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# Influencing factors that improve mental conditions patients with complementary therapy at Nur Hidayah Hospital, Bantul, Yogyakarta

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**Abstract.** Mental health is a concern of many parties. Complementary therapy is carried out in line with physical treatment with the aim of reducing the number of cases of mental health disorders, one of them at Nur Hidayah Hospital. This study used random forest and extended Cox regression to determine improvement in the mental condition of patients with complementary therapy. The research data used data from the medical records of 102 patients with Al-Quran Complementary Therapy. Random forest classifier does not give good accuracy only 0.58. Log-rank test showed that the variables attitude, problem Prayer, interaction history and treatment reactions had different survival curves between the categories of each variable. The interaction history variable does not meet the proportional hazard assumption so that the Cox model used is stratified and time-dependent Cox. The best model is the Cox stratified model with the interaction having the smallest AIC value of 286.84. Factors that have a significant effect on the time to improve mental conditions are gender and the main complaint in the patient strata who have a history of interaction and the age variable in the stratum of patients who have had a history of interaction.
**Keywords:** Al-Quran, Complementary Therapy, Extended Cox, Mental Conditions, Survival.

## 1 Introduction

Mental health is concerning issue around the globe. It is related to mental state and well-being enabling a person to cope with pressures in life, realize their abilities, study well and work well, and contribute to society. Hence, mental health plays an important role in supporting the productivity and quality of physical health. Up to 20% of the Indonesian population has the potential of mental disorders [1]. This number is unexpectedly high is due to the limited number of experts capable of carrying out prevention and control efforts and the lack of a recording and reporting system related to mental disorders.

Complementary and alternative medicine (CAM) is a treatment that includes a variety of approaches ranging from a mental approach through religious aspects (Al-Qur'an, prayer), spiritual which shows positive results on the patient's mental health condition [2]. This complementary medicine has been used in many countries [3-5]. The use of this therapy has also been developed in Indonesia, one of which is carried out by the Nur Hidayah Hospital, Bantul, with the practice of complementary therapy in the form of Al-Quran therapy and complementary units. This unit accepts patients based on the results of medical observations who have a low mental condition so that they require complementary therapy and can come from the wishes of the patient without medical complaints. Complementary therapy is expected to have a significant positive influence in the process of improving the patient's mental condition. Information about the patient's mental improvement time with complementary therapy is also very important to note in treatment efforts. Medical personnel will receive related information so that it becomes educational material for patients and as an evaluation for the development of complementary therapies.

Complementary therapy Al-Quran combine mental focus and spirituality to help relax the body and mind. Religion and spirituality are known as important roles in coping with illness. Previous studies examining the holistic nursing approach should include religion and spiritual interventions, since pain, negative experiences such as mental stress are frequently present in medical problems [6] and other studies use of CAM in Saudi older adults using multivariable Cox regression showed that the death hazard ratio in 2006 and 2015 showed no

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ifference in mortality between groups of CAM users and nonusers [7]. Many previous studies have examined descriptively [2,4,7,8] while the analysis regarding the time to improve complementary therapy is still limited. Some of the factors that are suspected to be the affected improvement of mental health condition is gender. Information on the patient's mental improvement time with complementary therapy is also something needs to be considered as a treatment effort. Therefore, it is needed to see the relationship between time to event and the factors that are suspected to influence. The survival analysis is useful statistical methods to analyse the timing of event.

Therefore, the objectives of this study are to classify patient status based on predictor variables using random forest and discuss the time of mental improvement of patients with complementary therapy using extended Cox regression. This study was conducted to provide additional literature regarding the analysis of time for improving mental conditions and to find out the influencing factors, especially for cases of complementary therapy patients at Nur Hidayah Hospital using Cox regression survival analysis. This model aims to determine which factors that influence and how much its influence on the time of improving mental health in patients with complementary therapy Al-Quran.

Time of improving mental conditions is calculated from the patient's admission to the hospital until the mental condition improves (mental conditions improve with a marked decrease in attitude values, prayer problem and interaction history to zero). The value of attitude, prayer problem and interaction history are represented by 0, 1 and 2, respectively. Factors that are hypothesized to have an influence are attitude values, religious disturbances, history of interaction, gender, age, marital status, education, main complaint, chronic disease history and therapeutic reactions. The outcomes of this study are essential for healthcare providers and decision-makers to evaluate healthcare practices and to develop strategies that improve mental health.

## 2 Material and methods

### 2.1 Data source

The data used in this study is secondary data taken from the medical records of 102 patients at the Complementary Unit of Nur Hidayah Hospital, Bantul Regency from 1 January 2020 to 15 May 2022.

### 2.2 Complementary therapy Al-Quran

This Complementary unit accepts patients based on the results of medical observations who have a low mental condition so that they require complementary therapy and can come from the wishes of the patient without medical complaints. Complementary therapy practices carried out at the Complementary Unit of Nur Hidayah Hospital use Al-Qur'an therapy with a therapist who will read the Al-Qur'an in front of patient. Condition while therapy will be recorded on the assessment form and then a quick screening is carried out to assess the patient's initial condition through the SGR value then therapy is carried out. Patients are given a value of 0,1,2 for each SGR value, namely attitude (S), prayer problem (G) and interaction history (R).

The attitude value (S) describes the patient's psychological condition and is categorized into normal (0), anxious (1), unconscious (2). Prayer problem value (G) describes the history of prayer performed by the patient and is categorized as no distractions (0), lazy (1), not prayer (2). The value of interaction history (R) describes the history of supernatural in patients and families and is categorized into none (0), ever had a history of interaction (1), had a history of interaction (2).

After screening, patients are given complementary therapy using Al-Quran therapy by trained therapists. The implementation of therapy at Nur Hidayah Hospital can be done repeatedly according to the patient's mental condition. If the patient's mental condition is not normal, it is advisable to make a repeat visit. Based on information from officers and therapists at Nur Hidayah Hospital, this therapy is expected to help improve the patient's mental condition to normal. Normal conditions are characterized by all S, G and R values being zero.

### 2.3 Variables

This study used several variables consisting of response variables and predictor variables. The response variable in this study was the survival time of complementary therapy patients at Nur Hidayah Hospital. Survival time is the length of time (days) the patient enters the Complementary Unit of Nur Hidayah Hospital until an improvement in mental condition occurs. The observed event was an improvement in mental condition which was marked by all S, G and R values being zero. S, G, and R values each have a value of 0, 1, and 2. If there is only one S/G/R value that is not zero then the data is censored. An illustration of determining event data can be seen in Table 1.

**Table 1**. Determining event

| First SGR Value | | | Final SGR Value | | | Censoring |
|---|---|---|---|---|---|---|
| S1 | G1 | R1 | S2 | G2 | R2 | |
| 1 | 0 | 0 | 0 | 0 | 0 | Event |
| 1 | 1 | 0 | 0 | 1 | 0 | Censored |
| 2 | 2 | 1 | 1 | 2 | 0 | Censored |
| 2 | 2 | 1 | 0 | 0 | 0 | Event |
| 0 | 1 | 1 | 0 | 0 | 1 | Censored |
| 2 | 2 | 2 | 1 | 0 | 1 | Censored |
| 0 | 0 | 0 | 0 | 0 | 0 | Event |

The predictor variables attitude (S), prayer problem (G), supernatural interaction history (R), gender, age, marital status, education, main complaint, chronic disease history, and therapy reaction. Gender was

classified into male and female. Age is the age of respondent in years. Marital status was classified into unmarried and married Education was classified into elementary school, junior high school, high school, and college.

Main complaint was classified into mentally and physically. The mentally category was addressed to respondents who has complaints about psychological mental conditions such as anxiety, confusion, and other mental disorders. The physical category was addressed to respondents who has complaints about physical conditions such as body aches, dizziness and other physical problems. Therapy reaction was classified into active and passive. The active category was addressed to respondents who had which reacts actively when treated. The passive category was addressed to respondents who do not reacts when treated.

### 2.4 Methods

The method used in this study is the classification of random forest and extended Cox. A random forest is a classifier consisting of a collection of tree-structured classifiers. The common element in all of these procedures is that for the *k*th tree, a random vector is generated, independent of the past random vectors but with the same distribution and a tree is grown using the training set and random vector. After a large number of trees is generated, they vote for the most popular class [9]. Label class in this study based on status patient. That are code by Improve explain who patient an improvement in mental condition and code by Not Improve explain that patient was not have an improvement in mental condition.

The stages of survival analysis are carried out by conducting Kaplan-Meier analysis is a curve that describes the relationship between the estimated survival function at time t and survival time and log-rank testing compared the Kaplan-Meier survival curves in each group [10]. Proportional hazard assumption testing for states that the hazard function of different individuals is proportional or the hazard ratio of different individuals is constant. If the proportional hazard assumption is violated, the Cox proportional hazard model cannot be carried out then we can continue proceed with extended Cox modelling including stratified and time-dependent Cox [10]. Comparison of accuracy measures of model is carried out using the AIC value. The best model has the smallest AIC value [11].

Step analysis in this study was carried out by

1. Describe the characteristics of complementary therapy patients at Nur Hidayah Hospital.
2. Performed classification analysis using random forest using 5-fold cross validation.
3. Create the confusion matrix and performance of the random forest model.
4. Obtain the survival curve using the Kaplan-Meier method and testing the differences using the log-rank test.
5. Checking the proportional hazard assumption on each predictor variable that is suspected of influencing the improvement of the patient's mental condition.
6. Establish a time model for improving the patient's condition using the extended Cox model.
   a. Forming strata from variables that do not meet the proportional hazard assumption.
   b. Performing model using stratified Cox models without interaction and stratified Cox models with interactions.
   c. Conduct interaction tests between stratified Cox models without interaction and stratified Cox models with interactions.
   d. Feature elimination using stepwise in each model to find the most influential.
   e. Modelling with the time-dependent Cox model. Form a model with a time function $g(t)=t$, $g(t)=ln(t)$, and heaviside function.
7. Selecting the best Cox model using the smallest AIC criterion. Calculate the hazard ratio and interpret the best Cox model. Draw conclusions from research results.

## 3 Results

### 3.1 Patient characteristics

The average age of complementary therapy patients at Nur Hidayah Hospital is 40.86 years, with the youngest being 2 years old and the oldest being 79 years old. Based on the event explanation used in this study, it was found that 54 patients have improvement in their mental condition (improved event) and 48 patients were censored data because they did not experience an improvement in their mental condition.

The Unconscious patients only 27% experienced mental improvement. There were 67% of prayer patients who experienced an improvement in their mental condition and there were only 31% of not prayer patients who experienced an improvement in their mental condition. Only 43% of patients who had a history of interaction experienced an improvement in their mental condition. Male patients have a greater percentage of experiencing an improvement in their mental condition compared to women, which is 61%. The percentage of patients for all marital status is >50% where unmarried patients experience a greater percentage of improving their mental condition than married patients.

All levels of education had a percentage that experienced an improvement in mental conditions >50%, but in junior high schools only 20% experienced improvement. Patients with major mental or physical complaints had the same percentage of improvement, namely 53%. The percentage of patients who experienced an improvement in their mental condition was greater for patients who did not have a history of chronic disease, namely 56%. Patients who reacted

passively when therapy was carried out had a greater percentage of improving their condition than reacting passively, which was 74%.

### 3.2 Random forest classification analysis

Variable importance from random forest classification shown in Figure 1. The five most important variables for classifying patients using a random forest are age, education, interaction history, attitude, and prayer problem.

In the random forest classification of each decision tree which is grown based on data resampling will carries its own error in each decision tree. Calculation of the error obtained on each tree decisions that are built are the result of misclassification observations. Figure 2 shows us that the Out-of-Bag (OOB) error rate was the lowest with 100 trees. The optimal number of variables was set at eight.

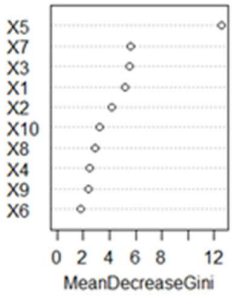



**Fig. 1.** Variables Importance

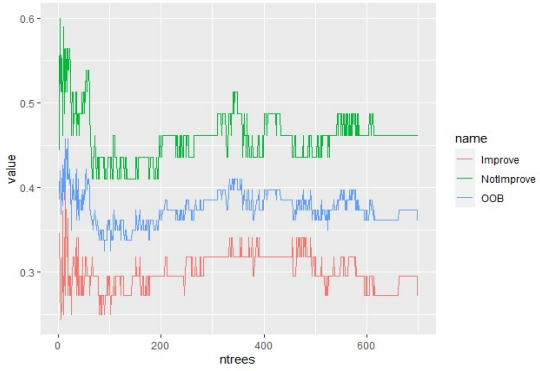



**Fig. 2.** Comparison error rates in increasing trees

The model using 5-fold cross validation give us result confusion matrix in Table 2 and performance random forest model in Table 3. Misclassification of patient status still occurs and this model has an accuracy of 0.58.

**Table 2.** Confusion matrix

| | Actual | |
|---|---|---|
| Predicted | Improve | Not Improve |
| Improve | 8 | 6 |
| Not Improve | 2 | 3 |

Random forest classification is used to predict patient status based on predictors, but this classification is not good enough to see whether an individual enters the improve class or not, so the analysis in this study is continued with survival analysis.

**Table 3.** Performance of the random forest model

| | Random Forest Model |
|---|---|
| Accuracy | 0.58 |
| Sensitivity | 0.80 |
| Specificity | 0.33 |
| AUC | 0.57 |

### 3.3 Survival analysis

Previous research examined only descriptively and compared CAM effectiveness with simple statistics so that this study will increase the complexity of the analysis by accommodating time to event. The median time that complementary therapy patients did not improve their mental condition was 30, meaning that patients had a 50% chance of not improving on the 30th day. It can be seen in Figure 3 that from day 0 to day 120 the survival curve drops slowly, this indicates that the longer the time, the greater the chance of improvement. On day 120 to day 370 it shows the lowest and constant line so the chance of not improving on day 120 to day 370 is the same and the chance of improving after day 120 is greater than before day 120.

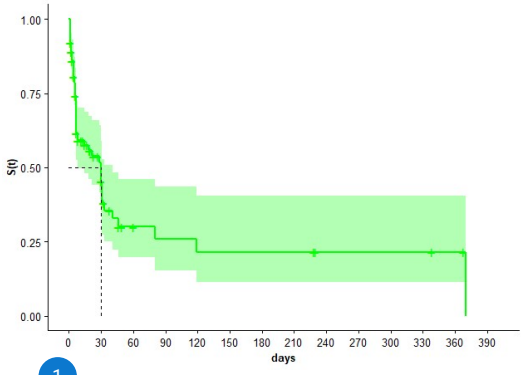



**Fig. 3.** Kaplan-Meier curve of time to improve mental conditions

The curve of patients with loss of consciousness is above the curve of patients with an anxious attitude, which means that the chance of not experiencing improvement in mental condition is higher in patients with loss of consciousness than patients with an anxious attitude. The curve of patients with non-prayer conditions is above the curve of patients with prayer conditions, which means that the chance of not experiencing improvement in their mental condition is higher in patients who do not prayer compared to patients who prayer.

The curve of patients who have a history of interaction is above the curve of patients who have and

do not have a history of interaction, which means that the chances of not experiencing improvement in their mental condition are higher in patients who have a history of interaction than patients who do not have a history of interaction. The curve of patients who experience active therapy reactions is above passive reactions, which means that the chance of not experiencing improvement in mental condition is higher in patients with passive reactions than patients with active reactions.

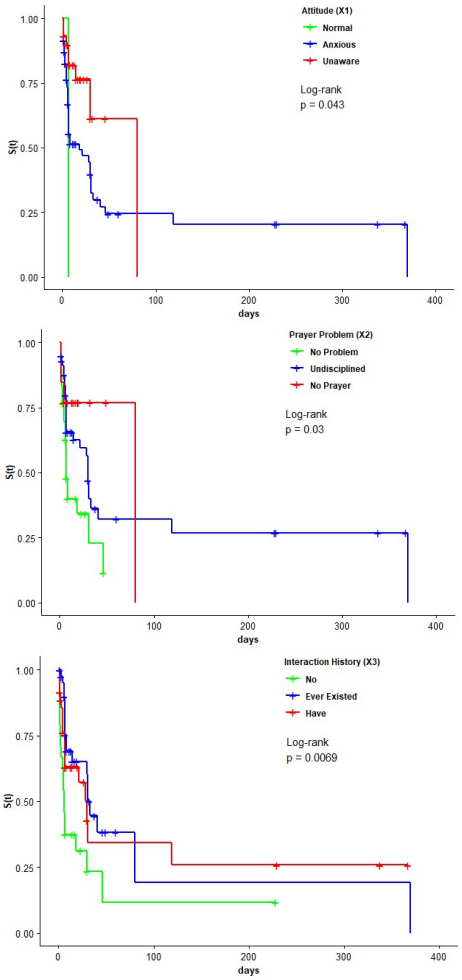



**Fig. 4.** Kaplan-Meier of attitude, prayer problem, and interaction history

Kaplan-Meier Curve Figure 4 attitude, prayer problem, interaction history and therapy reaction variables intersect between each category, meaning that patients with different categories have different chances of experiencing improvement in their mental condition. The Kaplan-Meier curves for women and men coincide with each other so that there is no difference in the chances of improving mental conditions between the sexes. The curves of marital status, education, main complaint and chronic disease history also coincide with each category so that patients with different categories have the same probability of experiencing an improvement in their mental condition.

The results of the log-rank test for each variable that is thought to affect the time to improve the mental condition of patients with complementary therapy at Nur Hidayah Hospital can be seen in Table 4. attitude, prayer problem, interaction history and therapy reaction variables have different survival curves between each category variable. Variables gender, marital status, education, main complaint and chronic disease history also coincide with each category so that patients with different categories have the same probability of experiencing an improvement in their mental condition. There is no difference in the chances of improving mental conditions between gender.

**Table 4.** Log-rank test

| Variable | Chisq | *P*-value |
|---|---|---|
| Attitude ($X_1$) | 6,30 | 0,040* |
| Prayer Problem ($X_2$) | 7,00 | 0,030* |
| Interaction History ($X_3$) | 9,90 | 0,007* |
| Gender ($X_4$) | 0,80 | 0,400 |
| Marital Status ($X_6$) | 0,70 | 0,400 |
| Education ($X_7$) | 1,60 | 0,700 |
| Main Complaint ($X_8$) | 0,01 | 0,900 |
| Chronic Disease History ($X_9$) | 0,80 | 0,400 |
| Therapy Reaction ($X_{10}$) | 6,20 | 0,010* |

*Significant

### *3.3.1 Assumption proportional hazard*

The Goodness of fit test is used to obtain a more objective decision. Table 5 shows that with a significance level of α of 5%, the predictor variable has a p-value greater than α except for the Interaction History variable. The Interaction History variable gives a decision to Reject $H_0$ which indicates that this variable does not meet the proportional hazard assumption.

**Table 5.** Goodness of fit

| Variable | Statistic | *P*-value |
|---|---|---|
| Attitude ($X_1$) | 4,634 | 0,0986 |
| Prayer Problem ($X_2$) | 0,685 | 0,7101 |
| Interaction History ($X_3$) | 8,175 | 0,0168* |
| Gender ($X_4$) | 0,149 | 0,6995 |
| Marital Status ($X_6$) | 0,116 | 0,7336 |
| Education ($X_7$) | 0,235 | 0,6280 |
| Main Complaint ($X_8$) | 1,240 | 0,7434 |
| Chronic Disease History ($X_9$) | 0,316 | 0,5742 |
| Therapy Reaction ($X_{10}$) | 0,669 | 0,4133 |

*Significant

There is one variable that does not meet the proportional hazard assumption so that the strata that are formed are based on the number of categories of the interaction history variable, namely three strata are formed. Stratum 1 is not having a history of interaction, stratum 2 ever had a history of interaction and stratum 3 is having a history of interaction.

### 3.3.2 Extended Cox Modelling

Extended Cox modelling including stratified and time-dependent Cox. Stratum for the modelling used from previous section. There are three stratum so the model was carried out using stratified Cox without interaction and with interaction. Stratified Cox model with interactions using variables that interact with the stratification variables are prayer problem, gender, main complaint, age and treatment reactions while the other variables are included in the model but do not interact with the stratified variables.

Interaction testing is carried out to determine whether there is interaction between the stratified variables and the variables included in the model. The results of the interaction test on the Cox stratified model show that with a degree of freedom of 12, the test statistic value is 31.63 and the p-value is 0.00158. By using a significance level of $\alpha = 0.05$, the p-value $< \alpha$. The decision that can be taken is to reject $H_0$, there is an interaction between the Interaction History variable and the predictor variable. The conclusion that can be drawn is that the stratified Cox model with interaction is better than the model without interaction.

Stepwise elimination was performed on the Cox stratified model with interactions to obtain the most significant variables from the model. The smallest AIC value of all stepwise stages is in the 3rd stage of 286.84. Variables formed in the stratified Cox model with the smallest AIC are attitude, chronic disease history and interaction variables, namely the interaction history variable with prayer problem, the interaction history variable with gender, the interaction history with age variable, the interaction history with main complaint variable, and the variables interactions history with therapeutic reactions.

Time-dependent variables are formed from variables that do not meet the proportional hazard assumptions that depend on time so that new variables are formed. The model with the time function $g(t)=t$ has a new variable namely Time × Interaction History. The model with the time function $g(t)=ln(t)$ has a new variable, namely ln(Time) × Interaction History. The heaviside function is used to overcome the difference in hazard ratio at different time intervals. The heaviside function used with cut of in $100^{th}$ day.

**Table 6.** Model comparison

| Model | AIC |
|---|---|
| Cox Proportional Hazard | 414.272 |
| Stratified Cox without Interaction | 298.925 |
| Stratified Cox with Interaction | 286.839 |
| Time-dependent Time Function | 409.332 |
| Time-dependent Heaviside Function | 404.856 |

There are four Cox models formed, so a comparison of accuracy measures is carried out using the AIC value. The best model that show in Table 6 has the smallest AIC value. The smallest AIC value of all models is 286.839, namely in the stratified Cox model with interactions. Based on this, it was found that the best model that can be used to model the improvement of the mental condition of patients with complementary therapy at Nur Hidayah Hospital, Bantul, is the stratified Cox model with Interaction.

### 3.3.3 Model interpretation

Parameter estimation of the model stratified Cox with interaction shown in Table 7. Hazard ratio of significant variables shown in Table 8. Male patients who do not have a history of interaction have a 21.277 times tendency to improve their mental condition compared to female patients who have a history of interaction. Male patients who have had and still have a history of interaction and female patients who have and do not have a history of interaction have the same tendency as male patients who do not have a history of interaction in experiencing an improvement in their mental condition.

**Table 7.** Parameter estimation

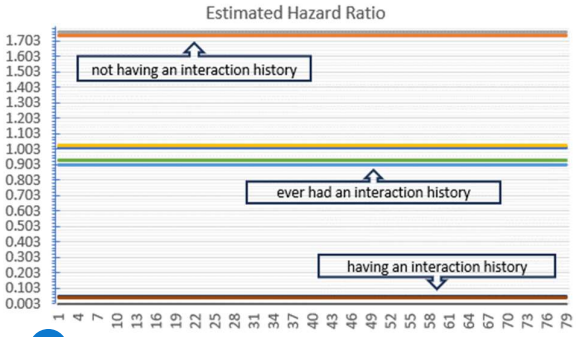
| Variable | Parameter Estimates | *P*-value |
|---|---|---|
| Attitude (1) | 0,075 | 0,948 |
| Attitude (2) | -1,636 | 0,199 |
| Prayer problem (1) | 0,154 | 0,792 |
| Prayer problem (2) | 1,057 | 0,459 |
| Gender (1) | 0,014 | 0,982 |
| Age | 0,020 | 0,384 |
| Main Complaint (1) | 0,554 | 0,482 |
| Chronic Disease History (1) | -0,835 | 0,131 |
| Therapy Reaction (1) | 0,489 | 0,459 |
| Interaction History (1) × Prayer problem (1) | -1,200 | 0,152 |
| Interaction History (2) × Prayer problem (1) | -0,053 | 0,961 |
| Interaction History (1) × Prayer problem (2) | -2,473 | 0,161 |
| Interaction History (2) × Prayer problem (2) | -0,765 | 0,675 |
| Interaction History (1)× Gender (1) | 0,012 | 0,989 |
| Interaction History (2)× Gender (1) | -3,056 | **0,003** |
| Interaction History (1) × Age | -0,075 | **0,019** |
| Interaction History (2) × Age | -0,059 | 0,108 |
| Interaction History (1) × Main Complaint (1) | -0,654 | 0,518 |
| Interaction History (2) × Main Complaint (1) | -3,699 | **0,011** |
| Interaction History (1) × Therapy Reaction (1) | -1,094 | 0,246 |
| Interaction History (2) × Therapy Reaction (1) | -1,902 | 0,100 |

Patients with mental complaints who do not have a history of interaction have a 40 times tendency to improve their mental condition compared to patients with physical complaints who have a history of

1 nteraction. Patients with mental complaints who have had and still have a history of interaction and patients with physical complaints who have had and do not have a history of interaction have the same tendency towards patients with mental complaints who do not have a history of interaction in experiencing improvement in their mental condition.

**Table 8.** Hazard ratio estimates

| Variable | Hazard Ratio Estimates (95% CI) |
|---|---|
| Interaction History (2) × Gender (1) | 0,047(0,006 ;0,358) |
| Interaction History (1) × Age | 0,928(0,872 ;0,988) |
| Interaction History (2) × Main Complaint (1) | 0,025(0,001 ;0,431) |




1 **ig. 5.** Estimated hazard ratio for each category in interaction history variable

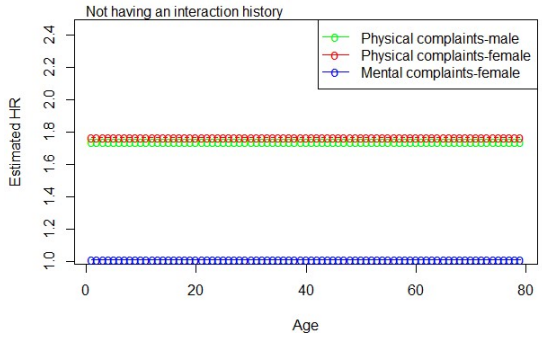



**Fig. 6.** Estimated hazard ratio for not having an interaction history


**Fig. 7.** Estimated hazard ratio for ever had an interaction history

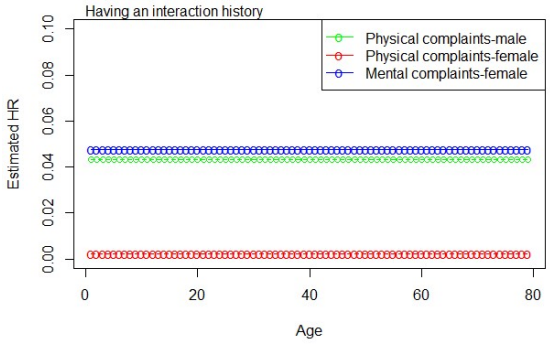



**Fig. 8.** Estimated hazard ratio for having an interaction history

Based on Figure 5, the increasing tendency of patients to experience improvement in mental condition is indicated by the lower the value of the interaction history variable where the hazard ratio value at stratum 1 (not having an interaction history) is the highest. The red line in Figure 6, Figure 7, Figure 8 shows that female patients with a main physical complaint have a tendency to improve their mental condition which varies according to interaction history variable and experience an increasing tendency to improve when the interaction history value is lower, the value is lowest when the patient has an Interaction History.

This best model already considering the time needed for the patient to improve mental health condition so that it can explain properly the factors that affect the patient's time mental improvement sooner or later. Factors that did not have a significant effect were attitude, prayer problem, chronic disease history, and therapy reactions. Based on these conclusions obtained some suggestions as follows. Future research can add medical variables where these variables have definite measurements. The hospital can record complementary therapy medical records in a more integrated manner with other medical records so that patient monitoring can be more effective. The therapist can pay attention to the factors that influence the time to improve mental conditions so that they can provide education to patients as an effort to make improvements better.

## 4 Conclusion

Attitude, prayer problem, interaction history and therapy reaction variables have different affect the time to improve the mental condition. The best model for modelling the improvement of the mental condition of patients with complementary therapy at Nur Hidayah Hospital is using stratified Cox regression with interaction. Factors that significantly influence the time of improvement of the mental condition of complementary therapy patients are age for the patients that ever had the interaction, gender and main complaint for the patients that have interaction history. The increasing tendency of patients to experience

Improvement in mental condition is indicated by interaction history variable. Lowest estimated hazard ratio when the patient has an interaction history, physical complaint and female. Male patient with physical complaint has the lowest estimated hazard ratio when he ever had an interaction history.

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