Leukoaraiosis in Typically Aging Adults Compared to Participants with Prior Strokes

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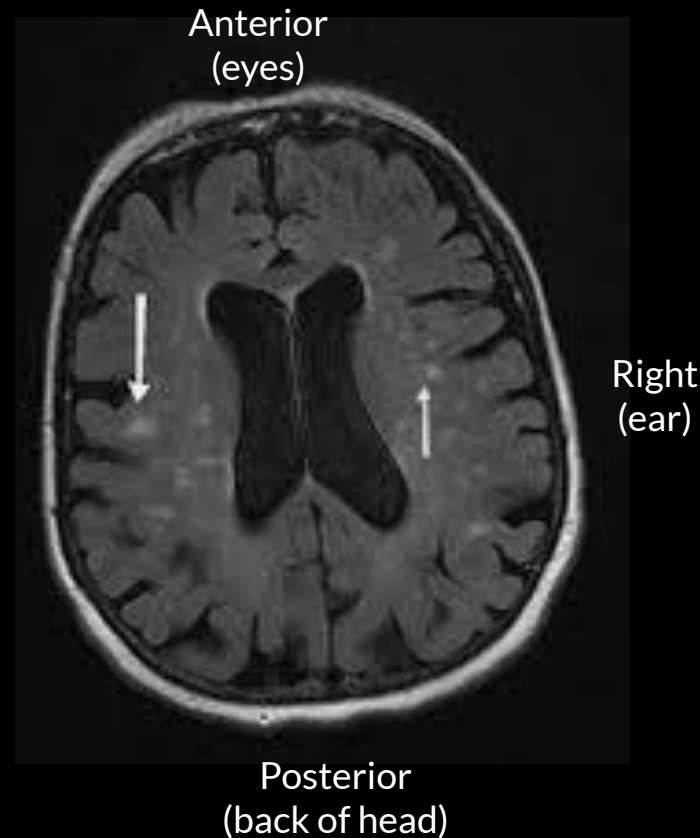
Introduction: Leukoaraiosis

What is it?

Bilateral hyperbright intensity on T2-weighted MR images

What causes it?

Cause is generally unknown, but could be caused by reduced blood flow and hardening arteries as a result of:

- **Cerebral small vessel disease**

- **Diabetes**

- **Hypertension**

- **Age**

- **Sex**

Anterior (eyes)

Right (ear)

Posterior (back of head)

Introduction: Leukoaraiosis in Aging

- Common to typical aging adults (*Simoni et al.,* *2012*)
  - More severe leukoaraiosis has been associated with cognitive decline *(Ross et al., 2005)*
- Age, sex (female), and presence of chronic conditions affecting blood flow (e.g. diabetes, heart disease, hypertension) tend to have more severe leukoaraiosis *(Simoni et al., 2012)*
  - 91,000 participants across 10 different studies

*Examples of leuko in typical aging, mild (left) to severe (right). Axial cross-sections.*
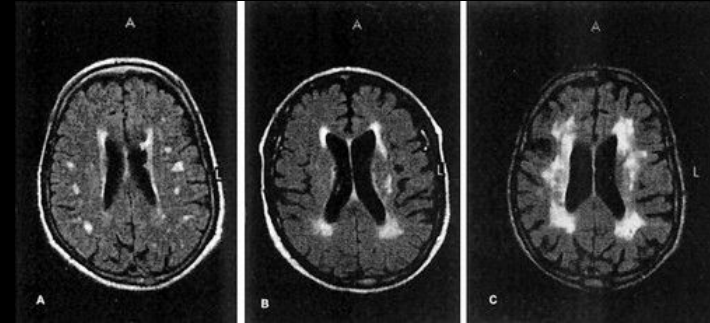
Inzitari, 2003

Introduction: Leukoaraiosis in Stroke

- Presence of leukoaraiosis in stroke is strongly associated with risk of incident stroke and dementia
  - **More leukoaraiosis and stroke = higher risk of dementia and another stroke**
- Leukoaraiosis may also be an independent predictor of stroke outcomes *(Smith, 2010; Basilakos et al., 2019)*
  - **More leukoaraiosis = poorer stroke recovery**

Leuko examples in stroke, leuko highlighted in blue, stroke in bright white
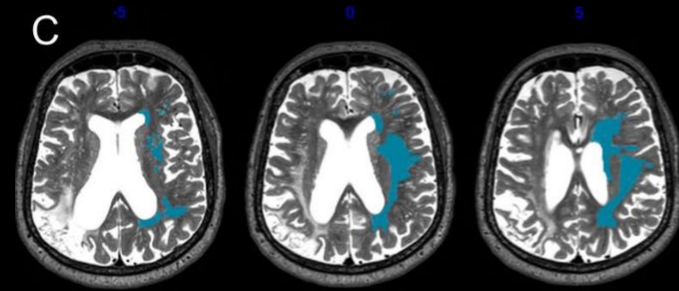
Basilakos, Stark, et al., 2019

Research Gap: Very little work has evaluated the differences in leukoaraiosis severity in stroke survivors versus typical aging peers

Hypotheses

1. Members of the stroke group will demonstrate significantly more severe leukoaraiosis than an age- and education-matched control group
   a. Females will present with more leukoaraiosis than males (as shown in Simoni et al., 2012)

Methods

Subjects

- N=11 (3 females) with chronic left hemisphere stroke (most with clinical aphasia)
  - Average age, M=63.18 years (SD=9.18); Education, M=17.36 years (SD=3.44)
- N=18 (9 females) typical controls (age-matched)
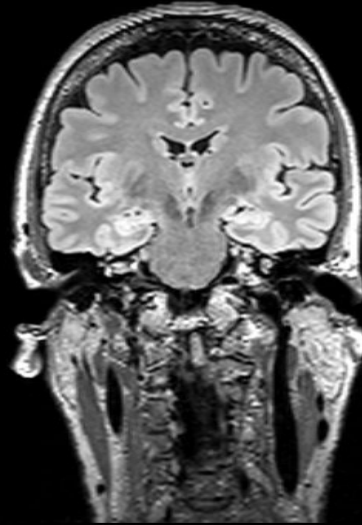 - Average age, M=58.78 (SD=10.14); Education, M=17.39 years (SD=1.91)

Leukoaraiosis Rating

- Fazekas visual rating scale *(Fazekas et al., 1987, 2002)*: scale of 0-3 (3=most severe) for periventricular hyperintensities and deep white matter hyperintensities in right hemisphere only
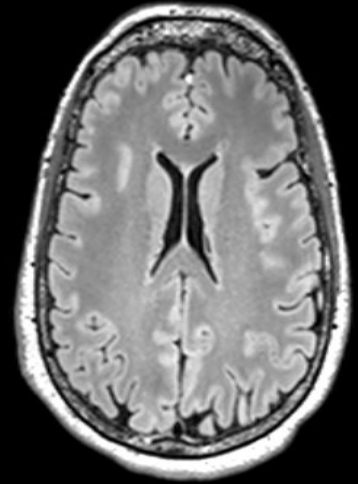- Total Fazekas Score = a score of 0-6, with 6 being most severe

Interpreting brain images

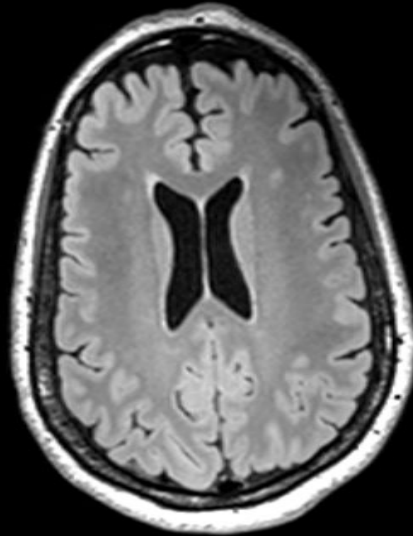Sagittal Plane   Coronal Plane   Axial Plane
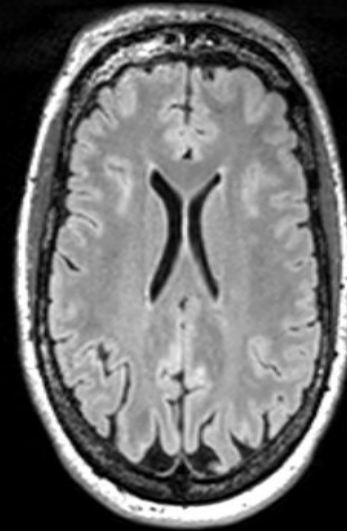
Example Images: PVH *(right hemisphere is right of screen)*
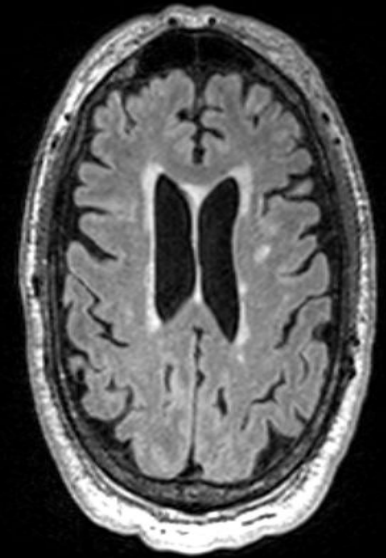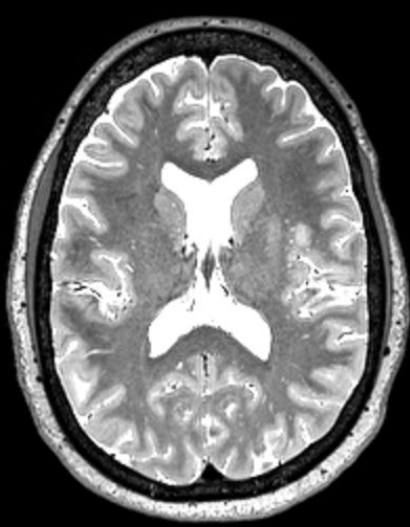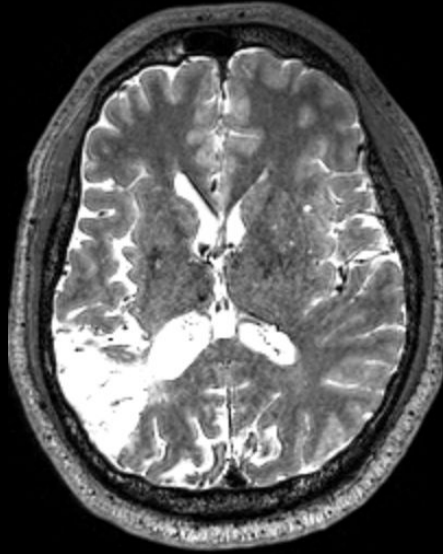
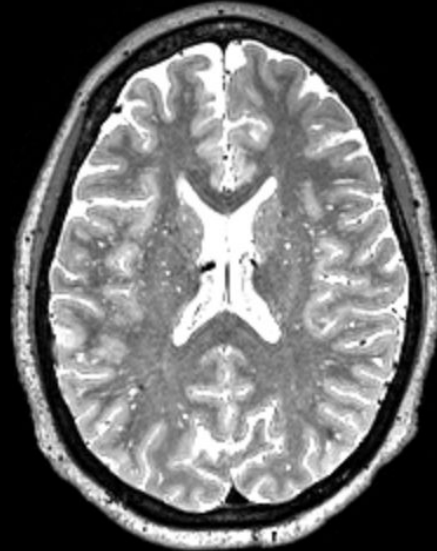Level 0   Level 1   Level 2   Level 3

Example Images: DWMH *(right hemisphere is right of screen)*
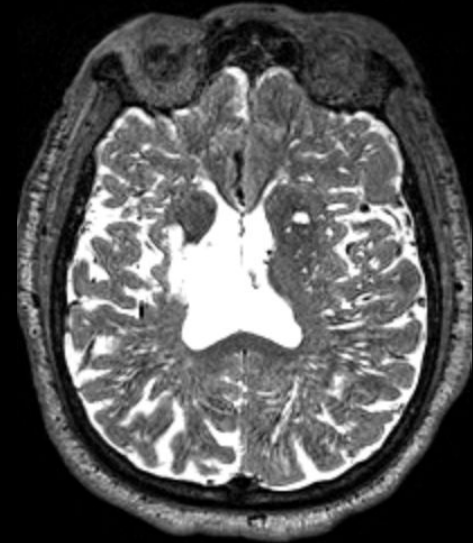
Level 0   Level 1   Level 2   Level 3

Results: Demographics of Groups

No significant difference in age or education between control and stroke group
- Statistical test used: Mann-Whitney U-Test, nonparametric due to sample size
- Age: U=72, p=0.22 *[not significant]*
- Education: U=104, p=0.82 *[not significant]*

No significant difference in proportion of females between control and stroke group
- Statistical test used: Chi-Square, for use in categorical samples
- Pearson Chi Square=1.45, p=0.23 *[not significant]*

No significant difference in proportion of diabetes between control and stroke group
- Statistical test used: Chi-Square, for use in categorical samples
- Pearson Chi Square=1.45, p=0.23 *[not significant]*

Results

Leukoaraiosis severity (total Fazekas score) was not significantly different by group
- Pearson Chi Square=3.93, p=0.56 [not significant]

Leukoaraiosis severity was not significantly related to age or education in our sample (*using Spearman correlation for non-parametric samples*)
- Age, rs=0.04, p=0.42   [not significant]
- Education, rs=-0.27, p=0.078   [not significant]

There was a significant effect of sex and of diabetes across all participants (stroke and control group combined)
- Sex, Chi Square=11.86, p=0.037 [females more severe]
- Diabetes, Chi Square=16.91, p=.005 [presence of diabetes = more severe leuko]

Conclusions

1. No significant difference in leukoaraiosis between those with and without stroke
   - May be driven by small sample size
2. In this sample, leukoaraiosis was not significantly associated with age or education
   - May be because leukoaraiosis is typically most severe in oldest age (i.e. >=75 years), and our sample was substantially younger *(Simoni et al., 2012)*
3. As in other studies, females (N=12) presented with more severe leukoaraiosis despite being younger overall (55.33 years compared with males, 64.06 years) and those with diabetes presented with more severe leukoaraiosis *(Simoni et al., 2012)*

Future Directions

1. Identify the relationship between leukoaraiosis severity and cognitive-linguistic scores
2. Increase sample size with comparable female:male ratios

Note: Data collection cut short because of COVID19 -- this is an ongoing study

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Results: Frequency of Scores by Group

Group	Total Fazekas	DWMH	PVH
	max=6	max=3	max=2
Stroke	N=1 0 N=2 1 N=4 2 N=2 3 N=1 4 N=1 5	N=1 0 N=4 1 N=5 2 N=1 3	N=5 0 N=4 1 N=2 2 N=0 3
Control	N=1 0 N=1 1 N=3 2 N=7 3 N=4 4 N=2 5	N=2 0 N=6 1 N=6 2 N=4 3	N=2 0 N=10 1 N=4 2 N=2 3