

Log Rank Test Regarding Modern Treatment On Heart Failure

Mohd Asrul Affendi Abdullah^{1*}, Foo Poh Yee¹, Sabariah Saharan¹, Siti Afiqah Muhamad Jamil², Shahiron Shahidan³

¹Department of Mathematics and Statistics, Faculty of Applied Science and Technology, Univeristi Tun Hussein Onn Malaysia, 84600, Campus Pagoh, Muar, Johor, Malaysia.

²Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

³Faculty of Civil and Environmental Engineering, Universiti Tun Hussien Onn Malaysia, Parit Raja 86400, Batu Pahat Johor, Malaysia

*Corresponding author's email: afendi@uthm.edu.my

ABSTRACT: Heart failure is a type of cardiovascular disease (CVD) and the CVD is the top cause of death around the world. There was a study highlighted the survival time of the heart failure patients after received Active ACE inhibitor or Placebo as treatment by using Kaplan-Meier estimator method.. This study aims to test the significance survival time by log rank test. Log rank test is the most common technique of contrasting the survival curves between different groups which takes the whole observation period into account. The log rank test indicated that the treatment groups have significance difference in the estimated survival time with a p-value of 0.00. There is enough evidence to say that the Active ACE inhibitor can proposes longer survival time to heart failure patients than the Placebo

Keywords: Heart failure, Log rank test, Survival time

1. INTRODUCTION

Cardiovascular disease (CVD) has now been the top cause of death around the world. It also has been the leading cause of death in Malaysian. Hence, it needs to find out effectiveness treatment that can propose longer life expectancy for Malaysian to reduce the mortality rate caused by this disease. There was a study using Kaplan-Meier estimator to construct a life table to estimate the survival time of patients after treatment and a Kaplan-Meier survival curve to compare the survival pattern of the patients between Active ACE inhibitor and Placebo treatments[1]. This study gave results that the life table using Kaplan-Meier approach showed the estimated survival time for Active ACE inhibitor group is longer than the Placebo group and the Placebo group experience event more quickly than the Active ACE inhibitor group by compared the Kaplan-Meier survival curve between two treatment groups. However, this study did not implement any significance test to prove that the result is significance enough. Rather than provide a comparison of the total survival experience of the two groups, Kaplan-Meier survival curves only compare the survival between different groups at some specific time and gives a contrast at one particular time point **Error! Reference source not found.** This is the weakness of comparing Kaplan-Meier survival curve of two different groups

Error! Reference source not found. To overcome this weakness, a significance test can be implemented.

Log-rank test is a significance test that can provides chance to predict survival probabilities and to contrast the survival between groups. As **Error! Reference source not found.** proposed that the log-rank test not able to test the consequent of the other explanatory variables but it normally used to examination whether the observed groups have statistically different in survival times. This study aims to find out the treatment that proposes longer estimated survival time for the heart failure patients based on a significance test, Log rank test and to prove that the result obtained from the investigated study is correct.

2. METHODOLOGY

Log Rank Test

The log rank test implements for the future study. The log rank test is the most common technique of contrasting the survival curves between different groups which takes the whole observation period into account [4][5]. The log rank test followed the same assumptions of Kaplan-Meier method hence it would be an appropriate test for this study. The log-rank test addresses the null hypothesis of there the probability of an event is same for any time point. These exposures can help in define whether there is significance difference between two treatments. The log rank statistic is approximately distributed as chi-square test statistic and the formula is as follows **Error! Reference source not found.**

$$\chi^2 = \sum \frac{(\sum O_{jt} - \sum E_{jt})^2}{\sum E_{jt}}$$

where

$\sum O_{jt}$ - total of the observed number of events (deaths) in the j th group of treatment over time

$\sum E_{jt}$ - total of the expected number of events (deaths) in the j th group of treatment over time

$j = 1, 2$

The observed and expected numbers of events at every single event time in each group need to calculate before calculate the test statistic. The expected number of events

is solved at each event time in each group according to the following equation:

$$E_{jt_i} = N_{jt_i} * \left(\frac{O_{jt_i}}{N_{jt_i}} \right)$$

N_{jt_i} - number at risk in the j^{th} group of treatment at i th ordered time

O_{jt_i} - number of observed events (deaths) at i th ordered time

N_{jt_i} - total the number at risk at i th ordered time

$j = 1, 2$

$i = 1, 2, 3, \dots, n$

The test statistic is approximately distributed as chi-square with $k - 1$ degree of freedom, where k is the number of comparing groups. The critical value for the test $\chi^2_{\alpha, v}$ can be learning in the table of Percentage Points of the χ^2 Distribution with significance level of 0.05.

3. RESULTS AND DISCUSSION

The log rank test used to define whether there is significance difference between Active ACE inhibitor treatment and Placebo treatment. The null hypothesis and the alternative hypothesis are stated as below.

Null hypothesis, $H_0: S_1(t) = S_2(t)$ / There is no difference regarding survival among two treatments.

Alternative hypothesis, $H_a: S_1(t) \neq S_2(t)$ / There is difference regarding survival among two treatments

Table-I: Log rank test's output for Placebo and Active ACE inhibitor group.

	Chi-Square	df	Sig.
Log Rank (Mantel-Cox)	21.273	1	0.000

Table-I displays the output of log rank statistics. The log rank statistic for the treatment group is 21.273 and the p value is 0.000. Since the log rank statistic $\chi^2 = 21.273$ is larger than critical value, $\chi^2_{0.05, 1} = 3.841$; the p-value (0.00) is less than the significance level of 0.05 hence the null hypothesis is rejected and there is difference regarding survival among Active ACE inhibitor treatment and Placebo treatment.

4. CONCLUSION

The log rank test result showed that there are enough evidence to reject the null hypothesis of there is no difference regarding survival among two treatments and conclude there is difference regarding survival among Active ACE inhibitor and Placebo at 5% level of

significance. It proved the result obtained from the investigated study by using Kaplan-Meier estimator is correct. As a nutshell, the Active ACE inhibitor is the treatment which can proposes longer survival time for the heart failure patients compared to Placebo. This treatment should be wisely using for the heart failure patients. In future study, investigation on other treatments in heat failure diseases can develop by using Kaplan-Meier estimator method and log rank test to find out the most effectiveness treatment for heart failure patients. Since, there are other treatments besides Active ACE inhibitor and Placebo.

ACKNOWLEDGEMENT

I would like grateful to Research Management Center (RMC) Universiti Tun Hussien Onn Malaysia for the financial support.

REFERENCES

- [1] Abdullah, M. A. A. & Foo, P. Y (2019). Kaplan-Meier Estimator Regarding Modern Treatment On Heart Failure.
- [2] Jager, K. J., Van Dijk, P. C., Zoccali, C., & Dekker, F. W. (2008). The analysis of survival data: the Kaplan–Meier method. *Kidney international*, 74(5), pp. 560-565.
- [3] Goel, M. K., Khanna, P., & Kishore, J. (2010). Understanding survival analysis: Kaplan-Meier estimate. *International journal of Ayurveda research*, 1(4), pp. 274.
- [4] Bland, J. M., & Altman, D. G. (2004). The logrank test. *Bmj*, 328(7447), pp. 1073.
- [5] Schober, P., & Vetter, T. R. (2018). Survival analysis and interpretation of time-to-event data: the tortoise and the hare. *Anesthesia and analgesia*, 127(3), pp. 792.