Features
Patient History 1/3	Primary reason for coming to ADC; Principal referral source; Patient Sex; Hispanic/Latino ethnicity; Hispanic origins; Primary language; Years of education; Marital status; Living situation; Level of independence; Type of residence; Is the subject left- or right-handed?; Subject's age at visit; Derived NIH race definitions; Indicator of first-degree family member with cognitive impairment; Indicator of mother with cognitive impairment; Indicator of father with cognitive impairment; In this family, is there evidence of a dominantly inherited AD mutation?; In this family, is there evidence for an AD mutation (from list of specific mutations)?; Source of evidence for AD mutation; In this family, is there evidence for an FTLN mutation?; In this family, is there evidence for a mutation other than an AD or FTLN mutation?; Smoked cigarettes in last 30 days; Smoked more than 100 cigarettes in life; Total years smoked cigarettes; Average number of packs smoked per day; If the subject quit smoking, age at which he/she last smoked (i.e., quit); In the past three months, has the subject consumed any alcohol?; During the past three months, how often did the subject have at least one drink of any alcoholic beverage such as wine, beer, malt liquor, or spirits?; Heart attack/cardiac arrest; More than one heart attack/cardiac arrest?; Year of most recent heart attack
Patient History (cont.) 2/3	Atrial fibrillation; Angioplasty/endarterectomy/stent; Cardiac bypass procedure; Pacemaker and/or defibrillator; Congestive heart failure; Angina; Heart valve replacement or repair; Other cardiovascular disease; Stroke; More than one stroke reported as of the Initial Visit; Most recently reported year of stroke as of the Initial Visit; Transient ischemic attack (TIA); More than one TIA reported as of the Initial Visit; Most recently reported year of TIA as of the Initial Visit; Parkinson's disease (PD); Year of PD diagnosis; Other parkinsonian disorder; Year of parkinsonian disorder diagnosis; Seizures; Traumatic brain injury (TBI); Traumatic brain injury (TBI) with brief loss of consciousness; TBI with extended loss of consciousness - 5 minutes or longer; TBI without loss of consciousness - as might result from military detonations or sports injury; Year of most recent TBI; Diabetes; If Recent/active or Remote/inactive diabetes, which type?; Hypertension; Hypercholesterolemia; Vitamin b12 deficiency; Thyroid disease; Arthritis; Type of arthritis

Patient (cont.) 3/3	History	Arthritis, region affected - upper extremity; Arthritis, region affected - lower extremity; Arthritis, region affected - spine; Region affected - unknown; Incontinence - urinary; Incontinence - bowel; Sleep apnea history reported at Initial Visit; REM sleep behavior disorder (RBD) history reported at Initial Visit; Hyposomnia/insomnia history reported at Initial Visit; Other sleep disorder history reported at Initial Visit; Alcohol abuse - clinically significant occurring over a 12-month period manifested in one of the following areas: work, driving, legal, or social; Other abused substances - clinically significant impairment occurring over a 12-month period manifested in one of the following areas: work, driving, legal, or social; Post-traumatic stress disorder (PTSD); bipolar disorder; Schizophrenia; Active depression in the last two years; Depression episodes more than two years ago; Anxiety; Obsessive-compulsive disorder (OCD); Developmental neuropsychiatric disorders (e.g., autism spectrum disorder [ASD], attention-deficit hyperactivity disorder [ADHD], dyslexia); Other psychiatric disorder; History of traumatic brain injury (TBI); Subject's height (inches); Subject's weight (lbs); body mass index (BMI); Subject blood pressure (sitting), systolic; Subject blood pressure (sitting), diastolic; Subject resting heart rate (pulse); Without corrective lenses, is the subject's vision functionally normal?; Does the subject usually wear corrective lenses?; If the subject usually wears corrective lenses, is the subject's vision functionally normal with corrective lenses?; Without a hearing aid(s), is the subject's hearing functionally normal?; Does the subject usually wear a hearing aid(s)?; If the subject usually wears a hearing aid(s), is the subject's hearing functionally normal with a hearing aid(s)?
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Medication	Subject taking any medications; Total number of medications reported at each visit; Reported current use of any type of antihypertensive or blood pressure medication; Reported current use of an antihypertensive combination therapy; Reported current use of an angiotensin converting enzyme (ACE) inhibitor; Reported current use of an antiadrenergic agent; Reported current use of a beta-adrenergic blocking agent (beta-blocker); Reported current use of a calcium channel blocking agent; Reported current use of a diuretic; Reported current use of a vasodilator; Reported current use of an angiotensin II inhibitor; Reported current use of lipid lowering medication; Reported current use of nonsteroidal anti-inflammatory medication; Reported current use of an anticoagulant or antiplatelet agent; Reported current use of an antidepressant; Reported current use of an antipsychotic agent; Reported current use of an anxiolytic, sedative, or hypnotic agent; Reported current use of a FDA-approved medication for Alzheimer's disease symptoms; Reported current use of an antiparkinson agent; Reported current use of estrogen hormone therapy; Reported current use of estrogen + progestin hormone therapy; Reported current use of a diabetes medication
Genetics	Number of APOE e4 alleles
Clinical Dementia Rating (CDR)	Memory; Orientation; Judgment and problem-solving; Community affairs; Home and hobbies; Personal care; CDR sum of boxes; Global CDR
Geriatric Depression Scale (GDS)	Is the subject able to complete the GDS, based on the clinician's best judgment?; Are you basically satisfied with your life?; Have you dropped many of your activities and interests?; Do you feel that your life is empty?; Do you often get bored?; Are you in good spirits most of the time?; Are you afraid that something bad is going to happen to you?; Do you feel happy most of the time?; Do you often feel helpless?; Do you prefer to stay at home, rather than going out and doing new things?; Do you feel you have more problems with memory than most?; Do you think it is wonderful to be alive now?; Do you feel pretty worthless the way you are now?; Do you feel full of energy?; Do you feel that your situation is hopeless?; Do you think that most people are better off than you are?; Total GDS Score

Neuropsychological Battery 1/4	Was any part of the MMSE completed?; Administration of the MMSE was;; Language of MMSE administration; Subject was unable to complete one or more sections due to visual impairment; Subject was unable to complete one or more sections due to hearing impairment; Orientation subscale score - Time; Orientation subscale score - Place; Intersecting pentagon subscale score; Total MMSE score (using D-L-R-O-W); The remainder of the battery was administered;; Language of test administration; Total score from the previous test administration; Total number of story units recalled from this current test administration; Logical Memory IIA - Delayed - Total number of story units recalled; Logical Memory IIA - Delayed - Time elapsed since Logical Memory IA - Immediate; Total score for copy of benson figure; Total score for 10- to 15-minute delayed drawing of benson figure; Recognized original stimulus from among four options; Digit span forward trials correct; Digit span forward length; Digit span backward trials correct; Digit span backward length; Animals - Total number of animals named in 60 seconds; Vegetable - Total number of vegetables named in 60 seconds; Trail Making Test Part A - Total number of seconds to complete; Part A - Number of commission errors; Part A - Number of correct lines; Trail Making Test Part b - Total number of seconds to complete; Part b - Number of commission errors; Part b - Number of correct lines
Neuropsychological Battery (cont.) 2/4	WAIS-R Digit Symbol; boston Naming Test (30) - Total score; Number of correct F-words generated in 1 minute; Number of F-words repeated in 1 minute; Number of non-F-words and rule violation errors in 1 minute; Number of correct L-words generated in 1 minute; Number of L-words repeated in 1 minute; Number of non-L-words and rule violation errors in 1 minute; Total number of correct F-words and L-words; Total number of F-word and L-word repetition errors; Total number of non-F/L-words and rule violation errors; Per clinician, based on the neuropsychological examination, the subject's cognitive status is deemed; Modality of communication used to administer neuropsychological battery; Was any part of MoCA administered?; If no part of MoCA administered, reason code; Where was MoCA administered?; Language of MoCA administration; MoCA Total Score - corrected for education; MoCA: Visuospatial/executive - Trails; MoCA: Visuospatial/executive - Cube; MoCA: Visuospatial/executive - Clock contour; MoCA: Visuospatial/executive - Clock numbers; MoCA: Visuospatial/executive - Clock hands; MoCA: Language - Naming; MoCA: Memory - Registration (two trials); MoCA: Attention - Digits; MoCA: Attention - Letter A; MoCA: Attention - Serial 7s; MoCA: Language - Repetition; MoCA: Language - Fluency

Neuropsychological Battery (cont.) 3/4	MoCA: Abstraction; MoCA: Delayed recall - No cue; MoCA: Delayed recall - Category cue; MoCA: Delayed recall - Recognition; MoCA: Orientation - Date; MoCA: Orientation - Month; MoCA: Orientation - Year; MoCA: Orientation - Day; MoCA: Orientation - Place; MoCA: Orientation - City; Craft Story 21 Recall (Immediate) - Total story units recalled, verbatim scoring; Craft Story 21 Recall (Immediate) - Total story units recalled, paraphrase scoring; Number Span Test: Forward - Number of correct trials; Number Span Test: Forward - Longest span forward; Number Span Test: backward - Number of correct trials; Number Span Test: backward - Longest span backward; Craft Story 21 Recall (Delayed) - Total story units recalled, verbatim scoring; Craft Story 21 Recall (Delayed) - Total story units recalled, paraphrase scoring; Craft Story 21 Recall (Delayed) - Delay time; Craft Story 21 Recall (Delayed) - Cue (boy) needed; Multilingual Naming Test (MINT) - Total score; Multilingual Naming Test (MINT) - Total correct without semantic cue; Multilingual Naming Test (MINT) - Semantic cues: Number given; Multilingual Naming Test (MINT) - Semantic cues: Number correct with cue; Multilingual Naming Test (MINT) - Phonemic cues: Number given; Multilingual Naming Test (MINT) - Phonemic cues: Number correct with cue; MoCA blind Total raw score - uncorrected; MoCA-blind Total Score - corrected for education; Rey Auditory Verbal Learning: Trial 1 total recall; Rey Auditory Verbal Learning: Trial 1 intrusions
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Neuropsychological Battery (cont.) 4/4	Rey Auditory Verbal Learning: Trial 2 total recall; Rey Auditory Verbal Learning: Trial 2 intrusions; Rey Auditory Verbal Learning: Trial 3 total recall; Rey Auditory Verbal Learning: Trial 3 intrusions; Rey Auditory Verbal Learning: Trial 4 total recall; Rey Auditory Verbal Learning: Trial 4 intrusions; Rey Auditory Verbal Learning: Trial 5 total recall; Rey Auditory Verbal Learning: Trial 5 intrusions; Rey Auditory Verbal Learning: Trial 6 total recall; Rey Auditory Verbal Learning: Trial 6 intrusions; Oral Trail Making Test - Part A: Total number of seconds to complete; Oral Trail Making Test - Part A: Number of commission errors; Oral Trail Making Test - Part A: Number of correct lines; Oral Trail Making Test Part b: Total number of seconds to complete; Oral Trail Making Test Part b: Number of commission errors; Oral Trail Making Test Part b: Number of correct lines; Rey Auditory Verbal Learning: total delayed recall; Rey Auditory Verbal Learning: delayed intrusions; Rey Auditory Verbal Learning: recognition total correct; Rey Auditory Verbal Learning: recognition total false positives; Verbal naming test: total correct without a cue; Verbal naming test: total correct with a phonemic cue; How valid do you think the participant's responses are?; What makes this participant's responses less valid? Hearing impairment; What makes this participant's responses less valid? Distractions; What makes this participant's responses less valid? Interruptions; What makes this participant's responses less valid? Lack of effort or disinterest; What makes this participant's responses less valid? Fatigue; What makes this participant's responses less valid? Emotional issues; What makes this participant's responses less valid? Unapproved assistance; What makes this participant's responses less valid? Other
Neuropsychiatric Inventory (NPI) Questionnaire	NPI-Q co-participant; Delusions in the last month; Hallucinations in the last month; Agitation or aggression in the last month; Depression or dysphoria in the last month; Anxiety in the last month; Elation or euphoria in the last month; Apathy or indifference in the last month; Disinhibition in the last month; Irritability or lability in the last month; Motor disturbance in the last month; Nighttime behaviors in the last month; Appetite and eating problems in the last month

Functional Activities Questionnaire (FAQ)	In the past four weeks, did the subject have any difficulty or need help with: Writing checks, paying bills, or balancing a checkbook; In the past four weeks, did the subject have any difficulty or need help with: Assembling tax records, business affairs, or other paper; In the past four weeks, did the subject have any difficulty or need help with: Shopping alone for clothes, household necessities, or groceries; In the past four weeks, did the subject have any difficulty or need help with: Playing a game of skill such as bridge or chess, working on a hobby; In the past four weeks, did the subject have any difficulty or need help with: Heating water, making a cup of coffee, turning off the stove; In the past four weeks, did the subject have any difficulty or need help with: Preparing a balanced meal; In the past four weeks, did the subject have any difficulty or need help with: Keeping track of current events; In the past four weeks, did the subject have any difficulty or need help with: Paying attention to and understanding a TV program, book, or magazine; In the past four weeks, did the subject have any difficulty or need help with: Remembering appointments, family occasions, holidays, medications; In the past four weeks, did the subject have any difficulty or need help with: Traveling out of the neighborhood, driving, or arranging to take public transportation
CSF Tests	Amyloid Beta in CSF; Abnormally elevated CSF Tau or pTau
Physical Exam 1/2	Were there abnormal neurological exam findings?; Parkinsonian signs; Resting tremor - left arm; Resting tremor - right arm; Slowing of fine motor movements - left side; Slowing of fine motor movements - right side; Rigidity - left arm; Rigidity - right arm; bradykinesia; Parkinsonian gait disorder; Postural instability; Neurological sign considered by examiner to be most likely consistent with cerebrovascular disease; Cortical cognitive deficit (e.g., aphasia, apraxia, neglect); Focal or other neurological findings consistent with SIVD (subcortical ischemic vascular dementia); Motor (may include weakness of combination of face, arm, and leg; reflex changes, etc.) - left side; Motor (may include weakness of combination of face, arm, and leg; reflex changes, etc.) - right side; Cortical visual field loss - left side; Cortical visual field loss - right side; Somatosensory loss - left side; Somatosensory loss - right side; Higher cortical visual problem suggesting posterior cortical atrophy (e.g., prosopagnosia, simultagnosia, balint's syndrome) or apraxia of gaze

Physical (cont.) 2/2	Exam	Findings suggestive of progressive supranuclear palsy (PSP), corticobasal syndrome (CBS), or other related disorders; Eye movement changes consistent with PSP; Dysarthria consistent with PSP; Axial rigidity consistent with PSP; Gait disorder consistent with PSP; Apraxia of speech; Apraxia consistent with CBS - left side; Apraxia consistent with CBS - right side; Cortical sensory deficits consistent with CBS - left side; Cortical sensory deficits consistent with CBS - right side; Ataxia consistent with CBS - left side; Ataxia consistent with CBS - right side; Alien limb consistent with CBS - left side; Alien limb consistent with CBS - right side; Dystonia consistent with CBS, PSP, or related disorder - left side; Dystonia consistent with CBS, PSP, or related disorder - right side; Myoclonus consistent with CBS - left side; Myoclonus consistent with CBS - right side; Findings suggesting ALS (e.g., muscle wasting, fasciculations, upper motor and/or lower motor neuron signs); Normal pressure hydrocephalus - gait apraxia; Other findings (e.g., cerebella ataxia, chorea, myoclonus)
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Table S5: Features available for NACC training. The table provides the features available for model training in the NACC dataset organized by category, including patient history, medication usage, genetic markers, Clinical Dementia Rating scores, Geriatric Depression Scale scores, neuropsychological battery test scores, Neuropsychiatric Inventory Questionnaire scores, Functional Activities Questionnaire scores, CSF markers and physical examination findings.

Category	Features
Patient History 1/3	Patient Sex; Hispanic/Latino ethnicity; Primary language; Years of education; Marital status; Type of residence; Is the subject left- or right-handed?; Derived NIH race definitions; Subject's age at visit; Indicator of mother with cognitive impairment; Indicator of father with cognitive impairment; Subject's height (inches); Subject's weight (lbs); Subject blood pressure (sitting), systolic; Subject blood pressure (sitting), diastolic; Subject resting heart rate (pulse); Primary reason for coming to ADC; Principal referral source; Hispanic origins; Living situation; Level of independence; Indicator of first-degree family member with cognitive impairment; In this family, is there evidence of a dominantly inherited AD mutation?; In this family, is there evidence for an AD mutation (from list of specific mutations)?; Source of evidence for AD mutation; In this family, is there evidence for an FTLN mutation?; In this family, is there evidence for a mutation other than an AD or FTLN mutation?; Smoked cigarettes in last 30 days; Smoked more than 100 cigarettes in life; Total years smoked cigarettes; Average number of packs smoked per day; If the subject quit smoking, age at which he/she last smoked (i.e., quit)
Patient History (cont.) 2/3	In the past three months, has the subject consumed any alcohol?; During the past three months, how often did the subject have at least one drink of any alcoholic beverage such as wine, beer, malt liquor, or spirits?; Heart attack/cardiac arrest; More than one heart attack/cardiac arrest?; Year of most recent heart attack; Atrial fibrillation; Angioplasty/endarterectomy/stent; Cardiac bypass procedure; Pacemaker and/or defibrillator; Congestive heart failure; Angina; Heart valve replacement or repair; Other cardiovascular disease; Stroke; More than one stroke reported as of the Initial Visit; Most recently reported year of stroke as of the Initial Visit; Transient ischemic attack (TIA); More than one TIA reported as of the Initial Visit; Most recently reported year of TIA as of the Initial Visit; Parkinson's disease (PD); Year of PD diagnosis; Other parkinsonian disorder; Year of parkinsonian disorder diagnosis; Seizures; Traumatic brain injury (TBI); Traumatic brain injury (TBI) with brief loss of consciousness; TBI with extended loss of consciousness - 5 minutes or longer; TBI without loss of consciousness - as might result from military detonations or sports injury; Year of most recent TBI; Diabetes; If Recent/active or Remote/inactive diabetes, which type?; Hypertension

Patient (cont.) 3/3	History	Hypercholesterolemia; Vitamin b12 deficiency; Thyroid disease; Arthritis; Type of arthritis; Arthritis, region affected - upper extremity; Arthritis, region affected - lower extremity; Arthritis, region affected - spine; Region affected - unknown; Incontinence - urinary; Incontinence - bowel; Sleep apnea history reported at Initial Visit; REM sleep behavior disorder (RBD) history reported at Initial Visit; Hyposomnia/insomnia history reported at Initial Visit; Other sleep disorder history reported at Initial Visit; Alcohol abuse - clinically significant occurring over a 12-month period manifested in one of the following areas: work, driving, legal, or social; Other abused substances - clinically significant impairment occurring over a 12-month period manifested in one of the following areas: work, driving, legal, or social; Post-traumatic stress disorder (PTSD); bipolar disorder; Schizophrenia; Active depression in the last two years; Depression episodes more than two years ago; Anxiety; Obsessive-compulsive disorder (OCD); Developmental neuropsychiatric disorders (e.g., autism spectrum disorder [ASD], attention-deficit hyperactivity disorder [ADHD], dyslexia); Other psychiatric disorder; History of traumatic brain injury (TBI); body mass index (BMI); Without corrective lenses, is the subject's vision functionally normal?; Does the subject usually wear corrective lenses?; If the subject usually wears corrective lenses, is the subject's vision functionally normal with corrective lenses?; Without a hearing aid(s), is the subject's hearing functionally normal?; Does the subject usually wear a hearing aid(s)?; If the subject usually wears a hearing aid(s), is the subject's hearing functionally normal with a hearing aid(s)?
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Medication	Subject taking any medications; Total number of medications reported at each visit; Reported current use of any type of antihypertensive or blood pressure medication; Reported current use of an antihypertensive combination therapy; Reported current use of an angiotensin converting enzyme (ACE) inhibitor; Reported current use of an antiadrenergic agent; Reported current use of a beta-adrenergic blocking agent (beta-blocker); Reported current use of a calcium channel blocking agent; Reported current use of a diuretic; Reported current use of a vasodilator; Reported current use of an angiotensin II inhibitor; Reported current use of lipid lowering medication; Reported current use of nonsteroidal anti-inflammatory medication; Reported current use of an anticoagulant or antiplatelet agent; Reported current use of an antidepressant; Reported current use of an antipsychotic agent; Reported current use of an anxiolytic, sedative, or hypnotic agent; Reported current use of a FDA-approved medication for Alzheimer's disease symptoms; Reported current use of an antiparkinson agent; Reported current use of estrogen hormone therapy; Reported current use of estrogen + progestin hormone therapy; Reported current use of a diabetes medication
Genetics	Number of APOE e4 alleles
Clinical Dementia Rating (CDR)	Memory; Orientation; Judgment and problem-solving; Community affairs; Home and hobbies; Personal care; CDR sum of boxes; Global CDR
Geriatric Depression Scale (GDS)	Are you basically satisfied with your life?; Have you dropped many of your activities and interests?; Do you feel that your life is empty?; Do you often get bored?; Are you in good spirits most of the time?; Are you afraid that something bad is going to happen to you?; Do you feel happy most of the time?; Do you often feel helpless?; Do you prefer to stay at home, rather than going out and doing new things?; Do you feel you have more problems with memory than most?; Do you think it is wonderful to be alive now?; Do you feel pretty worthless the way you are now?; Do you feel full of energy?; Do you feel that your situation is hopeless?; Do you think that most people are better off than you are?; Total GDS Score; Is the subject able to complete the GDS, based on the clinician's best judgment?

Neuropsychological Battery 1/3	Orientation subscale score - Time; Orientation subscale score - Place; Total MMSE score (using D-L-R-O-W); boston Naming Test (30) - Total score; Logical Memory IIA - Delayed - Total number of story units recalled; Total number of story units recalled from this current test administration; Animals - Total number of animals named in 60 seconds; Trail Making Test Part A - Total number of seconds to complete; Trail Making Test Part b - Total number of seconds to complete; Multilingual Naming Test (MINT) - Total score; MoCA Total Score - corrected for education; MoCA: Visuospatial/executive - Trails; MoCA: Visuospatial/executive - Cube; MoCA: Visuospatial/executive - Clock contour; MoCA: Visuospatial/executive - Clock numbers; MoCA: Visuospatial/executive - Clock hands; MoCA: Language - Naming; MoCA: Attention - Digits; MoCA: Attention - Letter A; MoCA: Attention - Serial 7s; MoCA: Language - Repetition; MoCA: Language - Fluency; MoCA: Abstraction; MoCA: Delayed recall - No cue; MoCA: Orientation - Date; MoCA: Orientation - Month; MoCA: Orientation - Year; MoCA: Orientation - Day; MoCA: Orientation - Place; MoCA: Orientation - City; Digit span forward trials correct; Digit span backward trials correct; Number of correct F-words generated in 1 minute; Was any part of the MMSE completed?; Administration of the MMSE was;; Language of MMSE administration; Subject was unable to complete one or more sections due to visual impairment
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Neuropsychological Battery (cont.) 2/3	Subject was unable to complete one or more sections due to hearing impairment; Intersecting pentagon subscale score; The remainder of the battery was administered;; Language of test administration; Logical Memory IIA - Delayed - Time elapsed since Logical Memory IA - Immediate; Total score for copy of benson figure; Total score for 10- to 15-minute delayed drawing of benson figure; Recognized original stimulus from among four options; Digit span forward length; Digit span backward length; Vegetable - Total number of vegetables named in 60 seconds; Part A - Number of commission errors; Part A - Number of correct lines; Part b - Number of commission errors; Part b - Number of correct lines; Number of F-words repeated in 1 minute; Number of non-F-words and rule violation errors in 1 minute; Number of correct L-words generated in 1 minute; Number of L-words repeated in 1 minute; Number of non-L-words and rule violation errors in 1 minute; Total number of correct F-words and L-words; Total number of F-word and L-word repetition errors; Total number of non-F/L-words and rule violation errors; Per clinician, based on the neuropsychological examination, the subject's cognitive status is deemed; Modality of communication used to administer neuropsychological battery; Was any part of MoCA administered?; If no part of MoCA administered, reason code; Where was MoCA administered?; Language of MoCA administration; MoCA: Memory - Registration (two trials); MoCA: Delayed recall - Category cue; MoCA: Delayed recall - Recognition; Craft Story 21 Recall (Immediate) - Total story units recalled, verbatim scoring; Craft Story 21 Recall (Immediate) - Total story units recalled, paraphrase scoring; Number Span Test: Forward - Number of correct trials; Number Span Test: Forward - Longest span forward; Number Span Test: backward - Number of correct trials
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Neuropsychological Battery (cont.) 3/3	Number Span Test: backward - Longest span backward; Craft Story 21 Recall (Delayed) - Total story units recalled, verbatim scoring; Craft Story 21 Recall (Delayed) - Total story units recalled, paraphrase scoring; Craft Story 21 Recall (Delayed) - Delay time; Craft Story 21 Recall (Delayed) - Cue (boy) needed; Multilingual Naming Test (MINT) - Total correct without semantic cue; Multilingual Naming Test (MINT) - Semantic cues: Number given; Multilingual Naming Test (MINT) - Semantic cues: Number correct with cue; Multilingual Naming Test (MINT) - Phonemic cues: Number given; Multilingual Naming Test (MINT) - Phonemic cues: Number correct with cue; MoCA blind Total raw score - uncorrected; MoCA-blind Total Score - corrected for education; Rey Auditory Verbal Learning: Trial 1 total recall; Rey Auditory Verbal Learning: Trial 1 intrusions; Rey Auditory Verbal Learning: Trial 2 total recall; Rey Auditory Verbal Learning: Trial 2 intrusions; Rey Auditory Verbal Learning: Trial 3 total recall; Rey Auditory Verbal Learning: Trial 3 intrusions; Rey Auditory Verbal Learning: Trial 4 total recall; Rey Auditory Verbal Learning: Trial 4 intrusions; Rey Auditory Verbal Learning: Trial 5 total recall; Rey Auditory Verbal Learning: Trial 5 intrusions; Rey Auditory Verbal Learning: Trial 6 total recall; Rey Auditory Verbal Learning: Trial 6 intrusions; Oral Trail Making Test - Part A: Total number of seconds to complete; Oral Trail Making Test - Part A: Number of commission errors; Oral Trail Making Test - Part A: Number of correct lines; Oral Trail Making Test Part b: Total number of seconds to complete; Oral Trail Making Test Part b: Number of commission errors; Oral Trail Making Test Part b: Number of correct lines; Rey Auditory Verbal Learning: total delayed recall; Rey Auditory Verbal Learning: delayed intrusions; Rey Auditory Verbal Learning: recognition total correct; Rey Auditory Verbal Learning: recognition total false positives; Verbal naming test: total correct without a cue; Verbal naming test: total correct with a phonemic cue; How valid do you think the participant's responses are?
Neuropsychiatric Inventory (NPI) Questionnaire	Delusions in the last month; Hallucinations in the last month; Agitation or aggression in the last month; Depression or dysphoria in the last month; Anxiety in the last month; Elation or euphoria in the last month; Apathy or indifference in the last month; Disinhibition in the last month; Irritability or lability in the last month; Motor disturbance in the last month; Nighttime behaviors in the last month; Appetite and eating problems in the last month; NPI-Q co-participant

Functional Activities Questionnaire (FAQ)	In the past four weeks, did the subject have any difficulty or need help with: Writing checks, paying bills, or balancing a checkbook; In the past four weeks, did the subject have any difficulty or need help with: Assembling tax records, business affairs, or other paper; In the past four weeks, did the subject have any difficulty or need help with: Shopping alone for clothes, household necessities, or groceries; In the past four weeks, did the subject have any difficulty or need help with: Playing a game of skill such as bridge or chess, working on a hobby; In the past four weeks, did the subject have any difficulty or need help with: Heating water, making a cup of coffee, turning off the stove; In the past four weeks, did the subject have any difficulty or need help with: Preparing a balanced meal; In the past four weeks, did the subject have any difficulty or need help with: Keeping track of current events; In the past four weeks, did the subject have any difficulty or need help with: Paying attention to and understanding a TV program, book, or magazine; In the past four weeks, did the subject have any difficulty or need help with: Remembering appointments, family occasions, holidays, medications; In the past four weeks, did the subject have any difficulty or need help with: Traveling out of the neighborhood, driving, or arranging to take public transportation
Physical Exam 1/2	Were there abnormal neurological exam findings?; Parkinsonian signs; Resting tremor - left arm; Resting tremor - right arm; Slowing of fine motor movements - left side; Slowing of fine motor movements - right side; Rigidity - left arm; Rigidity - right arm; bradykinesia; Parkinsonian gait disorder; Postural instability; Neurological sign considered by examiner to be most likely consistent with cerebrovascular disease; Cortical cognitive deficit (e.g., aphasia, apraxia, neglect); Focal or other neurological findings consistent with SIVD (subcortical ischemic vascular dementia); Motor (may include weakness of combination of face, arm, and leg; reflex changes, etc.) - left side; Motor (may include weakness of combination of face, arm, and leg; reflex changes, etc.) - right side; Cortical visual field loss - left side; Cortical visual field loss - right side; Somatosensory loss - left side; Somatosensory loss - right side; Higher cortical visual problem suggesting posterior cortical atrophy (e.g., prosopagnosia, simultagnosia, balint's syndrome) or apraxia of gaze

Physical (cont.) 2/2	Exam	Findings suggestive of progressive supranuclear palsy (PSP), corticobasal syndrome (CBS), or other related disorders; Eye movement changes consistent with PSP; Dysarthria consistent with PSP; Axial rigidity consistent with PSP; Gait disorder consistent with PSP; Apraxia of speech; Apraxia consistent with CBS - left side; Apraxia consistent with CBS - right side; Cortical sensory deficits consistent with CBS - left side; Cortical sensory deficits consistent with CBS - right side; Ataxia consistent with CBS - left side; Ataxia consistent with CBS - right side; Alien limb consistent with CBS - left side; Alien limb consistent with CBS - right side; Dystonia consistent with CBS, PSP, or related disorder - left side; Dystonia consistent with CBS, PSP, or related disorder - right side; Myoclonus consistent with CBS - left side; Myoclonus consistent with CBS - right side; Findings suggesting ALS (e.g., muscle wasting, fasciculations, upper motor and/or lower motor neuron signs); Normal pressure hydrocephalus - gait apraxia; Other findings (e.g., cerebella ataxia, chorea, myoclonus)
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Table S6: Features available for NACC testing. The table provides the features available for model testing in the NACC dataset organized by category, including patient history, medication usage, genetic markers, Clinical Dementia Rating scores, Geriatric Depression Scale scores, neuropsychological battery test scores, Neuropsychiatric Inventory Questionnaire scores, Functional Activities Questionnaire scores, and physical examination findings.

Category	Features
Patient History	Patient Sex; Hispanic/Latino ethnicity; Years of education; Derived NIH race definitions; Subject's age at visit
Genetics	Number of APOE e4 alleles
Clinical Dementia Rating (CDR)	Memory; CDR sum of boxes; Global CDR
Geriatric Depression Scale (GDS)	Total GDS Score
Neuropsychological Battery	Total MMSE score (using D-L-R-O-W); boston Naming Test (30) - Total score; Logical Memory IIA - Delayed - Total number of story units recalled; Total number of story units recalled from this current test administration; Animals - Total number of animals named in 60 seconds; Trail Making Test Part A - Total number of seconds to complete; Trail Making Test Part b - Total number of seconds to complete; Digit span forward trials correct; Digit span backward trials correct; Number of correct F-words generated in 1 minute

Table S7: Features available for HABS. The table provides the features available for model testing in the HABS dataset organized by category, including patient history, medication usage, genetic markers, Clinical Dementia Rating scores, Geriatric Depression Scale scores, and neuropsychological battery test scores.

Category	Features
Patient History	Patient Sex; Hispanic/Latino ethnicity; Primary language; Years of education; Marital status; Type of residence; Is the subject left- or right-handed?; Derived NIH race definitions; Subject's age at visit; Indicator of mother with cognitive impairment; Indicator of father with cognitive impairment; Subject's height (inches); Subject's weight (lbs); Subject blood pressure (sitting), systolic; Subject blood pressure (sitting), diastolic; Subject resting heart rate (pulse)
Genetics	Number of APOE e4 alleles
Clinical Dementia Rating (CDR)	Memory; Orientation; Judgment and problem-solving; Community affairs; Home and hobbies; Personal care; CDR sum of boxes; Global CDR
Geriatric Depression Scale (GDS)	Are you basically satisfied with your life?; Have you dropped many of your activities and interests?; Do you feel that your life is empty?; Do you often get bored?; Are you in good spirits most of the time?; Are you afraid that something bad is going to happen to you?; Do you feel happy most of the time?; Do you often feel helpless?; Do you prefer to stay at home, rather than going out and doing new things?; Do you feel you have more problems with memory than most?; Do you think it is wonderful to be alive now?; Do you feel pretty worthless the way you are now?; Do you feel full of energy?; Do you feel that your situation is hopeless?; Do you think that most people are better off than you are?; Total GDS Score

Neuropsychological Battery	Orientation subscale score - Time; Orientation subscale score - Place; Total MMSE score (using D-L-R-O-W); boston Naming Test (30) - Total score; Logical Memory IIA - Delayed - Total number of story units recalled; Total number of story units recalled from this current test administration; Animals - Total number of animals named in 60 seconds; Trail Making Test Part A - Total number of seconds to complete; Trail Making Test Part b - Total number of seconds to complete; Multilingual Naming Test (MINT) - Total score; MoCA Total Score - corrected for education; MoCA: Visuospatial/executive - Trails; MoCA: Visuospatial/executive - Cube; MoCA: Visuospatial/executive - Clock contour; MoCA: Visuospatial/executive - Clock numbers; MoCA: Visuospatial/executive - Clock hands; MoCA: Language - Naming; MoCA: Attention - Digits; MoCA: Attention - Letter A; MoCA: Attention - Serial 7s; MoCA: Language - Repetition; MoCA: Language - Fluency; MoCA: Abstraction; MoCA: Delayed recall - No cue; MoCA: Orientation - Date; MoCA: Orientation - Month; MoCA: Orientation - Year; MoCA: Orientation - Day; MoCA: Orientation - Place; MoCA: Orientation - City
Neuropsychiatric Inventory (NPI) Questionnaire	Delusions in the last month; Hallucinations in the last month; Agitation or aggression in the last month; Depression or dysphoria in the last month; Anxiety in the last month; Elation or euphoria in the last month; Apathy or indifference in the last month; Disinhibition in the last month; Irritability or lability in the last month; Motor disturbance in the last month; Nighttime behaviors in the last month; Appetite and eating problems in the last month

Functional Activities Questionnaire (FAQ)	In the past four weeks, did the subject have any difficulty or need help with: Writing checks, paying bills, or balancing a checkbook; In the past four weeks, did the subject have any difficulty or need help with: Assembling tax records, business affairs, or other paper; In the past four weeks, did the subject have any difficulty or need help with: Shopping alone for clothes, household necessities, or groceries; In the past four weeks, did the subject have any difficulty or need help with: Playing a game of skill such as bridge or chess, working on a hobby; In the past four weeks, did the subject have any difficulty or need help with: Heating water, making a cup of coffee, turning off the stove; In the past four weeks, did the subject have any difficulty or need help with: Preparing a balanced meal; In the past four weeks, did the subject have any difficulty or need help with: Keeping track of current events; In the past four weeks, did the subject have any difficulty or need help with: Paying attention to and understanding a TV program, book, or magazine; In the past four weeks, did the subject have any difficulty or need help with: Remembering appointments, family occasions, holidays, medications; In the past four weeks, did the subject have any difficulty or need help with: Traveling out of the neighborhood, driving, or arranging to take public transportation
Blood Tests	AB42/AB40 Ratio

Table S8: Features available for ADNI. The table provides the features available for model testing in the ADNI dataset organized by category, including patient history, medication usage, genetic markers, Clinical Dementia Rating scores, Geriatric Depression Scale scores, neuropsychological battery test scores, Neuropsychiatric Inventory Questionnaire scores, Functional Activities Questionnaire scores, and blood tests.

Dataset (Label)	Age (mean $\pm$ std)	Male gender (n, %)	Education in years (mean $\pm$ std)	Race (White; Black; Asian; American Indian; Pacific; Multi-race)	CDR (0.0, 0.5, 1.0, 2.0, 3.0)	MRIs available (T1, T2*, FLAIR)
Training						
NACC training [n = 333]						
Frontal Lobe Tau-Negative [n=267, 80.18%]	71.23 $\pm$ 8.17	131, 49.06%	16.40 $\pm$ 2.49	221; 15; 2; 12; 0; 15	158; 93; 15; 0; 1	0, 0, 0
Frontal Lobe Tau-Positive [n=66, 19.82%]	70.33 $\pm$ 8.15	30, 45.45%	16.27 $\pm$ 2.51	62; 2; 0; 0; 0; 2	6; 37; 15; 8; 0	0, 0, 0
Occipital Lobe Tau-Negative [n=288, 86.49%]	71.22 $\pm$ 8.09	145, 50.35%	16.45 $\pm$ 2.44	241; 16; 2; 12; 0; 15	162; 104; 17; 4; 1	0, 0, 0
Occipital Lobe Tau-Positive [n=45, 13.51%]	70.00 $\pm$ 8.64	16, 35.56%	15.84 $\pm$ 2.76	42; 1; 0; 0; 0; 2	2; 26; 13; 4; 0	0, 0, 0
Medial Temporal Lobe Tau-Negative [n=216, 64.86%]	70.63 $\pm$ 8.44	102, 47.22%	16.32 $\pm$ 2.47	174; 14; 1; 12; 0; 13	147; 60; 8; 0; 1	0, 0, 0
Medial Temporal Lobe Tau-Positive [n=117, 35.14%]	71.84 $\pm$ 7.59	59, 50.43%	16.47 $\pm$ 2.53	109; 3; 1; 0; 0; 4	17; 70; 22; 8; 0	0, 0, 0
Lateral Temporal Lobe Tau-Negative [n=261, 78.38%]	70.95 $\pm$ 8.23	126, 48.28%	16.45 $\pm$ 2.46	216; 16; 1; 12; 0; 14	158; 88; 13; 1; 1	0, 0, 0
Lateral Temporal Lobe Tau-Positive [n=72, 21.62%]	71.44 $\pm$ 7.95	35, 48.61%	16.08 $\pm$ 2.58	67; 1; 1; 0; 0; 3	6; 42; 17; 7; 0	0, 0, 0
Medial Parietal Lobe Tau-Negative [n=279, 83.78%]	71.44 $\pm$ 8.12	137, 49.10%	16.50 $\pm$ 2.46	231; 16; 2; 12; 0; 16	164; 98; 16; 1; 0	0, 0, 0
Medial Parietal Lobe Tau-Positive [n=54, 16.22%]	69.06 $\pm$ 8.16	24, 44.44%	15.70 $\pm$ 2.56	52; 1; 0; 0; 0; 1	0; 32; 14; 7; 1	0, 0, 0
Lateral Parietal Lobe Tau-Negative [n=282, 84.68%]	71.26 $\pm$ 8.17	142, 50.35%	16.51 $\pm$ 2.45	235; 16; 2; 12; 0; 15	162; 102; 16; 1; 1	0, 0, 0
Lateral Parietal Lobe Tau-Positive [n=51, 15.32%]	69.90 $\pm$ 8.07	19, 37.25%	15.59 $\pm$ 2.56	48; 1; 0; 0; 0; 2	2; 28; 14; 7; 0	0, 0, 0
p-values	6.71e-01	7.69e-01	1.99e-01	N.A.	1.49e-83	
OASIS [n = 372]						
Frontal Lobe Tau-Negative [n=328, 88.17%]	69.06 $\pm$ 8.45	145, 44.21%	16.39 $\pm$ 2.33	288; 36; 2; 1; 0; 1	297; 27; 4; 0; 0	327, 324, 324
Frontal Lobe Tau-Positive [n=44, 11.83%]	73.86 $\pm$ 6.14	14, 31.82%	15.80 $\pm$ 2.43	37; 7; 0; 0; 0; 0	21; 12; 9; 2; 0	44, 44, 44
Occipital Lobe Tau-Negative [n=337, 90.59%]	69.26 $\pm$ 8.45	152, 45.10%	16.42 $\pm$ 2.35	297; 37; 2; 1; 0; 0	302; 29; 4; 2; 0	336, 333, 333
Occipital Lobe Tau-Positive [n=35, 9.41%]	73.14 $\pm$ 6.42	7, 20.00%	15.37 $\pm$ 2.12	28; 6; 0; 0; 0; 1	16; 10; 9; 0; 0	35, 35, 35
Medial Temporal Lobe Tau-Negative [n=310, 83.33%]	68.81 $\pm$ 8.31	138, 44.52%	16.43 $\pm$ 2.27	269; 38; 2; 1; 0; 0	291; 18; 1; 0; 0	309, 307, 306
Medial Temporal Lobe Tau-Positive [n=62, 16.67%]	73.74 $\pm$ 7.37	21, 33.87%	15.77 $\pm$ 2.63	56; 5; 0; 0; 0; 1	27; 21; 12; 2; 0	62, 61, 62
Lateral Temporal Lobe Tau-Negative [n=335, 90.05%]	69.16 $\pm$ 8.38	141, 42.09%	16.42 $\pm$ 2.30	294; 38; 2; 1; 0; 0	311; 22; 2; 0; 0	334, 331, 331
Lateral Temporal Lobe Tau-Positive [n=37, 9.95%]	73.83 $\pm$ 6.87	18, 48.65%	15.35 $\pm$ 2.50	31; 5; 0; 0; 0; 1	7; 17; 11; 2; 0	37, 37, 37
Medial Parietal Lobe Tau-Negative [n=341, 91.67%]	69.35 $\pm$ 8.45	146, 42.82%	16.38 $\pm$ 2.33	298; 39; 2; 1; 0; 1	316; 23; 2; 0; 0	340, 337, 337
Medial Parietal Lobe Tau-Positive [n=31, 8.33%]	72.71 $\pm$ 6.51	13, 41.94%	15.68 $\pm$ 2.47	27; 4; 0; 0; 0; 0	2; 16; 11; 2; 0	31, 31, 31
Lateral Parietal Lobe Tau-Negative [n=335, 90.05%]	69.30 $\pm$ 8.52	144, 42.99%	16.38 $\pm$ 2.33	292; 40; 2; 1; 0; 0	309; 23; 3; 0; 0	334, 331, 331
Lateral Parietal Lobe Tau-Positive [n=37, 9.95%]	72.61 $\pm$ 6.00	15, 40.54%	15.76 $\pm$ 2.44	33; 3; 0; 0; 0; 1	9; 16; 10; 2; 0	37, 37, 37
p-values	1.71e-08	2.52e-01	9.94e-03	N.A.	3.59e-143	
A4 [n = 444]						
Frontal Lobe Tau-Negative [n=367, 82.66%]	71.78 $\pm$ 4.81	165, 44.96%	16.22 $\pm$ 2.85	335; 7; 19; 1; 0; 3	367; 0; 0; 0; 0	367, 367, 68
Frontal Lobe Tau-Positive [n=77, 17.34%]	72.15 $\pm$ 5.04	25, 32.47%	16.29 $\pm$ 2.78	72; 3; 1; 0; 0; 1	77; 0; 0; 0; 0	77, 77, 12
Occipital Lobe Tau-Negative [n=399, 89.86%]	71.96 $\pm$ 4.95	173, 43.36%	16.24 $\pm$ 2.89	362; 10; 20; 1; 0; 4	399; 0; 0; 0; 0	399, 399, 72
Occipital Lobe Tau-Positive [n=45, 10.14%]	70.82 $\pm$ 3.75	17, 37.78%	16.11 $\pm$ 2.31	45; 0; 0; 0; 0; 0	45; 0; 0; 0; 0	45, 45, 8
Medial Temporal Lobe Tau-Negative [n=329, 74.10%]	71.40 $\pm$ 4.78	143, 43.47%	16.15 $\pm$ 2.87	305; 5; 14; 1; 0; 3	329; 0; 0; 0; 0	329, 329, 61
Medial Temporal Lobe Tau-Positive [n=115, 25.90%]	73.12 $\pm$ 4.83	47, 40.87%	16.46 $\pm$ 2.73	102; 5; 6; 0; 0; 1	115; 0; 0; 0; 0	115, 115, 19
Lateral Temporal Lobe Tau-Negative [n=381, 85.81%]	71.70 $\pm$ 4.76	166, 43.57%	16.18 $\pm$ 2.83	348; 7; 20; 1; 0; 3	381; 0; 0; 0; 0	381, 381, 72
Lateral Temporal Lobe Tau-Positive [n=63, 14.19%]	72.70 $\pm$ 5.30	24, 38.10%	16.56 $\pm$ 2.85	59; 3; 0; 0; 0; 1	63; 0; 0; 0; 0	63, 63, 8
Medial Parietal Lobe Tau-Negative [n=400, 90.09%]	71.85 $\pm$ 4.82	172, 43.00%	16.22 $\pm$ 2.82	368; 9; 16; 1; 0; 4	400; 0; 0; 0; 0	400, 400, 71
Medial Parietal Lobe Tau-Positive [n=44, 9.91%]	71.78 $\pm$ 5.20	18, 40.91%	16.32 $\pm$ 3.00	39; 1; 4; 0; 0; 0	44; 0; 0; 0; 0	44, 44, 9
Lateral Parietal Lobe Tau-Negative [n=386, 86.94%]	72.00 $\pm$ 4.86	169, 43.78%	16.23 $\pm$ 2.86	351; 9; 19; 1; 0; 4	386; 0; 0; 0; 0	386, 386, 69
Lateral Parietal Lobe Tau-Positive [n=58, 13.06%]	70.82 $\pm$ 4.69	21, 36.21%	16.26 $\pm$ 2.72	56; 1; 1; 0; 0; 0	58; 0; 0; 0; 0	58, 58, 11
p-values	6.74e-02	8.21e-01	9.98e-01	N.A.	N.A.	
FHS [n = 216]						
Frontal Lobe Tau-Negative [n=198, 91.67%]	54.96 $\pm$ 8.52	101, 51.01%	15.47 $\pm$ 2.07	198; 0; 0; 0; 0; 0	198; 0; 0; 0; 0	0, 0, 0
Frontal Lobe Tau-Positive [n=18, 8.33%]	53.22 $\pm$ 7.86	11, 61.11%	15.28 $\pm$ 1.87	18; 0; 0; 0; 0; 0	18; 0; 0; 0; 0	0, 0, 0
Occipital Lobe Tau-Negative [n=206, 95.37%]	54.75 $\pm$ 8.46	105, 50.97%	15.48 $\pm$ 2.04	206; 0; 0; 0; 0; 0	206; 0; 0; 0; 0	0, 0, 0
Occipital Lobe Tau-Positive [n=10, 4.63%]	56.30 $\pm$ 8.81	7, 70.00%	14.90 $\pm$ 2.33	10; 0; 0; 0; 0; 0	10; 0; 0; 0; 0	0, 0, 0
Medial Temporal Lobe Tau-Negative [n=201, 93.06%]	54.67 $\pm$ 8.52	101, 50.25%	15.45 $\pm$ 2.03	201; 0; 0; 0; 0; 0	201; 0; 0; 0; 0	0, 0, 0
Medial Temporal Lobe Tau-Positive [n=15, 6.94%]	56.80 $\pm$ 7.69	11, 73.33%	15.47 $\pm$ 2.39	15; 0; 0; 0; 0; 0	15; 0; 0; 0; 0	0, 0, 0
Lateral Temporal Lobe Tau-Negative [n=203, 93.98%]	54.81 $\pm$ 8.51	102, 50.25%	15.49 $\pm$ 2.04	203; 0; 0; 0; 0; 0	203; 0; 0; 0; 0	0, 0, 0
Lateral Temporal Lobe Tau-Positive [n=13, 6.02%]	55.00 $\pm$ 7.96	10, 76.92%	14.92 $\pm$ 2.14	13; 0; 0; 0; 0; 0	13; 0; 0; 0; 0	0, 0, 0
Medial Parietal Lobe Tau-Negative [n=207, 95.83%]	54.81 $\pm$ 8.47	106, 51.21%	15.47 $\pm$ 2.05	207; 0; 0; 0; 0; 0	207; 0; 0; 0; 0	0, 0, 0
Medial Parietal Lobe Tau-Positive [n=9, 4.17%]	55.11 $\pm$ 8.80	6, 66.67%	15.00 $\pm$ 2.18	9; 0; 0; 0; 0; 0	9; 0; 0; 0; 0	0, 0, 0
Lateral Parietal Lobe Tau-Negative [n=201, 93.06%]	54.79 $\pm$ 8.58	106, 52.74%	15.50 $\pm$ 2.08	201; 0; 0; 0; 0; 0	201; 0; 0; 0; 0	0, 0, 0
Lateral Parietal Lobe Tau-Positive [n=15, 6.94%]	55.20 $\pm$ 6.92	6, 40.00%	14.80 $\pm$ 1.47	15; 0; 0; 0; 0; 0	15; 0; 0; 0; 0	0, 0, 0
p-values	9.99e-01	5.08e-01	9.72e-01	N.A.	N.A.	

Table S9: Study population characteristics broken down by regional tau label status for the training set. Demographic and clinical attributes for the training cohorts used in the regional tau model. Statistical significance for between-group comparisons was assessed using one-way ANOVA for continuous variables (age, education), and one-sided chi-squared tests for categorical variables (gender, race, CDR), with p-values reported in scientific notation for each comparison. Statistical comparisons were not concluded for differences in MRI availability. The N.A. entries in the table signify scenarios when statistical tests could not be concluded and when data were not available.

Dataset (Label)	Age (mean $\pm$ std)	Male gender (n, %)	Education in years (mean $\pm$ std)	Race (White; Black; Asian; American Indian; Pa- cific; Multi-race)	CDR (0.0, 0.5, 1.0, 2.0, 3.0)	MRIs available (T1, T2*, FLAIR)
Testing						
ADNI [n = 625]						
Frontal Lobe Tau-Negative [n=549, 87.84%]	73.35 $\pm$ 7.74	254, 46.27%	16.43 $\pm$ 2.45	465; 54; 14; 2; 0; 10	333; 183; 30; 2; 1	549, 549, 289
Frontal Lobe Tau-Positive [n=76, 12.16%]	72.83 $\pm$ 7.45	37, 48.68%	16.00 $\pm$ 2.22	66; 8; 1; 0; 0; 0	20; 39; 14; 3; 0	76, 76, 37
Occipital Lobe Tau-Negative [n=579, 92.64%]	73.29 $\pm$ 7.67	271, 46.80%	16.45 $\pm$ 2.42	490; 57; 15; 2; 0; 10	350; 195; 32; 2; 0	579, 579, 304
Occipital Lobe Tau-Positive [n=46, 7.36%]	73.19 $\pm$ 8.12	20, 43.48%	15.46 $\pm$ 2.22	41; 5; 0; 0; 0; 0	3; 27; 12; 3; 1	46, 46, 22
Medial Temporal Lobe Tau-Negative [n=452, 72.32%]	72.59 $\pm$ 7.54	209, 46.24%	16.49 $\pm$ 2.43	380; 49; 12; 2; 0; 6	312; 125; 13; 2; 0	452, 452, 241
Medial Temporal Lobe Tau-Positive [n=173, 27.68%]	75.10 $\pm$ 7.84	82, 47.40%	16.08 $\pm$ 2.39	151; 13; 3; 0; 0; 4	41; 97; 31; 3; 1	173, 173, 85
Lateral Temporal Lobe Tau-Negative [n=534, 85.44%]	73.10 $\pm$ 7.63	246, 46.07%	16.49 $\pm$ 2.42	450; 55; 13; 2; 0; 9	340; 172; 21; 1; 0	534, 534, 285
Lateral Temporal Lobe Tau-Positive [n=91, 14.56%]	74.38 $\pm$ 8.07	45, 49.45%	15.71 $\pm$ 2.33	81; 7; 2; 0; 0; 1	13; 50; 23; 4; 1	91, 91, 41
Medial Parietal Lobe Tau-Negative [n=569, 91.04%]	73.49 $\pm$ 7.64	269, 47.28%	16.46 $\pm$ 2.43	479; 59; 15; 2; 0; 10	346; 189; 29; 4; 1	569, 569, 301
Medial Parietal Lobe Tau-Positive [n=56, 8.96%]	71.17 $\pm$ 8.02	22, 39.29%	15.59 $\pm$ 2.22	52; 3; 0; 0; 0; 0	7; 33; 15; 1; 0	56, 56, 25
Lateral Parietal Lobe Tau-Negative [n=559, 89.44%]	73.33 $\pm$ 7.71	264, 47.23%	16.47 $\pm$ 2.43	477; 55; 14; 2; 0; 7	341; 189; 26; 3; 0	559, 559, 298
Lateral Parietal Lobe Tau-Positive [n=66, 10.56%]	72.90 $\pm$ 7.66	27, 40.91%	15.61 $\pm$ 2.25	54; 7; 1; 0; 0; 3	12; 33; 18; 2; 1	66, 66, 28
p-values	3.79e-02	9.90e-01	2.47e-04	N.A.	5.90e-83	
HABS [n = 173]						
Frontal Lobe Tau-Negative [n=147, 84.97%]	78.05 $\pm$ 6.19	60, 40.82%	15.94 $\pm$ 3.15	127; 18; 1; 0; 0; 0	126; 18; 0; 0; 0	147, 0, 146
Frontal Lobe Tau-Positive [n=26, 15.03%]	77.28 $\pm$ 5.71	10, 38.46%	16.92 $\pm$ 2.35	23; 3; 0; 0; 0; 0	24; 2; 0; 0; 0	26, 0, 26
Occipital Lobe Tau-Negative [n=161, 93.06%]	77.72 $\pm$ 6.14	65, 40.37%	15.99 $\pm$ 3.10	139; 20; 1; 0; 0; 0	141; 17; 0; 0; 0	161, 0, 160
Occipital Lobe Tau-Positive [n=12, 6.94%]	80.79 $\pm$ 5.19	5, 41.67%	17.33 $\pm$ 2.15	11; 1; 0; 0; 0; 0	9; 3; 0; 0; 0	12, 0, 12
Medial Temporal Lobe Tau-Negative [n=144, 83.24%]	77.48 $\pm$ 6.08	59, 40.97%	16.12 $\pm$ 3.06	128; 15; 1; 0; 0; 0	127; 14; 0; 0; 0	144, 0, 143
Medial Temporal Lobe Tau-Positive [n=29, 16.76%]	80.17 $\pm$ 5.89	11, 37.93%	15.90 $\pm$ 3.07	22; 6; 0; 0; 0; 0	23; 6; 0; 0; 0	29, 0, 29
Lateral Temporal Lobe Tau-Negative [n=152, 87.86%]	77.84 $\pm$ 6.11	61, 40.13%	16.01 $\pm$ 3.01	134; 16; 1; 0; 0; 0	134; 15; 0; 0; 0	152, 0, 151
Lateral Temporal Lobe Tau-Positive [n=21, 12.14%]	78.61 $\pm$ 6.22	9, 42.86%	16.62 $\pm$ 3.41	16; 5; 0; 0; 0; 0	16; 5; 0; 0; 0	21, 0, 21
Medial Parietal Lobe Tau-Negative [n=166, 95.95%]	77.86 $\pm$ 6.04	67, 40.36%	15.99 $\pm$ 3.08	144; 20; 1; 0; 0; 0	144; 19; 0; 0; 0	166, 0, 165
Medial Parietal Lobe Tau-Positive [n=7, 4.05%]	79.79 $\pm$ 8.03	3, 42.86%	18.29 $\pm$ 1.38	6; 1; 0; 0; 0; 0	6; 1; 0; 0; 0	7, 0, 7
Lateral Parietal Lobe Tau-Negative [n=156, 90.17%]	78.00 $\pm$ 5.96	64, 41.03%	16.02 $\pm$ 3.10	135; 19; 1; 0; 0; 0	136; 17; 0; 0; 0	156, 0, 155
Lateral Parietal Lobe Tau-Positive [n=17, 9.83%]	77.34 $\pm$ 7.54	6, 35.29%	16.71 $\pm$ 2.64	15; 2; 0; 0; 0; 0	14; 3; 0; 0; 0	17, 0, 17
p-values	6.22e-01	1.00e+00	5.42e-01	N.A.	N.A.	

Table S10: Study population characteristics broken down by regional tau label status for the test set. Demographic and clinical attributes for the testing cohorts used in the regional tau model. Statistical significance for between-group comparisons was assessed using one-way ANOVA for continuous variables (age, education), and one-sided chi-squared tests for categorical variables (gender, race, CDR), with p-values reported in scientific notation for each comparison. Statistical comparisons were not concluded for differences in MRI availability. The N.A. entries in the table signify scenarios when statistical tests could not be concluded and when data were not available.

Metric	$A\beta$ label	Meta- τ label
Accuracy	0.68	0.82
Balanced Accuracy	0.68	0.76
Precision	0.62	0.52
Sensitivity/Recall	0.77	0.67
Specificity	0.59	0.85
F1 score	0.69	0.59
MCC	0.37	0.48
AUROC	0.79	0.84
AP	0.78	0.60
NPV	0.75	0.92

(a)

Metric	$\tau_{\text{med-temp}}$	$\tau_{\text{lat-temp}}$	$\tau_{\text{med-par}}$	$\tau_{\text{lat-par}}$	τ_{frontal}	$\tau_{\text{occipital}}$
Accuracy	0.68	0.75	0.84	0.82	0.76	0.80
Balanced Accuracy	0.71	0.74	0.72	0.72	0.61	0.78
Precision	0.43	0.33	0.27	0.31	0.24	0.23
Sensitivity/Recall	0.75	0.72	0.58	0.60	0.42	0.76
Specificity	0.66	0.76	0.87	0.84	0.81	0.80
F1 score	0.55	0.45	0.37	0.40	0.31	0.36
MCC	0.36	0.36	0.32	0.33	0.18	0.34
AUROC	0.79	0.83	0.82	0.79	0.71	0.84
AP	0.60	0.50	0.37	0.39	0.30	0.37
NPV	0.89	0.94	0.96	0.95	0.90	0.98

(b)

Table S11: Model performance. Performance metrics for $A\beta$ and τ labels on the combined ADNI ($A\beta$: $n = 1404$, τ : $n = 625$), HABS ($A\beta$: $n = 282$, τ : $n = 173$) and NACC* ($A\beta$: $n = 147$, τ : $n = 45$) cohorts are shown. Table (a) presents the performance metrics for $A\beta$ and meta- τ labels, and table (b) presents the performance metrics for the regional τ labels, including medial temporal (med-temp), lateral temporal (lat-temp), medial parietal (med-par), lateral parietal (lat-par), frontal, and occipital regions. Note that all available data from ADNI and HABS, and a held-out set from NACC were used for model testing.

Metric	A β label	Meta- τ
Accuracy	0.71	0.67
Balanced Accuracy	0.68	0.73
Precision	0.71	0.52
Sensitivity/Recall	0.89	0.94
Specificity	0.47	0.52
F1 score	0.79	0.67
MCC	0.39	0.45
AUROC	0.80	0.81
AP	0.82	0.71
NPV	0.74	0.94

Table S12: Performance metrics for amyloid and tau labels for the held-out NACC test set. Performance metrics for A β and τ labels on the held-out NACC* (A β : $n = 147$, τ : $n = 45$) cohorts are shown.

Metric	$A\beta$ label	Meta- τ label
Accuracy	0.67	0.83
Balanced Accuracy	0.68	0.76
Precision	0.61	0.53
Sensitivity/Recall	0.76	0.64
Specificity	0.60	0.87
F1 score	0.68	0.58
MCC	0.36	0.48
AUROC	0.78	0.84
AP	0.78	0.60
NPV	0.75	0.92

(a)

Metric	$\tau_{\text{med-temporal}}$	$\tau_{\text{lat-temporal}}$	$\tau_{\text{med-parietal}}$	$\tau_{\text{lat-parietal}}$	τ_{frontal}	$\tau_{\text{occipital}}$
Accuracy	0.68	0.75	0.84	0.82	0.76	0.80
Balanced Accuracy	0.71	0.74	0.72	0.72	0.61	0.78
Precision	0.43	0.32	0.27	0.30	0.24	0.23
Sensitivity/Recall	0.75	0.71	0.57	0.59	0.41	0.76
Specificity	0.66	0.76	0.87	0.84	0.81	0.80
F1 score	0.54	0.45	0.36	0.40	0.30	0.35
MCC	0.36	0.35	0.31	0.33	0.18	0.34
AUROC	0.79	0.82	0.81	0.79	0.70	0.84
AP	0.60	0.49	0.35	0.38	0.29	0.35
NPV	0.89	0.94	0.96	0.95	0.90	0.98

(b)

Table S13: Overall performance metrics for all labels on external testing cohorts (ADNI and HABS). Subtable (a) shows the performance metrics for $A\beta$ and meta- τ labels and Subtable (b) details the metrics on the regional τ labels.

Metric	$A\beta$ label	Meta- τ label
Accuracy	0.67	0.79
Balanced Accuracy	0.68	0.76
Precision	0.61	0.47
Sensitivity/Recall	0.80	0.70
Specificity	0.56	0.81
F1 score	0.69	0.56
MCC	0.36	0.45
AUROC	0.79	0.84
AP	0.78	0.60
NPV	0.76	0.92

(a)

Metric	$\tau_{\text{med-temp}}$	$\tau_{\text{lat-temp}}$	$\tau_{\text{med-par}}$	$\tau_{\text{lat-par}}$	τ_{frontal}	$\tau_{\text{occipital}}$
Accuracy	0.68	0.74	0.83	0.81	0.74	0.78
Balanced Accuracy	0.71	0.73	0.71	0.71	0.61	0.77
Precision	0.43	0.32	0.25	0.30	0.24	0.22
Sensitivity/Recall	0.76	0.72	0.58	0.60	0.44	0.76
Specificity	0.66	0.75	0.85	0.83	0.79	0.78
F1 score	0.55	0.44	0.35	0.40	0.31	0.34
MCC	0.36	0.35	0.30	0.32	0.18	0.33
AUROC	0.79	0.83	0.82	0.79	0.70	0.84
AP	0.61	0.50	0.37	0.40	0.30	0.37
NPV	0.89	0.94	0.96	0.95	0.90	0.98

(b)

Table S14: Performance metrics on the combined ADNI ($n = 1404$), HABS ($n = 282$) and NACC* ($n = 147$) cohorts without using MRI embeddings. Subtable (a) shows the performance metrics for $A\beta$ and meta- τ labels and subtable (b) details the metrics on the regional τ labels.

Metric	$A\beta$ label	Meta- τ label
Accuracy	0.61	0.74
Balanced Accuracy	0.64	0.76
Precision	0.55	0.41
Sensitivity/Recall	0.94	0.80
Specificity	0.33	0.73
F1 score	0.69	0.54
MCC	0.34	0.42
AUROC	0.81	0.83
AP	0.79	0.53

(a)

Metric	$\tau_{\text{med-temp}}$	$\tau_{\text{lat-temp}}$	$\tau_{\text{med-par}}$	$\tau_{\text{lat-par}}$	τ_{frontal}	$\tau_{\text{occipital}}$
Accuracy	0.78	0.77	0.68	0.75	0.75	0.76
Balanced Accuracy	0.73	0.72	0.73	0.69	0.62	0.70
Precision	0.57	0.34	0.17	0.24	0.25	0.18
Sensitivity/Recall	0.61	0.66	0.80	0.61	0.45	0.64
Specificity	0.84	0.78	0.67	0.77	0.80	0.76
F1 score	0.59	0.45	0.29	0.34	0.32	0.28
MCC	0.44	0.35	0.26	0.26	0.19	0.24
AUROC	0.80	0.80	0.77	0.77	0.70	0.79
AP	0.62	0.48	0.22	0.33	0.30	0.32

(b)

Table S15: Performance metrics for all labels with Catboost on the combined ADNI, HABS, and NACC* test set. Table (a) shows Catboost’s performance metrics for $A\beta$ and meta- τ labels. Table (b) details performance metrics for regional τ labels.

Comparison	Test	Coefficient	P-value
$P(A\beta)$ vs CL	Pearson’s	0.58	4.04×10^{-124}
	Spearman’s	0.53	2.45×10^{-100}
$P(\tau)$ vs meta- τ SUVR	Pearson’s	0.59	2.35×10^{-58}
	Spearman’s	0.47	9.64×10^{-36}

Table S16: Correlation coefficients and significance levels for model predicted probabilities against true PET values. Two-sided correlation tests indicate significant associations between model predicted probabilities for both $A\beta$ and τ against continuous centiloid values (CL) and meta- τ SUVRs, respectively. Refer to Figure 3a for the graphical representation of the data.

Region	Statistic	Coefficient	p-value
Medial temporal	r	0.56	1.14×10^{-52}
	ρ	0.44	4.52×10^{-31}
Lateral temporal	r	0.52	1.86×10^{-43}
	ρ	0.37	2.63×10^{-21}
Medial parietal	r	0.44	2.35×10^{-31}
	ρ	0.28	1.01×10^{-12}
Lateral parietal	r	0.45	1.54×10^{-32}
	ρ	0.37	1.16×10^{-13}
Frontal	r	0.35	3.74×10^{-19}
	ρ	0.20	4.78×10^{-7}
Occipital	r	0.40	1.68×10^{-25}
	ρ	0.28	2.74×10^{-12}

Table S17: Correlation analyses results comparing model probabilities for regional τ positivity to the tau PET SUVR value in the same region. Two-sided Spearman’s ρ and Pearson’s r coefficients are reported. No correction for multiple comparisons were applied. See Supplementary Figure S4 for a graphical representation of the results.

Groups compared	p-value
A-T- vs. A+T-	2.63×10^{-4}
A+T- vs. A+MTL+	2.99×10^{-3}
A+MTL+ vs. A+NEO+	4.96×10^{-3}
A+MTL+ vs. A-T-	8.97×10^{-9}
A+NEO+ vs. A+T-	1.49×10^{-14}
A+NEO+ vs. A-T-	1.72×10^{-36}

Table S18: Dunn’s post hoc test results for pairwise comparisons between disease stages. Summary of pairwise comparisons between different disease stages using two-sided post hoc Dunn’s tests, with adjustments for multiple comparisons made using Holm’s method. Significant differences were observed between all compared pairs.

Groups	Measure	U Statistic	p-value
Meta- τ Tertiles	P(A β)	3707	4.01×10^{-20}
	CL	5047	1.92×10^{-13}
CL Tertiles	P(τ)	6655	3.17×10^{-07}
	Meta- τ SUVR	5876	6.78×10^{-10}

Table S19: Statistical analysis comparing low/medium and high PET groups using one-sided Mann-Whitney U tests on the combined ADNI and HABS external test cohorts in A β + cases. Model predicted probabilities for amyloid, $P(\text{A}\beta)$, were compared between the low/medium and high tau PET groups, and a similar analysis was run comparing centiloid scores across the τ groups. Significant differences were found in both comparisons, with cases in the low/medium τ group having lower $P(\text{A}\beta)$ and lower CL than cases in the high τ PET group. Conversely, model predicted probabilities for τ , $P(\tau)$, and meta-temporal τ SUVR, were compared between centiloid (CL) groups. A one-sided Mann-Whitney revealed significant differences between cases in the low/medium CL group compared to those in the high CL group. Refer to Figure 4 for the graphical representation of the data

	SUVr #1	SUVr #2	SUVr #3	SUVr #4	SUVr #5
Medial temporal, $AMI = 0.219, p = 1.40 \times 10^{-03}$					
Model #1	7	9	11	3	1
Model #2	4	1	0	4	2
Model #3	9	1	0	0	0
Model #4	0	0	2	3	2
Model #5	0	4	0	0	1
Lateral temporal, $AMI = 0.176, p = 5.60 \times 10^{-03}$					
Model #1	9	9	2	4	4
Model #2	0	2	8	4	0
Model #3	1	4	1	0	3
Model #4	4	0	1	2	0
Model #5	4	0	0	0	2
Medial parietal, $AMI = 0.134, p = 4.84 \times 10^{-02}$					
Model #1	4	2	7	3	4
Model #2	6	8	4	1	0
Model #3	5	3	1	0	0
Model #4	3	0	0	3	2
Model #5	5	0	0	3	0
Lateral parietal, $AMI = 0.288, p = 1.60 \times 10^{-03}$					
Model #1	15	3	2	0	4
Model #2	0	2	0	8	6
Model #3	0	5	3	1	0
Model #4	1	2	3	2	0
Model #5	1	2	4	0	0
Frontal, $AMI = 0.138, p = 2.16 \times 10^{-02}$					
Model #1	6	13	6	6	3
Model #2	4	2	0	0	3
Model #3	6	0	1	2	0
Model #4	0	1	4	2	0
Model #5	4	0	1	0	0
Occipital, $AMI = 0.233, p = 1.00 \times 10^{-03}$					
Model #1	18	9	1	3	0
Model #2	1	0	2	0	6
Model #3	4	1	0	4	0
Model #4	4	1	2	1	0
Model #5	3	0	4	0	0

Table S20: Breakdown of model-based and SUVr-derived communities. The contingency tables show the breakdown of model-based and SUVr-derived communities for each regional label in spatial analysis. Each cell denotes the number of brain regions in the intersection of a model-based community and an SUVr-derived community. Communities are order-invariant. p -values indicate statistical results from one-sided spatial permutation tests ($n = 5000$) on the adjusted mutual information (AMI).

Group	Median	IQR
$P(A\beta)$ vs Cerebral amyloid angiopathy		
None	0.41	[0.34, 0.50]
Mild	0.57	[0.51, 0.64]
Moderate	0.61	[0.53, 0.66]
Severe	0.63	[0.58, 0.67]
$P(\tau)$ vs Cerebral amyloid angiopathy		
None	0.52	[0.40, 0.63]
Mild	0.72	[0.58, 0.77]
Moderate	0.74	[0.65, 0.79]
Severe	0.77	[0.74, 0.79]
$P(A\beta)$ vs Thal phase for amyloid plaques		
P0 (A0)	0.37	[0.33, 0.42]
P1 (A1)	0.33	[0.29, 0.35]
P2 (A1)	0.39	[0.34, 0.50]
P3 (A2)	0.46	[0.41, 0.62]
P4 (A3)	0.62	[0.57, 0.67]
P5 (A3)	0.60	[0.52, 0.65]
$P(\tau)$ vs Thal phase for amyloid plaques		
P0 (A0)	0.48	[0.41, 0.55]
P1 (A1)	0.40	[0.35, 0.43]
P2 (A1)	0.51	[0.39, 0.66]
P3 (A2)	0.59	[0.50, 0.74]
P4 (A3)	0.78	[0.68, 0.79]
P5 (A3)	0.74	[0.67, 0.79]
$P(A\beta)$ vs Braak stage for neurofibrillary degeneration (NFD)		
S0 (B0)	0.34	[0.27, 0.44]
S1 (B1)	0.35	[0.34, 0.40]
S2 (B1)	0.42	[0.32, 0.48]
S3 (B2)	0.58	[0.55, 0.61]
S4 (B2)	0.46	[0.40, 0.50]
S5 (B3)	0.61	[0.54, 0.66]
S6 (B3)	0.62	[0.56, 0.68]
$P(\tau)$ vs Braak stage for neurofibrillary degeneration (NFD)		
S0 (B0)	0.38	[0.34, 0.56]
S1 (B1)	0.43	[0.38, 0.52]
S2 (B1)	0.50	[0.41, 0.56]
S3 (B2)	0.71	[0.70, 0.73]
S4 (B2)	0.52	[0.50, 0.57]
S5 (B3)	0.74	[0.65, 0.79]
S6 (B3)	0.76	[0.71, 0.82]

$P(A\beta)$ vs CERAD score for density of neocortical neuritic plaque		
C0	0.37	[0.33, 0.46]
C1	0.43	[0.34, 0.49]
C2	0.51	[0.44, 0.60]
C3	0.62	[0.55, 0.67]
$P(\tau)$ vs CERAD score for density of neocortical neuritic plaque		
C0	0.48	[0.40, 0.54]
C1	0.50	[0.42, 0.59]
C2	0.67	[0.55, 0.73]
C3	0.76	[0.69, 0.79]
$P(A\beta)$ vs CERAD score for density of diffuse plaques		
No diffuse plaques	0.37	[0.33, 0.46]
Sparse diffuse plaques	0.34	[0.33, 0.37]
Moderate diffuse plaques	0.51	[0.46, 0.59]
Frequent diffuse plaques	0.61	[0.53, 0.66]
$P(\tau)$ vs CERAD score for density of diffuse plaques		
No diffuse plaques	0.48	[0.41, 0.60]
Sparse diffuse plaques	0.41	[0.35, 0.45]
Moderate diffuse plaques	0.67	[0.56, 0.78]
Frequent diffuse plaques	0.74	[0.67, 0.79]

Table S21: Median & interquartile range (IQR) for model probabilities ($P(A\beta)$ & $P(\tau)$) against various neuropathological grades. Refer to Figure 6 for the graphical representation of the data and to Table S22 for detailed test statistics and associated p-values.

Neuropathology Variable	Model Probability	Test	Statistic	P-value
Cerebral amyloid angiopathy	$P(A\beta)$	Spearman correlation	$\rho = 0.43$	3.17×10^{-7}
		Kruskal-Wallis	$H = 26.46$	7.62×10^{-6}
	$P(\tau)$	Spearman correlation	$\rho = 0.42$	4.15×10^{-7}
		Kruskal-Wallis	$H = 25.36$	1.30×10^{-5}
Thal phase for amyloid plaques	$P(A\beta)$	Spearman correlation	$\rho = 0.49$	2.94×10^{-9}
		Kruskal-Wallis	$H = 48.32$	3.05×10^{-9}
	$P(\tau)$	Spearman correlation	$\rho = 0.45$	8.10×10^{-8}
		Kruskal-Wallis	$H = 42.02$	5.82×10^{-8}
Braak stage for neurofibrillary degeneration (NFD)	$P(A\beta)$	Spearman correlation	$\rho = 0.60$	6.14×10^{-14}
		Kruskal-Wallis	$H = 54.81$	5.05×10^{-10}
	$P(\tau)$	Spearman correlation	$\rho = 0.61$	2.08×10^{-14}
		Kruskal-Wallis	$H = 54.05$	7.19×10^{-10}
CERAD score for density of neocortical neuritic plaque	$P(A\beta)$	Spearman correlation	$\rho = 0.63$	8.33×10^{-16}
		Kruskal-Wallis	$H = 52.18$	2.74×10^{-11}
	$P(\tau)$	Spearman correlation	$\rho = 0.61$	5.97×10^{-15}
		Kruskal-Wallis	$H = 50.37$	6.68×10^{-11}
CERAD score for density of diffuse plaques	$P(A\beta)$	Spearman correlation	$\rho = 0.54$	6.52×10^{-11}
		Kruskal-Wallis	$H = 37.84$	3.05×10^{-8}
	$P(\tau)$	Spearman correlation	$\rho = 0.46$	5.10×10^{-8}
		Kruskal-Wallis	$H = 29.61$	1.66×10^{-6}

Table S22: Statistical results for neuropathological validation of model probabilities, as shown in Figure 6 and described in detail in Table S21. For each neuropathology variable and model probability label ($P(A\beta)$ & $P(\tau)$), both the Spearman correlation coefficient ρ and the Kruskal Wallis H statistic are presented along with H-test p-values and two-tailed p-values for ρ .

Region	F value	p-value	p-adjusted
Meta-temporal	18.71	3.03×10^{-18}	3.54×10^{-18}
Medial temporal	6.67	3.56×10^{-06}	3.56×10^{-06}
Lateral temporal	33.03	1.47×10^{-32}	2.56×10^{-32}
Medial parietal	98.87	5.35×10^{-94}	3.74×10^{-93}
Lateral parietal	49.94	4.54×10^{-49}	1.06×10^{-48}
Occipital	76.66	4.10×10^{-74}	1.44×10^{-73}
Frontal	27.99	1.49×10^{-27}	2.09×10^{-27}

Table S23: Type III ANOVA results on unharmonized tau PET data. This table presents the two-sided ANCOVA results assessing the effects of cohort membership on tau PET SUVR measurements across different regions of interest in the unharmonized data. F statistics, raw p-values, and p-values adjusted for multiple comparisons using the Benjamini-Hochberg method are reported. The results indicate statistically significant cohort differences in tau SUVRs in all ROIs.

Region	F value	p-value	p-adjusted
Meta temporal	1.56	1.67×10^{-01}	2.21×10^{-01}
Medial temporal	0.60	7.00×10^{-01}	7.00×10^{-01}
Lateral temporal	1.86	9.88×10^{-02}	1.73×10^{-01}
Medial parietal	4.02	1.23×10^{-03}	8.61×10^{-03}
Lateral parietal	3.50	3.70×10^{-03}	1.30×10^{-02}
Occipital	1.86	9.85×10^{-02}	1.73×10^{-01}
Frontal	1.49	1.90×10^{-01}	2.21×10^{-01}

(a)

Region	Contrast	Estimate	SE	df	t-ratio	p-value
Medial parietal	A4 - FHS	0.08	0.02	2147	3.56	5.13×10^{-03}
Medial parietal	FHS - HABS	-0.08	0.03	2147	-3.13	2.20×10^{-02}
Medial parietal	FHS - OASIS	-0.08	0.02	2147	-3.61	4.17×10^{-03}
Lateral parietal	A4 - FHS	0.08	0.02	2147	3.73	2.69×10^{-03}
Lateral parietal	FHS - HABS	-0.09	0.03	2147	-3.45	7.45×10^{-03}
Lateral parietal	FHS - OASIS	-0.07	0.02	2147	-3.54	5.45×10^{-03}

(b)

Table S24: Results of Type III ANOVA after harmonization, adjusting for age, sex, diagnosis, and amyloid status as covariates. (a) The first subtable presents two-sided ANCOVA results for each region, with p-values corrected using the Benjamini-Hochberg method. (b) The second subtable shows significant pairwise comparisons from two-sided Tukey’s post-hoc analysis for regions where ANOVA indicated a significant cohort effect.

Label	AUROC Difference	AP Difference
Amyloid	0.03	0.03
Meta temporal tau	-0.01	0.00
Medial temporal tau	-0.01	0.02
Lateral temporal tau	0.00	-0.01
Medial parietal tau	-0.03	0.05
Lateral parietal tau	-0.05	0.03
Frontal tau	-0.05	0.04
Occipital tau	-0.03	-0.01

Table S25: Performance changes after harmonization of the tau PET data. Values represent the difference in AUROC and AP metrics between harmonized and unharmonized models, with positive values indicating improved performance after harmonization.

Supplementary figures

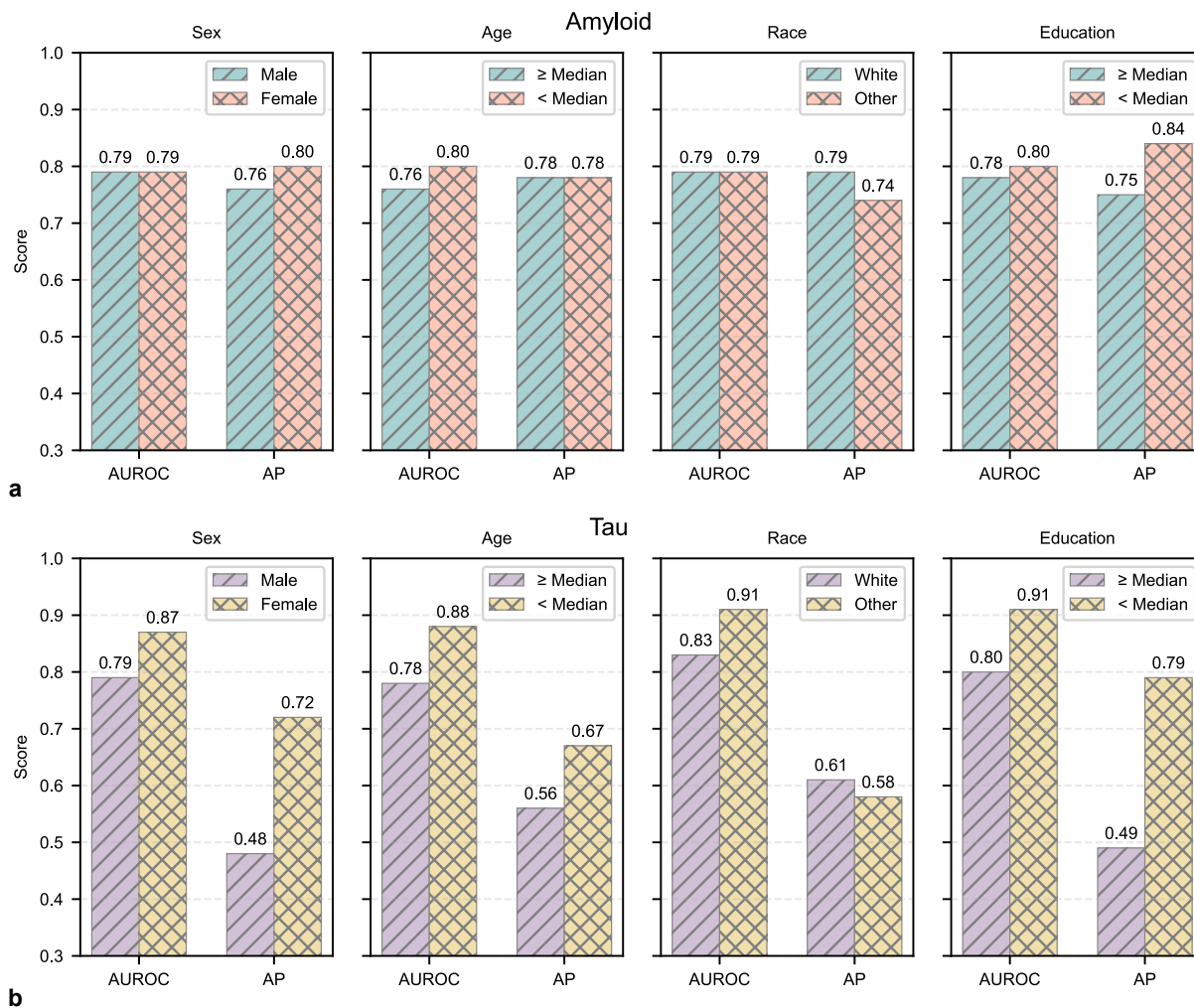


Figure S1: Model performance across demographic subgroups. Area under the receiver operating characteristic (AUROC) and average precision (AP) values for (a) $A\beta$ and (b) meta- τ predictions stratified by key demographic subgroups. Sex: male ($A\beta$: $n = 905$, τ : $n = 387$) and female ($A\beta$: $n = 928$, τ : $n = 456$); median age: < 73.62 years ($A\beta$: $n = 916$, τ : $n = 415$) and ≥ 73.62 ($A\beta$: $n = 917$, τ : $n = 428$); race: White ($A\beta$: $n = 1612$, τ : $n = 723$) and other ($A\beta$: $n = 212$, τ : $n = 114$); education level: < 16 years ($A\beta$: $n = 570$, τ : $n = 252$) and ≥ 16 years ($A\beta$: $n = 1261$, τ : $n = 590$).

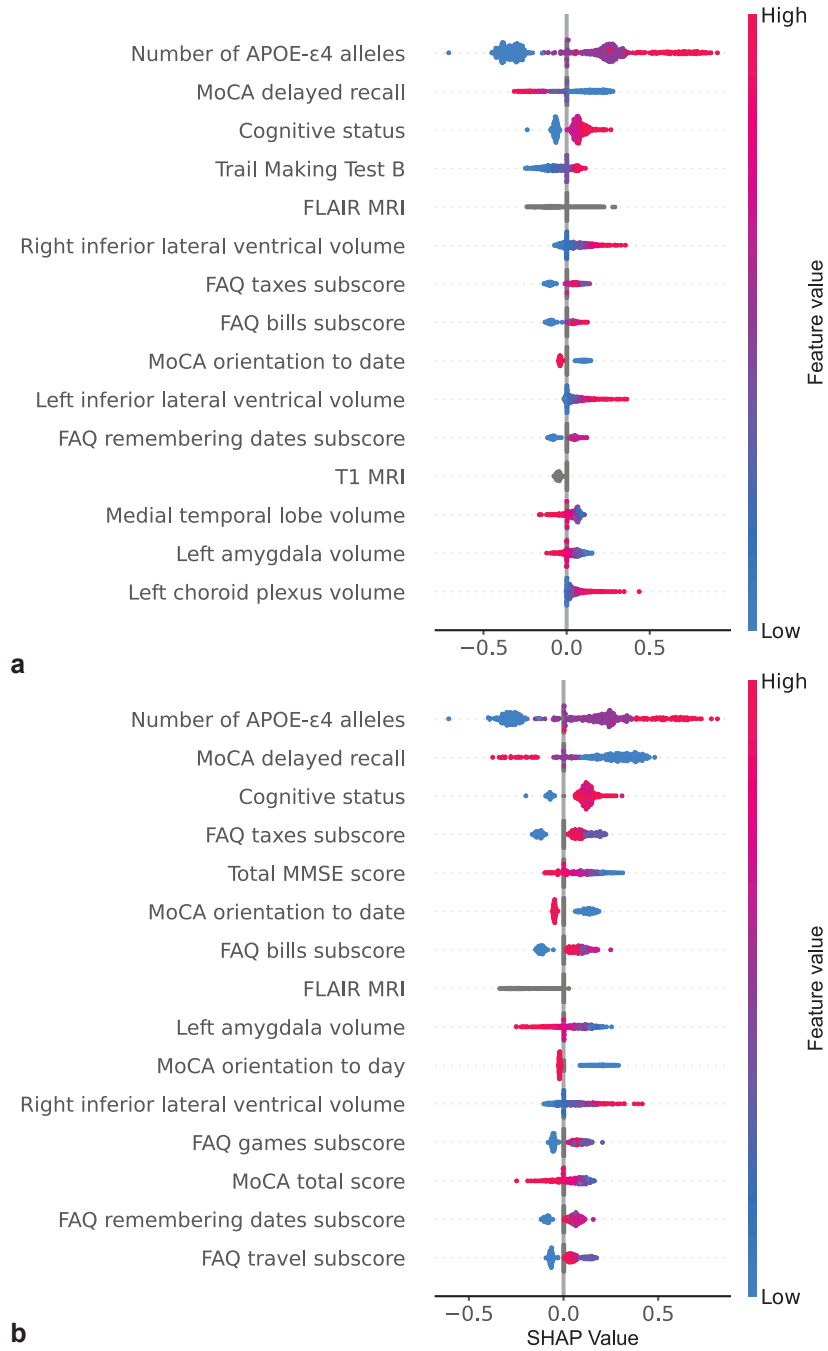


Figure S2: Shapley analysis. The figure presents the top fifteen contributing features for the model's positive predictions of (a) $A\beta$ and (b) τ labels, ranked by their mean Shapley values. These values, which represent the average contribution of each feature to the model's decision, were used to rank the features from highest to lowest impact.

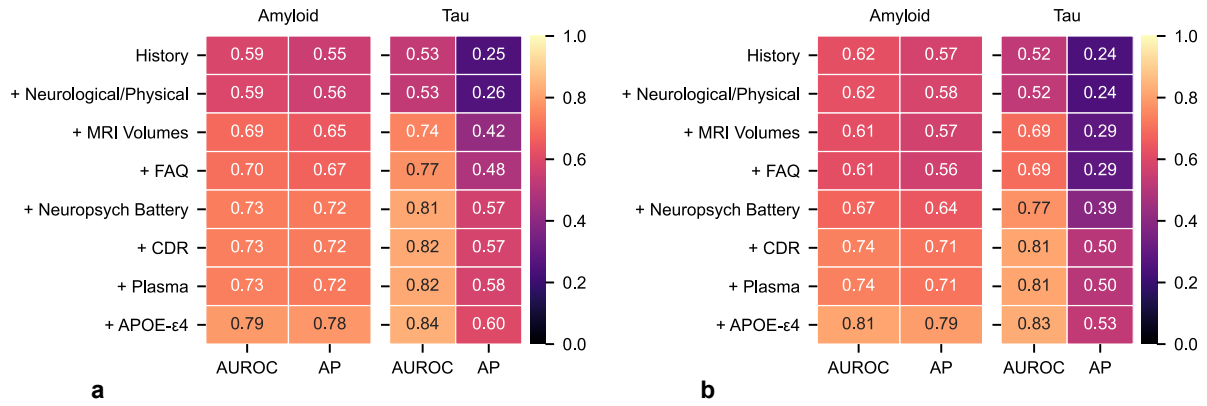


Figure S3: AUROC and AP performance using incremental clinical features. Heatmap presenting the AUROC and AP values for $A\beta$ and meta- τ predictions using various combinations of clinical features for (a) our model without image embeddings (b) CatBoost.

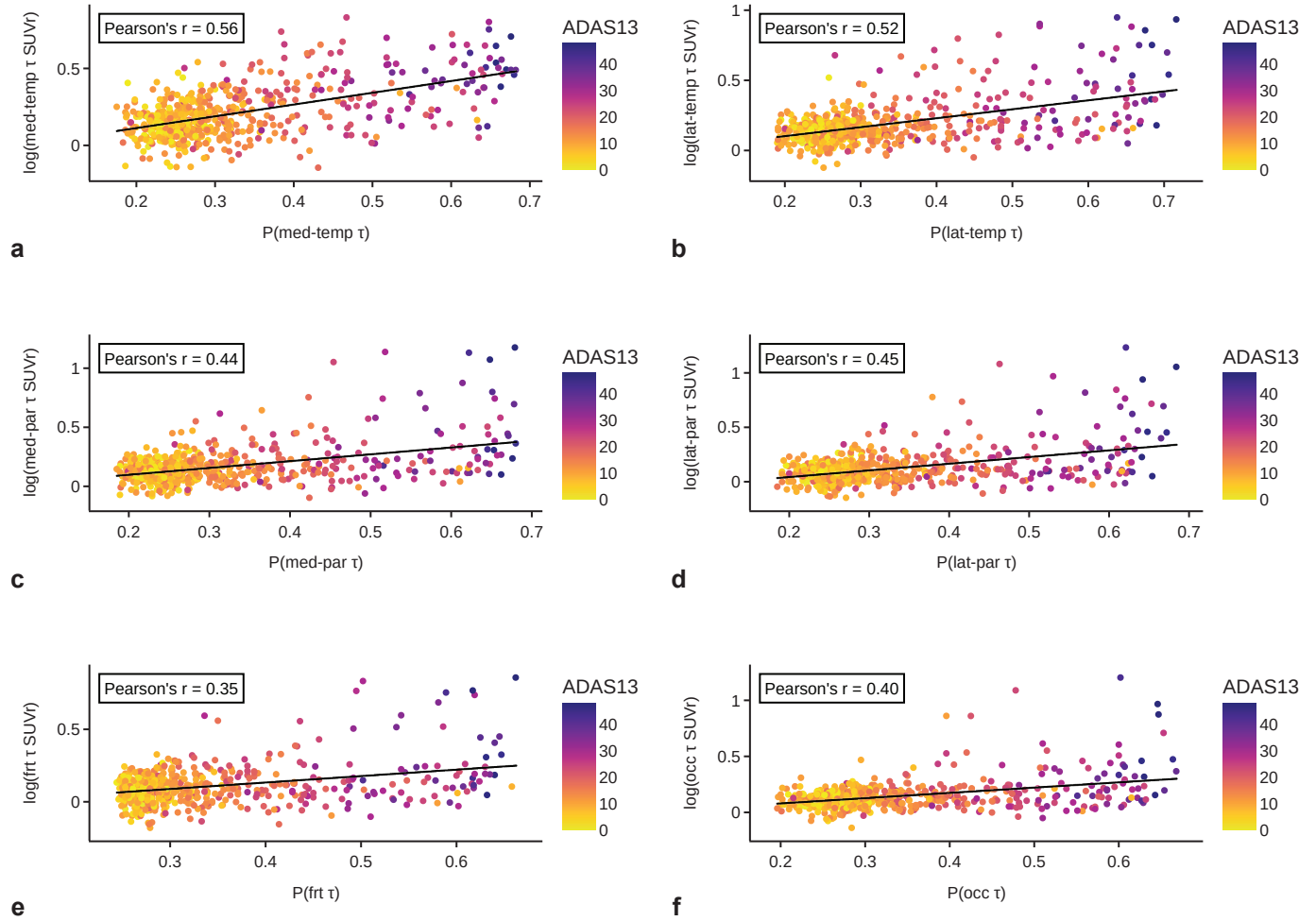


Figure S4: Regional tau model's alignment with biological outcomes. The bubble plots illustrate model-predicted probabilities of regional τ positivity with the respective regional τ PET SUVR values. SUVR values were log transformed before computing two-sided Pearson's r correlations. Detailed statistics are reported in Table S17, including two-sided Pearson's and Spearman's correlation coefficients with p-values.

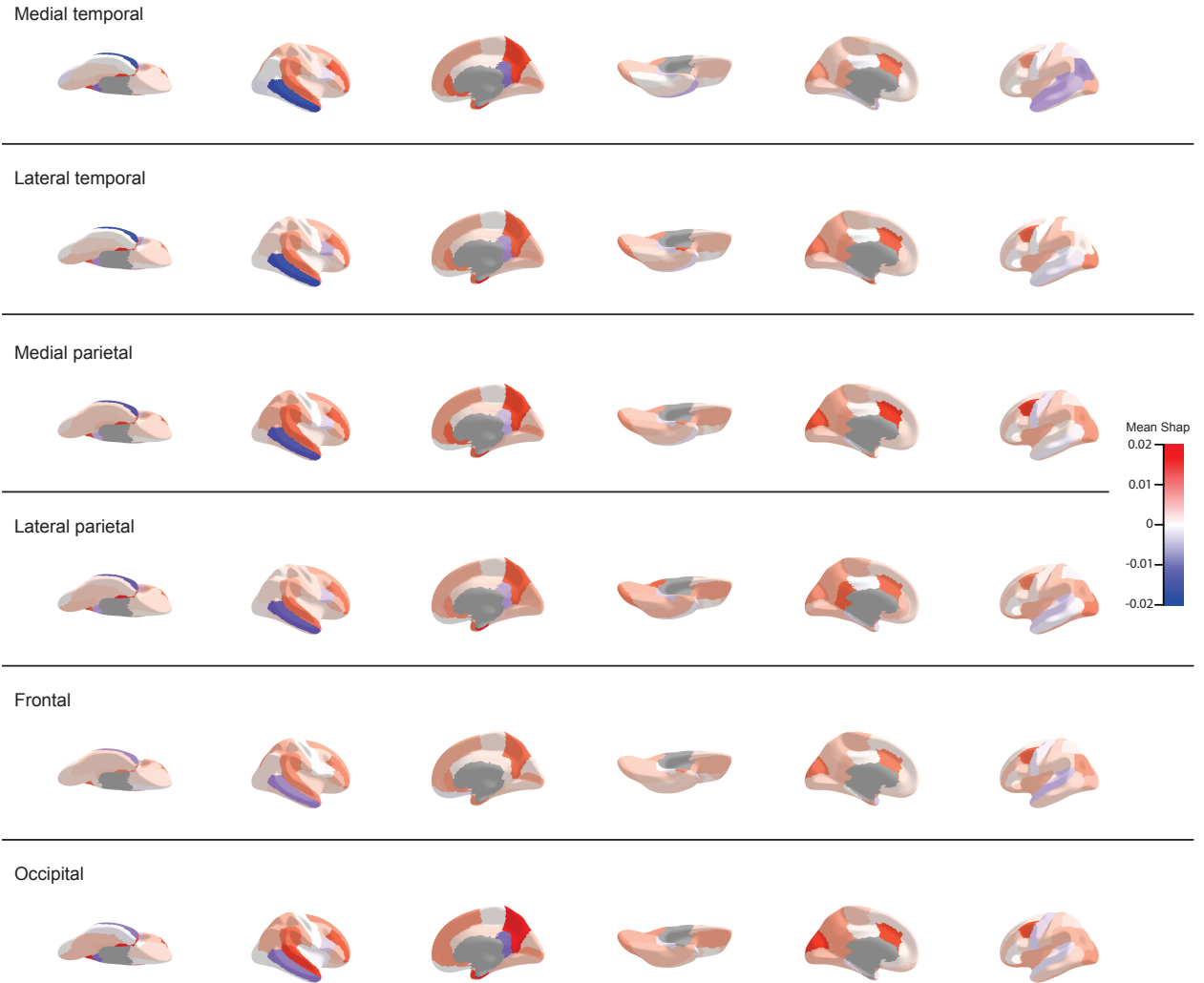


Figure S5: Inflated cortical surfaces showing Shapley values of regional brain volumes for regional tau predictions. Shapley values are overlaid on the Desikan-Killiany-Tourville atlas to illustrate the relative importance of different cortical volumes in predicting regional tau positivity. The first panel displays the mean Shapley values for the medial temporal predictions and subsequent panels are ordered according to Braak stages.

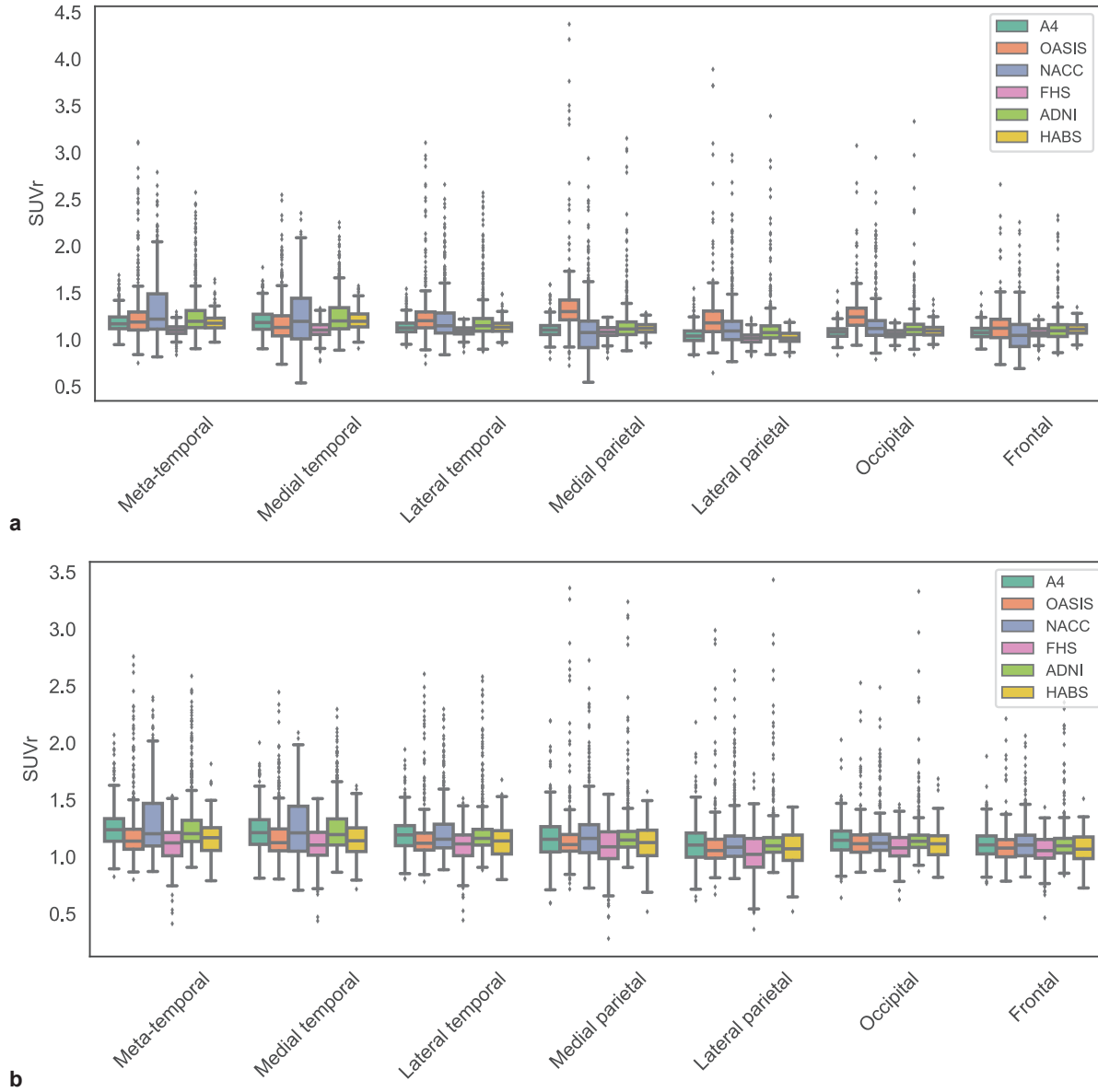


Figure S6: Impact of harmonization on SUVR distributions across cohorts. The top panel presents boxplots of unharmonized SUVR values for each τ PET ROI, while the bottom panel displays SUVR values after harmonization. Each box represents the distribution of SUVR within a cohort, with different colors indicating different cohorts. Harmonization reduced the batch effect of cohort-specific variability, while controlling for meaningful covariates. Detailed statistics are reported in Supplementary Tables S23 and S24.