Brain Tumor Data Analysis Report

1. Project Summary

This project focuses on analyzing a brain tumor clinical dataset to identify key patterns related to patient demographics, tumor characteristics, treatment strategies, and survival outcomes. The objective was to convert raw medical data into actionable insights that can support early diagnosis, treatment planning, and outcome improvement. Using exploratory data analysis and dashboard-driven insights, the project highlights how tumor stage, treatment combination, and early detection significantly influence patient survival rates.

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2. Business Problem

Healthcare providers face challenges in:

- Identifying high-risk tumor cases early

- Understanding which treatments improve survival

- Monitoring patients requiring frequent follow-ups

Key Questions Addressed:

- How do tumor type and stage impact survival?

- Which treatments result in better patient outcomes?

- What patient groups require closer monitoring?

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3. Dataset Overview

- **Records:** 20,000 patient cases

- **Features:** 19 clinical attributes

- **Data Type:** Structured medical dataset

Key Attributes

- Patient Demographics: Age, Gender, Family History

- Tumor Details: Type, Size, Stage, Location, Histology

- Treatment Details: Surgery, Chemotherapy, Radiation

- Outcome Metrics: Survival Rate, MRI Result, Follow-Up Requirement

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4. Data Preparation & Quality Check

- Verified data completeness (no missing or invalid values)

- Standardized categorical variables

- Validated numerical ranges for clinical relevance

- Dataset was analysis-ready with minimal preprocessing

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5. Methodology

1. Data understanding and cleaning

2. Exploratory Data Analysis (EDA)

3. KPI creation and trend analysis

4. Dashboard visualization

5. Insight generation and interpretation

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6. Key Findings & Insights

6.1 Patient Demographics

- Brain tumors are most common in patients aged **35–65**

- Slight male dominance in tumor occurrence

- Patients with family history show higher malignant tumor risk
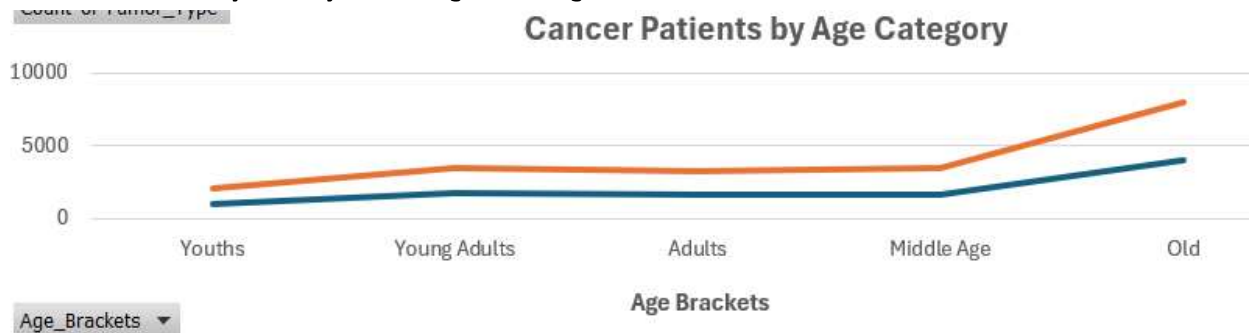
6.2 Tumor Characteristics

- **Benign tumors:** ~52% of cases

- **Malignant tumors:** ~48%, mostly in Stage III & IV

- Tumor size increases with stage progression

- Malignant tumors show faster growth rates

6.3 Tumor Location Analysis

- Most affected regions:

  - Parietal Lobe

  - Temporal Lobe

○ Frontal Lobe

● Certain locations are linked with severe symptoms and advanced stages

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6.4 Treatment Effectiveness

● Surgery is the most commonly used treatment

● Chemotherapy and radiation are mainly applied to advanced-stage tumors

● **Combination therapy (Surgery + Chemo + Radiation)** results in the highest survival rates

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6.5 Survival Analysis

● Benign tumors show survival rates above **80%**

● Malignant tumors have significantly lower survival, especially Stage IV

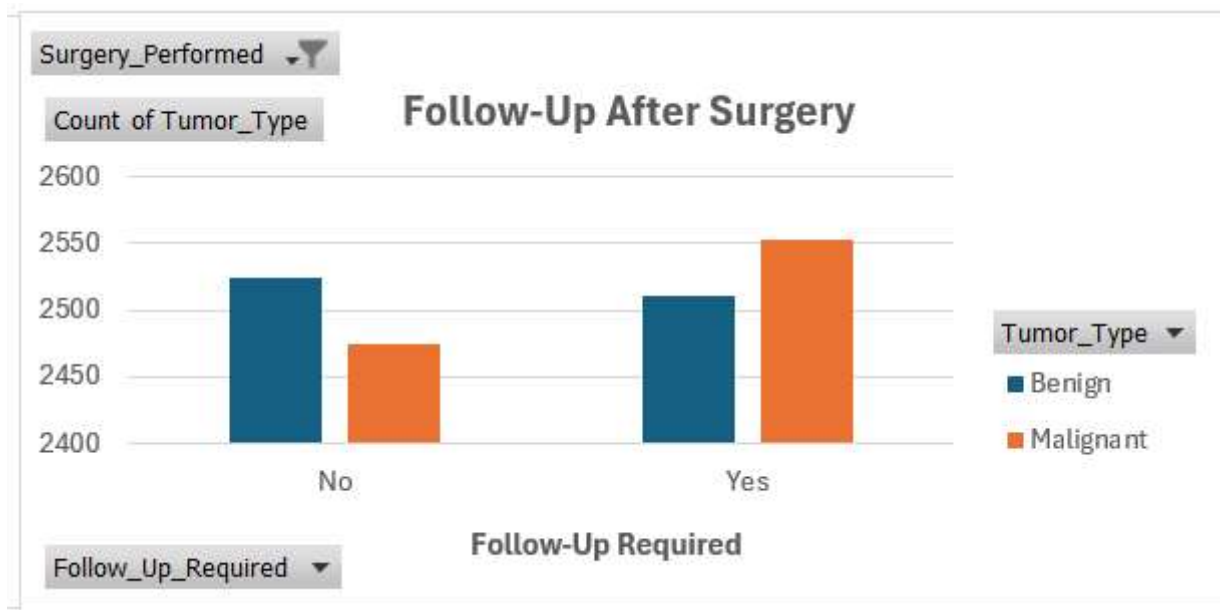● Survival decreases sharply with tumor stage progression

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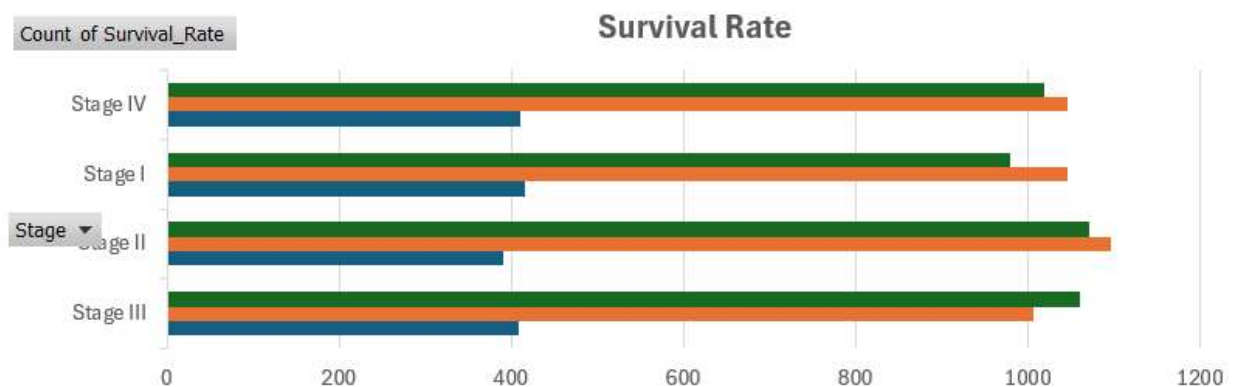
6.6 MRI & Follow-Up Analysis

● Positive MRI results strongly correlate with:

- ○ Malignant tumors

- ○ Larger tumor size

- ○ Mandatory follow-ups

- Follow-up requirement is a strong indicator of patient risk level

7. Dashboard Summary

The interactive dashboard provides:

- High-level KPIs for quick assessment

- Tumor stage vs survival visualizations

- Treatment comparison charts

- MRI and follow-up risk indicators

Dashboard Outcome:
Enabled faster identification of high-risk patients and evaluation of treatment effectiveness.

8. Business Impact

- Supports **early diagnosis** strategies

- Helps doctors prioritize **high-risk patients**

- Improves **treatment planning decisions**

- Enables data-driven healthcare insights

9. Recommendations

1. Introduce early screening for high-risk age groups

2. Use tumor stage and MRI results as primary risk indicators

3. Apply combination therapy for advanced-stage cases

4. Build predictive models for survival estimation

10. Limitations

- Dataset does not include real-time patient updates

- External lifestyle and environmental factors not included

- Survival data is estimated, not longitudinal

11. Future Scope

- Machine learning models for survival prediction

- Real-time hospital dashboard integration

- Treatment recommendation system

- Time-series patient monitoring analysis

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12. Project Conclusion

This brain tumor analysis project demonstrates how structured healthcare data can be transformed into meaningful insights. By identifying the relationship between tumor characteristics, treatment strategies, and survival outcomes, the project showcases the practical application of data analytics in medical decision-making.