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Factors Associated with Depressive Syndrome in Adult Congenital Heart Disease Patients at RSUP Haji Adam Malik Medan

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Abstract

Besides being one of the causes of death in the world, adult congenital heart disease sufferers seem to be forgotten and neglected from what is called depression and anxiety. Not much has been described about depressive psychopathology in adult congenital heart disease patients. The purpose of this study was to analyze the factors associated with depressive syndrome in congenital heart disease patients. This cross-sectional study was conducted by 97 adult congenital heart disease patients recruited sequentially, consisting of 8 independent variables and 1 dependent variable. Depression scores were assessed using the BDI-II measuring instrument. Most sexes were female, with as many as 59 subjects (60.2 %). The most marital status was 66 subjects (67.3 %). The most occupations were those who worked as many as 70 subjects (71.4 %), the most previous history of surgery/intervention were those who did not have a history of prior surgery/intervention as many as 56 subjects (57.1 %), the most comorbid diseases were those who did not have a history of comorbid diseases as many as 86 subjects (87.8 %), age with a median value of 33 (18 - 45), the median value of education for adult CHD patients was 15 (12 - 18), the median NYHA grade value of adult CHD patients is 2 (1 - 4). The characteristics of patients who are highly educated, NYHA classmates, and who have jobs should be a concern because they will be more likely to experience depressive syndrome.

Keywords: Adult congenital heart disease patients, BDI-II, Depressive syndrome

Introduction

A significant increase in children born with congenital heart defects survives into adulthood. However, depending on the heart defect problem experienced, it may be necessary to undergo several surgeries in their first year of life [1]. The congenital heart disease (CHD) population continues to grow by more than 1.4 million adults estimated to be living with congenital heart disease in the United States [2]. Data in Indonesia, the incidence of congenital heart disease is 134 people out of 10,000 population per year, and the most common type is Asiatic PJB. Ventricular septal defect in children and atrial septal defect in adults, while the typical cyanotic congenital heart disease is tetralogy of Fallot, both in children and adults [3].

Admissions with a congenital heart disease diagnosis have higher intensive care unit (ICU) admission rates, longer length of hospitalization and higher mortality for most admissions other than cardiac diagnoses. These data will add to our understanding of the economic impact of adults with congenital heart

disease [4]. Operative or catheter interventional therapy for these patients may be more complex than if the problem was addressed in childhood and may have to be combined with additional procedures, such as coronary artery bypass or coronary angioplasty if advanced ischemic heart disease occurs. On the other hand, new interventions can be performed without surgery in necessary cases [5]. Advances in interventional medicine in the modern era have allowed almost all congenital heart Diseases, including critical congenital heart diseases, to be intervened so that survival rates increase [6,7].

When we talk about patients with adult congenital heart disease, in one of the largest cities in Indonesia, namely Medan, people more often pay attention and face unique health challenges, among which is a high risk of mental health problems such as depression. Therefore, we wanted to explore the depressive syndrome of adult congenital heart disease patients in Medan so that we could understand the deeper relationship between heart conditions and mental health problems and recommend various relevant and practical measures for the holistic nursing of these patients. The most common congenital heart disease, the incidence of congenital heart disease worldwide, is estimated at 1.2 million cases from 135 million live births each year. In Indonesia, the incidence of congenital heart disease is estimated to reach 43,200 cases from 4.8 million live births (9:1,000 live births) each year [8].

But in reality, one-third of these patients have difficulties with anxiety, depression [9,10] and behavioral or other emotional [11-13]. Somatic diseases such as extracardiac complications, respiratory, kidney, hematological, neurological and bone 1 - 4 complications are no exception [14-17].

Research is necessary because depression can result in severe physical and mental impacts of congenital heart disease [9,18-20]. In addition, depression can increase the risk of heart disease severity [15] and interfere with adherence to medication and care [21-23]. Therefore, the research aims to deepen knowledge and a better understanding of providing psychosocial services and improving patients' quality of life [21], in addition, taking into account risk factors, impact and relevant therapeutic approaches in this context to act against depressive syndrome among adult congenital heart patients. We envision this study providing helpful information for relevant health professionals, researchers and other community members and stakeholders.

Materials and methods

Study design and setting

The study was conducted at the outpatient installation of the integrated heart center of RSUP H. Adam Malik Medan, The ethics committee of the Faculty of Medicine, University of North Sumatra and RSUP H. Adam Malik, through the Director of Human Resources Education and Research, have permitted this research. This study used a tool in the form of a questionnaire consisting of 21 statements with 4 answer choices from each statement. This measuring instrument consists of 21 questions with the lowest value of 0 and the highest score of 63 with the aim of the intended respondents, namely adult congenital heart patients aged 18 - 45 years. This study used a good measuring tool, namely by using the BDI-II questionnaire, which has been carried out validation tests version Indonesian and determined the cut-off point by Ginting and friends in 2012 with the value of Cronbach's α for the Indonesian version of BDI-II is 0.91 for people with depression. With cut-off points. The optimal Indonesian BDI-II for mild depression is 17. Please note that the BDI-II questionnaire is used not to determine the diagnosis of depression but only as a screening tool. Diagnosis is only obtained from interviews based on PPDGJ-III diagnosis criteria [22].

Samples and how to sample selection

The study sample was adult congenital heart disease patients who came for treatment to the Outpatient Installation of the Integrated Heart Center of RSUP H. Adam Malik Medan in September 2023 - January 2024 who met the inclusion criteria, namely aged 18 - 45 years, diagnosed with congenital heart disease by cardiac specialists, willing to be research subjects and exclusion, namely having a history of other psychiatric disorders, have a history of use of psychiatric drugs and other addictive substances. How do you take sampling with probability sampling type consecutive sampling?

Sample size

In this study, there are 8 independent variables, and in determining the formula for this sample size, we will search for bivariate relationships for each independent variable. The sample size will be the sample size in this study. To see the bivariate relationship, the categorical scaled independent variable will be used to diagnose unpaired numerical comparative analytical research of 2 groups of 1-time measurements. For numerically-scale independent variables, numerical correlative analytical research diagnosis will be used to see the bivariate relationship [23].

There are 2 steps before determining the sample size for a multivariate numerical predictive study with 1 measurement. The first is to use a large sample table for multivariate study diagnosis of numerical 1-time measurements. After that, we still have to calculate the entire bivariate relationship between each dependent variable. Then, the sample size will be determined as the most significant [23].

First step

By assigning a type 1 error of 5 % and a type 2 error of 20 % for the 2-way hypothesis and a coefficient of determination of 0.25 for 50 subjects [23].

Second step

The determination of sample size must also be considered based on the sample size formula for its bivariate relationship with each independent variable, as it is known that the independent variable in this study consists of categorical variables and numerical variables [23].

This study began with conducting preliminary research by including 15 congenital heart disease patients at the Integrated Heart Center Heart Poly of RSUP Haji Adam Malik Medan to obtain many samples that were close to the actual situation, and a large sample count was carried out.

To find the sample size for the diagnosis of numeral-numerical correlative analytical research, the sample size is recommended as follows [23]:

$$n = \left[\frac{(Z\alpha + Z\beta)}{0.5 \ln\left(\frac{1+r}{1-r}\right)}\right]^2 + 3^2 \quad (1)$$

where n is the number of subjects, α is the Type 1 error set at 5 %, $Z\alpha$ Standard value alpha = 1.96, Beta (β) is the Type 2 error set at 20 %, $Z\beta$ is the Standard value Beta = 0.84 and r that is minimal correlation coefficient that is considered meaningful.

To find the sample size in the diagnosis of unpaired numerical comparative analytical research of 2 groups of 1 measurement, we first see the formula for the combined standard intersection, namely [23]:

$$sg^2 = \frac{(S1^2 \times (n1 - 1) + S2^2 \times (n2 - 1))}{n1 + n2 - 2} \quad (2)$$

where sg is combined raw intersection, sg^2 is combined variants, S1 Means Group 1 Standard Intersection in Previous Research, n1 is a Large sample of Group 1 in previous studies, S2 Group 2 standard intersection in earlier studies and n2 is a Large sample of group 2 in previous studies.

After obtaining the combined standard intersection, the next step is:

$$n_1 = n_2 = 2 \times \left[\frac{(Z\alpha + Z\beta) \times sg)}{x1 - x2}\right]^2 \quad (3)$$

The parameters derived from the literature are sg (combined standard intersection), while those set by researchers are Zα, Zβ and x1 − x2; therefore, in this study, it is determined that Zα be Standard alpha value → 5 % = 1.96 → 2 directions, Zβ same as Standard beta value → 20 % = 0.84, sg that is Combined raw intersection and x1 − x2 be Minimum difference in mean considered meaningful = 12.6.

Based on the 2 sample size calculation steps above, it is concluded that the most significant number of samples is from the large table of patient age samples, which is as many as 97 adult patient subjects with congenital heart disease.

How it works

Variable identification

Categorical independent variables: Sex, marital status, occupation, history of surgery or previous cardiac medical interventions and comorbid diseases of adult congenital heart disease patients. Numerical independent variables: Age, length of education and NYHA class of adult congenital heart disease patients. Dependent variable: Depressive syndrome of adult congenital heart disease patients.

Data analysis

Data analysis on research using Microsoft Excel software and Statistical Package for the Social Sciences (SPSS). Linear regression analysis can only be used if the conditions of the linear regression test are met. In contrast, the linear regression conditions include the normal residual distribution (proven by a histogram graph), average residue = 0 (proven by descriptive), no outlier (proven by case-wise diagnostic), constant (proven by a scatter graph between residues and independent variables), independent (proven by the Durbin Watson test), there is no multicollinearity (proven by the Pearson test and tolerance test) on the independent variable and the relationship between the free and bound variables is linear (evidenced by the scatter graph between the independent variable and the dependent variable) [24].

The linear regression test steps for numerically independent variables are normality tests using the Kolmogorov-Smirnov test. Suppose at least one of the independent variables or numerical variables is usually distributed. In that case, the Pearson test will be performed, and if the 2 variables are not normally distributed, the Spearman test will be carried out. If the correlation of the independent variable has a value of $p < 0.25$, then the independent variable qualifies for inclusion in a multivariate linear regression analysis. After that, independent variables that meet the criteria $p < 0.25$ will be entered into a multivariate linear regression analysis for analysis [26,27].

For categorical independent variable analysis, the analysis plan is: 1) Descriptive analysis and normality test, 2) Bivariate analysis with independent t-test or Mann-Whitney U test, 3) Multivariate analyses, 4) Resume analysis and 5) Report analytics.

For the analysis of numerically independent variables, the analysis plan is: 1) Descriptive analysis and normality test, 2) Bivariate analysis with Pearson test or Spearman test, 3) Multivariate analysis, 4) Resume analysis and 5) Report analytics.

Results and discussion

Results

Characteristics demographics

Table 1 is presented to answer the first specific purpose: To determine demographic characteristics in adult congenital heart disease patients. The categorical variables discussed in **Table 1** are gender, marital status, occupation, surgery/medical intervention history and comorbid diseases. Categorical data are presented in sum (n) and percentage (%) [25].

The numerical variables discussed in **Table 1** are age, length of education and NYHA class of adult congenital heart disease patients. Numerical variables are presented in concentration (mean) and spread (standard deviation) because it was found that the data were normally distributed with the Kolmogorov-Smirnov test, and in this study the number of samples was n = 97, where $p \geq 0.05$, namely the variables of age, length of education and the rest numerical variables were presented in the concentration (median) and spread (minimum and maximum) because the data were abnormally distributed with the Kolmogorov-Smirnov test and in this study, the number of samples is n = 97 where $p < 0.05$ for each variable [25].

Table 1 shows the sex variable of adult congenital heart disease patients, most of whom were female, with as many as 59 subjects (60.2 %). The most marital status variables were married as many as 66 subjects (67.3 %). The most job variables were working with as many as 70 subjects (71.4 %). The highest variable history of surgery or other medical actions was those who had never had surgery or other menstrual interventions, as many as 56 subjects (57.1 %). The most comorbid disease variables were those without disease, with as many as 86 subjects (87.8 %).

Table 1 also shows the age variable of adult congenital heart disease patients with a median value (min-max) of 33 (18 - 45). Education duration variable with median (min-max) value 15 (12 - 18) and NYHA class variable with median (min-max) value 2 (1 - 4).

In this study, the number of independent variables is 8 variables. Therefore, the analysis used is multiple linear regression or multivariate linear analysis with a predictive concept framework. The steps performed for multivariate linear regression analysis are descriptive and normality test analysis, bivariate analysis, multivariate analysis, resume analysis and the results report. An independent variable must be included in a multivariate regression analysis for its bivariate analysis with a $p < 0.25$ value. This study contained 8 independent variables, including 3 numerical free variables and 5 categorical independent variables [25,27].

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Table 1 Demographic overview of adult congenital heart disease patients.

	Average ± S.D.	**Median (min-max)**	**n %**
Age of adult congenital heart disease patients		33(18 - 45)	
Gender of PJB patient adult			
- Female			59(60.2)
- Male			38(38.8)
Duration of education for adult congenital heart disease patients (year)		15(12 - 18)	
Marital status			
- Marry			66(67.3)
- Not married			31(31.6)
Adult work			
- Work			70(71.4)
- Does not work			27(27.6)
History of adult medical surgery/intervention			
- Exist			41(41.8)
- None			56(57.1)
NYHA Class		2(1 - 4)	
Comorbidities disease			
- Exist			11(11.2)
- None			86(87.8)
BDI-II score	18.53 ± 6.34		

Association between age, duration of education, NYHA classes and depressive syndrome in adult congenital heart disease patients

In **Table 2**, the Pearson test was performed for the independent variable on a numerical scale, namely the age variable of adult congenital heart disease patients, because the variables are normally distributed

and the linearity requirements are met with the total BDI-II score. The results of the Pearson test obtained the variable age of congenital heart disease patients with a value of $p = 0.080$. Because the p-value < 0.25, the age of congenital heart disease patients can be included in a linear regression multivariate analysis test with a predictive concept framework [25]. The Pearson test was also performed for the independent variable on a numerical scale: The length of education of adult congenital heart disease patients. The variable is usually distributed, and linearity requirements are met with the total BDI-II score. The Pearson test obtained the variable length of education of congenital heart disease patients with $p = 0.062$. Because the p-value < 0.25, the old education variable of congenital heart disease patients deserves to be included in the linear regression multivariate analysis test with a predictive concept framework [25]. They were obtained for the NYHA class variable of congenital heart disease patients with $p = 0.010$. Since the p-value < 0.25, NYHA class variables can be included in linear regression multivariate analysis tests with predictive concept frameworks [23].

Table 2 Relationship between age, duration of education, NYHA classes and depressive syndrome in adult congenital heart disease patients.

Variable	Average ± S.D.	Median (min-max)	N	R	*p*
Score BDI-II	18.53 ± 6.34				
Age		33(18 - 45)	97	−0.179	0.080
Duration of education		15(12 - 18)	97	0.190	0.062
NYHA class		2(1 - 4)	97	0.261	0.010

Relationship between sex, marital status, occupation, history of surgery, comorbid diseases and depressive syndrome in adult congenital heart disease patients

Table 3 for independent variables on the categorical scale, namely the sex variables of congenital heart disease patients, consists of 2 groups. A Mann-Whitney U test is performed if any of the group's data are not normally distributed. The results of the Mann-Whitney U test obtained the sex variable of congenital heart disease patients with a value of $p = 0.089$. Because the p-value < 0.25, the sex variable of congenital heart disease patients deserves to be included in a linear regression multivariate analysis test with a predictive concept framework [25] - marital status variables of congenital heart disease patients, consisting of only 2 groups. A Mann-Whitney U test is performed if any of the group's data are not normally distributed. The results of the Mann-Whitney U test obtained the marital status variable of congenital heart disease patients with a value of $p = 0.090$. Because the p-value < 0.25, the marriage status variable of adult congenital heart disease patients deserves to be included in a linear regression multivariate analysis test with a predictive concept framework [25]. The independent variable on the categorical scale, namely the occupational variable of adult congenital heart disease patients, consists of only 2 groups. Independent T-tests are performed if both group data are typically distributed. The results of the Independent T-test obtained the occupational variable of patients with congenital heart disease with a value of $p = 0.095$ because $p < 0.25$, then the occupational variable of adult congenital heart disease patients is eligible to be included in the linear regression multivariate analysis test with a predictive concept framework [25]. Likewise, the variable's history of surgery and comorbid diseases are eligible for testing [23].

Table 3 Relationship between sex, marital status, occupation, history of surgery, comorbid diseases and depressive syndrome in adult congenital heart disease patients.

Variable	N	*p*
Gender of Adult congenital heart disease patients		
- Female	59	0.089
- Male	38	
Marital status of adult congenital heart disease patients		
- Marry	66	
- Unmarried	31	0.090
Work of adult congenital heart disease patients		
- Work	70	0.095
- Not working	27	
History of surgery/medical intervention of adult congenital heart disease patients		
- Exist	41	0.082
- None	56	
History of surgery/medical intervention of adult congenital heart disease patients		
- Exist	11	0.133
- None	87	

Multivariate analysis

After bivariate analysis, multivariate analysis is continued if it meets the requirements for conducting a linear regression test, namely the requirements of residues, dependent variables, independent variables and dependent variable relationships with independent variables. When performing a linear regression multivariate test with a predictive concept framework, it is recommended to use the backward method, which means that the SPSS program will filter data from independent variables that have autocorrelation and are not statistically meaningful until the most statistically suitable model is found, previously in the SPSS data it was seen that the ANOVA value < 0.01, which means that there is at least 1 statistically significant independent variable. Therefore, we can look at the summary model with the best coefficient of determination [25].

First multivariate analysis

Table 4 shows that Model 3 has the highest coefficient of determination, which is 90 %. However, referring to the coefficient table of Model 3 in SPSS, it can be seen that the model is not yet fit. This is because there is 1 independent variable, namely the sex variable, with a value of $p = 0.170$. To obtain a fit linear regression, multivariate model, meaningless independent variables are recommended to be removed. Based on statistical considerations, a new linear regression analysis was decided, discarding the sex variable.

Table 4 Model summary of the first multivariate analysis.

Model	R	R square	Adjusted R square	Std. an error in the estimate	Durbin-Watson
1	0.500[a]	0.950	0.821	5.689	
2	0.495[b]	0.945	0.881	5.670	
3	0.488[c]	0.938	0.901	5.661	
4	0.469[d]	0.920	0.811	5.693	1.968

Second multivariate analysis

In **Table 5**, it can be seen that Model 2 is the model with the highest coefficient of determination, which is 83 %. Referring to the coefficient table of Model 2 in SPSS, it can be seen that the model is not yet fit. This is because there is 1 independent variable, namely the marital status variable, with a value of p = 0.274. Meaningless independent variables are removed to obtain a fit linear regression multivariate model. Based on statistical considerations, it was decided to make a new linear regression analysis, discarding marital status variables.

Table 5 Model summary of second multivariate analysis.

Model	R	R square	Adjusted R square	Std. an error in the estimate	Durbin-Watson
1	0.484[a]	0.834	0.761	5.710	
2	0.481[b]	0.831	0.831	5.685	
3	0.469[c]	0.820	0.811	5.693	1.968

Third multivariate analysis

In **Table 6**, it can be seen that Model 2 is the model with the highest coefficient of determination at 81 %. This is because there is 1 independent variable, the operation history variable, with a value of p = 0.081. Meaningless independent variables are removed to obtain a fit linear regression multivariate model. Based on statistical considerations, it was decided to make a new linear regression analysis, discarding the operating history status variable.

Table 6 Model summary of third multivariate analysis.

Model	R	R square	Adjusted R square	Std. an error in the estimate	Durbin-Watson
1	0.470[a]	0.821	0.731	5.722	
2	0.469[b]	0.820	0.811	5.693	1.968

Fourth multivariate analysis

In **Table 7**, it can be seen that Model 2 is the model with the highest coefficient of determination, which is 81 %. The assumptions of linear regression have been met to conclude that model 4 is fit [25].

Table 7 Model summary of the fourth multivariate analysis.

Model	R	R square	Adjusted R square	Std. an error in the estimate	Durbin-Watson
1	0.436[a]	0.901	0.790	5.799	
2	0.435[b]	0.891	0.810	5.766	2.093

Table 8 Depression score residual statistics.

	Minimum	Maximum	Mean	Std. deviation	n
Predicted value	13.76	27.04	18.98	2.982	97
Residual	−14.038	14.747	−0.453	5.782	97
Std. predicted value	−1.867	2.982	0.039	1.089	97
Std. residual	−2.435	2.558	−0.079	1.003	97

a. Dependent variable: BDI_II

In **Table 8**, for the requirements of residues, the distribution of residues must be expected, the average residue is 0, there are no outliers, constant (homoscedasticity) and independent. From the histogram graph and plot, it can be seen that the distribution gives a standard impression, coupled with the normality test using Kolmogorov-Smirnov, which also shows a value of $p = 0.143$, which is $p > 0.05$. Therefore, it can be concluded that the distribution of residues is normal. From the figure of **Table 7**, it can be seen that the distribution of residues is 0. Therefore, the average residual condition of 0 was met. From **Table 8**, it is also seen that the minimum value is −2.435, the maximum value is 2.558, and the standard intersection is 1.003; therefore, the condition of no outliers is also met, namely where the residual range value in the standard intersection is −3 and the standard intersection 3. In addition, it can be seen that the Durbin-Watson value in **Table 7** of the summary model is 2.093, so the independent condition of the residue is met, which is around number 2. From SPSS data, it can also be seen that the scatter graph between residues and independent variables is constant. That is, it does not form a specific pattern [25].

The requirements of the dependent variable (depression score) have met the requirements for a linear regression test, which is the normal distribution. This study has met this condition with $p = 0.143$ with the Kolmogorov-Smirnov test. The relationship of the independent variable with the dependent variable is also with a linear impression, so this condition has also been fulfilled. **Table 7** shows that the model with the best coefficient of determination value is Model 2, which has 81 %. From the SPSS model 2 data, there is no tolerance value > 0.4, so the condition of no autocorrelation or multicollinearity has been met [25].

Linear regression analysis report

By conducting backward method analysis, a linear regression equation was obtained based on the linear regression analysis resume table, depression score = 3.251 + 0.911* length of education for congenital heart disease patients + 3,071* NYHA class for congenital heart disease patients −3,493* work for congenital heart disease patients. All linear regression assumptions have been satisfied, such as linearity, normality, 0 residues, no residue outlier, independent and constant (homoscedasticity) [25].

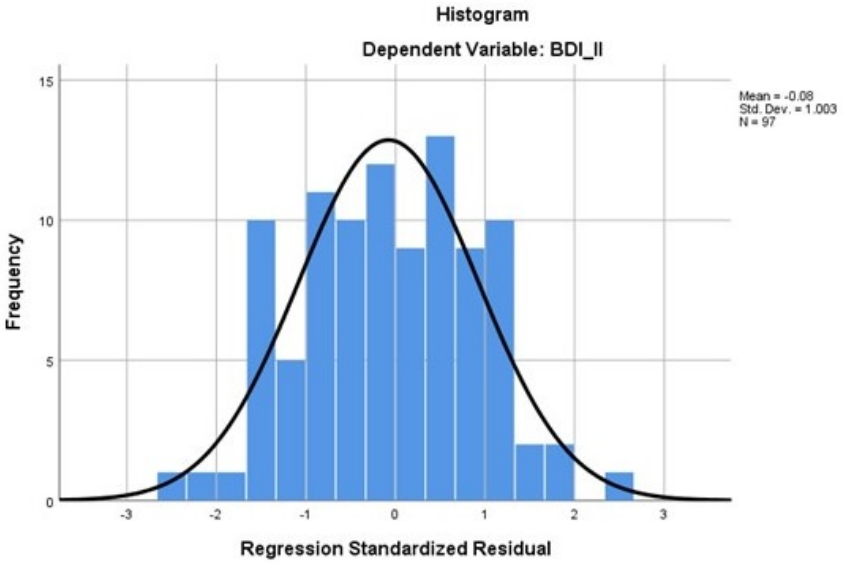

Figure 1 Histogram graph to test linearity assumptions.

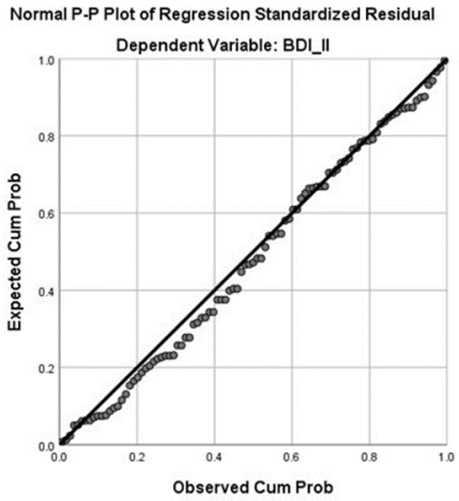

Figure 2 Standard P-P plot to see the normality assumption of the residue.

Table 9 Factors associated with depressive syndrome in patients.

BDI-II score	Correlation coefficients	Regresi multivariate β	p^*
Constanta			
Duration of education	0.284	0.911	0.062
NYHA class	0.342	3.071	0.010
Work	−0.251	−3.493	0.095

Table 9 is presented to answer hypotheses about depression. Therefore, from the results of the table, it can be concluded that there is a significant relationship between the old education variable of congenital heart disease patients and depressive syndrome with a value of $p = 0.062$. There is a substantial relationship between the NYHA class of congenital heart disease patients and depressive syndrome, with a value of $p = 0.010$. There is a significant relationship between the work of congenital heart disease patients and depressive syndrome, with a value of $p = 0.095$ [25].

Discussion

This study successfully answered all research hypotheses. This study hypothesizes that there is a relationship between the age of adult congenital heart disease patients, the sex of adult congenital heart disease patients, the length of education of adult congenital heart disease patients, the marital status of adult congenital heart disease patients, the occupation of adult congenital heart disease patients, the history of surgery/medical interventions that adult congenital heart disease patients have carried out, the NYHA class of adult congenital heart disease patients and comorbid diseases of adult congenital heart disease patients who seek treatment at the outpatient installation of the Integrated Jantung Center of the Adam Malik Haji Center General Hospital Medan.

The results of this study showed that the variables of the length of education of adult congenital heart disease patients, NYHA class of adult congenital heart disease patients and occupation of adult congenital heart disease patients were associated with depressive syndrome in adult congenital heart disease patients. In the results of this study, it was also found that the variable of the duration of education of adult congenital heart disease patients has a positive correlation coefficient of depression, which means that the higher the education of adult congenital heart disease patients, the higher the BDI-II score, which means the higher the depression in adult congenital heart disease patients. The occupational variable of adult congenital heart disease patients has a negative correlation coefficient, which means that the more non-working adult congenital heart disease patients, the higher the BDI-II score, which means that the higher the depression in adult congenital heart disease patients. The NYHA class variable has a positive correlation coefficient, which means that the higher the NYHA class of adult congenital heart disease patients, the higher the BDI-II score, meaning that the higher the depression in adult congenital heart disease patients.

Biological plausibility

Depression, in this case, depressive syndrome, can be attributed to biological, psychological and sociocultural factors. Several possibilities can be seen from the relationship between these variables and depressive disorders, which are not a single cause but multifactorial [26].

The Beck Depression Inventory is a self-report measurement tool that has been widely used in a variety of studies to assess depression. This measuring instrument consists of 21 questions, with the lowest value of 0 and the highest 63. Each question item is worth 0 to 3, depending on the severity of depressive symptoms. Beck Depression Inventory-II is a depression measurement tool that can be used in individuals aged 13 years and over. One of the main characteristics that led to the increasing popularity of BDI-II use is that most people can complete 21 self-report items within 5 - 10 min. We recommend that this measuring instrument be supported by sufficient lighting and concentration maintained while working on it [22,27].

The neurobiology that influences depression is neurotransmitter abnormalities (neurochemicals), with monoamines (serotonin, noradrenaline and dopamine) being heavily involved. Anatomically, depression is associated with structural and functional abnormalities in the limbic-cortico-striato-pallido-thalamic pathway that includes the orbitofrontal cortex, anterior cingulate cortex, basal ganglia, hippocampus, parahippocampus and amygdala. Structural anatomical abnormalities in depressed individuals are found in

both grey matter and white matter. Consistently reported grey matter abnormalities associated with depression are decreased volume of the hippocampus, prefrontal cortex, orbitofrontal cortex (subgenual), anterior cingulate cortex and basal ganglia structure. From a cognitive perspective, Aaron Beck posits the triad beck of a negative view of oneself, a negative view of others and the world and a negative view of the future [26].

Adult congenital heart disease patients whose lives are accompanied by a significant burden in various aspects of their personal lives may be especially prone to mental disorders. Although most patients adjust their lifestyle, a large number of congenital heart disease patients experience emotional distress that can lead to depression. It is associated with depression in adult congenital heart disease patients, which can be referred to as "learned helplessness". Patients are permanently faced with stressful situations related to their disease associated with lack of control. They tend to adjust to passive roles (helplessness). Learned helplessness contributes to the development of depression. Aggravating psychosocial factors, pressures and lack of social support can lead to helplessness [28].

The impact of emotional distress on health among congenital heart disease patients suggests that high levels of emotional distress increase medical risks that can be detrimental to death. Depression is associated with death in coronary artery disease patients, and anxiety can damage heart health in adult congenital heart disease patients. It is estimated that adult congenital heart disease patients who experience depression that is not detected and not treated immediately can increase the risk of recurrent heart disease [28].

Perception of congenital heart disease is a chronic disease, where congenital heart disease patients interpret their chronic disease into their self-awareness (illness identity). Four disease identity statuses exist: Engulfment, rejection, acceptance and enrichment. This assumption has to do with psychological and physiological relationships. Engulfment is a notion of psychological and physiological maladaptiveness. The patient may reject the disease, and this is a self-defense mechanism [28].

Characteristics of demographics

In this study, there was a significant relationship between the variables of length of education, NYHA class and occupation with depressive syndrome in adult congenital heart disease patients. This is in line with several previous studies. There was no association between age, sex, marital status, history of prior surgery/medical intervention and comorbid diseases of adult congenital heart disease patients with depressive syndrome in adult congenital heart disease patients. It is also not in line with some earlier studies.

Association between age, duration of education, NYHA classes and depressive syndrome in adult CHD patients

The age variable of adult congenital heart disease patients was not associated with depression in adult congenital heart disease patients. This study is not in line with Nielsen *et al.* [29] study of 22,912 patients with adult congenital heart disease and 224,259 controls, which found higher serious depression outcomes among young and middle-aged patients with adult congenital heart disease compared to controls [29]. Differences may be related to differences in methods. In contrast, previous studies using Swedish national patient registries containing discharge diagnoses, surgical procedures, populations and analyses were also different, with more specific adult congenital heart disease diagnoses, including group lesions on one of the study variables [29]. This study is not in line with Moons *et al.* [30] research in which adult congenital heart disease patients found that depressive symptomatology scores were higher in patients older than young. This difference may be related to several different demographic variables and characteristics

in this study and previous studies, where the research criteria have also been limited to 18 - 45 years. This possibility may also lead to discrepancies in previous studies.

The study is also out of step with a survey conducted by Moons *et al.* [31]. This difference may be related to differences in the age of adult samples (≥ 18 years) not limited to the oldest age, differences in the analysis used APPROACH-IS (Assessment of Patterns of Patient-Reported Outcomes in Adults with Congenital Heart Disease - International Study), this study was conducted in 15 countries. There were also differences in the study sites of adult congenital heart disease patients hospitalized 1 year earlier. The reason for hospitalization seems relevant because patients hospitalized for heart surgery report a 0.3 better quality of life than patients treated for other reasons.

Increased lifespan in adult congenital heart disease results in a growing group of older people in the adult congenital heart disease population. The mental health of patients aged 60 years or older compared to patients aged 18 - 39 and 40 - 59 years. Older adult congenital heart disease patients experience fewer symptoms of anxiety and have better mental health status. The observation that older individuals tend to have better mental health status and less stress is consistent with findings in the general population and other medical conditions. Transitioning from middle age to mid-60, anxiety levels seem to be declining. This may be partly due to a phenomenon known as "response shift," a term used to describe how people can change their views or feelings about certain phenomena (e.g., what's essential to their quality of life) after they've experienced a particular experience. For example, someone suffering from a chronic illness may adjust their expectations or values over time and feel less anxious than before.

Furthermore, it is known that specific brain changes can cause changes in anxiety levels. More specifically, white matter degeneration during aging is linked to reduced anxiety in adults older than the general population. Therefore, it is not surprising that anxiety levels in older adult congenital heart disease patients are lower than in younger age groups. Further research on age-related issues, including mental health, is needed to gain adequate insight into the needs of this growing population [32].

There was a significant association between the variables of length of education and depression in adult congenital heart disease patients. This is in line with Moon *et al.* [33] in Korea on 200 adult congenital heart disease patients, 47 % of whom had completed higher education or scientific depression. This is likely related to the similarity of inclusion criteria for the age of study subjects over 18 years and outpatient adult congenital heart disease patients. In line with research conducted by Enomoto and Nakazawa [15] on 258 patients with congenital heart disease, there is a link between education and adult congenital heart disease. Fewer higher education graduates are depressed. This is related to the age equation of adult congenital heart disease patients 20 - 46 years. The study is also in line with Alemayehu *et al.* [34] in Ethiopia on 424 subjects. It found that adult congenital heart disease patients who had poor knowledge were 5 times more likely to have depression compared to those with good knowledge. This similarity may be related to the same design using cross-sectional, similar demographic characteristics and similar educational backgrounds [17].

There was a significant association between the patient's NYHA class variables and depression in adult congenital heart disease patients. The study aligns with Alemayehu *et al.* [34] in Ethiopia on 424 heart failure patients. It was found that heart failure patients who had classes III and IV were more likely to have depression than classes I and II. Advanced heart failure patients may worry about worsening symptoms, disease-related complications, dietary restrictions, and not being able to perform and they are always dependent on others. This can directly or indirectly lead to depression. This suggests that patients with advanced heart failure require an initial evaluation of depression and that heart specialists work closely with psychiatrists to perform screening. This equation may also be related to the same design using cross-sectional [13,16,35].

Relationship between sex, marital status, occupation, history of surgery, comorbid diseases and depressive syndrome in adult congenital heart disease patients

The sex variable was not associated with depression in CHD patients. This is not in line with research conducted by Kasmi *et al.* [37] on 67 dextro-transposition of the great arteries (d-TGA) patients, who found gender-related depression in d-TGA patients. A survey by Moon *et al.* [36] of 200 adult congenital heart disease patients found that 45 % were women.

These differences may be related to the female sex being associated with a higher lifetime risk of depressive disorder. Although the mechanism of sex-dependent variation in mental disorder susceptibility in adult congenital heart disease patients is unknown, these findings are in line with typical epidemiological patterns of higher prevalence of depressive disorders in women. The interaction between biological factors and psychosocial vulnerability may put women with d-TGA at higher risk of internalization difficulties [37].

This difference may be related to eligible subjects (aged-18 years) born with d-TGA between 1984 and 1995 who were identified using medical records at 2 major hospitals. The inclusion criteria for diagnosing subjects with specific d-TGA (with complex ventricular septum or ventricular septal defect) are corrected during the first 2 months of life. Exclude patients who have a birth weight below 2.5 kg, known genetic anomalies, associated extracardiac or cardiovascular anomalies requiring reconstruction of the aortic arch, severe sensory deficits (vision, hearing) or severe neurological comorbidities (e.g., brain injury and brain tumor) [37]. The difference may also have to do with one of the variables of congenital heart disease diagnosis experienced by more specific subjects, such as d-TGA.

Marital status variables were not associated with depression in adult congenital heart disease patients. This is not in line with Alemayehu *et al.* [34] in Ethiopia of 424 heart failure patients. Unmarried heart failure patients were 9.25 times more likely to have depression than married patients [16,38].

This may be related to differences in the study population of heart failure patients undergoing follow-up at 4 government hospitals. The study implementation time is shorter, only 30 days (January 1 - 30, 2021). The study also stated that unmarried patients had a positive correlation with depression compared to married ones. Suspected unmarried heart failure patients are unable to share their stress with others/partners [34]. These differences may also be related to cultural differences.

There is a significant association between occupational variables and depression in adult congenital heart disease patients. In line with a study conducted by Enomoto and Nakazawa [15] on 258 patients with congenital heart disease. There is a link between work and depression in adult congenital heart disease patients, with fewer patients working full-time, more part-time workers, and more homemakers among adult congenital heart disease patients. This similarity may be related to the age similarity of subjects, namely adult congenital heart disease patients aged 20 - 46 years, similarity in demographic characteristics, and the subject's occupational background [5,39,40].

Previous surgery/intervention history variables were not associated with depression in adult congenital heart disease patients. This study is not in line with a study by Moon *et al.* [33] of 200 adult congenital heart disease patients found that 38 % of patients had undergone 1 heart surgery, 24.3 % had undergone 2 heart surgeries, and 22.1 % had undergone 3 or more heart surgeries [41].

These differences may be related to differences in subject criteria, the absence of complications or syndromes associated with severe intellectual disability (for example, trisomy 21), differences in the measuring instruments used by the Center for Epidemiological Studies of the Depression Scale (CES-D), which is a commonly used instrument for depression screening in patients with chronic diseases. As many as 55 % of adult congenital heart disease patients experience medical problems such as arrhythmias, bacterial endocarditis, congestive heart failure and pulmonary vascular disease and require further surgery

even after receiving pediatric surgery. Adult congenital heart disease patients also suffer from various psychological difficulties caused by heart disease, for example, fear of death, treatment decision-making and anxiety associated with preparing for heart surgery [33]. This difference may also be related to using numerical variables in previous studies, whereas this study used categorical variables.

Comorbid disease variables were not associated with depression in adult congenital heart disease patients. This does not align with Yang *et al.* [42] of 2,122 adult congenital heart disease patients and 8,488 controls. Coronary artery disease and chronic obstructive pulmonary disease were significant comorbidities mediating the association between adult congenital heart disease and depression, with a proportion mediated by coronary artery disease at 35.5 % and chronic obstructive pulmonary disease at 12.9 % [43].

This may be related to differences in the study methods used. A retrospective cohort study and 3-year implementation time were followed from January 1, 2010 - December 31, 2013. Previous research has also found that adult patients with congenital heart disease are more likely to be depressed and have non communicable comorbidities than adults without adult congenital heart disease. Adults with congenital heart disease had a higher risk of depression, finding that coronary heart disease and COPD were influential comorbidities and mediated the association between adult congenital heart disease and depression, especially in patients with complex congenital heart disease [36].

This difference may also be related to categorical variables without being classified again for each comorbid disease in the study. In contrast, previous studies, such as COPD coronary heart disease, were classified in more detail.

Mental disorders and mental health problems are more common in people with somatic morbidity than in individuals who do not suffer from it - about 40 % of individuals with chronic physical illness present with mental disorders. The probability of developing a mental disorder in people with physical conditions is 25 - 300 % higher. Congenital heart disease is an example of a chronic physical condition associated with mental health problems. Early in life, individuals with congenital heart disease may experience traumatic experiences due to invasive procedures and prolonged intensive care treatments. Growing up with congenital heart disease can also trigger existential questions as patients can be faced with a potentially reduced life expectancy. From this perspective, it can be understood that some congenital heart disease patients develop anxiety disorders and depression. Genetic predisposition for certain mental disorders also plays a role [32].

Depression has a strong relationship with heart failure that adult CHD patients can experience. Depression patients can cause poor physiological heart function. Heart failure and impaired quality of life are also associated with the mental health of adult CHD patients. Adult CHD patients who are depressed are at risk for readmission to the hospital. Heart failure with depression dramatically affects their quality of life, and they have a 2-fold risk of death or heart attack. The 5-year mortality rate for heart failure patients is 50 %. The average survival is 1.7 years for males and 3.2 years for females. Only 25 % of males and 38 % of females have survived the past 5 years. This mortality rate is 4 - 8 times greater than that of the general population of the same age. A study was conducted in New York on heart failure in patients with depression rates from 13 to 77.5 % and outpatients from 13 to 42 %, and depression is 5 times more common in heart failure patients compared to the entire population [44].

Adult congenital heart disease is the persistence of structural abnormalities present from birth involving the heart and large blood vessels in adult life, i.e., over the age of 16 years. Adult congenital heart disease is an ever-increasing burden to the health care system [35,45].

This study aims to analyze factors associated with depressive syndrome in adult congenital heart patients. So, when this study runs with the help of tools distributed to respondents, it turns out that the factors of patients with higher education, NYHA classes and those who have jobs are more susceptible to

depressive syndrome. At the same time, the other 5 factors have no association with depressive syndrome. The results of this study have answered a research question.

The advantage of this study is that it is based on researchers' knowledge through a literature review. Studies with similar methods and measuring instruments have never been conducted in North Sumatra that analyze factors associated with depressive syndrome in adult congenital heart disease patients, so that this study can be used as a guideline in future studies with similar topics. The results of this study are expected to provide knowledge about analyzing factors associated with depressive syndrome in patients with congenital heart disease so that it is expected to prevent or reduce the risk of depression in adult congenital heart disease patients.

The limitation of this study is that it was conducted at 1 service center and was only possible in cross-section due to limited resources. This study is expected to be better carried out in a broader scope. It needs to identify psychosocial stressors experienced by adult congenital heart disease patients so that it becomes an additional consideration in determining factors related to depressive syndrome experienced by adult congenital heart disease patients.

Conclusions

From this study, a conclusion can be drawn that there is no relationship between the patient's age, sex, marital status, history of surgery and comorbidities of adult congenital heart disease and depressive syndrome in adult congenital heart disease patients. Meanwhile, there is a relationship between work, education and NYHA classes for depressive syndrome in adult congenital heart disease patients. So that further efforts can be made in dealing with this problem.

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