PROJECT REPORT

submitted to
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ABSTRACT

This project investigates the comparative effectiveness of standard anti-retroviral therapy and new Ayurvedic therapy in patients with HIV infection using Kaplan-Meier survival analysis and type-1 censoring. Utilizing retrospective data from clinical trials, the study aims to compare survival outcomes between the two treatment groups. The analysis examines survival probabilities over time, considering factors such as treatment adherence and patient characteristics. The analysis methodology and key findings are discussed, along with considerations for future research directions.

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INTRODUCTION

- **Clinical trials** play a pivotal role in assessing the effectiveness of interventions, particularly in the realm of medical research and treatment evaluation.
- **Survival analysis**, a statistical method commonly employed in clinical trials, focuses on determining the length of time until a specific event occurs, such as death or disease recurrence.
- Understanding survival probabilities is crucial for evaluating the efficacy of interventions, especially in contexts where the primary outcome is the length of time until an event of interest.
- The Kaplan-Meier method stands out as a powerful tool for estimating survival probabilities over time, particularly in situations where censoring, such as loss to follow-up or incomplete data, is prevalent.
- By providing estimates of survival probabilities at various time points, the Kaplan-Meier method enables researchers to assess the impact of interventions on prolonging survival and compare outcomes between different treatment groups.
- This study aims to utilize Kaplan-Meier survival analysis and type-1 censoring to investigate the survival outcomes of patients with HIV infection undergoing standard anti-retroviral therapy versus new Ayurvedic therapy.
- Through a retrospective analysis of clinical trial data, this research seeks to shed light on the comparative effectiveness and safety of these treatment modalities, highlighting potential implications for clinical practice and future research endeavors.

MATERIALS & METHODS

01. Survival Probabilities using Kaplan Meier

- Estimates survival probabilities from observed data.
- Uses formula $S(t_i) = \frac{n-d_i}{n}$ for each interval.
- Updates overall survival probability by multiplying interval probabilities.
- Kaplan-Meier curve plots cumulative survival probabilities.

02. Estimation of mean survival time using type-1 censoring:

Survival Rate $\hat{\lambda} = \frac{1}{\hat{u}}$

Mean Survival Time $\hat{u} = \frac{\sum \delta_i t_i + \sum (1-\delta_i) T_i}{\sum \delta_i}$

03. Utilization of data

Survival times from clinical trials evaluating HIV interventions

- **Standard Anti-Retroviral Therapy:** Survival times recorded in days, including asterisks (*) for surviving patients at trial end.

6, 12, 21, 27, 32, 39, 43, 43, 46*, 89, 115*, 139*, 181*, 211*, 217*, 261, 263, 270, 295*, 311, 335*, 346*, 365*

- **New Ayurvedic Therapy:** Survival times recorded in days, including asterisks (*) for surviving patients at trial end.

9, 13, 27, 38, 45*, 49, 49, 79*, 93, 118*, 118*, 126, 159*, 211*, 218, 229*,263*, 298*, 301, 333, 346*, 353*, 362*

RESULTS

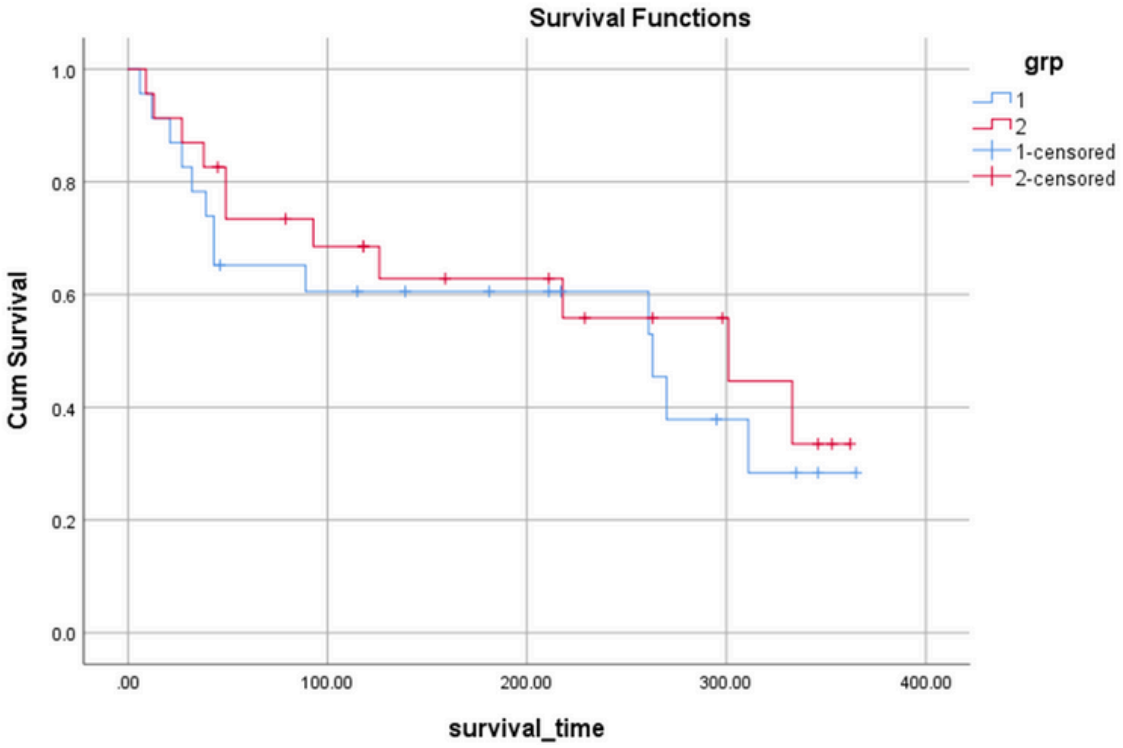
Kaplan Meier Product Limit Estimates — **Outcome**

Group-1

Cumulative Proportion Surviving at the Time	Sl. No.	1	2	3	4	5	6	8	10	16	17	18	20
	Time	6	12	21	27	32	39	43	89	261	263	270	311
	Estimate	0.957	0.913	0.870	0.826	0.783	0.739	0.652	0.606	0.530	0.454	0.378	0.284

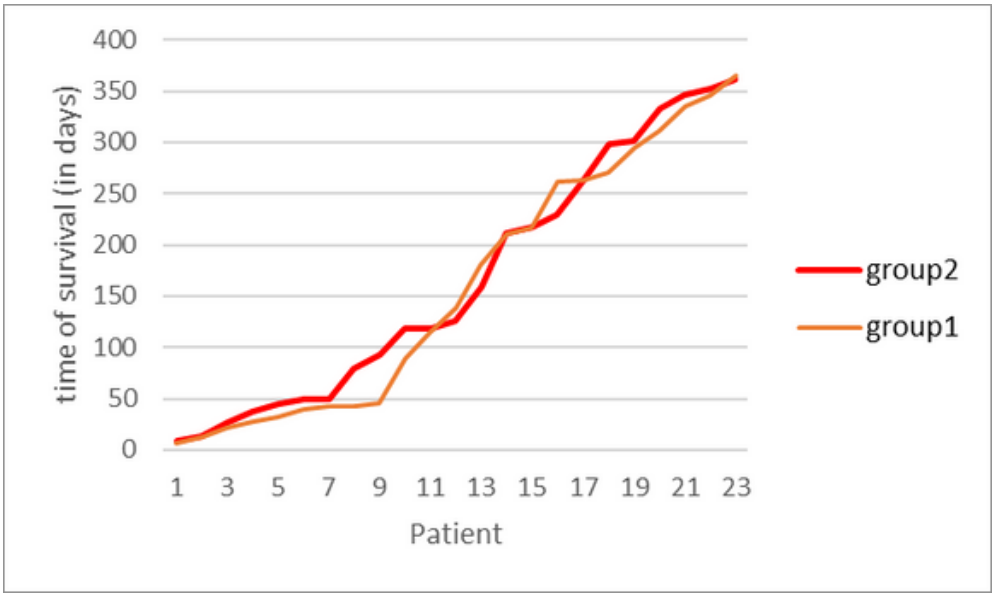
Group-2

Cumulative Proportion Surviving at the Time	Sl. No.	1	2	3	4	7	9	12	15	19	20
	Time	9	13	27	38	49	93	126	218	301	333
	Estimate	0.957	0.913	0.870	0.826	0.734	0.685	0.628	0.558	0.447	0.335



RESULTS

Type-I Censoring	Outcome



Mean survival time	μ	282.0769
Survival rate	λ	0.003545

Group-1

Mean survival time	μ	348.8182
Survival rate	λ	0.002867

Group-2

Interpretation of Kaplan-Meier Results

Both groups exhibited a gradual decline in survival probabilities over time, reflecting the occurrence of event among patients.

- Group 1, receiving standard anti-retroviral therapy, demonstrated slightly higher survival probabilities compared to Group 2, which received new Ayurvedic therapy.
- Notably, Group 1 experienced earlier events, as evidenced by the steeper decline in survival probabilities during the initial follow-up period.

Comparison of Mean Survival Time

Employing type-1 censoring, the mean survival time (μ) for each group was estimated and obtained as

282.08

DAYS FOR GROUP - 1

348.82

DAYS FOR GROUP - 2

These findings suggest that, on average, patients in Group 2 took longer time to recover than those in Group 1, although the difference in mean survival times was not substantial.

- **Survival rate (λ) provides insights into the probability of survival at each time point.**
- **Group 1 exhibited a survival rate of approximately 0.0035, indicating patients take less time to recover.**
- **Similarly, Group 2 demonstrated a survival rate of around 0.0029, signifying a slightly lower but consistent recovery rate.**

Summary of findings

- Group 1 showed both higher survival probability and mean survival time in Kaplan Meier and Type-1 censoring respectively.
- Notably, Group 1 showed higher survival rate compared to Group 2.

CONCLUSIONS

01. Implications for treatment efficacies

- Observed differences in survival outcomes between treatment groups necessitate further investigation into standard anti-retroviral therapy versus new Ayurvedic therapy.
- Besides survival probabilities, factors like adverse events, treatment adherence, and patient characteristics could influence treatment outcomes.

02. Future Directions

- It's essential to acknowledge the limitations of this analysis, including the retrospective nature of the data and potential confounding variables not accounted for in the analysis.
- Future studies could explore additional factors influencing survival outcomes, such as treatment response biomarkers, comorbidities, and socioeconomic factors.

03. Overall Significance

Despite differences in survival outcomes, both treatments offer potential benefits, emphasizing the importance of considering individual patient factors and treatment preferences to optimize outcomes and quality of life.

REFERENCES

To view all calculations, click on this.

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3059453/
2. Applied Stochastic Processes by Sudhendu Biswas
3. Statistical Methods for Survival Data Analysis by Elisa T. Lee and John Wenyu Wang

All calculations and their respective outputs and plots have been performed/obtained using tools like MS Excel, SPSS or R.
We request the viewer to go through the calculations listed along with the formulae utilized in calculating those for at least once.

ACKNOWLEDGEMENTS

We gratefully acknowledge the valuable data sourced from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3059453/ for this project. This project was conducted as part of our final semester coursework in Biostatistics and Survival Analysis. We extend our appreciation to **Prof. Alka Sabharwal** for their guidance and mentorship throughout the course. Additionally, we thank our fellow classmates for their collaboration and insightful discussions during the project.

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