



Correlation Analysis of Fatigue with Sleep Disturbance, Depression and Anxiety in Elderly Patients with Myocardial Infarction

Jin Jiao¹, Jin Song¹, Yuanyuan Cui¹, Yilin Wang², Yanling Li¹, Jing Li¹, Yan Su¹, Xiaojing Du³, Yan Wang³, Guiping Sun³ and Minxiang Wei^{4*}

¹Hebei Key Laboratory of Cancer Radiotherapy and Chemotherapy, Department of Medical Oncology, Affiliated Hospital of Hebei University, Hebei, Baoding 071000, China

²Department of Nursing, School of Basic Medicine of Shandong University, Shandong, Jinan 250012, China

³Department of Nursing, Nursing School of Hebei University, Hebei, Baoding 071000, China

⁴Department of Breast Surgery, Affiliated Hospital of Hebei University, Hebei, Baoding 071000, China

Jin Jiao, Jin Song and Yuanyuan Cui contributed equally.

ABSTRACT

The main objective of this study was to investigate the status of sleep disturbance, fatigue, anxiety and depression in patients with myocardial infarction (MI) and analyse the relationship between fatigue and sleep disturbance, anxiety and depression. A cross-sectional research method was used to recruit 190 patients who were at least one-week post-MI as the research participants. The Pittsburgh Sleep Quality Index, the Chinese version of the Multidimensional Fatigue Scale and the Hospital Anxiety and Depression Scale were used to analyse the relationship between fatigue and sleep disorders, anxiety and depression, assess the depression status and explore the relationship between myocardial infarction. In this study, 55.3% of patients had sleep disorders, 25.3% had anxiety tendencies with a gender difference, 20.0% had depression tendencies, and 33.2% had fatigue with no gender difference. Anxiety, depression and sleep disturbance were all related to fatigue ($P < 0.05$). The results of the multiple regression analysis showed that anxiety, depression and sleep disturbance jointly explained 44.8% of the variation in fatigue. To conclude sleep disturbance, depression and anxiety could be influencing factors of fatigue in patients with MI, which affect the rehabilitation process of MI, particularly in elderly patients. Medical staff should consider educating the impact of anxiety, depression, fatigue and sleep disorders on MI and how to determine the needs of patients regarding mental health, symptoms and self-care strategies.

Article Information

Received 01 March 2023

Revised 22 May 2023

Accepted 06 June 2023

Available online 28 August 2023
(early access)

Authors' Contribution

JJ, SJ, CYJ conceived of the study. WYL, LYL, LJ, SY, DXJ, WY participated in its design and coordination. SGP, WMX helped to draft the manuscript. All authors read and approved the final manuscript.

Key words

Myocardial infarction, Fatigue, Sleep disturbance, Depression, Anxiety

INTRODUCTION

Coronary heart disease (CHD) is a common cardiovascular disease (CVD) among the elderly population. Myocardial infarction (MI) is a type of CHD that is multifactorial in origin and CHD increases with age.

Acute MI (AMI), which is myocardial necrosis caused by acute and persistent ischemia and hypoxia in the coronary arteries, is another common CVD. The clinical manifestations of AMI can include persistent retrosternal pain, heart failure, shock and arrhythmia and can pose a serious threat to a patient's life. Acute MI is most prevalent in Europe and the United States (Cormican *et al.*, 2021), where approximately 1.5 million people suffer an MI each year (Pajjuru *et al.*, 2022). In recent years, China has seen a significant increase in MI cases, with at least 500,000 new cases per year and at least 2 million cases currently.

Patients with MI can present with various symptoms and exhibit an average of 4.75 symptoms (Chen, 2019). Fatigue is a common chief complaint of patients with MI and can be difficult to manage; it primarily manifests as physical, mental and psychological fatigue (Gong *et al.*,

* Corresponding author: minxiang4477@163.com
0030-9923/2023/0001-0001 \$ 9.00/0



Copyright 2023 by the authors. Licensee Zoological Society of Pakistan.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

2022) and can cause sleep disorders. Sleep disorders are defined as an imbalance between the amount of time spent sleeping at night and the amount of time spent being awake during the day. The average adult sleeps 7.5 h. Recent studies have discovered that sleep behaviour reflects individual lifestyles, women report a higher incidence of sleep disorders, and most elderly patients with CHD have sleep disorders (Wang, 2021). Sleep disorders lead to poor prognosis and a severe decline in quality of life in patients with MI. Additionally, patients with MI have an increased incidence of depression and anxiety (Xu, 2020). One study investigated the association of depression and sleep duration with CVD and mortality. The study suggested that in addition to short sleep duration being strongly associated with CVD mortality and stroke, both depression and long sleep duration were independently associated with an increased risk of death from CVD, particularly CHD (Cheng *et al.*, 2022). Furthermore, depression after MI is a significant clinical problem, and its comorbidity complicates depression treatment and cardiovascular outcomes. The major comorbidities of CVD include obesity, diabetes mellitus and hyperlipidaemia, which are all related to the severity of sleep disturbance (Mitra *et al.*, 2021).

Most Chinese studies on the relationship between fatigue and myocardial infarction have to date focused on interventions for somatic symptoms in patients with CHD. However, the relationship between fatigue and sleep disorders in patients with MI remains underexplored. The purpose of this study was to investigate and analyse the current status of fatigue in patients with MI and the association between fatigue and sleep disorders, anxiety and depression in patients with MI to provide a reference for cardiac rehabilitation.

MATERIALS AND METHODS

Study participants

The purposive sampling method was used to select 190 elderly patients who were hospitalised for at least one week after MI from June 2020 to December 2021 in the Department of Cardiovascular Medicine of Affiliated Hospital of Hebei University.

The inclusion criteria for the study were as follows: (1) ST-segment elevation AMI or non-ST-segment elevation AMI; (2) Age ≥ 60 years; (3) Provided signed informed consent and participated voluntarily.

The exclusion criteria for the study were as follows: (1) Suffering from severe comorbidities, such as cancer, chronic pain, diabetes with poor glycaemic control, uncontrolled hypertension and nephropathy requiring haemodialysis; (2) Diagnosed with depression or anxiety

disorder prior to MI; (3) Antidepressant or benzodiazepine use before and during MI; (4) Mental cognitive disorders.

During the first week of admission, a demographic data survey was completed, including gender, age and residential status. Medical data involving prior diagnosis, acute treatment and infarct size was measured using the biochemical marker troponin I. The left ventricular ejection fraction was measured via chest echocardiography. One week after surgery, the questionnaires were administered to the patients for analysis.

Pittsburgh sleep quality index

The Pittsburgh sleep quality index (PSQI) is a standardised self-assessment questionnaire developed by Daniel J. Buysse to evaluate retrospective sleep quality and disorders over the preceding month (Buysse *et al.*, 1989). The index comprises 7 subscales including 19 items: (1) sleep quality (1 item); (2) sleep latency (2 items); (3) sleep duration (1 item); (4) sleep efficiency (3 items); (5) sleep disorders (9 items); (6) sleep medication (1 item); (7) daily dysfunction (2 items). Each subscale has a score range of 0–3 with a total score of 0–21. The higher the score, the worse the sleep quality and the more serious the sleep disorder. Respondents with a total score greater than 5 are classified as poor sleepers, while those with a score of 5 or less are classified as good sleepers. The internal consistency of the PSQI is 0.83 (Liu *et al.*, 2021).

Multidimensional fatigue inventory

The multidimensional fatigue inventory (MFI-20) was designed by Stems *et al.* (1996). In 2012, Han and Tian (2012) created the Chinese version of the MFI-20, including 20 items and 3 dimensions of fatigue, primarily physical fatigue, mental fatigue and psychological fatigue. The resulting scale scores range from 4–20 for each scale. The higher the score, the higher the fatigue. Cronbach's alpha is a statistic that refers to the average value of the halved reliability coefficient obtained by all possible item division methods of the scale, and it is the most commonly used reliability measurement method. For internal consistency, cronbach's alpha coefficient of the MFI-20 (Wondie and Hinz, 2021) was 0.881.

Hospital anxiety and depression scale

The hospital anxiety and depression scale (HADS) was created by Zigmond and Snaith (1983). It comprises 14 items and includes anxiety and depression subscales with 7 items each. The scale score ranges from 0–3, and the degree of anxiety and depression deepened. The normal score range is ≤ 7 , 8–10 is possible anxiety and depression and ≥ 11 is anxiety and depression. Cronbach's alpha was 0.80 and 0.93, respectively.

Statistical analysis

The statistical package for the social sciences (SPSS, v.15.0) was used. Descriptive statistics were expressed as (mean±SD), and the target variable of regression analysis was fatigue. Pearson’s correlation coefficients (*r*) were used to explore associations between variables. Gender differences were evaluated using independent sample *t*-tests. To identify variables that best predicted fatigue in MI patients, a multiple regression model was used with sleep disturbance, anxiety, depression, gender and age as independent variables. The statistically significant difference was considered *P* < 0.05.

RESULTS

General patient information

The average patient age was 70.2±6.3 years old. Sixty cases were female (31.3%), and 130 cases were male (68.7%). Ninety-three cases lived with their spouse (48.9%), and 77 patients smoked (40.5%). There were 35 patients with a history of angina pectoris (18.4%), and 60 patients had a family history of CVD (31.6%). More than half of the patients with MI had ST-segment elevation (Table I).

Table I. Baseline data of patients.

Gender	Live with spouse	Smoke	History of angina	Family history of CVD
Female (n=60)	25	6	23	20
Male (n=130)	96	76	68	55

Patients with sleep disorders, anxiety, depression and fatigue

According to HADS scores, there were gender differences in sleep disorders and anxiety among MI patients in this study, and the differences were statistically significant (*P* < 0.05). There was no gender difference between fatigue and depression (Table II).

Patients with sleep disorders, fatigue, anxiety and depression

To study the correlation between MI fatigue and sleep disorders, anxiety and depression, the fatigue and sleep disorder, anxiety and depression details of patients with MI were arranged and combined. Each factor was processed, and the factor analysis method was used to assess the factors with the highest correlation coefficient between MI fatigue and sleep disorder, anxiety and depression. Myocardial infarction fatigue and sleep disorder, anxiety and depression were incorporated into the corresponding regression equation, *R*-value and *P*-value were calculated,

and the results were analysed. The study indicated that fatigue was associated with sleep disturbance, anxiety and depression in patients with MI. Anxiety (*R*=0.423), sleep disorder (*R*=0.466) and depression (*R*=0.643) were all correlated with fatigue. The difference was statistically significant with *P*<0.05 (Table III and Fig. 1).

Table II. Gender differences in MI symptoms ($\bar{x}\pm s$).

Gender	Sleep disorders	Fatigue	Depression	Anxiety
Female (N=60)	7.85±2.39*	66.56±7.89	4.64±3.55	6.92±3.96*
Male (N=130)	6.79±2.27	59.96±7.91	4.38±3.67	4.82±3.67

* Compared with male, the difference was statistically significant (*P* < 0.05).

Table III. Correlation of sleep disorder, anxiety, depression and fatigue (*r*).

Variable	Fatigue	Anxiety	Depression	Sleep disorder
fatigue	--			
anxiety	0.423 *	--		
depression	0.643 *	0.628 *	--	
sleep disorder	0.466 *	0.535 *	0.455*	--

* *P* < 0.05

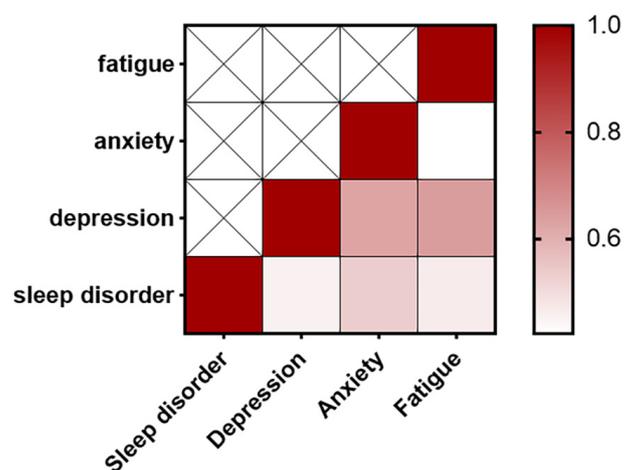


Fig. 1. Correlation of sleep disorder, anxiety, depression and fatigue.

Factors influencing patient fatigue

To clarify the relationship, age and gender were controlled, fatigue was used as a dependent variable, and sleep disorder, anxiety and depression were used as independent variables for a regression model analysis. The regression models explained 44.8% of the variance

in fatigue, with anxiety-depression and sleep disturbances being the significant influencing factors and predictors (Table IV).

Table IV. Influencing factors of patient fatigue (n=190).

Variable	Regression coefficient	Normalized regression coefficients	T value	P value
Constant	32.468	-	6.897	0.000
Anxiety-depression	6.989	0.256	3.786	0.000
Sleep disorders	8.674	0.314	4.112	0.000

R²=0.448

DISCUSSION

The study's findings suggest a relationship between sleep disturbances, fatigue, anxiety and depression, particularly for older patients with MI. In the multiple regression model analysis, it was established that both anxiety-depression and sleep disturbances could explain a significant degree of variation in fatigue, which were detrimental to the post-operative rehabilitation process of elderly patients with MI.

After percutaneous transluminal coronary intervention treatment, AMI patients suffered from notable weight loss (Wang and Zhang, 2018; Miao and Zhang, 2018) and were prone to negative emotions, such as anxiety, fear and depression due to the influence of economic pressure and their lack of adequate understanding of the disease. This can affect treatment effectiveness and can lead to disease recurrence (Cai *et al.*, 2020; Su *et al.*, 2021; Ren *et al.*, 2022). For patients with MI, it is important to clarify the relationship between fatigue and sleep disorders, anxiety and depression for rehabilitative nursing, particularly for the elderly. Fisser *et al.* (2017) indicated that the incidence of anxiety and depression was 42% and 31% in patients with ST-segment elevation MI, which reflect higher values than the MI results in this study. Fatigue is a clinical symptom that deserves attention because approximately 70% of patients with AMI may have fatigue symptoms (Tang *et al.*, 2017), indicating fatigue is a significant problem after MI that should be assessed during routine screening. However, fatigue is a highly subjective symptom, the nature of which can vary after the incidence of MI compared with before it (Tang *et al.*, 2017).

Patients have reported fatigue occurring before and after an acute cardiac event. Patients with MI may experience an increased incidence of fatigue, and it is often accompanied by anxiety and depression. Studies have shown that the risk of CHD in patients with sleep

disorders is 1.44 (1.09–1.90) (Su *et al.*, 2021). In this study, approximately 55.3% of patients reported sleep disorders, which is higher than the 42.7% indicated by Wang (2020). The present study found that women with MI reported more anxiety and fatigue than sleep disorders. Compared with men, fatigue was a more eminent problem for women with MI, which was consistent with the conclusion suggested by An *et al.* (2019). This study speculates that it could be due to more severe coronary artery disease (CAD) outcomes in women compared with men, with more women (17%) than men (12%) dying within 3 years after indexed MI (van Loo *et al.*, 2014). Hospital mortality after AMI was also more significant among women (16%) compared with men (11%) (Canto *et al.*, 2012). The data provides evidence that women with MI may experience increased levels of post-operative anxiety and depression compared with men. This could be due to the more critical prognosis and a more painful course of CAD events that occur in women compared with men. Therefore, understanding the relationship between fatigue and sleep disorders, anxiety and depression in patients with MI is essential to formulate a more accurate scientific diagnosis, treatment and rehabilitation program.

Studies have assessed the effect of post-MI treatment on sleep disorders, suggesting that people with insomnia are more likely to suffer from depression (Lu, 2020). One study suggested that depression could be a risk factor affecting fatigue levels (Gong *et al.*, 2022). Regression models in this study also indicated that sleep disturbances and depression were strong predictors of fatigue. The treatment of anxiety and depression is beneficial to the prognosis of patients who have experienced MI. Medical staff should improve their awareness of the impact of anxiety, depression, fatigue and sleep disorders on post-operative rehabilitation for MI patients. Fatigue post-MI requires comprehensive intervention, which should focus on biological factors and psychosocial factors.

There were limitations to this study. First, the sample size of statistical measurement was insufficient. When conducting a study to obtain effective research results, sufficient sample size is particularly important. Second, there were relatively few studies on fatigue and sleep disorders, depression and anxiety in patients with MI, and theoretical knowledge remains lacking. Future studies of fatigue and sleep disturbances, anxiety, fear, and depression among patients with MI are needed to prospectively examine sleep disturbances, anxiety, and other associations with major adverse cardiac events in this CV population. Differences in cardiac symptoms between men and women should be considered as a direction for clinical practice.

CONCLUSION

This study indicated gender differences concerning sleep disorders and anxiety in patients with MI, but there was no gender difference related to fear and depression. Anxiety, sleep disorders, depression and fatigue were correlated. These results could enhance effective risk management, timely pain management and treatment interventions, and improve the quality of life of patients associated with CHD.

Funding

Key R & D Program of Science and Technology Department of Hebei Province (192777102D).

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of Affiliated Hospital of Hebei University, and all subjects signed the informed consent.

Availability of data and materials

All data generated or analyzed during this study are included in this published article

Statement of conflict of interest

The authors have declared no conflict of interest.

REFERENCES

- An, L., Li, W., Shi, H., Zhou, X., Liu, X., Wang, H., Liu, J. and Fan, S., 2019. Gender difference of symptoms of acute coronary syndrome among Chinese patients: A cross-sectional study. *Eur. J. Cardiovasc. Nur.*, **18**: 179-184. <https://doi.org/10.1177/1474515118820485>
- Buysse, D.J., Reynolds, C.F., Monk, T.H., Berman, S.R. and Kupfer, D.J., 1989. The pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiat. Res.*, **28**: 193-213. [https://doi.org/10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4)
- Cai, S.Q., Fu, C.H. and Cai, Q., 2020. Analysis of sleep disorders after coronary intervention and corresponding nursing interventions. *World J. Sleep Med.*, **7**: 1679-1681.
- Canto, J.G., Rogers, W.J., Goldberg, R.J., Peterson, E.D., Wenger, N.K., Vaccarino, V., Kiefe, C.I., Frederick, P.D., Sopko, G. and Zheng, Z.J., 2012. Association of age and sex with myocardial infarction symptom presentation and in hospital mortality. *J. Am. Med. Assoc.*, **307**: 813-822. <https://doi.org/10.1001/jama.2012.199>
- Chen, H.M., 2019. Symptoms and features of myocardial infarction. *J. Med. Aesthetice Cosmetol.*, **28**: 168.
- Cheng, X., Ouyang, F., Ma, T., He, L., Gong, L., Yin, J., Zhang, G. and Bai, Y., 2022. The individual and joint associations of depression and sleep duration with cardiometabolic diseases and mortality: A prospective cohort study. *Atherosclerosis*, **361**: 10-17. <https://doi.org/10.1016/j.atherosclerosis.2022.09.016>
- Cormican, D.S., Sonny, A., Crowley, J., Sheu, R., Sun, T., Gibson, C.M., Núñez-Gil, I.J. and Ramakrishna, H., 2021. Acute myocardial infarction complicated by cardiogenic shock: Analysis of the position statement from the European society of cardiology acute cardiovascular care association, with perioperative implications. *J. Cardiothorac. Vasc. Anesth.*, **35**: 3098-3104. <https://doi.org/10.1053/j.jvca.2020.10.062>
- Fisser, C., Marcinek, A., Hetzenecker, A., Debl, K., Luchner, A., Sterz, U., Priefert, J., Zeman, F., Kohler, M., Maier, L.S., Buchner, S. and Arzt, M., 2017. Association of sleep-disordered breathing and disturbed cardiac repolarization in patients with ST-segment elevation myocardial infarction. *Sleep Med.*, **33**: 61-67. <https://doi.org/10.1016/j.sleep.2017.01.007>
- Gong, L., Lin, Q., Dong, M.Q., Du, J.L., Zhu, F., Jiang, J.P., Zhao, H.X. and Shao, S.W., 2022. Fatigue development in patients with acute myocardial infarction. *Chin. J. Nurs.*, **57**: 176-181.
- Han, Q.F. and Tian, J., 2012. The reliability and validity of the multidimensional fatigue inventory-20 in cancer patients. *Chin. J. Nurs.*, **47**: 548-550.
- Liu, L.H., Zhang, B.Y. and Jin, X.M., 2021. Effects of critical thinking nursing combined with emotional nursing on sleep disorders and psychological status of patients with coronary heart disease. *Henan med. Res.*, **30**: 5368-5372.
- Lu, Y., 2020. Effects of integrated medical care and rehabilitation nursing on sleep disorders after PCI in patients with acute myocardial infarction. *Nurs. Pract. Res.*, **17**: 1-4.
- Miao, T. and Zhang, X.M., 2018. Effects of continuous care on quality of life, anxiety and depression in patients with acute myocardial infarction after PCI. *Hainan med. J.*, **29**: 2065-2067.
- Mitra, A.K., Bhuiyan, A.R. and Jones, E.A., 2021. Association and risk factors for obstructive sleep apnea and cardiovascular diseases: A systematic review. *Diseases*, **9**: 88. <https://doi.org/10.3390/diseases9040088>
- Pajjuru, V.S., Thandra, A., Walters, R.W., Papudesi,

- B.N., Aboeata, A., Vallabhajosyula, S., Altin, S.E., Sutton, N.R., Alla, V.M. and Goldsweig, A.M., 2022. Sex disparities in in-hospital outcomes of left ventricular aneurysm complicating acute myocardial infarction: A United States nationwide analysis. *Am. Heart J. Plus Cardiol. Res. Pract.*, **13**: 100104. <https://doi.org/10.1016/j.ahjo.2022.100104>
- Ren, P.N., Zhang, Y., Ding, L., Tang, A.L., Dong, L., Ge, Y., Yuan, H.Y., Xu, F.L. and Zhu, Z.Y., 2022. Effect of exercise fear on self-efficacy and exercise compliance in patients with acute myocardial infarction after percutaneous coronary intervention. *Mil. Nurs.*, **39**: 21-24.
- Smets, E.M., Garszen, B., Cull, A. and de Haes, J.C., 1996. Application of the multidimensional fatigue inventory (MFI-20) in cancer patients receiving radiotherapy. *Br. J. Cancer*, **73**: 241-245. <https://doi.org/10.1038/bjc.1996.42>
- Su, Z., Dong, Q.Y., Liu, Z.Y., Yang, C.H. and Deng, T.T., 2021. Experience of anxiety and depression after percutaneous coronary intervention for coronary heart disease. *Chin. J. Trad. Chin. Med. Inf.*, **28**: 103-106.
- Sun, Z.X., Liu, X.H., Jiao, Y., Zhou, T., Yang, L.N. and Fan, J.Y., 2017. Reliability and validity of hospital anxiety and depression scale. *Chin. J. Clin. (Electronic ed.)*, **11**: 198-201.
- Tang, N., Zhong, M.S. and Li, X.B., 2017. Effect of positive psychological quality on fatigue in patients with acute myocardial infarction after intervention. *J. Nurs. Sci.*, **32**: 85-87.
- van Loo, H.M., van den Heuvel, E.R., Schoevers, R.A., Anselmino, M., Carney, R.M., Denollet, J., Doyle, F., Freedland, K.E., Grace, S.L., Hosseini, S.H., Parakh, K., Pilote, L., Rafanelli, C., Roest, A.M., Sato, H., Steeds, R.P., Kessler, R.C. and Jonge, P.D., 2014. Sex dependent risk factors for mortality after myocardial infarction: Individual patient data meta-analysis. *BMC Med.*, **12**: 242-242. <https://doi.org/10.1186/s12916-014-0242-y>
- Wang, M. and Zhang, X.L., 2018. Effects of intensive nursing intervention on anxiety, depression and nursing satisfaction in patients with coronary heart disease complicated with atrial fibrillation after PCI. *Nurs. Pract. Res.*, **15**: 29-31.
- Wang, Y., 2020. *Prevalence of sleep disorders and its relationship with coronary heart disease in rural adults in Henan Province*. Zhengzhou University, 2020.
- Wang, Y.H., 2021. Analysis of causes and nursing intervention strategies of sleep disorders in elderly patients with coronary heart disease. *World J. Sleep Med.*, **8**: 561-562.
- Wondie, Y. and Hinz, A., 2021. Application of the multidimensional fatigue inventory to Ethiopian cancer patients. *Front. Psychol.*, **12**: 687994. <https://doi.org/10.3389/fpsyg.2021.687994>
- Xu, L.L., 2020. *Clinical observation on intervention of anxiety state in patients with acute myocardial infarction by smoothing mood and relieving depression*. Liaoning University of Traditional Chinese Medicine,
- Zigmond, A.S. and Snaith, R.P., 1983. The hospital anxiety and depression scale. *Acta Psychiatr. Scand.*, **67**: 361-370. <https://doi.org/10.1111/j.1600-0447.1983.tb09716.x>