

# An Anatomical Assessment of Brain Infarcts: A MRI Study

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## Introduction

Chronic cerebral infarction is the third leading cause of death in the Western world, following non-cerebral cardiovascular disease and cancer. It is also a major cause of long-term disability. One in five patients that present with first-ever stroke will survive to ten years. In the United States up to 780 000 people are annually afflicted with cerebral infarction and it contributes to 150 000 deaths per year.<sup>1</sup>

Infarct is the term used to describe a specific area which has lost its blood supply. The arteries of internal organs that have imperfect anastomoses are referred to as end-arteries. Obstructions of these vessels lead to ischaemia and cause necrosis of that specific part or tissue. Infarction is a result of the acute occlusion of an artery either by a thrombosis or an embolism.<sup>2</sup>

Stroke occurs due to ischaemia or haemorrhage and presents as an abrupt onset of focal or global neurological symptoms that lasts longer than 24 hours. Stroke is mainly caused by thrombosis, cerebral embolism, ischaemia and cerebral haemorrhage.<sup>1</sup>

Currently no studies exist regarding the exact prevalence of brain infarction amongst South Africans. European research stipulates that the most common age group affected is above 55 years of age.<sup>3</sup> This study was therefore conducted to determine the exact prevalence of infarcts amongst the general South African population according to age and sex.

## Aims

The aims of the research study were to determine:

- The percentage of infarcts found in the brain according to the following subdivisions:
  - Dominant brain hemisphere
  - Dominant brain lobe
  - Affected arterial distribution area
  - Anatomical structures affected
- The distribution of infarct type predominance according to the following categories:
  - Different infarct types
  - Age and sex

## Materials and Methods

Patients that were referred for brain MRI examinations at a private radiology practice in Pretoria and who presented with brain infarcts for the period 1 January 2006 until 31 January 2007 were included in the study. A total number of 2 588 patients were referred for brain MRI's during this period. Children (newborn 17 years) were excluded from the study since MRI examinations are only performed on children to investigate specific brain pathologies such as tumours, hydrocephalus and sinusitis. For the above-mentioned timeframe 454 children were examined and 290 (13.58%) patient records could not be found. These patients were therefore excluded from the study. The total sample size for the study was therefore 1 844 patients.

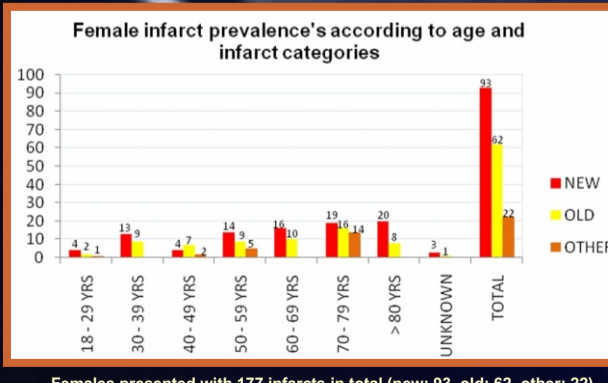
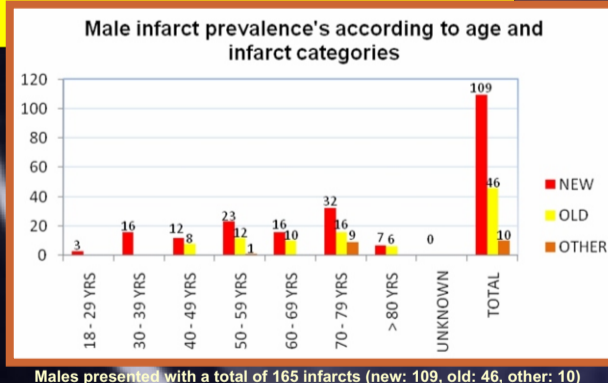
MRI's were carried out with a whole-body 1.5 T MRI-system (Symphony/Avanto; Siemens; General Electric). Continuous 5mm sliced T1-weighted (TR, 500 msec; TE, 10 msec), T2-weighted (TR, 4000 msec; TE, 89 msec), FLAIR (TR, 9000 msec; TE, 125msec), and Diffusion-Weighted (TR, 3100 msec; TE, 89 msec) scans was acquired with the fast spin-echo technique for diagnostic purposes.

All MRI examinations are noted and recorded in a logistics book for reference purposes and statistics. These books were used to compile individual lists of each month, to determine the exact amount of brain MRI's performed. Each month's list was then analyzed and sorted according to sex (male & female) and age. Patients were then categorized according to their ages, by using 10-year interval groups i.e. 18-29 years, 30-39 years etc. This determined the most common age group and sex being affected.

The report for each brain MRI examination was obtained by using the Promed Viking System (Promed Computer Services: 19972005; Build 4.0.0.0). The reports are in a standard format and normally indicate whether or not the patient presented with a normal brain MRI examination, or with pathology. Patients were sorted according to the diagnosis made on the reports, i.e. normal, infarct, and other pathology (sinusitis, tumour, hydrocephalus, etc). Patients that presented with old or new brain infarcts or acute or subacute ischemic incidents were noted as infarcts for this study. This allowed the calculation of the number of infarcts present for each individual month, as well as for the total time period.

Each report also stipulates the exact location of the infarct, i.e. new left frontal lobe and left middle cerebral artery infarct. It further specifies the type of infarct noted, i.e. new, embolic, cerebral or old lacunar in right parietal lobe. The patients were subdivided into old and new infarct categories, according to age and sex. Each patient's infarct type and location was noted. This allowed the calculation of the infarct prevalence, according to the most dominant brain lobe, anatomical structure and infarct type.

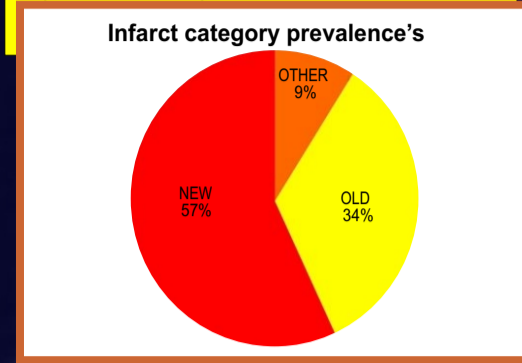
## 2. Prevalence of infarcts according to age and sex



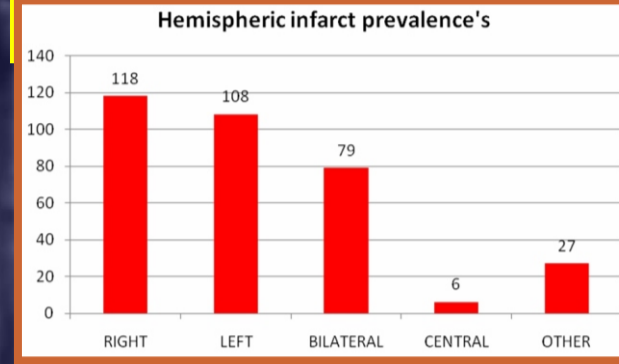
## Results

**1. Total Infarct prevalence**  
Two hundred and ninety nine patients from the sample size of 1844 presented with infarcts. The infarct prevalence was therefore 16.10%. Of these, 21 patients presented with more than one infarct, i.e. an old and a new infarct simultaneously. A further 18 patients presented with infarcts that were classified as old and lacunar. The total number of infarcts was therefore 338.

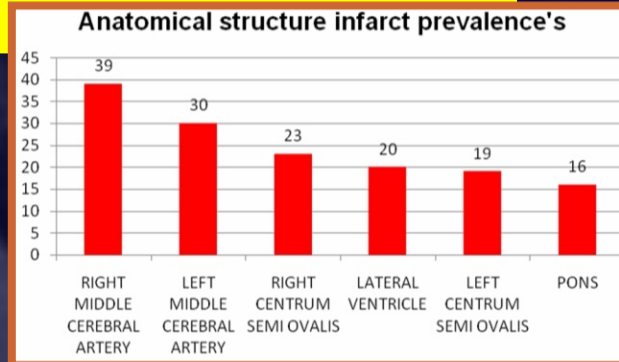
## 3. Prevalence of infarcts according to categories (Old, new, other)



## 5. Dominant hemispheric infarct location

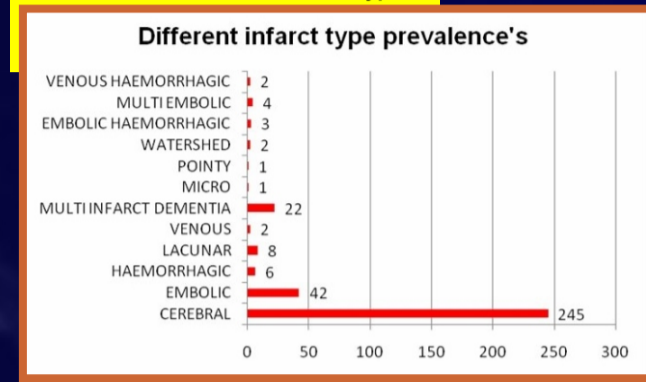


## 7. Dominant anatomical structure infarct location

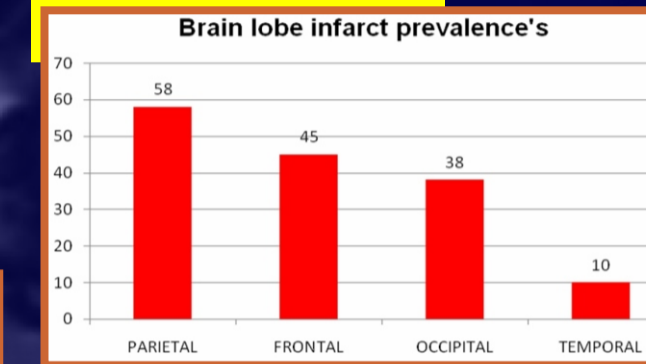


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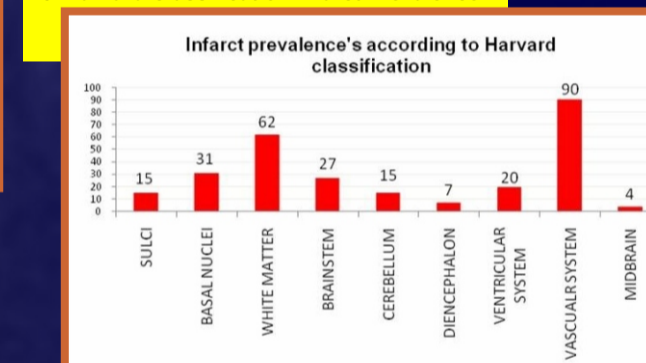
## 4. Prevalence of different infarct types



## 6. Dominant brain lobe infarct location



## 8. Harvard Classification Infarct Prevalence



## Discussion

Of the 338 infarcts noted, 56.80% were new, 33.73% old and 9.47% other types (i.e. lacunar, venous, etc.). Female patients (54.39%) presented with more old infarcts when compared to their male (45.61%) counterparts. Fewer males (31.25%) also presented with other infarct types when compared to females (68.75%). The most common age groups affected by infarcts were 70-79 years (31.36%), 50-59 years (18.93%) and 60-69 years (15.38%).

Normal cerebral infarcts accounted for 72.49% of the infarcts noted. Other infarcts presented with the following prevalence's: Embolic: 14.50%, Multi Infarct Dementia (MID): 7.7%, haemorrhagic: 3.25%, lacunar: 2.37% and venous: 1.18%. Males presented with twice as many infarcts when compared to their female counterparts. Lacunar infarcts only affected people over the age of 50 years and affected more men (62.50%) than women (37.50%). Venous infarcts were only noted in female patients aged 18-29 years and MID only affected patients aged 70-79 years of age. It was also more prevalent in women than men.

The parietal lobe presented with the highest infarct prevalence (34.91%), followed by the frontal lobe (26.03%), occipital lobe (19.53%) and the temporal lobe (11.24%). No significant difference was noted regarding the male to female ratio affected. The right hemisphere (34.91%) presented with mildly higher infarct prevalence than the left hemisphere (31.95%), but the difference was not significant. The right middle cerebral artery (11.54%) presented with the highest infarct prevalence when evaluating anatomical structures affected, followed by the left MCA (8.88%). Females aged 18-29 years of age presented with twice as many infarcts when compared to their male counterparts. The right vertebral artery and the left anterior cerebral artery did not present with any infarcts.

The vascular system (26.63%) presented with the most infarcts and affected males and females of all ages. White matter infarcts presented with 18.34% infarcts. Males aged 18-29 years presented with three times less infarcts when compared to females aged 18-29 years of age.

## Conclusion

This study indicated that women presented with more old infarcts than men, due to the high infarct prevalence's in young females caused by pregnancy and the use of oral contraceptives. The most common age group affected was 70-79 years, which correlates with literature. Lacunar infarcts were more prevalent in men and only occurred in patients over 55 years. Venous infarcts only presented in young females and were mainly thrombotic in origin. MID only affected patients aged 70-79 years of age, as was expected, since this disease occurs due to age-related changes. In our study however, MID was more prevalent in women than men. The right hemisphere presented with mild infarct predominance with the right parietal lobe and right MCA presenting with the highest infarct prevalence's.

The uniqueness of this study is the in-depth evaluation of infarcts according to dominant brain lobe, hemisphere and structures affected, as well as the different infarct categories (old, new, other) and different infarct type prevalence's (i.e. Lacunar, etc.) noted. No other studies have focused on these factors. This study therefore pinpointed the exact infarct locations found and contrasts with other studies which mainly focused on one infarct territory, causative factor, or preferred modality. This is also one of few South African population-based studies performed concerning stroke prevalence's noted in Gauteng. It is recommended that other studies be performed on other populations from different regions in South Africa, focusing on race and socio-economic determinants. This study can therefore be used as a baseline comparative study.

## References

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