# Cambridge Cognitive Examination and Hachinski Ischemic Score as predictors of MRI confirmed pathology in dementia: a cross-sectional study

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# Title: Cambridge Cognitive Examination and Hachinski Ischemic Score as predictors of MRI confirmed pathology in dementia: a cross-sectional study

**Running Title (40 characters max):** Predictors of dementia pathology on MRI

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## Abstract

Aims and Background:

Dementia, a common illness among older people, is diagnosed through a combination of clinical assessment, cognitive assessment tools, and neuroimaging. The aim of this retrospective, naturalistic study was to explore the association between the clinical assessment tools used in a memory clinic and the findings of Magnetic Resonance Imaging (MRI) scans in patients receiving a formal dementia diagnosis.

Methods:

Data was collected as part of routine clinical practice for all patients assessed at a memory assessment clinic in East Sussex, UK. Included patients had an MRI scan and received a formal diagnosis of dementia following assessment. Cerebrovascular and atrophy findings on MRI were quantified using visual analogue scales. Multinomial logistic regression analysis was used to investigate the associations between atrophy on MRI with age, gender, Cambridge Cognitive Examination (CAMCOG), and Hachinski Ischemic Score (HIS). Ordinal logistic regression analysis was used to study the associations between vascular findings on MRI with age, gender, CAMCOG, and HIS.

Results:

Male gender was associated with an increased likelihood of moderate atrophy (Relative Risk Ratio (RRR)=1.92, p=0.048), severe atrophy (RRR=3.03, p=0.006) and regional atrophy (RRR=2.24, p=0.006) on MRI. Higher CAMCOG scores were associated with decreased risk of regional (RRR=0.98, p=0.028) atrophy on MRI. There were no significant associations between age, or HIS, and atrophy on MRI. An increase in age of one year was associated with an increase in severity of vascular pathology reported on MRI (OR=1.08, p<0.001). Male gender was associated with reduced severity of vascular pathology reported on MRI (OR=0.52, p<0.001). There were no associations between CAMCOG, or HIS, and vascular pathology on MRI.

Discussion:

Our data shows that CAMCOG is associated with MRI findings of atrophy and that vascular pathology was greater in older patients. We highlight the importance of using a multi-modal approach in the diagnosis of dementia.

## What's already known about this topic? What does this article add?

- Atrophic and vascular pathology are known to coexist in patients with Alzheimer's and vascular dementia.
- Neuroimaging frequently identifies mixed pathology that may not be identified through clinical assessment and enables clinicians to detect or rule out rarer causes of memory impairment.
- We quantify the ability of two common clinical assessment tools to predict dementia pathology detected on MRI. Our findings confirm the importance of neuroimaging in the diagnosis of dementia.

## Key Words:

Dementia, Alzheimer's Dementia, Vascular Dementia, Diagnosis, Cognitive Assessment, Cambridge Cognitive Examination, Hachinski Ischemic Score, Magnetic Resonance Imaging.

## Introduction

Dementia is a common illness especially among older people. In the UK the mean age standardised prevalence of late-onset dementia in those aged over 65 is 7.1%[1]. Dementia comprises a host of neuropathological syndromes the vast majority of which are chronic and irreversible. Dementia manifests in a myriad of characteristic symptoms which may include disturbance of memory, thinking, orientation, comprehension, calculation, learning capacity, language and judgement and lead to a progressive deterioration in every day function [2]. The most prevalent form of dementia by far is Alzheimer's dementia (AD) which accounts for up to two thirds of cases[1]. The second most common form is vascular dementia (VaD) which accounts for 10-20% of all cases. Dementia with Lewy Bodies and Frontotemporal Dementia are less common but not infrequently encountered[1]. There are also several rarer types. Mixed type pathologies are also common, with atrophic and vascular findings present on neuroimaging in AD and VaD, for example[3].

In the UK the formal diagnosis of dementia is normally undertaken in community memory clinics through the use of clinical and collateral history, mental state examination, cognitive assessment tools, and neuroimaging. In our local service the Cambridge Cognitive Examination (CAMCOG) [4] is used to assess cognition. Other clinical rating scales used include the modified Hachinski Ischemic Score (HIS) which can be helpful in the diagnosis of VaD[5]. These clinical assessments are used to discriminate between different dementia diagnoses, with neuroimaging used to rule out the presence of factors such as tumours and to help in confirming the clinical diagnosis whenever possible. MRI is the most commonly used modality of imaging for investigation of dementia[6]. Validated cognitive assessment tools are used to provide measures of specific clinical components in dementia, however, it remains unclear how well these assessments correlate with the expected pathology on MRI imaging.

In the present study, we aim to explore the relationship between these cognitive/clinical assessment tools and magnetic resonance imaging (MRI) findings in those diagnosed with a dementia illness. To our knowledge this is one of the largest naturalistic studies to assess correlations between cognitive and neuropsychiatric assessments, and MRI findings in dementia.

### Objectives

The objective of this retrospective, naturalistic study was to explore the association between the clinical assessment tools used in a memory clinic and the findings of MRI scans in patients receiving a formal dementia diagnosis. We hypothesised that worse performance on the CAMCOG would predict increased levels of atrophy, whilst positive scores on the HIS would predict increased levels of vascular pathology.

## Methods

### Study design and setting

The present study is a naturalistic retrospective cross-sectional study of patients with a diagnosis of dementia. Data were collected at the time of assessment as part of routine clinical practice at a memory assessment clinic in East Sussex, UK. Patients were referred for assessment and treatment by their general practitioner due to memory complaints between 2004 and 2011. All investigations

following referral to the service, including MRI scans, were completed as part of the routine clinical practice of the memory service.

## Participants

Referral to the memory assessment service was the route of entry for all patients included in the dataset.

### *Inclusion Criteria*

For inclusion patients were required to have received a formal diagnosis of dementia following assessment. Patients receiving a diagnosis of Alzheimer's dementia, vascular dementia, mixed dementia, dementia with Lewy Bodies, frontotemporal dementia and Parkinson's dementia were included in the study. For inclusion, patients were required to have had an MRI scan of the brain completed by the local neuroradiology centre.

### *Exclusion Criteria*

To ensure consistency of reporting, patients who had an MRI scan of the brain at another centre were excluded. Likewise, patients with missing or incomplete MRI outcome data for atrophy findings or vascular pathology were also excluded from the study as were those who had a CT scan instead.

### *Clinical Diagnosis*

Clinical diagnoses of dementia were made using the criteria of the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV)[7].

### *Outcome Measure*

The outcome measure in this study was the presence atrophy and vascular pathology on MRI. Images used by the clinic were all obtained at a single imaging centre and evaluated for the level of abnormalities by one of three consultant neuroradiologists. Magnetic resonance images were graded according to a qualitative visual assessment of both cerebral atrophy and cerebrovascular disease (CVD), which is routinely used to assess patients in a purely clinical setting.

For findings of atrophy, the neuroradiologist visually estimated the extent of these findings. The location and degree of atrophy were qualitatively characterised into 10 subgroups based on the distribution and severity of atrophic changes: no atrophy, minor generalised atrophy, moderate generalised atrophy, severe generalised atrophy, frontotemporal atrophy, temporal or frontoparietal atrophy, parietal or frontoparietal atrophy, frontal atrophy, occipital atrophy and hippocampal atrophy. Due to the small size of some groups, regional atrophy (frontotemporal atrophy, temporal or frontoparietal atrophy, parietal or frontoparietal atrophy, frontal atrophy, occipital atrophy and hippocampal atrophy) was grouped together for the purpose of analysis.

For cerebrovascular findings, the neuroradiologist visually estimated the extent of these findings. Based on the number and extent of lacunes, periventricular hyperintensities, deep white matter hyperintensities, microinfarcts and cerebrovascular lesions, patients were qualitatively categorised into four subgroups of cerebrovascular findings: none, mild, moderate and severe.

### *Predictor Variables*

The predictor variables in this study are based on the clinical assessment tools routinely used in the

memory assessment service. The Cambridge Cognitive Examination (CAMCOG) was used to measure global cognitive status[4]. The modified Hachinski Ischemic Score (HIS) is used as a measure of the likelihood of vascular pathology based on the nature of dementia presentation and vascular risk factors[5]. Clinically a score of 4 or greater on the HIS is indicative of a diagnosis of vascular dementia. Age and sex were included as potential confounding variables.

### Statistical Analysis:

Data were summarised using descriptive statistics and graphical methods. Due a zero inflated distribution of scores on the HIS, and the low frequency of patients scoring above the clinical cut-off of 4 or greater in our study population, we treated the HIS as a binary predictor with a cut-off of 1 or greater.

Multinomial logistic regression analysis was used to investigate the associations between atrophy on MRI with age, gender, CAMCOG, and HIS. Ordinal logistic regression analysis was used to study the associations between vascular findings on MRI with age, gender, CAMCOG, and HIS. Relative risk ratios (RRR) are reported from the multinomial logistic regression and odds ratios (OR) from the ordinal logistic regression, together with 95% confidence intervals. P-values $< 0.05$ were considered significant. The proportional odds assumption for the ordinal regression analysis was checked and no evidence of violation was identified.

Statistical analysis was performed using R version 3.3.2[8]. The 'multinom' function from the 'nnet' package was used for multinomial logistic regression[9]. The 'polr' function from the 'mass' package was used for ordinal regression[9]. Additional auxiliary packages were used for descriptive statistics and graphing[10-14].

## Results:

### Participants

Study participants were drawn from a clinical database containing all patients (n = 652) assessed by the memory assessment service between 2004 and 2011. A flow diagram of study eligibility and exclusion is shown in figure 1. Of the patients assessed by the service during study interval, 502 patients (77%) received a diagnosis of dementia and were eligible for the study. Patients that did not receive a diagnosis of a neurodegenerative disorder or vascular dementia were therefore not eligible for the study. Such patients were mainly diagnosed with one of the following conditions: depression, intracranial tumour, alcoholic dementia, mild cognitive impairment, or normal pressure hydrocephalus.

A total of 33 patients were excluded from the study because either MRI was carried out at another imaging centre, patients were not suitable for MRI scanning (e.g. metal implant), were unable to tolerate it or had a CT scan instead. A total of 469 patients were therefore included in the study.

### Descriptive Data

The study population comprised 204 male patients (43.5%), 252 females (53.7%). The gender of the remaining 13 patients was not recorded. The mean age of male participants was 79.1 years (SD = 6.53, range = 60 to 99), whilst the mean age of female participants was 79.7 years (SD = 6.6, range = 61 to 93).

Patients in the study were diagnosed with a range of dementia diagnoses, most frequently Alzheimer's dementia (62.5%), vascular dementia (15.1%), and mixed dementia (15.4%). Table 1 shows the distribution of all dementia diagnoses within the study cohort.

CAMCOG data was available for 431 patients, with 38 patients having missing data. The mean score on the CAMCOG was 73.0 (SD = 12.8, interquartile range (IQR) = 65.5 to 83.0). CAMCOG data approximated a normal distribution. HIS data was available for 433 patients, with 36 patients having missing data. The mean on the HIS was 0.64 (SD = 1.44, range = 0 to 14). The HIS was treated as a binary predictor for the regression analyses with patients either scoring 0 (n = 305) or ≥ 1 (n = 128).

### Outcome Data

The counts and percentages of MRI atrophy findings are listed in table 2. Occipital, frontal and frontotemporal atrophy occurred infrequently and therefore were grouped with temporal, parietal, or frontoparietal atrophy as a single outcome of regional atrophy in the regression analyses. Table 3 lists the specific regional findings reported in the patient cohort. The counts and percentages of vascular findings are listed in table 4.

The presence or absence of other findings detected on MRI imaging were also recorded for most patients in the study population (n = 465, 99.1%) and are listed in table 5.

### Main Results

Logistic regression of findings of atrophy on MRI imaging on age, gender, CAMCOG, HIS are presented in table 6. Odds of atrophy are expressed relative to no atrophy as the reference level. Male gender was associated with an increased likelihood of moderate atrophy (RRR = 1.92, p = 0.048), severe atrophy (RRR = 3.03, p = 0.006) and regional atrophy (RRR = 2.24, p = 0.006) on MRI. Higher CAMCOG scores were associated with decreased odds of regional (RRR = 0.98, p = 0.028) atrophy on MRI. There was no significant association between age, or HIS (0 or ≥ 1), and findings of atrophy on MRI imaging. The effect of CAMCOG, gender, and HIS on MRI findings of atrophy is demonstrated in a probability plot calculated from the parameters of the logistic regression model in figure 2.

Ordinal regression of findings of vascular pathology on MRI imaging on age, gender, CAMCOG, and HIS, are presented in table 7. An increase in age of one year was associated with an increase in severity of vascular pathology reported on MRI (OR = 1.08, p <0.001). Male gender was associated with reduced severity of vascular pathology reported on MRI (OR = 0.52, p <0.001). Scores on the CAMCOG and HIS did not demonstrate any significant association with findings of vascular pathology on MRI imaging.

The effect of age, gender, and HIS on MRI findings of vascular pathology is demonstrated in a probability plot calculated from the parameters of the ordinal regression model in Figure 3.

## Discussion

### Key Results

Our memory assessment clinic made a dementia diagnosis for 77% of patients referred to the service with memory difficulties. Overall, the range and proportion of dementia diagnoses were in

keeping with national data, however, the diagnostic rate of Dementia with Lewy bodies was lower than what has been reported by some studies[1].

MRI imaging was used as part of the clinic's diagnostic process in 94% of patients. MRI imaging was used alongside history, examination and clinical assessment tools to guide the clinical diagnosis of dementia. In addition to identification of the atrophic and vascular pathology found in dementia, MRI imaging of the study participants also identified 6 patients with tumours, 4 patients with haematomas or aneurysms, 3 intracranial cysts and 55 patients with infarction. In addition to the study participants two patients were excluded from the study after receiving primary diagnoses of normal pressure hydrocephalus and intracranial tumour; both diagnoses would have been made following MRI imaging.

We found that lower CAMCOG scores (indicative of poor performance) were associated with an increased likelihood of severe atrophy on MRI imaging in our population. CAMCOG scores did not demonstrate a significant association with mild, moderate, or regional atrophy, and did not demonstrate a significant association with vascular findings. The association between lower CAMCOG scores and severe atrophy was in keeping with our hypothesis. The association between severe atrophy and CAMCOG performance is likely to be stronger than associations with mild and moderate atrophy, as patients with severe atrophy demonstrate the highest levels of intra-cranial pathology.

Male gender was associated with increased likelihood of moderate, severe, and regional atrophy on MRI imaging in our population. We found that male gender was associated with reduced severity of vascular pathology on MRI imaging in our population. In our cohort gender therefore appears to have a differential effect on atrophic and vascular changes, with males having more atrophic pathology, and less vascular pathology. Gender differences in vascular pathology on MRI imaging have previously been reported in a large population of healthy participants aged 60-90; where females are suggested to exhibit an increased prevalence of white matter lesions, although these results did not reach significance[15].

As expected, we found that increasing age was associated with the likelihood of increased severity of vascular pathology on MRI imaging in our population. This is in keeping with published data on healthy participants aged 60-90[15]. We anticipated finding an increase in atrophic changes with age, however, there was no a significant association between age and atrophy.

No significant associations were detected between the HIS and MRI findings of atrophy or vascular pathology, although scope to identify significant associations was limited due to distribution of results on the HIS and the small numbers of patients scoring highly on the measure in our study population.

## Limitations

The study had a naturalistic and retrospective design, and this limited the data available for the study. Whilst naturalistic studies carry limitations the data they provide is representative of clinical practice, and the methodology facilitated the large sample size of the present study. The decision to use CAMCOG and HIS as key predictors was based on the frequency with which the tools were used clinically in the memory clinic. Both CAMCOG and HIS benefit from over 90% completeness in our population reflecting high rates of use in the local service. Whilst the memory clinic uses a number of other assessment tools, these are used less frequently in the clinic and due to selective deployment of tools by clinicians these would have demonstrated significant sampling bias.

Due to the distribution of scores on the HIS within our study population we were unable to use the clinical cut-off of 4 or greater as a predictor in the regression models. Only 20 patients had a clinically significant score on the Hachinski across all groups. Numbers of patients with a clinically significant HIS with any given combination of variables were too low to act as predictors in the regression model[16].

This study was limited to those patients that were referred to a memory assessment service and received a diagnosis of dementia. This resulted in a restricted range of CAMCOG scores included in the study as CAMCOG used by the service as the main cognitive measure to identify dementia. Inclusion of healthy age-matched controls and patients with mild cognitive impairment would have led to a broader range of CAMCOG scores and may potentially improve the predictive power of the tool for atrophy.

The regional atrophy group consisted of patients 112 with an Alzheimer's pattern atrophy, 21 patients with frontotemporal pattern atrophy, and 2 patients with occipital atrophy. The heterogeneity of this group may have impacted on our ability to detect associations that varied across the different atrophy patterns.

This study used a visual analogue measure of atrophic and vascular findings as used in routine clinical practice. The use of a visual analogue measure could be considered a limitation when compared with more precise methods such as volumetric analysis. Despite the limitations, a visual analogue approach is used in routine clinical practice and was felt to be an appropriate outcome given the naturalistic design of the study.

In this study 69 patients were found to have missing data (age, gender, HIS or CAMCOG) with these patients being excluded from the regression analyses. Comparison between patients with missing and complete data did not find any significant difference between the characteristics of the groups. This supports that the missing data is missing completely at random and would not be anticipated to have impacted on the outcome of the analysis.

## Interpretation

This is a large study assessing the associations between clinical assessment and MRI confirmed pathology findings in dementia patients. The study benefits from robust neuroimaging conducted at a single centre by a small team of senior neuroradiologists. We found a number of small but significant associations between CAMCOG, gender, age and MRI confirmed pathology. We found that both CAMCOG and Hachinski are limited in their ability to predict MRI pathology using our methodology. CAMCOG is used as primary cognitive assessment battery and has a role irrespective of predicting atrophy findings.

The lack of association between CAMCOG scores and the degree of vascular pathology in our study was unexpected. With increasing age we identify increased rates of vascular pathology, but this does not appear to correspond with worsening CAMCOG performance. This raises the question of what impact the vascular damage has in these individuals, and whether, they have a mixed, vascular or Alzheimer's dementia picture. Given vascular pathology is known to increase with age in healthy individuals, it is possible in some individuals that the vascular pathology identified on MRI is related to normal ageing rather than contributing to cognitive decline[15].

Our data did not conform to the known role of the HIS in the diagnostic process in differentiating Alzheimer's and vascular dementia[17]. Whilst we were unable to use the clinical cut-off of the HIS in the regression analyses, we were able to look at the descriptive data using the clinical cut-off. Using

the clinical cut-off of HIS greater than 4 we identified 20 patients (4.3%) reaching the clinical threshold yet identified 71 patients (15.1%) with Vascular Dementia. In patients with a HIS greater than 4 we found 5 (25%) patients received a clinical diagnosis of Alzheimer's dementia, and 1 (5%) received a diagnosis of Parkinson's dementia. This supports the understanding that cerebrovascular pathology can frequently co-exist with a host of neurodegenerative disorders[3].

In our service the HIS is calculated prior to completion of neuroimaging and given that 55 (11.7%) patients were found to have infarction on MRI imaging this may have led to underestimates of the true scores. Measures were completed by a range of clinicians in the memory clinic which may have led to inter-rater differences and variation in the application of the measure[18]. This may have reduced the utility of the HIS in our population versus data from clinical trials.

Whilst clinical assessment tools have only limited ability to predict MRI outcomes, we found a range of clinically significant pathology on MRI scans within our population supporting the ongoing role of MRI scanning in the memory clinic. MRI imaging alone has only limited utility without interpreting it with the rest of the clinical assessment.

### Generalisability

The proportions of dementia diagnoses in our study population are representative of rates in the UK population. The study used a naturalistic methodology and a large sample of patients from the South East of England. The study explored the clinical assessment process in a single memory clinic and explored the associations in the data based on the clinical process used in the clinic. Despite data being gathered from a single clinic we believe our data can be generalised to other similar UK populations.

## Conclusions

In this retrospective naturalistic study we explored the associations between the CAMCOG and HIS and MRI findings in dementia. In keeping with our hypotheses we found data to support an association between poor CAMCOG performance and an increase in severe atrophy and a positive association between older age and vascular findings. We also found differential effects of gender on vascular and atrophic pathology, and further exploration of these findings is required. Whilst our study did not demonstrate a positive association between HIS and vascular damage the HIS is well validated in other populations. Our data shows that clinical assessment tools demonstrate clear associations with MRI findings, however, we highlight the importance of using a multi-modal approach in the diagnosis of dementia.

## Other Information

### Funding:

There are no sources of funding to disclose for this project.

### Conflict of interests:

There are no known conflicts of interest of the authors. The data to be analysed will be considered retrospectively and so there are no conflicts in role between clinicians and researchers.

### Ethical Approval:

This study was approved by the Health Research Authority; under IRAS application number 219001.

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*Table 1: Counts and percentages of dementia diagnoses in study participants*

| Diagnosis | Count | Percentage |
|---|---|---|
| Alzheimer's Dementia | 293 | 62.5 |
| Dementia with Lewy Bodies | 20 | 4.3 |
| Frontotemporal dementia | 9 | 1.9 |
| Mixed Dementia | 72 | 15.4 |
| Parkinson's dementia | 4 | 0.9 |
| Vascular dementia | 71 | 15.1 |
| Total | 469 | 100.0 |

*Table 2: Degree of atrophy findings on MRI imaging in study participants*

| Atrophy Location | Count | Percentage |
|---|---|---|
| No atrophy | 121 | 25.8 |
| Minor generalised atrophy | 87 | 18.6 |
| Moderate generalised atrophy | 80 | 17.1 |
| Severe/major atrophy | 46 | 9.8 |
| Regional | 135 | 28.8 |
| Total | 469 | 100.0 |

*Table 3: Distribution of regional atrophy findings on MRI imaging in study participants*

| Atrophy Location | Count | Percentage |
|---|---|---|
| Frontal and frontotemporal atrophy | 21 | 15.6 |
| Occipital atrophy | 2 | 1.5 |
| Temporal, Parietal or frontoparietal atrophy | 112 | 83.0 |
| Total | 135 | 100.0 |

*Table 4: Distribution of vascular findings on MRI imaging in study participants*

| Vascular Findings | Count | Percentage |
|---|---|---|
| No Vascular | 60 | 12.8 |
| Mild Vascular | 168 | 35.8 |
| Moderate Vascular | 128 | 27.3 |
| Severe Vascular | 113 | 24.1 |
| Total | 469 | 100.0 |

*Table 5: Counts and percentages of other MRI findings detected in study participants*

| MRI Finding | Count | Percentage |
|---|---|---|
| No other finding | 339 | 72.9 |
| Tumour | 6 | 1.3 |
| Hydrocephalus | 2 | 0.4 |
| Haematoma/aneurysm | 4 | 0.9 |
| Infarct | 55 | 11.8 |
| Sinusitis/polyps | 51 | 11.0 |
| Intracranial Cyst | 3 | 0.6 |
| Other | 5 | 1.1 |
| Total | 465 | 100.0 |

MRI = Magnetic Resonance Imaging

*Table 6: Results of multinomial logistic regression of predictors on MRI findings of atrophy (model fitted to N=384)*

| Outcome relative to no atrophy | Predictor | Relative Risk Ratio | 95% CI | p value |
|---|---|---|---|---|
| Mild Atrophy | Age | 1.01 | 0.96 to 1.06 | 0.68 |
| | Gender (Male) | 1.58 | 0.81 to 3.09 | 0.18 |
| | CAMCOG | 1.02 | 0.99 to 1.05 | 0.22 |
| | Hachinski ≥ 1 | 0.72 | 0.35 to 1.48 | 0.38 |
| Moderate Atrophy | Age | 1.03 | 0.98 to 1.08 | 0.28 |
| | Gender (Male) | 1.92 | 1 to 3.67 | 0.048 |
| | CAMCOG | 0.99 | 0.97 to 1.02 | 0.57 |
| | Hachinski ≥ 1 | 1.19 | 0.62 to 2.29 | 0.6 |
| Severe atrophy | Age | 1 | 0.95 to 1.07 | 0.87 |
| | Gender (Male) | 3.03 | 1.38 to 6.67 | 0.006 |
| | CAMCOG | 0.97 | 0.94 to 1.00 | 0.05 |
| | Hachinski ≥ 1 | 1.36 | 0.62 to 3.00 | 0.45 |
| Regional Atrophy | Age | 1 | 0.95 to 1.04 | 0.88 |
| | Gender (Male) | 2.24 | 1.26 to 3.99 | 0.006 |
| | CAMCOG | 0.98 | 0.96 to 1.00 | 0.028 |
| | Hachinski ≥ 1 | 0.75 | 0.41 to 1.38 | 0.36 |

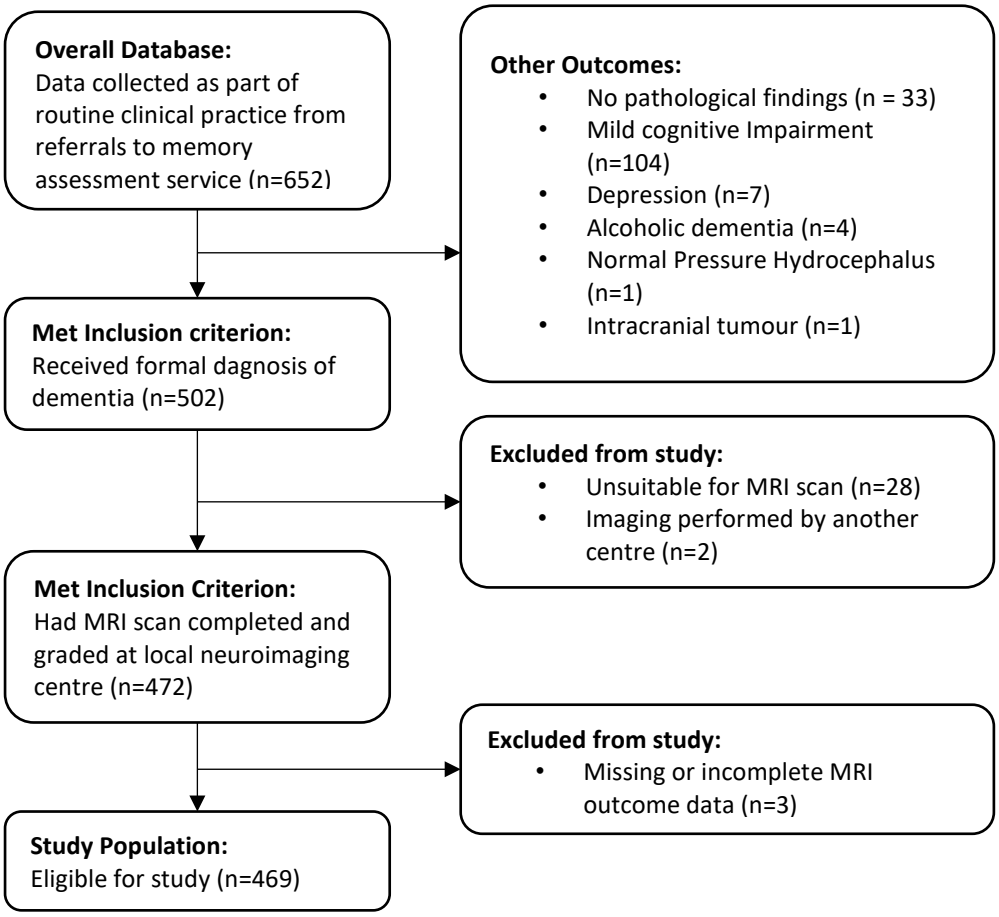
CAMCOG = Cambridge Cognitive Examination, CI = Confidence Interval

*Table 7: Results of logistic regression of predictors against MRI findings of vascular pathology (model fitted to N=384)*

| Predictor | Odds ratio | 95% CI | p value |
|---|---|---|---|
| Age | 1.08 | 1.05 to 1.11 | <0.001 |
| Gender (Male) | 0.52 | 0.35 to 0.76 | <0.001 |
| CAMCOG | 0.99 | 0.98 to 1.01 | 0.25 |
| Hachinski ≥ 1 | 1.36 | 0.91 to 2.02 | 0.13 |

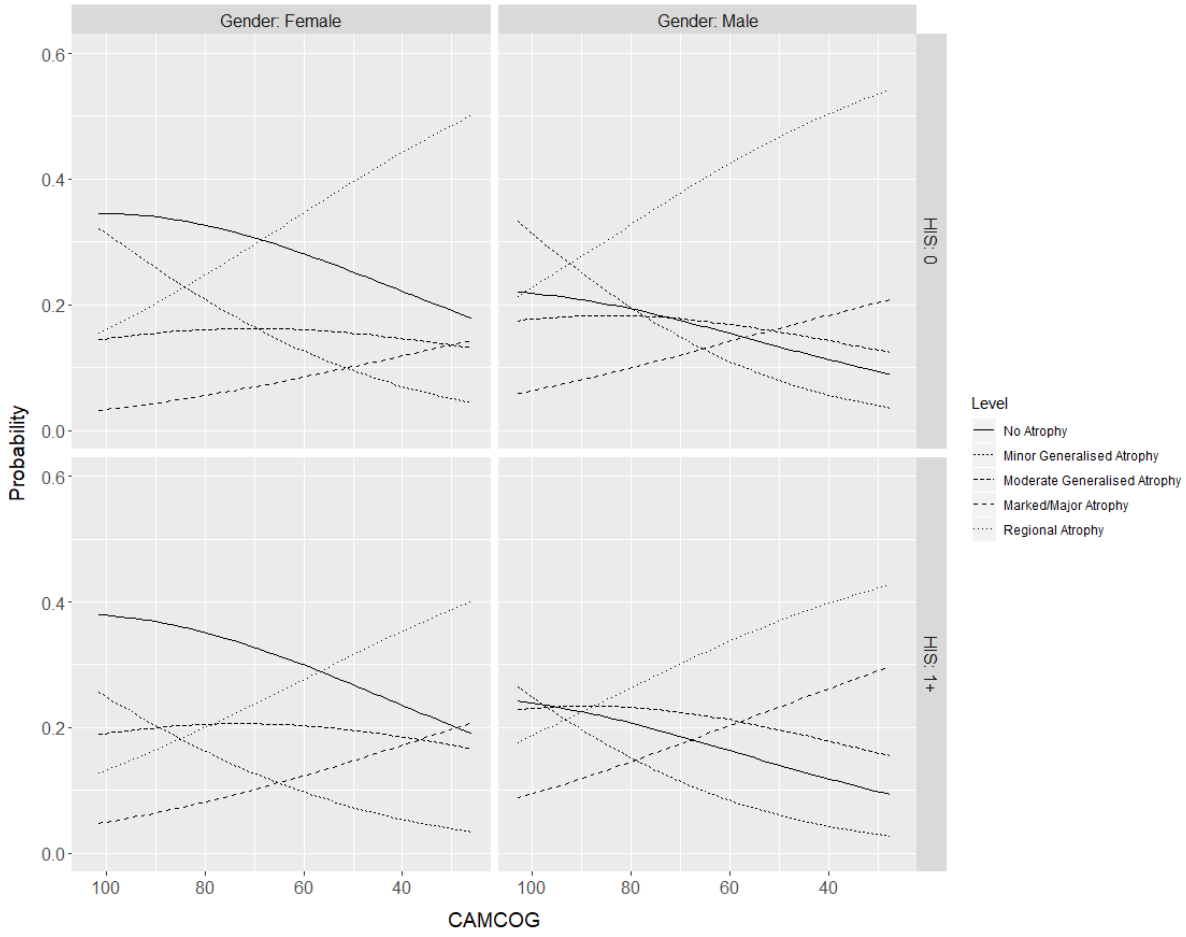
CAMCOG = Cambridge Cognitive Examination, CI = Confidence Interval

*Figure 1: Flow Diagram to show study inclusion and exclusion*



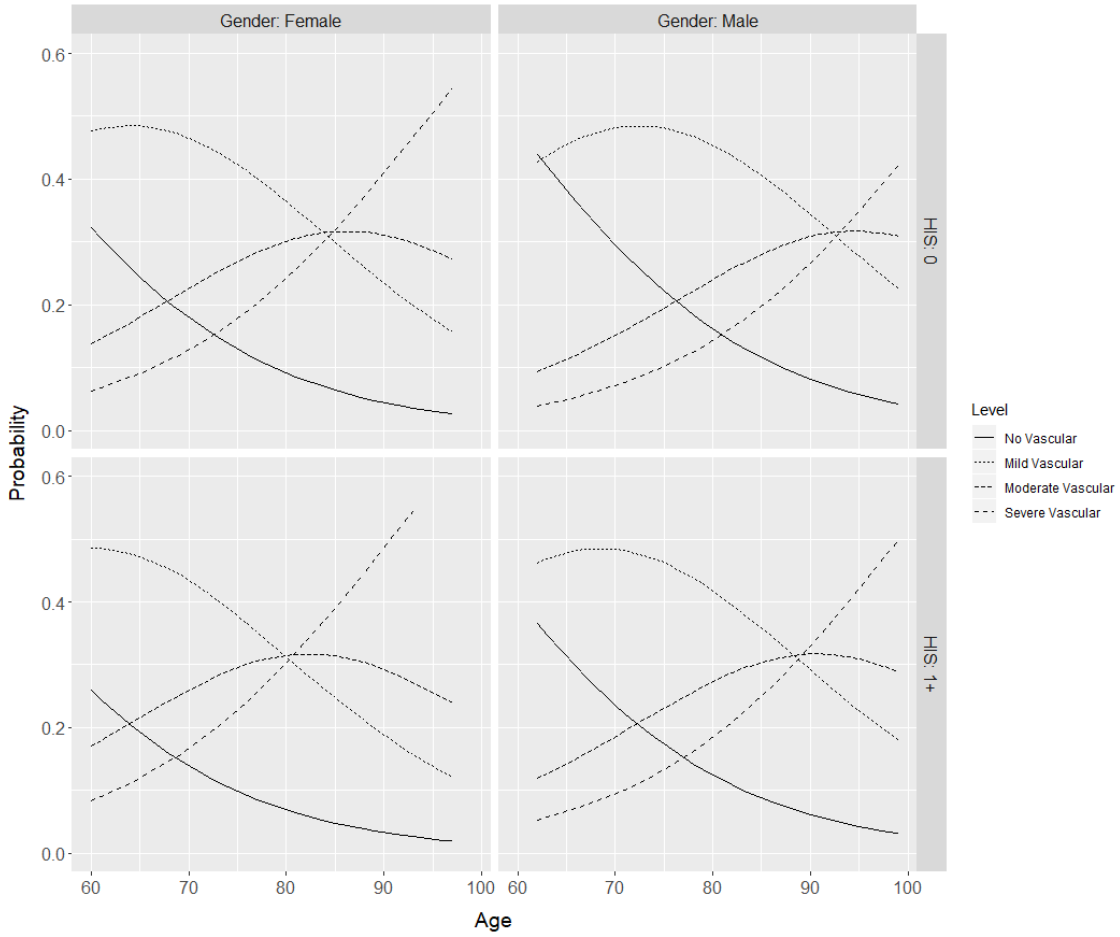

MRI = Magnetic Resonance Imaging

*Figure 2: Plot to show the predicted probability of atrophy findings on MRI against varying CAMCOG, gender and HIS*




MRI = Magnetic Resonance Imaging, CAMCOG = Cambridge Cognitive Examination

*Figure 3: Plot to show the predicted probability of vascular findings on MRI against varying age, gender and HIS*




MRI = Magnetic Resonance Imaging, HIS = Hachinski Ischemic Score