



Factors that Influence Survivability of Individuals with Brain Cancer

Onajia Stubblefield and Shesh Rai, Ph.D.

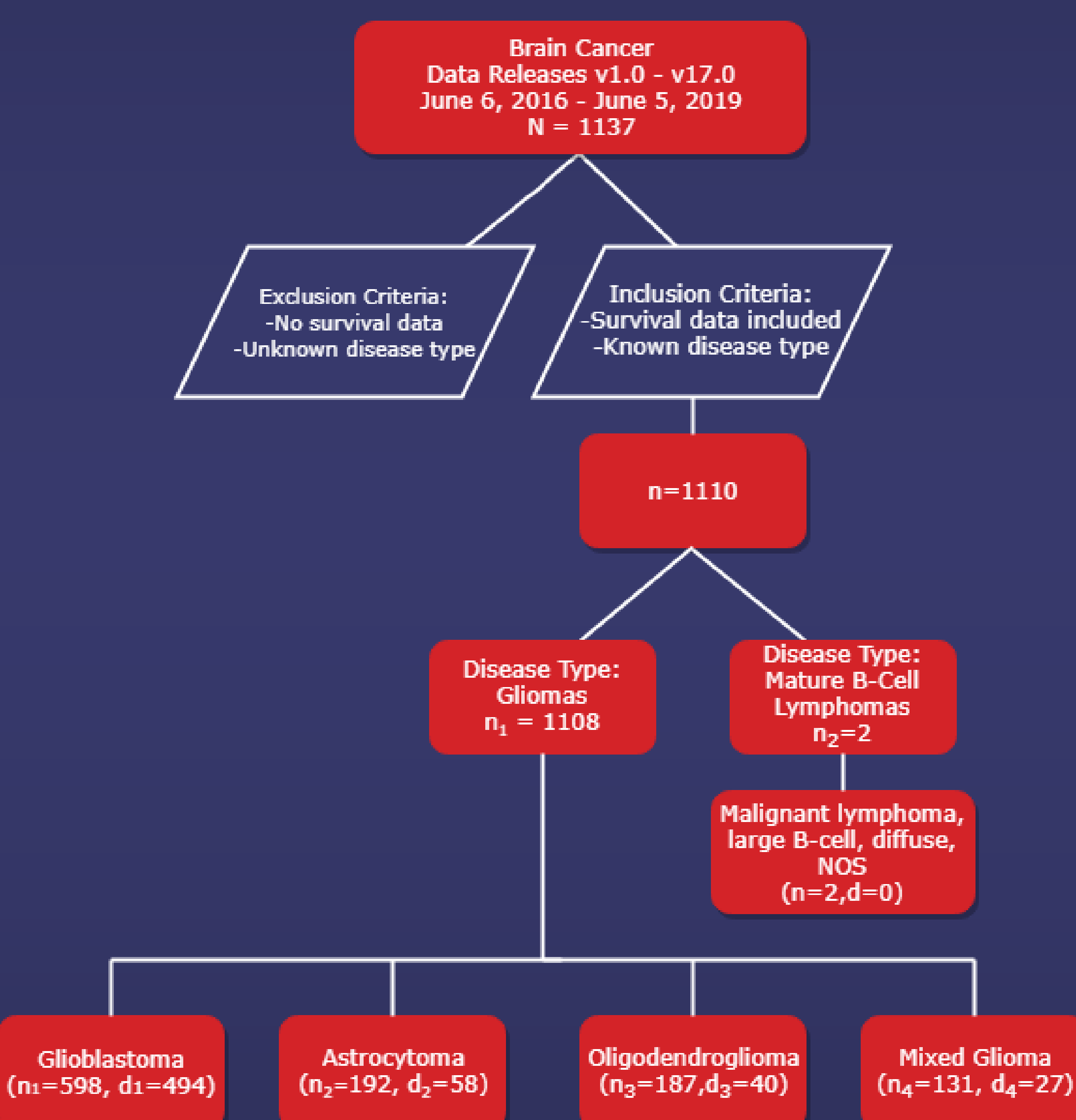
Department of Bioinformatics and Biostatistics

University of Louisville School of Public Health and Information Sciences

Introduction

About 1.4% percent of all new cancer cases in the US are brain cancer ("Cancer of the Brain and Other Nervous System – Cancer Stat Facts."). This year, it is estimated that 23,820 adults in the United States will be diagnosed with primary cancerous tumors of the brain and spinal cord and 17,760 adults will die from brain cancer this year ("Brain Tumor – Statistics."). While the cause of brain cancer is usually unknown, it is possible to approximate and compare the survivability of individuals based on their descriptive, phenotypic, and genotypic characteristics. The objective of this study was to analyze the effects of race, gender, sex, age, diagnosis, and genetic mutations on the survival of individuals with brain cancer from The Cancer Genome Atlas data portal.

Statistical Methods



- 1. Descriptive Statistics:** A summary of the data was made characterizing the four key diagnoses by sex, race, and age of primary diagnosis. Percentages may not add to 100% due to rounding.
- 2. ANOVA Test :** An ANOVA test on the age of diagnosis was run.
- 3. Log-rank Tests:** Log-rank tests were completed to compare the survival curves of males (sex = 1) vs. females (sex = 2), whites (race =0) vs. other races (race = 1), whites (race = 0) vs. blacks (race = 1), and each of the four utilized diagnoses vs. each other.
- 4. Cox Regression of Age, Sex, Diagnosis, and Race:** Two multivariable Cox regressions, whites vs. other and whites vs. blacks, were completed. The races were assigned the same values as in the log-rank tests. By sex, males were assigned the value of 0, while females were assigned 1. Numbers were assigned to diagnoses from highest percentage of deaths to lowest. Glioblastoma, Astrocytoma, Oligodendroglioma, and Mixed Glioma were, respectively, 0, 1, 2, and 3.
- 5. Multiple Correspondence Analysis:** From 20,770 genes, the five genes most commonly mutated and with significant survival times were selected. An MCA was created using indicators of the genes indicators (mutation/no mutation) to classify differences and relationships between the four diagnoses.

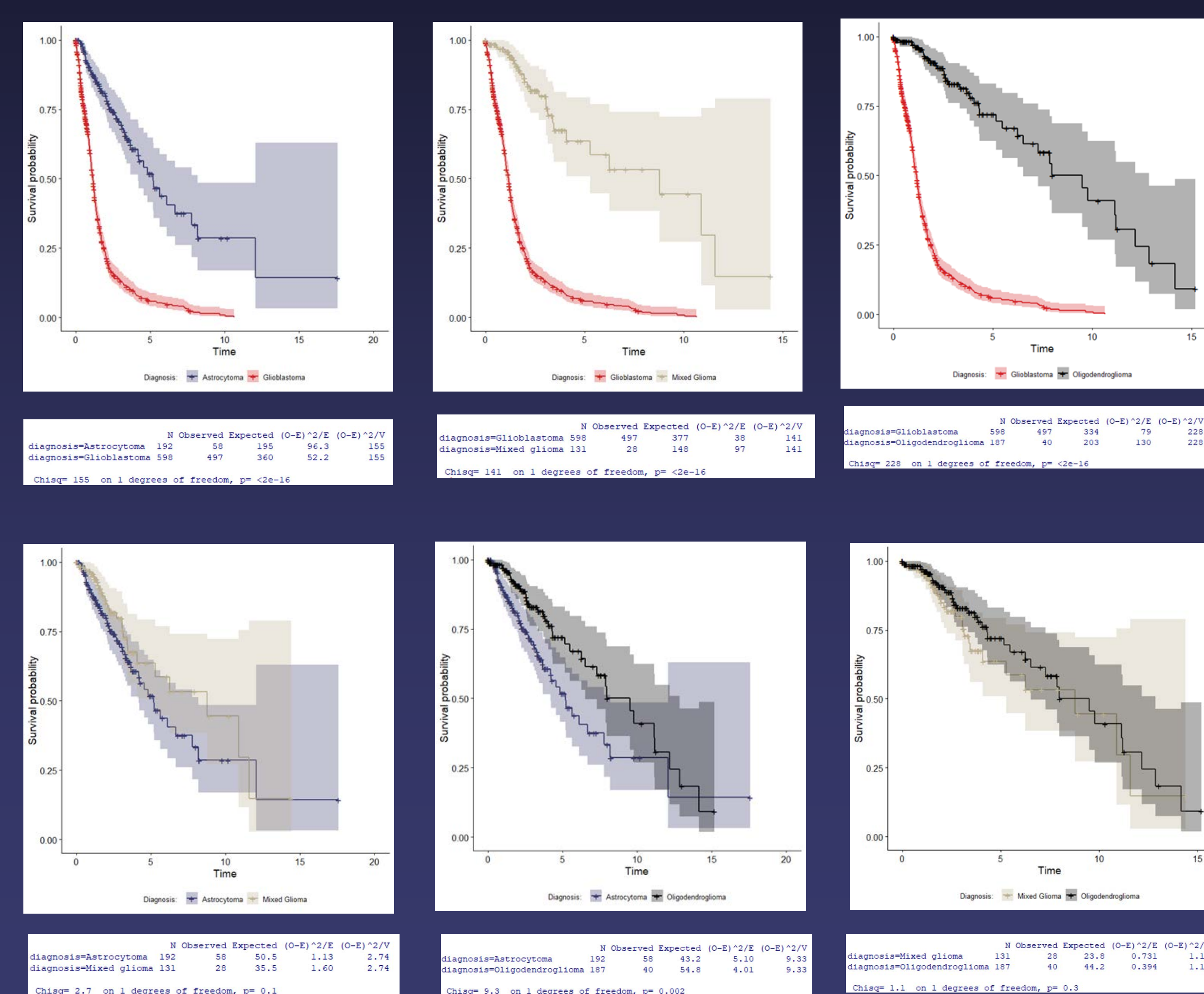
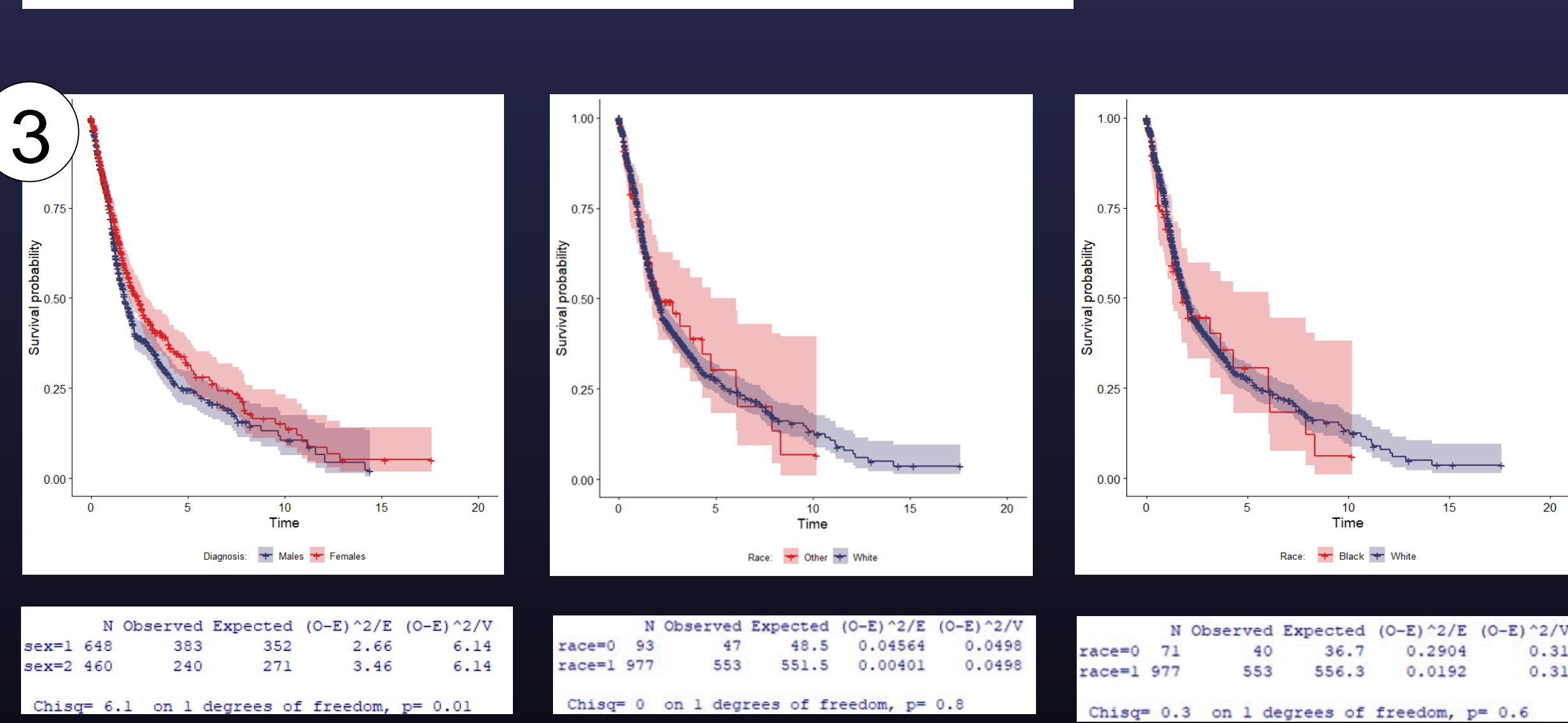
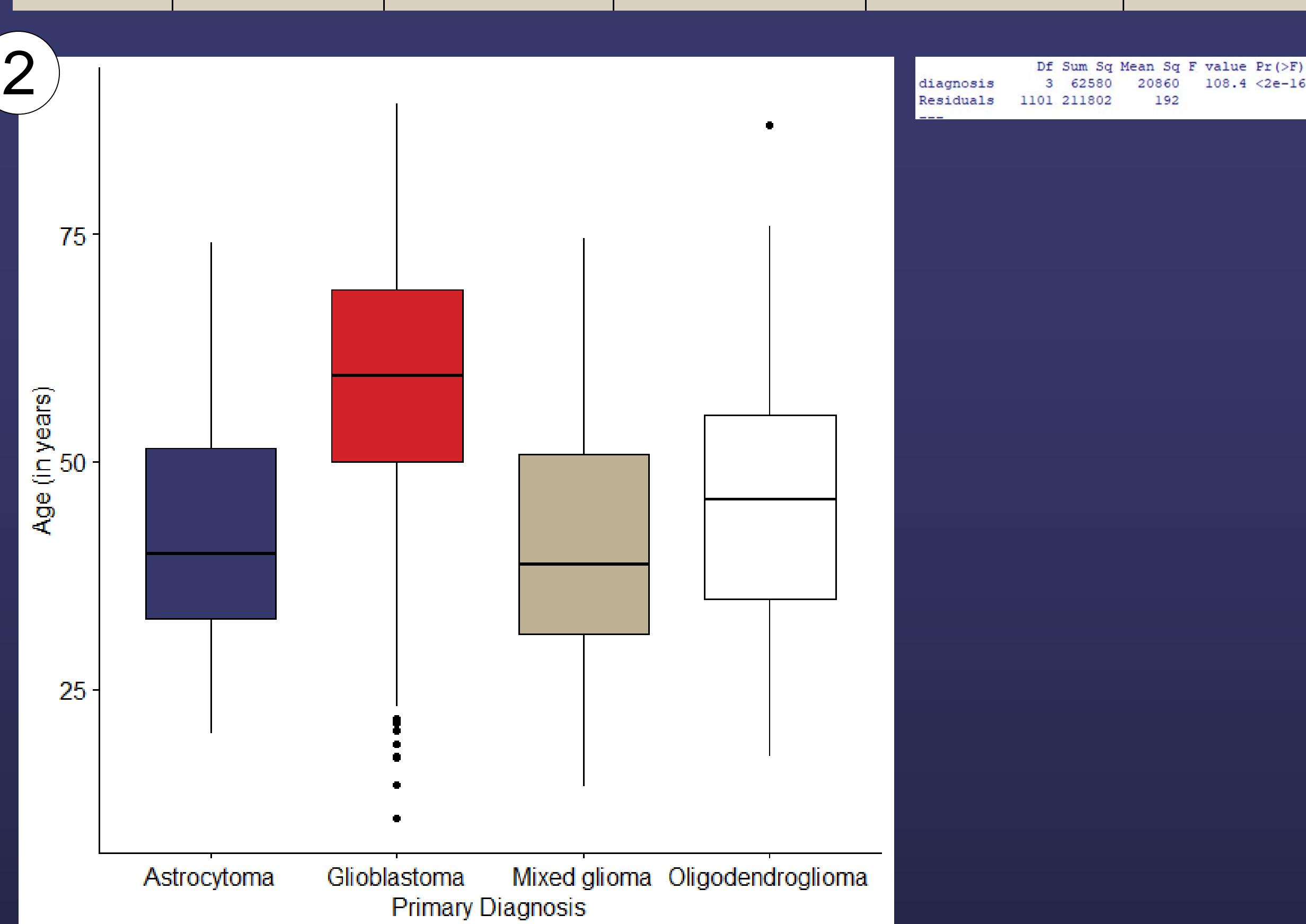
Results

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| | Astrocytoma | Glioblastoma | Mixed Glioma | Oligodendroglioma | Total |
|------------|-------------------------|-------------------------|------------------------|-------------------------|----------|
| Sex | | | | | |
| M | 106 (16.33%, 55.21%) | 366 (56.39%, 61.62%) | 73 (11.25%, 55.73%) | 103 (15.87%, 55.08%) | 648 |
| F | 86 (18.66%, 44.79%) | 232 (50.33%, 39.06%) | 58 (12.58%, 44.27%) | 84 (18.22%, 44.92%) | 460 |
| | 192 | 598 | 131 | 187 | N = 1108 |

| | Astrocytoma | Glioblastoma | Mixed Glioma | Oligodendroglioma | Total |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|----------|
| Race | | | | | |
| Hispanic or Latino | 6 (13.33%, 3.13%) | 14 (31.11%, 2.34%) | 11 (24.44%, 8.40%) | 14 (31.11%, 7.49%) | 45 |
| White | 158 (18.54%, 82.29%) | 430 (50.47%, 71.91%) | 112 (13.15%, 85.50%) | 152 (17.84%, 81.28%) | 852 |
| Black | 7 (11.86%, 3.65%) | 43 (72.88%, 7.19%) | 3 (5.08%, 2.29%) | 6 (10.17%, 3.21%) | 59 |
| Asian | 2 (9.52%, 1.04%) | 13 (61.90%, 2.17%) | 1 (8.26%, .76%) | 5 (23.81%, 2.67%) | 21 |
| N/A | 19 (14.50%, 9.90%) | 98 (74.81%, 16.39%) | 4 (3.05%, 3.05%) | 10 (7.63%, 5.35%) | 131 |
| | 192 | 598 | 131 | 187 | N = 1108 |

| | Astrocytoma | Glioblastoma | Mixed Glioma | Oligodendroglioma | Total |
|-------------------|----------------------|----------------------|----------------------|----------------------|-------------------------|
| Age at Dx. | | | | | |
| Mean (95% CI) | 42.3 (40.5, 44.1) | 58.3 (57.2, 59.5) | 41.5 (39.2, 43.7) | 46.1 (44.2, 48.1) | 51.49 (50.56, 52.42) |
| Median (Min, Max) | 39.8 (20.2, 74.0) | 59.4 (10.9, 89.3) | 38.7 (14.4, 74.6) | 45.9 (17.7, 87.0) | 52.44 (10.90, 89.29) |



4

n = 1070, number of events = 600

```

coef exp(coef) se(coef) z Pr(>|z|)
age 0.041842 1.042730 0.003282 12.751 <2e-16 ***
sex -0.143357 0.866445 0.084407 -1.698 0.0894 .
diagnosis -0.755860 0.469607 0.060834 -12.425 <2e-16 ***
race 0.196799 1.217499 0.152939 1.287 0.1982

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

exp(coef) exp(-coef) lower .95 upper .95
age 1.0427 0.9590 1.0360 1.0495
sex 0.8664 1.1541 0.7343 1.0223
diagnosis 0.4696 2.1294 0.4168 0.5291
race 1.2175 0.8214 0.9022 1.6430

Concordance = 0.788 (se = 0.009)
Likelihood ratio test = 576.2 on 4 df, p < 2e-16
Wald test = 450.1 on 4 df, p < 2e-16
Score (logrank) test = 529.5 on 4 df, p < 2e-16
  
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n = 1048, number of events = 593

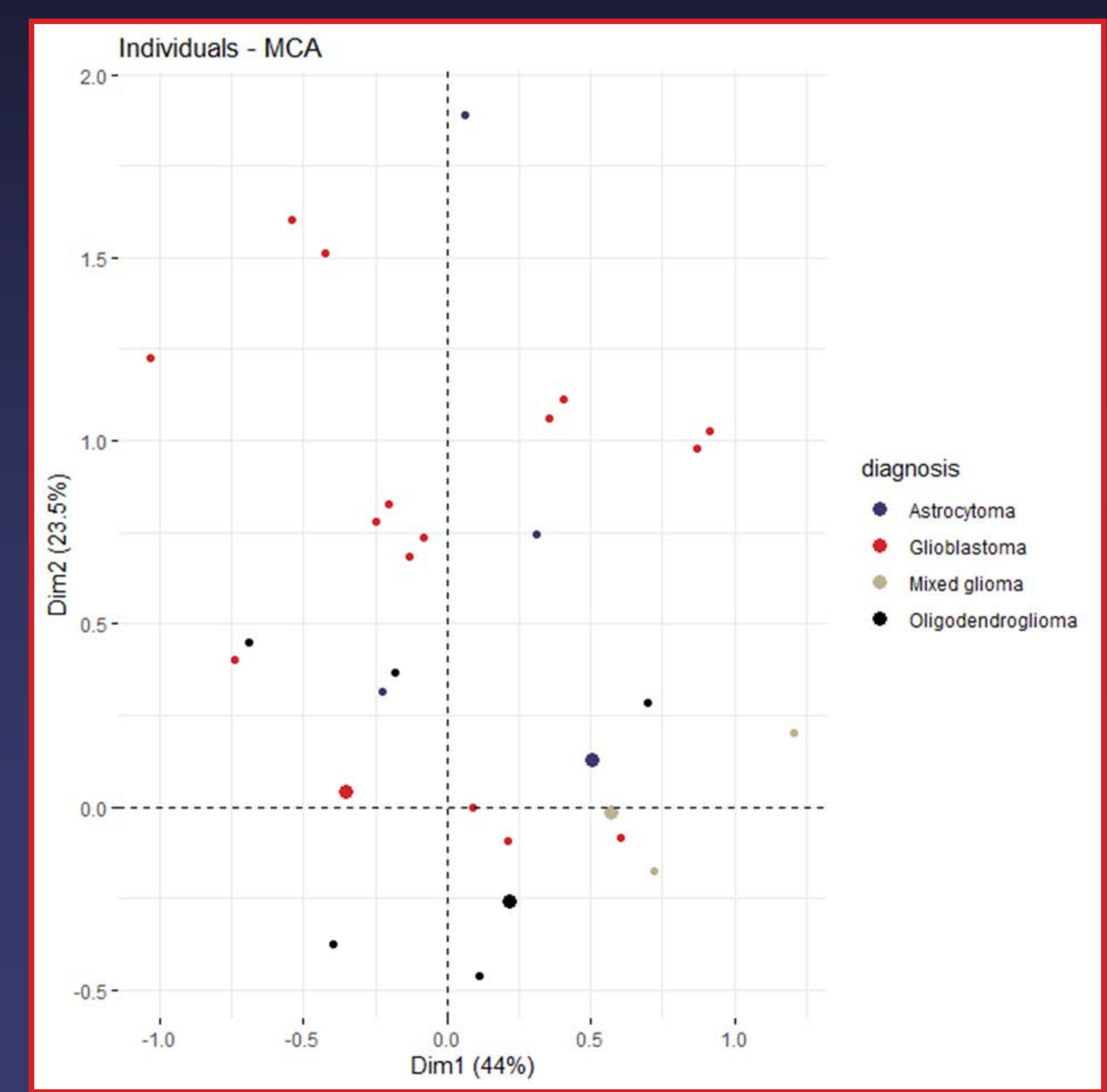
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coef exp(coef) se(coef) z Pr(>|z|)
age 0.041238 1.042100 0.003296 12.511 <2e-16 ***
sex -0.150704 0.860103 0.084979 -1.773 0.0762 .
diagnosis -0.751885 0.471477 0.061088 -12.308 <2e-16 ***
race 0.110645 1.116998 0.164828 0.671 0.5020

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

exp(coef) exp(-coef) lower .95 upper .95
age 1.0421 0.9596 1.0354 1.0489
sex 0.8601 1.1627 0.7281 1.0160
diagnosis 0.4715 2.1210 0.4183 0.5314
race 1.1170 0.8953 0.8086 1.5430

Concordance = 0.787 (se = 0.01)
Likelihood ratio test = 564.5 on 4 df, p < 2e-16
Wald test = 439.6 on 4 df, p < 2e-16
Score (logrank) test = 517.1 on 4 df, p < 2e-16
  
```



Conclusions

- Across all four primary diagnoses, there was a higher percentage of males than females.
- Patients' age at diagnosis with Glioblastoma is significantly different from the other diagnoses (p < .05).
- Age at diagnosis in Astrocytoma and Mixed Glioma are not significantly different (p > .05).
- Irrespective of diagnosis type, survival times significantly differ between males and females (p < .05).
- Survival difference between races is not significantly different (p > .5).
- Survival times are different for Glioblastoma vs. Astrocytoma (p < .05), Glioblastoma vs. Mixed Glioma (p < .05), Glioblastoma vs. Oligodendroglioma (p < .05), and Astrocytoma vs. Oligodendroglioma (p < .05).
- Using the Cox regression model, testing age, sex, diagnosis, and race simultaneously, age (p < .05) and diagnosis (p < .05) are the only two significant predictors of survival.
- The Multiple Correspondence Analysis indicated that Astrocytoma and Mixed Glioma are the most genetically similar diagnoses with Oligodendroglioma being the next similar, and Glioblastoma being the most dissimilar among the four diagnoses.

Acknowledgements

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References:
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 "Brain Tumor – Statistics." Cancer.Net, 18 Mar. 2019, www.cancer.net/cancer-types/brain-tumor/statistics.