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ORIGINAL

EMOTIONAL AND SLEEP PATTERNS IN ADOLESCENTS WITH CONGENITAL HEART DISEASE: IMPLICATIONS FOR PHYSICAL ACTIVITY AND SPORTS PARTICIPATION

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ABSTRACT

Adolescents with congenital heart disease (CHD) are at increased risk of emotional disturbances and sleep disorders, which may impact their ability to engage in physical activity and sports participation. This study aimed to evaluate the emotional and sleep status of adolescents with CHD and explore the implications for their overall well-being and physical activity levels. **Methods:** A total of 69 participants underwent assessments, including 47 adolescents with CHD (55.3% female) as the experimental group and 22 healthy adolescents (50% female) as the control group. Among the CHD patients, 21 had single malformations (61.9% female) and 26 had compound malformations (50% female). Emotional and sleep parameters were evaluated using the PHQ-9, GAD-7, PSQI, IES-R, PCL-C, and ASLEC scales. **Results:** Adolescents with CHD demonstrated significantly higher scores on the PHQ-9 and GAD-7 compared to the control group ($P < 0.05$), indicating elevated levels of depression and anxiety. Within the CHD cohort, those with compound malformations exhibited significantly higher scores on both scales than the control group ($P < 0.016$). Symptom analysis revealed that depressive symptoms in the compound malformation group were primarily characterized by fatigue ($P < 0.016$), while anxiety symptoms were predominantly related to

difficulty relaxing (P < 0.016). **Conclusion:** Adolescents with CHD, particularly those with complex congenital malformations, are at an elevated risk of depression, anxiety, and specific emotional symptoms. These findings highlight the need for regular psychosocial screening and targeted interventions to support emotional well-being and promote physical activity in this population. By addressing emotional and sleep challenges, healthcare providers can enhance adolescents' readiness for participation in sports and physical rehabilitation programs, fostering improved quality of life and holistic health outcomes.

KEYWORDS: Cervical Cancer; FIGO; Prognostic Factor

1. INTRODUCTION

Congenital heart disease (CHD) is one of the most common congenital anomalies, affecting millions of individuals worldwide. Advances in medical and surgical interventions have significantly improved the survival rates of children born with CHD, allowing many to reach adolescence and adulthood. However, the chronic nature of the disease, along with the physical limitations and psychosocial challenges it entails, places adolescents with CHD at increased risk for emotional disturbances and sleep disorders. These challenges are particularly pronounced during adolescence, a critical period of physical, emotional, and social development. Adolescents with CHD often face unique stressors, including limitations in physical activity, fear of medical procedures, and social stigma related to their condition (Roseman & Kovacs, 2019). These factors can lead to emotional problems such as depression and anxiety, which are known to negatively impact overall quality of life (Naef et al., 2017; Price & Duman, 2020). Sleep disturbances, a common comorbidity in CHD patients, further compound these challenges by affecting cognitive functioning, mood regulation, and physical recovery. Together, these emotional and sleep disturbances can create a feedback loop, hindering participation in physical activities and sports, which are essential for maintaining physical health, social engagement, and psychological well-being. Physical activity and sports participation are critical for adolescents, particularly for those with chronic health conditions like CHD (Hoffman & Kaplan, 2002). Regular physical activity has been shown to improve cardiovascular fitness, enhance emotional well-being, and reduce the risk of secondary complications in CHD patients. However, emotional and sleep disturbances often act as barriers (Oyarzún, Clavería Rodríguez, Larios Goldenberg, & Le Roy, 2018), reducing motivation and the perceived capability to engage in physical activities. Understanding the interplay between emotional status, sleep quality, and CHD is therefore crucial for developing targeted interventions to support these adolescents in achieving better health outcomes (Martínez‐Quintana et al., 2020; Roseman & Kovacs, 2019). In the study report on the population with CHD, it was found that compared with healthy people, older children and adolescents with CHD,

especially patients with complex CHD, showed more concern and vigilance about the subtle physical discomfort that appeared daily, and their overall emotional scale score was significantly higher (Dahlawi, Milnes, & Swallow, 2020; H.-L. Yang et al., 2020). But in an assessment of his emotional condition, previous studies have not reached consistent conclusions. Some studies have concluded that the emotional status of patients with CHD in adolescence does not show a significant difference compared with normal healthy people, but even so, the score of the anxiety and/or depressive symptom scale in adolescents in patients with CHD tends to be more critical (Karsdorp, Everaerd, Kindt, & Mulder, 2007; Spijkerboer, Utens, Bogers, Verhulst, & Helbing, 2008).This also reminds us that compared with normal adolescents, patients with CHD still have a high probability of anxiety, depression and other emotional disorders in adolescence (Samuel, Marckini, Parker, Kay, & Cook, 2020). Sleep plays a major role in the body's mental health and emotional regulation, and many emotional disorders are accompanied by a decline in the overall quality of sleep (Jackson, Misiti, Bridge, Daniels, & Vannatta, 2015; Monti, Jackson, & Vannatta, 2018).Although there is currently no systematic study of the sleep of patients with CHD in adolescence. However, most studies believe that the decline in the overall quality of sleep is a risk factor and maintenance factor for emotional disorders, there is often a two-way connection between sleep and emotions, and the decline in the overall quality of sleep is that the body is more prone to negative emotions such as anxiety and depression, and on the contrary, the emergence of negative emotions will also aggravate the further decline in sleep quality (Dutcher et al., 2021; Walker, 2009).This also reminds us that patients with CHD have a certain chance of a decline in the overall quality of sleep during adolescence. Emotional problems such as anxiety and depression are risk factors for death and disability, even in the general population. At present, there are few studies on the mood and sleep problems of patients with CHD in adolescence, and the correlation between the production of emotional and sleep problems such as anxiety and depression and the type of congenital heart malformations between them has not been well studied, let alone the specific symptoms of their mood abnormalities and overall sleep quality decline. Therefore, in this study, we determined to explore the overall situation of mood and sleep symptoms in adolescents compared with normal adolescents, and to further explore the correlation between mood and sleep symptoms and congenital cardiac malformation types.

2. Method

2.1 Study Design and Participants

We recruited patients with CHD who were hospitalized and underwent surgery at the First Hospital of Hebei Medical University and Hebei Provincial Children's Hospital from January 2009 to December 2013 as an experimental group. At the same time, healthy participants of similar age and sex to the

experimental group were recruited into the control group. Depending on the type of congenital cardiac malformation, we further divided the experimental group into a single malformation group (preoperative echocardiogram confirming the presence of only one congenital cardiac developmental malformation) and a compound malformation group (preoperative transsonic echocardiography confirming the presence of at least two congenital cardiac developmental malformations). The inclusion criteria of the experimental group are: (a) congenital heart disease diagnosed by echocardiography before hospitalization; (b) all underwent surgical treatment; (c) have basic reading comprehension skills; (4) the patient or family member signs the informed consent form. The criteria for inclusion in the control group were: (a) echocardiography confirmed that there were no congenital cardiac malformations; (b) have basic reading comprehension skills; (c) the subject or family members sign an informed consent form. The exclusion criteria for the two groups were: (a) the presence of organ failure; (b) have bleeding disorders or coagulation disorders; (c) the presence of diseases such as endocardial growth, active endocarditis or sepsis; (d) concomitant impairment of other organs such as diabetes, epilepsy, etc.; (e) Intellectual disabilities or cognitive dysfunctions; (f) severe mental illness (e.g., schizophrenia, bipolar disorder, etc.) (g) pregnancy status. We contacted a total of 134 patients with CHD, 22 healthy people of similar age and gender, and all the participants had complete data. Of the134 patients with CHD, 38 lost follow-up and 47 refused to participate. Of the remaining 49 patients with CHD, 2 were excluded due to limited reading comprehension and could not be evaluated, and of the remaining 47 patients who met the admission criteria,26 were cardiac compound malformations and 21 were single malformation of the heart. The 69 participants who participated in the study completed Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder Scale-7 (GAD-7), Pittsburgh Sleep Quality Index (PSQI), Event Impact Scale-Revised Edition (IES-R), Neuropsychological scales such as the PTSD Self-Assessment Scale (PCL-C) and the Adolescent Life Events Scale (ASLEC) (Figure 1).

2.2 Instruments

Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder Scale-7 (GAD-7) (Lo, Ong, Leong, Gooley, & Chee, 2016; Palmer & Alfano, 2017),are internationally used initial screening tool for depression and anxiety, and has been widely used in many clinical institutions.PHQ-9's 9 projects contain diagnostic criteria for depression in The Diagnostic and Statistical Manual of Mental Disorders (D SM). Can be used as a potential diagnostic measure of depression. GAD-7 was originally developed for generalized anxiety disorder, but it is also an effective screener for anxiety disorders. PHQ-9 and GAD-7 are easier to understand and remember than other scales and have been widely used in various groups of society, including the elderly, adolescents, pregnant women and other special groups. Pittsburgh

Sleep Quality Index (PSQI) (Kroenke, 2021) is a self-report questionnaire prepared by Dr. Buysse of the Department of Neurology of the University of Pittsburgh, which is widely used by clinicians and researchers to widely evaluate several dimensions of sleep, and has a good retest reliability and validity at home and abroad, mainly used for the determination of sleep conditions in people with sleep disorders, patients with mental disorders and the general population, and is an internationally recognized evaluation tool for the correlation between sleep quality and psychosomatic health. The Event Impact Scale - Revised Edition (IES-R) and the Adolescent Life Events Scale (ASLEC) measure the frequency and intensity of stress life events in the population. PTSD Self-Assessment Scale (PCL-C) (Levis, Benedetti, & Thombs, 2019) is a reliable measure of symptoms of PTSD in psychometrics, mostly used to measure the impact of traumatic events, general events, or specific events on a population.

2.3 Statistical Analysis

All counting data were normalized using One-Sample K-S, and data conforming to the normal distribution were assessed for equality of variance using The Levine test, using Anova or the Independent Sample T test (Student′s test) statistical data, unless otherwise indicated, the data are expressed in mean ± standard deviation; Data that do not conform to the normal distribution use Wilcoxon rank sum test statistics, which are Bonferroni-corrected for test levels of multiple independent sets of samples, and unless otherwise noted, the data are expressed in median and quartiles. Categorical variables are analyzed using a chi-square test.

3. Result

Of the 49 patients with CHD who participated in the review, except for 2 who were unable to complete the assessment due to limited reading comprehension, no patients were excluded due to comorbidities that limited life expectancy. The average age of patients with CHD who participated in the assessment was 12.68 years (12.64±2. 55 years), of which 26 (55.3%) patients are female.

Among the 47 patients who were finally included, according to the type of congenital cardiac malformation, they were divided into a single malformation group (21 patients) and a compound malformation group (26 patients). At the same time, 22 participants of similar age and sex to the experimental group were included as normal control groups. PHQ-9, GAD-7, P SQI, PCL-C, IES-R and ASELC scales were performed on all three groups of participants. Three groups of participants in terms of age, sex, height, body weight and body mass index (BMI) were examined. None of them made a significant difference (Table 1).

3.1 Emotional and Sleep Status of Patients with CHD in Adolescence

Of the 47 patients with CHD included, 16 (34%) experienced depression (PHQ-9 scale score >4), 13 (27.7%) experienced anxiety (GAD-7 scale score>4), and 2 (4.2%) experienced decreased sleep quality. (PSQI scale score>5). In the control participants, 4 patients experienced depression (18.9%), 5 (22.7%) experienced anxiety, and 2 patients (14.3%) experienced decreased sleep quality. In the total cohort, the population treated with CHD was more likely to experience depression and anxiety than the control group, and the difference was statistically significant (P<0.05), while there was no significant difference in sleep quality, life events and stress events between the two groups. (Table 2, Figure 2)

3.2 The Influence of the Type of Congenital Malformations on the Emotional and Sleep Status of Patients with CHD

In order to further explore the influence of the types of congenital heart malformations on anxiety and depression in patients with CHD, we further divided the congenital heart disease group into a single malformation group (only one congenital cardiac developmental malformation was shown on preoperative echocardiography) and a compound malformation group (preoperative echocardiography showed at least two congenital cardiac developmental malformations). In the group of 21 single malformations, 4 patients (19%) experienced depression, 4 patients (19%) experienced anxiety, and in the 26 cases of complex malformations, 12 patients (46.2%) experienced depression, 9 (34.6%) experienced anxiety, and 2 (7.7%) experienced decreased sleep quality. Compared with the normal control group and the single malformation group, the number of people proportion in the compound malformation group is higher in terms of depressive symptoms, the three sets of differences were statistically significant (P<0.05), and there was no significant difference in the proportion of people experiencing anxiety and decreased sleep quality in the three groups (Figure 3).According to the scoring results of the scale, the compound malformation group compared with the normal control group, the GAD-7 and PHQ-9 scale was significantly rated higher, the difference is statistically significant（P＜0.016）.The compound malformation group compared to the single malformation group, Its adolescent life events scale was significantly rated, the difference was statistically significant (P<0.016）.There were no significant differences in stress conditions between the three groups (Table 3, Figure 4).

3.3 Comparison of PHQ-9, GAD-7 and PSQI-related Symptoms in the Normal Control Group, Single Malformation Group and Compound Malformation Group

We conducted a specific analysis of the emotional and sleep symptoms

associated with PHQ-9, GAD-7 and PSQI, and further explored the presence of patients with CHD in PHQ-9, GAD-7 and PSQI more prominent manifestations of anxiety and/or depressive mood abnormalities and/or abnormal sleep. From the analysis, compared with the normal control group, the depressive symptoms of the compound malformation group were mainly manifested as feeling tired or inactive, and the anxiety symptoms were mainly manifested as difficult to relax, and the difference was statistically significant ($P < 0.016$), there were no significant differences in other related symptoms. There were no significant differences in the scores of symptoms associated with PHQ-9 and GAD-7 between the normal control group and the single malformation group and the single malformation group and the compound malformation group (Table 4, Table 5). There was no significant difference in PSQI-related symptom scores between the three groups.

4. Discussion

Patients with CHD will have many neuropsychological problems as they grow older, and these problems are often masked by sleep disorders and corresponding physical symptoms, and the current medical demand for social and psychological resources for this specific group of patients is gradually increasing, so it is very important to predict the emotional and sleep status of this population (Dietch et al., 2016).In our present study, we investigated the emotional and sleep status of patients with CHD during adolescence through neuropsychological scale evaluation, and explored the influence of congenital cardiac development malformations on their emotional and sleep status in adolescence. Overall, patients with CHD are more likely to experience negative emotions such as anxiety and depression, our data are consisitent with Efrén Martínez‐Quintana and Adrienne H. Kovacs and others's (Wilkins, Lang, & Norman, 2011) findings. Through our research, we found that the number of patients with congenital cardiac complex malformations who experienced negative emotions such as anxiety and depression increased significantly (Figure 3), and their overall scores of PHQ-9 and GAD-7 also increased significantly (Table 3).It shows that the occurrence of negative emotions in patients with CHD is affected by the type of congenital cardiac development deformity, which is basically consistent with the results proposed by Bennett P Samuel and others7 that patients with complex congenital heart disease are more prone to negative emotions such as anxiety and depression. However, our data differ from Adrienne (Kovacs et al., 2018), they argue that although the risk of negative emotions in patients with CHD is significantly increased, it is not significantly associated with the type of congenital heart malformation. And Jonathan R G (Etnel et al., 2021) is not considered that the risk of negative emotions such as depression and anxiety in patients with CHD was no different from others. We analyzed that the above different findings may be related to factors such as the number of samples, the choice of neuropsychological scale, the race, region, average age and family status of the subjects, and the type of

control group selected (Hosey et al., 2019; Manea, Gilbody, & McMillan, 2015). Our results indicate that patients with congenital cardiac compound malformations were more susceptible to life events, which is consistent with previous findings by Emily M. Bucholz, Jamie L. Jackson, and Marie Granberg, who concluded that patients with congenital heart disease had no significant difference in quality of life in long-term follow-up. However, there has been a lower level of social adaptation and problem-solving. There is still little report on the correlation between the decline in his social adaptability and his congenital malformations of the heart (Smoller, 2016; L. Yang et al., 2015). This study shows corresponding advantages over previous studies. First, we use PHQ-9, GAD-7, PSQI and other neuropsychological self-assessment scales, which are less age-restricted and easy to understand than other scales (Huntley et al., 2019), which are more suitable for screening patients with congenital heart disease at various stages of growth and development. Second, we pay more attention to the effect of the type of congenital heart malformation on the negative mood of patients with CHD in adolescence. Third, we found that the depression of patients with congenital cardiac compound malformations was mainly manifested by an increase in subjective fatigue, and anxiety was mainly manifested as a feeling of tension that could not be relaxed, which was the first time that a more detailed study of the specific symptoms of emotions and sleep problems in patients with CHD was studied. Moreover, we creatively studied the sleep status of patients with CHD in adolescence, although the current study did not show the change in the sleep status of patients with CHD in adolescence, but most studies support the occurrence of negative emotions and the decline in the quality of their sleep, still suggesting the importance of long-term follow-up of their sleep status (Kovacs et al., 2018; Kovacs et al., 2009). Our study also has certain limitations. First, the sample size we studied was small, and the conclusions we reached may be biased by the sample size, future studies need to expand the sample size to assess their emotional and sleep status more fully (Granberg, Rydberg, & Fisher, 2008; Jackson, Gerardo, Monti, Schofield, & Vannatta, 2018). Second, we have only made a rough assessment of their recently reviewed echocardiograms, and have not yet conducted a more in-depth study of the current hemodynamics of their hearts, and some subjects may already have potential cardiac hemodynamic abnormalities, which may bias our final findings, we need to study more carefully in the future the correlation between changes in cardiac hemodynamics and their emotional and sleep status. Third, we only studied the mood and sleep conditions of patients with CHD in adolescence, although we have conducted certain research and investigation of their life events and traumatic stress conditions, but there are still certain interference factors from surgical stress, which may lead to an increase in the corresponding scale score (Bucholz et al., 2020; Etnel et al., 2021), and future studies need to further compare surgical treatment with patients with congenital heart disease who have not received surgical treatment.

5. Conclusions

This study highlights the significant emotional and sleep challenges faced by adolescents with congenital heart disease (CHD), particularly those with complex congenital malformations. Elevated levels of depression and anxiety, along with specific symptoms such as fatigue and difficulty relaxing, underscore the psychological vulnerability of this population. Additionally, these psychosocial challenges are intricately linked to the physical and social limitations often associated with CHD, potentially hindering participation in physical activity and sports. The findings emphasize the critical need for routine psychosocial screening and targeted interventions for adolescents with CHD. Addressing emotional and sleep disturbances through multidisciplinary approaches can improve not only mental health outcomes but also physical activity levels, which are essential for cardiovascular health, social integration, and overall quality of life. Integrating mental health support with physical activity programs tailored to the unique needs of CHD patients can foster resilience, enhance self-efficacy, and promote a more active lifestyle. Future research should explore the long-term impacts of such interventions on sports participation, physical rehabilitation, and emotional well-being, paving the way for comprehensive care models that support the holistic development of adolescents with CHD. These efforts are crucial for enabling this vulnerable population to lead healthier, more fulfilling lives.

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Figures and Tables

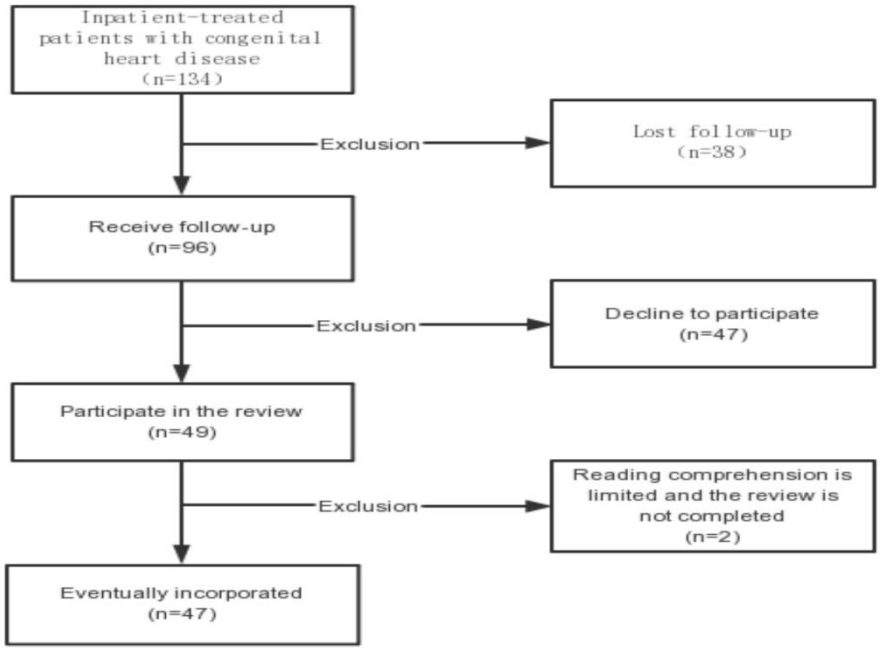

Figure 1: Experimental group subject inclusion process

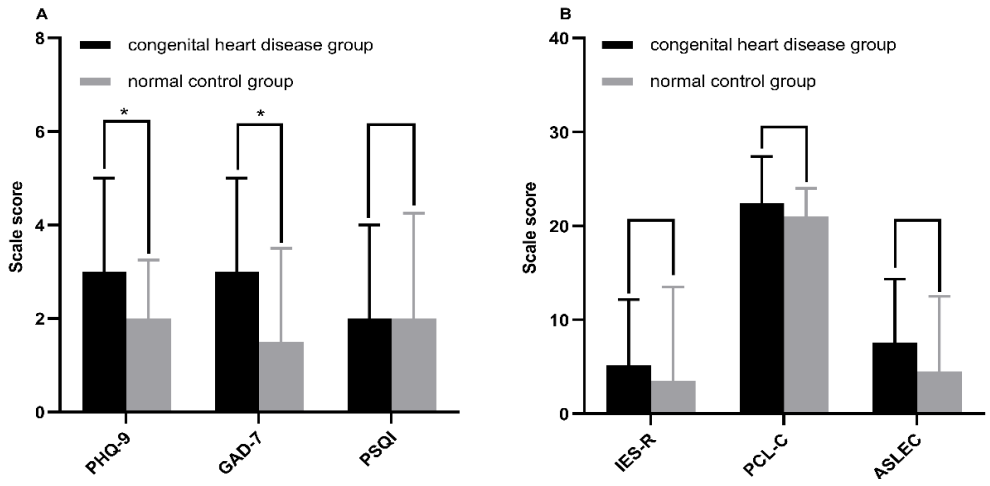

Figure 2: Scale scores in the congenital heart disease group compared to the normal control group. figure A show the comparison of mood and sleep conditions between the two groups; figure B show the comparison of stress and life events between the two groups. The scores of PHQ-9 and GAD-7 in the congenital heart disease group were significantly higher than those in the normal control group, and the difference was statistically significant (P<0.05); However, there were no significant differences in PSQI, IES-R, PCL-C and ASLEC scores between the two groups

PHQ-9: Patient Health Questionnaire-9; GAD-7: Generalized Anxiety Disorde-7; PSQI: Pittsburgh Sleep Quality Interview; IES-R: Impact of Event Scale-Revised; PCL-C: The PTSD Cheeklist-Civilian Version; ASLEC: Adolescent Self-Rating Life Events Checklist The numeric values in the figure A and figure B represent the median and quartile ranges, P < 0.05*

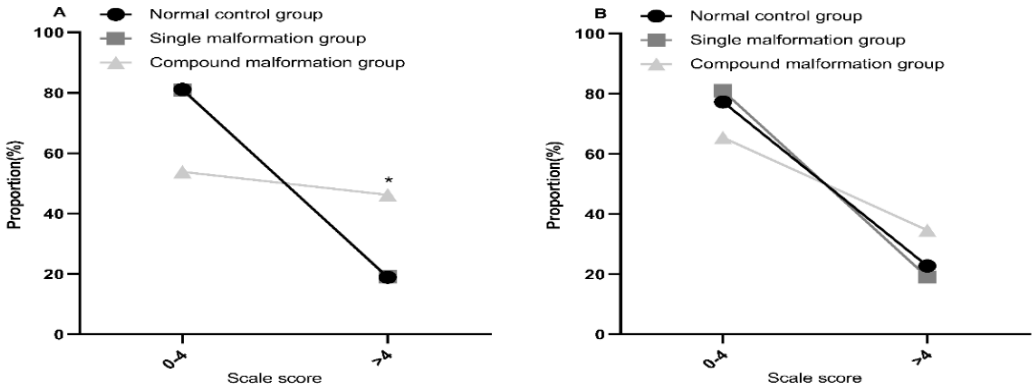

Figure 3: Proportion of people with emotional symptoms in the normal control group, single malformation group, and compound malformation group. Figure A shows the proportion of people with depressive mood problems in the Patient Health Questionnaire-9(PHQ-9) scores of the normal control group, the single malformation group, and the compound malformation group. Figure B shows the proportion of people with anxiety problems in the Generalized Anxiety Disorde-7(GAD-7) scores of the normal control group, the single malformation group, and the compound deformity group. The number of people with depressive symptoms in the compound malformation group was relatively high, and there were statistical differences in the three groups(P<0.05); There was no significant difference in anxiety symptoms between the three groups. *: $P < 0.05$

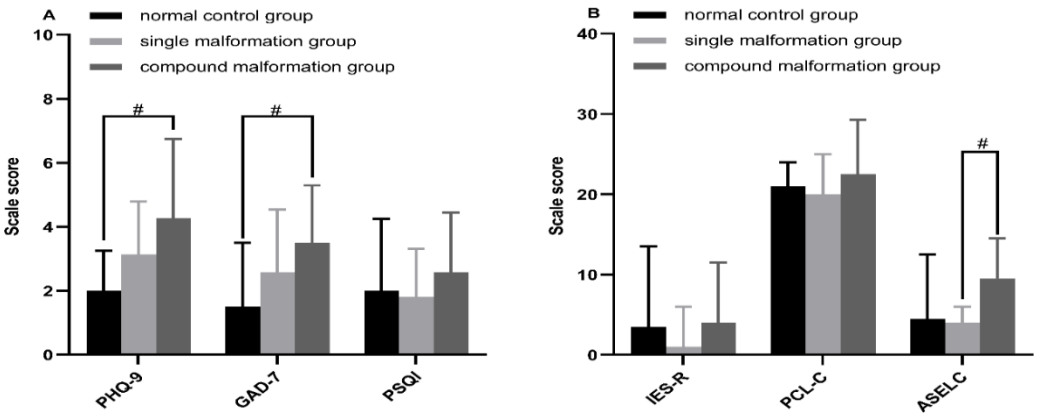

Figure 4: Comparison of scale scores for normal control group, single malformation group and compound malformation group. Figure A show the comparison of mood and sleep conditions between the three groups; Figure B show the comparison of stress and life events between the three groups. The scores of PHQ-9 and GAD-7 in the Compound malformation group were significantly higher than those in the normal control group, and the difference was statistically significant (P<0.016) ; The scores of ASLEC in the Compound malformation group were significantly higher than those in the single malformation group, and the difference was statistically significant (P<0.016)

PHQ-9: Patient Health Questionnaire-9; GAD-7: Generalized Anxiety Disorde-7; PSQI: Pittsburgh Sleep Quality Interview; IES-R: Impact of Event Scale-Revised; PCL-C: The PTSD Cheeklist-Civilian Version; ASLEC: Adolescent Self-Rating Life Events Checklist Values in the figure are expressed in median and quartiles (25% percentile, 75% percentile). #: The corrected difference is statistically significant.

Table 1: Clinical Characteristics of the Total Subjects

					CONGENTIAL HEART DISEASE GROUP(N=47)		
SUBJECT CHARACTERISTICS	**ALL SUBJECTS (N=69)**	**CONGENITAL HEART DISEASE GROUP (N=47)**	**NORMAL CONTROL GROUP (N=22)**	**P VALUE**	**SINGLE MALFORMATION GROUP (N=21)**	**COMPOUND MALFORMATION GROUP (N=26)**	**P VALUE**
AGE（YEARS）	12.68±2.37	12.64±2.55	12.77±1.94	0.828	12.7±3.0	12.8±2.7	0.974
WOMEN（%/N）	53.6/37	55.3/26	50/11	0.680	61.9/13	50/13	0.660
HEIGHT（CM）	159.36±10.77	157.85±9.89	162.59±12.05	0.088	156.4±10.6	156.4±11.7	0.108
WEIGHT（KG）	51.34±10.38	50.53±10.31	53.07±10.54	0.348	48.6±10.2	49.6±12.1	0.646
BMI（KG/M²）	20.11±2.95	20.12±2.76	20.09±3.39	0.965	19.6±1.7	20.0±3.5	0.991

P values denote differences between the congenital heart disease group and the Normal control groups, or between the Normal control groups、the Single malformation group and the Compound malformation group, respectively. The values in the table are expressed as mean ± standard deviations（SD）

**P<0.05*

Table 2: Scale Scores in the Congenital Heart Disease Group Compared to the Normal Control Group

SCALE NAME	**ALL SUBJECTS**	**CONGENITAL HEART DISEASE GROUP**		**NORMAL CONTROL GROUP**		**P VALUE**
		MEDIAN (25% PERCENTILE , 75% PERCENTILE)	**RANK AVERAGE**	**MEDIAN (25% PERCENTILE，75% PERCENTILE)**	**RANK AVERAGE**	
PHQ-9	3（1.5，5）	3（2，5）	38.96	2（1，3.25）	26.55	0.016*
GAD-7	3（1，5）	3（2，5）	38.34	1.5（0，3.5）	27.86	0.041*
PSQI	2（1，4）	2（1，4）	32.96	2（1.75，4）	39.36	0.209
IES-R	3（0，8.5）	3（0，6）	34.00	3.5（0，13.5）	37.14	0.532
PCL-C	21（18.0，25.0）	22（18，26）	35.34	21（18.75，24）	34.27	0.836
ASLEC	5（1，12）	6（2，12）	36.16	4.5（0，12.5）	32.52	0.481

PHQ-9: Patient Health Questionnaire-9; GAD-7: Generalized Anxiety Disorde-7; PSQI: Pittsburgh Sleep Quality Interview; IES-R: Impact of Event Scale-Revised; PCL-C: The PTSD Cheeklist-Civilian Version; ASLEC: Adolescent Self-Rating Life Events Checklist P values represented differences between the congenital heart disease group and the Normal control groups, *P < 0.05**.**

Table 3: Comparison of Scale Scores for Normal Control Group, Single Malformation Group and Compound Malformation Group

SCALE NAME	NORMAL CONTROL GROUP	P VALUE	SINGLE MALFORMATION GROUP	P VALUE	COMPOUND MALFORMATION GROUP	P VALUE
PHQ-9	2 (1, 3.25)	0.104	3 (2, 4)	0.094	4 (2.75, 6.25)	0.012#
GAD-7	1.5 (0, 3.5)	0.312	2 (1, 4)	0.081	3 (2, 5)	0.015#
PSQI	2 (1.75, 4)	0.077	2 (0, 3)	0.151	3 (1, 4)	0.599
IES-R	3.5 (0, 13.5)	0.256	1 (0, 6)	0.245	4 (0, 11.5)	0.966
PCL-C	21 (18.75, 24)	0.517	20 (17.5, 25)	0.118	22.5 (18, 29.25)	0.377
ASELC	4.5 (0, 12.5)	0.741	4 (2, 6)	0.015#	9.5 (3.75, 14.5)	0.157

PHQ-9:Patient Health Questionnaire-9;GAD-7:Generalized Anxiety Disorde-7;PSQI:Pittsburgh Sleep Quality Interview; IES-R :Impact of Event Scale-Revised; PCL-C: The PTSD Cheeklist-Civilian Version; ASLEC :Adolescent Self-Rating Life Events Checklist Values in the table are expressed in median and quartiles(25% percentile, 75% percentile) P values represented the differences between the normal control group and the single malformation group, the single malformation group and the compound malformation group, and the normal control group and the compound malformation group, respectively. The statistical test was performed using Kruskal-Wallis H and the test level was Bonferroni corrected. #: The corrected difference is statistically significant.

Table 4:(a) Comparison of PHQ-9 Results in the Normal Control Group, the Single Malformation Group, and the Compound Malformation Group

	NORMAL CONTROL GROUP	P VALUE	SINGLE MALFORMATION GROUP	P VALUE	COMPOUND MALFORMATION GROUP	P VALUE
THE TOTAL SCORE OF THE SCALE	2 (1,3.25)	0.104	3 (2,4)	0.094	4 (2.75,6.25)	0.012#
DON'T DO THINGS WITH VIGOR OR INTEREST	0.5 (0,1)	0.338	1 (0,1)	0.326	1 (0.75,1)	0.088
FEEL DEPRESSED, DEPRESSED, OR HOPELESS	1 (0,1)	0.467	1 (0,1)	0.536	1 (0.75,1)	0.184
DIFFICULTY FALLING ASLEEP, RESTLESS SLEEP, OR EXCESSIVE SLEEP	0 (0,0)	0.418	0 (0,0)	0.136	0 (0,1)	0.477
FEELING TIRED OR LACK OF ENERGY	0 (0,1)	0.222	0 (0,1)	0.047	1 (0,2)	0.003#
LOSS OF APPETITE OR EATING TOO MUCH	0 (0,0)	0.418	0 (0,0)	0.434	0 (0,0)	0.109

Table 4:(b) Comparison of PHQ-9 Results in the Normal Control Group, the Single Malformation Group, and the Compound Malformation Group

	NORMAL CONTROL GROUP	P VALUE	SINGLE MALFORMATION GROUP	P VALUE	COMPOUND MALFORMATION GROUP	P VALUE
FEEL BAD OR FAILED, OR LET YOURSELF OR YOUR FAMILY DOWN	0 (0,0)	0.328	0 (0,1)	0.662	0 (0,1)	0.162
IT IS DIFFICULT TO FOCUS ON THINGS	0 (0,1)	0.404	0 (0,1)	0.194	1 (0,1)	0.027
MOVE OR SPEAK SLOWLY ENOUGH TO BE NOTICED BY OTHERS, OR JUST THE OPPOSITE	0 (0,0)	0.961	0 (0,0)	0.825	0 (0,0)	0.863
THERE IS AN URGE TO DIE OR HURT YOURSELF	0 (0,0)	0.306	0 (0,0)	0.878	0 (0,0)	0.358

PHQ-9: Patient Health Questionnaire-9; Values in the table are expressed in median and quartiles (25% percentile, 75% percentile) P values represented the differences between the normal control group and the single malformation group, the single malformation group and the compound malformation group, and the normal control group and the compound malformation group, respectively. The statistical test was performed using Kruskal-Wallis H and the test level was Bonferroni corrected.

#: The corrected difference is statistically significant.

Table 5: (a) Comparison Of GAD-7 Results in the Normal Control Group, the Single Malformation Group, and the Compound Malformation Group

	NORMAL CONTROL GROUP	P VALUE	SINGLE MALFORMATION GROUP	P VALUE	COMPOUND MALFORMATION GROUP	P VALUE
THE TOTAL SCORE OF THE SCALE	1.5 (0,3.5)	0.312	2 (1,4)	0.081	3 (2,5)	0.015#
FEELING NERVOUS, ANXIOUS, OR ANXIOUS	0 (0,1)	0.704	1 (0,1)	0.809	1 (0,1)	0.815
INABILITY TO STOP OR CONTROL CONCERNS	0 (0,1)	0.545	0 (0,1)	0.026	1 (0,1)	0.122
WORRYING TOO MUCH ABOUT ALL SORTS OF THINGS	0 (0,1)	0.850	0 (0,1)	0.460	0 (0,1)	0.389
IT'S HARD TO RELAX	0 (0,0)	0.151	0 (0,1)	0.111	1 (0,1)	0.003#
UNABLE TO MEDITATE BECAUSE OF RESTLESSNESS	0 (0,0)	0.198	0 (0,1)	0.844	0 (0,1)	0.098
BECOME IRRITABLE OR IRRITABLE	0 (0,0.25)	0.934	0 (0,0.5)	0.554	0 (0,1)	0.495

Table 5: (b) Comparison Of GAD-7 Results in the Normal Control Group, the Single Malformation Group, and the Compound Malformation Group

	NORMAL CONTROL GROUP	P VALUE	SINGLE MALFORMATION GROUP	P VALUE	COMPOUND MALFORMATION GROUP	P VALUE
FEELING AS IF SOMETHING TERRIBLE WAS HAPPENING AND BEING SCARED	0 (0,1)	0.916	0 (0,1)	0.783	0 (0,1)	0.860

GAD-7: Generalized Anxiety Disorde-7; Values in the table are expressed in median and quartiles (25% percentile, 75% percentile) P values represented the differences between the normal control group and the single malformation group, the single malformation group and the compound malformation group, and the normal control group and the compound malformation group, respectively. The statistical test was performed using Kruskal-Wallis H and the test level was Bonferroni corrected. #: The corrected difference is statistically significant.

Table 6: Comparison of PSQI Results in the Normal Control Group, the Single Malformation Group, and the Compound Malformation Group

	NORMAL CONTROL GROUP	P VALUE	SINGLE MALFORMATION GROUP	P VALUE	COMPOUND MALFORMATION GROUP	P VALUE
THE TOTAL SCORE OF THE SCALE	0 (0,1)	0.077	0 (0,1)	0.151	1 (0,1)	0.599
SLEEP QUALITY	0 (0,1)	0.382	0 (0,0.5)	0.407	0 (0,1)	0.107
TIME TO FALL ASLEEP	0 (0,0.25)	0.376	0 (0,0)	0.262	0 (0,0)	0.806
SLEEP TIME	0 (0,0)	0.205	0 (0,0)	0.826	0 (0,0)	0.244
SLEEP EFFICIENCY	1 (0,1)	0.043	0 (0,1)	0.199	0.5 (0,1)	0.279
SLEEP DISORDERS	0 (0,0)	0.079	0 (0,0)	0.256	0 (0,0)	0.441
HYPNOTHERAPY DRUGS	1 (0,1)	0.329	0 (0,1)	0.369	1 (0,1)	0.905
DAYTIME DYSFUNCTION	2 (1.75,4)	0.214	2 (0,3)	0.396	3 (1,4)	0.638

PSQI: Pittsburgh Sleep Quality Interview; Values in the table are expressed in median and quartiles (25% percentile, 75% percentile) P values represented the differences between the normal control group and the single malformation group, the single malformation group and the compound malformation group, and the normal control group and the compound malformation group, respectively. The statistical test was performed using Kruskal-Wallis H and the test level was Bonferroni corrected.