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Understanding Sleep and Depression in Post-Myocardial Infarction Patients: A Tertiary Care Study

Mayank Dhalani *[1], Shrujal Patel [1], Ashka Shah [1], Deesha Hans [1], Dr Rikin Raj [2]

[1]GMERS Medical College, Gotri, Vadodara-390021, Gujarat, India.
[2]Assistant Professor, Department of Medicine, GMERS Medical College, Gotri, Vadodara-390021, Gujarat, India.

*Corresponding authors: Mayank Dhalani; *mayankdhalani1999@gmail.com*

Abstract

Background: Cardiovascular diseases are one of the leading causes of mortality and morbidity worldwide, with being the leading cause of death globally, taking an estimated 17.9 million lives each year. This study aimed to examine the sleep quality and prevalence of depression in post-myocardial infarction patients attending medicine outpatient clinics of tertiary care in western Gujarat. ***Method:*** After obtaining institutional ethical clearance, a total 80 number of patients with myocardial infarction were registered. A descriptive cross-sectional design was used to collect data from patients at least 4 weeks post myocardial infarction diagnosis and receiving follow-up care in the outpatient clinic. The Pittsburgh Sleep Quality Index and Patient Health Questionnaire-9 assessed sleep quality and depressive symptoms, respectively. ***Results:*** The maximum number of patients had mild to moderate difficulty in sleep. The significant predictors of poor sleep quality were diabetes mellitus and depression. There was no significant association found between gender, body mass index, and addiction. ***Conclusion:*** The study concluded that the sleep quality of post-myocardial infarction patients was mildly affected with minimal to mild depression, while the association for body mass index was expected but not found to be significant.

Keywords: ***Depression, Lifestyle, Mental health, Myocardial Infarction, Sleep quality***

Introduction

Cardiovascular diseases are one of the leading causes of mortality and morbidity worldwide, estimated at around 17.9 million deaths each year. More than four out of five CVD deaths are due to heart attacks and strokes, with one-third of these deaths occurring prematurely in people under 70 years of age [1]. Among these, Myocardial infarction (MI), the death of cardiac myocytes due to ischemia from oxygen supply-demand imbalance, is a leading cause. MI may present as the first sign of coronary artery disease or as a recurrence in chronic cases. Symptoms range from asymptomatic to life-threatening [2]. At present, India has the highest burden of acute coronary syndrome and ST-elevation myocardial infarction (STEMI) [3].

Cardiac catheterization, cardiac cath, or heart catheterization, is used to diagnose and treat various heart conditions. It is also recommended to determine the cause of some symptoms, such as chest pain or irregular heartbeat [4]. For patients with acute STEMI, prompt percutaneous coronary intervention (PCI) or angioplasty is the primary treatment [5]. PCI is a minimally invasive non-surgical procedure used to treat the narrowing of the coronary arteries of the heart found in coronary artery disease [6]. In cases of severe arterial blockage or failed PCI, coronary artery bypass grafting (CABG) is recommended, a surgical procedure that involves using harvested venous or arterial grafts to bypass obstructed coronary arteries [7]. Advancements in stent technology, procedural techniques like CABG, and adjunctive pharmacotherapy have significantly improved MI treatment outcomes [5]. Pharmacological therapy with a combination of antiplatelets, statins, beta-blockers, and ACE inhibitors has shown decreased mortality by six months in patients with Acute Coronary Syndromes (ACS), which is why MI patients are advised to continue lifelong therapy with these agents [8]. The routine use of antiplatelet agents, such as clopidogrel, prasugrel, or ticagrelor, with aspirin reduces patient morbidity and mortality [5].

The post-myocardial infarction sequels may be physical or psychosocial [9]. The physical consequences of MI include fatigue and limited physical activity, while psychosocial sequels of MI include anxiety, fear of impending death, social isolation, sleep disturbance, and depression [10,11]. Research suggests that poor sleep quality, characterized by sleeplessness and depressed mood, is linked to increased morbidity and mortality in coronary artery disease (CAD) patients [12]. Sleep disturbances in MI patients have also been associated with depression, worsened quality of life, and higher cardiovascular risk. Additionally, poor sleep quality during hospitalization has been linked to adverse clinical outcomes following acute myocardial infarction [13-15].

Worldwide, around 300 million people suffer from common psychiatric diseases such as depression and anxiety. Both these have long been associated with heart diseases [16]. Additionally, anxiety or depression can lead to reduced treatment compliance and lower treatment effectiveness, resulting in poor outcomes and higher mortality [17]. Given these concerns, cardiac rehabilitation (CR) has emerged as a comprehensive program aimed at improving key health

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indicators (e.g., ideal lipid, glucose, and blood pressure control) and healthy lifestyle characteristics (e.g., increased physical activity, good nutrition, counseling for quitting smoking when necessary, and attainment/maintenance of healthy body weight) [18].

This study is of significant importance as it aims to explore the impact of sleep quality and depression in post-MI patients, a topic that has not been extensively researched.

Studies and Findings (Results)

Methods

Study Setting and Design: The study was conducted in Western Gujarat, Vadodara's tertiary care medicine outpatient department. It was a descriptive cross-sectional study of post-myocardial infarction patients with a duration of more than 4 weeks following myocardial infarction.

Study Population: A meticulous data collection process was followed, with a convenience sample of post-myocardial infarction patients receiving follow-up care being recruited. The study included participants older than 18 years who had a myocardial infarction at least one month prior. Exclusion criteria were strictly adhered to, ensuring the quality and accuracy of the data collected from 80 eligible participants, all assessed for cognitive capacity.

Study Instrument: Two instruments were used to collect data, i.e., the Pittsburgh Sleep Quality Index (PSQI) (Annexure- 2) and the Patient Health Questionnaire (PHQ-9) (Annexure- 3).

The PSQI measures subjective sleep quality during the previous month and categorizes the scores as "poor" and "good"[19]. The PSQI had seven components (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction), and each had possible scores ranging from 0 to 3. All components yield a global subjective sleep quality score ranging from 0 to 21. A global score of more than 5 indicated poor sleep quality, and a less than 5 indicated good sleep quality [20]. The psychometric properties of the PSQI have been confirmed in previous studies with a test-retest reliability of 0.87 [21].

Depression was assessed using the PHQ-9 [22]. The PHQ-9 consisted of nine depressive symptoms, and participants indicated how frequently a symptom had bothered them during the previous two weeks ("not at all =0"; "for several days =1"; "for more than half of the days =2"; "nearly every day =3"). The total scores of the PHQ-9 were interpreted as: 0 – 4 = minimal depression; 5 – 9 = mild depression; 10– 14= moderate depression; 15 – 19 = moderately severe depression; and 20 –27= severe depression [23]. The PHQ-9 had a high sensitivity (88%) and specificity (88%) for major depression [24], and its Cronbach's α in the current study was 0.752.

Ethical Consideration: Ethical approval from the institutional ethics committee and the respective department of the medical college was taken before the start of the study. Written consent was obtained from all the participating patients, and confidentiality regarding the data was maintained.

Data Collection: Post-myocardial infarction patients were approached upon arrival at the medicine outpatient clinic and screened according to the inclusion criteria after obtaining ethical approval from the ethics committee. The study purpose and procedures were explained to the patients in the vernacular language, to those who met the criteria and were willing to participate. The participants who consented to the study were put in a private room to complete the data collection process. The data collection instrument was written in the Gujarati language. Data were collected from July 2022 to October 2022 (4 months).

Statistical Analysis: A chi-square test was used to examine the factors associated with the levels of sleep quality. A P-value of <0.05 (two-tailed) was considered statistically significant for all analyses.

Result

A total of 80 post-myocardial infarction patients participated in the study. Their mean age was 63 + 12.08. There were 68.75% males and about 31.25% females. The participants had other comorbidities, such as hypertension (61.25%), diabetes mellitus (42.5%), and hypothyroidism (6.25%). Sleep quality of post-myocardial infarction patients: Most post-myocardial infarction patients had mild to moderate difficulty in sleep. The patient's PSQI score was 4.27+2.85. A descriptive exploration of the seven components of PSQI shows that the participants had more problems with sleep disturbance.

Table 1: Association Between Quality of Sleep and Gender

Sleep Quality	Male (Expected) [χ2]	Female (Expected) [χ2]	Row Total	χ2 Contribution
Normal Sleep	1 (1.38) [0.10]	1 (0.62) [0.22]	2	0.32
Mild Difficulty in Sleep	46 (46.75) [0.01]	22 (21.25) [0.03]	68	0.04
Moderate Difficulty in Sleep	8 (6.88) [0.18]	2 (3.12) [0.40]	10	0.58
Column Total	55	25	80	

The chi-square test results show that the p-value is 0.620374 and the chi-square value is 0.9549. Thus, the result is insignificant at p-value <0.05 and shows no significant association with gender.

Table 2: Association Between Diabetes Mellitus (DM) and Sleep Difficulty Levels

Sleep Category	DM Present (Expected) [χ2]	DM Absent (Expected) [χ2]	Row Total
Normal Sleep	0 (0.85) [0.85]	2 (1.15) [0.62]	2
Mild Difficulty in Sleep	34 (28.9) [0.90]	34 (39.1) [0.66]	68
Moderate Difficulty in Sleep	0 (4.25) [4.25]	10 (5.75) [3.14]	10
Column Total	34	46	80

The chi-square test results show that the p-value is 0.005 and the chi-square value is 10.43. Thus, the result is significant at p-value <0.05 and correlates significantly with diabetes mellitus.

Table 3: Association Between Hypertension (HTN) and Sleep Difficulty Level

Sleep Category	HTN Present (Expected) [χ2]	HTN Absent (Expected) [χ2]	Row Total
Normal Sleep	2 (1.22) [0.49]	0 (0.77) [0.77]	2
Mild Difficulty in Sleep	42 (41.65) [0.002]	26 (26.35) [0.004]	68
Moderate Difficulty in Sleep	5 (6.12) [0.20]	5 (3.87) [0.32]	10
Column Total	49	31	80
Overall χ2 Value			1.81
p-value			0.405

The chi-square test results show that the p-value is 0.405 and the chi-square value is 1.81. Thus, the result is insignificant at p-value <0.05 and shows no significant association with hypertension.

Table 4: Association Between Sleep Difficulty and Depression Levels

Sleep Difficulty	Minimal Depression (Expected) [χ2]	Major (Expected) [χ2]	Row Total
Normal Sleep	2 (1.75) [0.03]	0 (0.25) [0.25]	2
Mild Difficulty in Sleep	62 (59.5) [0.1]	6 (8.5) [0.73]	68
Moderate Difficulty in Sleep	6 (8.75) [0.86]	6 (8.75) [0.86]	10
Column Total	70	10	80

The chi-square test results show that the p-value is 0.018, and the chi-square value is 8.04. Thus, the result is significant at p-value <0.05 and shows a significant association of sleep quality with depression.

Table 5: Association of Sleep Quality with Body Mass Index (BMI)

Sleep Quality	Normal Weight (Expected) [χ^2]	Pre-Obese (Expected) [χ^2]	Obese (Expected) [χ^2]	Row Total
Normal Sleep	0 (0.37) [0.37]	0 (0.47) [0.47]	2 (1.15) [0.62]	2
Mild Difficulty in Sleep	13 (12.75) [0.008]	19 (16.15) [0.50]	36 (39.1) [0.24]	68
Moderate Difficulty in Sleep	2 (1.87) [0.008]	0 (2.37) [2.37]	8 (5.75) [0.88]	10
Column Total	15	19	46	80

The chi-square test results show that the p-value is 0.24 and the chi-square value is 5.5. Thus, the result is not significant at p-value <0.05 and shows no significant association with body mass index.

Table 6: Association of Sleep Quality with Addiction

Sleep Quality	No Addiction (Expected) [χ^2]	Addiction Present (Expected) [χ^2]	Row Total
Normal Sleep	2 (1.65) [0.07]	0 (0.35) [0.35]	2
Mild Difficulty in Sleep	57 (56.1) [0.014]	11 (11.9) [0.06]	68
Moderate Difficulty in Sleep	7 (8.25) [0.18]	3 (1.75) [0.89]	10
Column Total	66	14	80

The chi-square test results show that the p-value is 0.452 and the chi-square value is 1.59. Thus, the result is statistically insignificant at p-value <0.05 and shows no significant association with addiction.

Discussion

This study aimed to assess the level of sleep quality and depression in patients who were at least 4 weeks post-myocardial infarction and attending the medicine outpatients' clinic for follow-up care in the tertiary care hospital of Vadodara. The patient's mean PSQI score was 4.27, and most patients had mild sleep difficulty; almost 85% and 12.5% had moderate sleep difficulty, which shows that most post-MI patients had sleep difficulties. There are no other studies from India with which to compare. Still, the findings of our study, like those of others, suggest that post-myocardial infarction patients continue to experience poor sleep quality after hospital discharge. In the Indian population, as more manual labor work is seen and because of their lifestyle, the sleep quality of patients is more affected. A 2019 study conducted in Oman among post-myocardial infarction patients revealed that 61.1% of the participants reported poor sleep quality. Interestingly, despite the high prevalence of poor sleep quality, the study reported a relatively low incidence of major depression (5%) among the participants [25].

Studies have shown that combining comorbidities and their treatments can lead to poor sleep quality [21]. Diabetes mellitus is one of the culprits contributing to poor sleep quality [26]. In our study, many participants (42.5%) had diabetes mellitus, and it may have contributed to sleep irregularities, as our study found the association between diabetes and sleep to be statistically significant.

This study also assessed depression and found that the mean depression score(PHQ-9) was 2.66 ± 0.32, and the majority of participants had Minimal depressive symptoms (87.5%). Only a few participants (5%) had Mild Major depression (might need a referral for psychotherapy and/or require hospital-based psychosocial rehabilitation). A large number had scores interpreted as Minimal depression (only need support, education, and watchful waiting). The low rates of Major Depression may be caused by several things, including strong religious practices and beliefs, easy access to healthcare, and a lack of concern for healthcare expenses at government tertiary health centers in western Gujarat. The findings in the current study were similar to those reported in a previous study conducted in Oman, which also identified higher rates of minimal depression at 95% and lower rates of major depression at 5% [25]. Physical activity and antidepressants modify the adverse prognosis in patients with post-MI depression [27]. Substantial research is still required to elucidate the significance of these possible modifiers and assess how they might be taken into account when treating depression in post-MI patients.

Poor sleep quality is highly prevalent in post-myocardial infarction patients, and in other studies, it is associated with depression in cardiovascular patients [28]. It is crucial to continuously monitor depression in post-myocardial infarction patients because it is a common predictor of death and morbidity. Studies show that 65% of patients suffer from symptoms of depression after acute myocardial infarction, and 15% to 22% of these present with significant depression post-discharge [29]. In our study, depression was found to be statistically significant in affecting overall sleep. Therefore, prevention and treatment of depression can curtail poor sleep quality [30].

We recommend utilizing formal support systems to assist patients in adapting to and coping with life after a heart attack. Screening, education, and support are vital in preventing the consequences of inadequate sleep quality and depression. The literature shows that 31% to 35% of post-myocardial infarction patients have limited participation in social activities during the first-year post-infarction. Still, those who receive appropriate psychological support have a better quality of life and less risk of reinfarction in the future [9]. Treatments such as short-term psychotherapy and others have also been reported to be beneficial [29,31].

The study emphasizes the necessity of routinely evaluating depression and sleep quality in follow-up care and long-term research, including patients who have had myocardial infarctions. The study's small sample size and limitations in the self-report data collection method must be considered when interpreting the results. It is possible that participants over-reported symptoms associated with sleep and underestimated symptoms connected to depression. We recommend conducting large-scale prospective cohort studies to investigate the prevalence and potential mechanisms of depression and poor sleep quality in patients who have had a myocardial infarction. To evaluate variables related to Sleep quality and Depression severity, a Chi-square analysis was performed. The study's conclusions demonstrated that even after being released from the hospital, post-myocardial infarction patients continue to have trouble with sleep quality. Therefore, it is necessary to include regular assessment of depression and sleep quality in cardiac rehabilitation in post-myocardial infarction patient follow-up therapy. However, it is important to note that this study had some limitations, such as the small sample size and the use of self-reported measures, which may have influenced the results.

Conclusion

This study's findings show that most post-myocardial infarction patients had mild difficulty in sleep, so sleep quality was affected after discharge from the hospital. Thus, mental health care should also be considered during the cardiac rehabilitation phase by increasing follow-up visits and consulting psychiatrists. In addition, the health care workers should provide interventions that can enhance sleep quality and help prevent depression. It should be practiced regularly to avoid the rate of reinfarction in myocardial infarction patients.

List of abbreviations

ACE: Angiotensin-Converting Enzyme
ACS: Acute Coronary Syndromes
AHA: American Heart Association
AMI: Acute Myocardial Infarction
BMI: Body Mass Index
CABG: Coronary Artery Bypass Grafting
CAD: Coronary Artery Disease
CR: Cardiac Rehabilitation
CVD: Cardiovascular Disease(s)
DM: Diabetes Mellitus
HTN: Hypertension
IHEC: Institutional Human Ethics Committee
MI: Myocardial Infarction
NHLBI: National Heart, Lung, and Blood Institute
OPD: Outpatient Department
PCI: Percutaneous Coronary Intervention
PHQ-9: Patient Health Questionnaire-9
PSQI: Pittsburgh Sleep Quality Index
QoL: Quality of Life
STEMI: ST-Elevation Myocardial Infarction
WHO: World Health Organization
χ^2: Chi-Square (test statistic)
P: p-value (statistical significance level)
Post-MI: Post-Myocardial Infarction

Declarations

Ethical Considerations

Ethical approval from the institutional ethics committee was obtained. (Ethics committee reference no: IHEC/22/OUT/SRUG009)

Conflicts of Interest

The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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Consent to Participate

Written informed consent was obtained from all participants prior to inclusion in the study

Consent for Publication

Not applicable, as no individual participant data is disclosed in this article.

Data Availability

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

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None

Author Contributions

MD: Conceptualization, Methodology, Software, Original Draft Preparation
SP: Data collection, Data Curation, Formal Analysis, Visualization
AS: Data collection, Data Curation, Formal Analysis, Visualization
DH: Data collection, Conceptualization, Formal Analysis, Visualization
RR: Conceptualization, Formal Analysis, Visualization

References

[1] World Health Organization. Cardiovascular diseases. Accessed February 19, 2025. https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1

[2] American Heart Association. ACC/AHA guidelines for the management of patients with acute myocardial infarction: executive summary. Circulation. 2007. doi:10.1161/circulationaha.107.187397

[3] Ruhil R. India has reached on the descending limb of tobacco epidemic. Indian J Community Med. 2018;43(3):153-156. doi:10.4103/ijcm.IJCM_213_17

[4] National Heart, Lung, and Blood Institute. What is cardiac catheterization? Accessed February 19, 2025. https://www.nhlbi.nih.gov/health/cardiac-catheterization

[5] Reddy K, Khaliq A, Henning RJ. Recent advances in the diagnosis and treatment of acute myocardial infarction. World J Cardiol. 2015;7(5):243-276. doi:10.4330/wjc.v7.i5.243

[6] Ahmad M, Mehta P, Reddivari AK, Mungee S. Percutaneous coronary intervention. StatPearls. Treasure Island, FL: StatPearls Publishing; 2023. PMID: 32310583.

[7] Bachar BJ, Manna B. Coronary artery bypass graft. StatPearls. Treasure Island, FL: StatPearls Publishing; 2023. Available from: https://www.ncbi.nlm.nih.gov/books/NBK507836/

[8] American College of Cardiology/American Heart Association. ACC/AHA guidelines for the management of patients with acute myocardial infarction. Circulation. Accessed February 19, 2025. https://www.ahajournals.org/doi/10.1161/circulationaha.107.187397

[9] Mierzyńska A, Kowalska M, Stepnowska M, Piotrowicz R. Psychological support for patients following myocardial infarction. Cardiol J. 2010;17(3):319-324.

[10] Pedersen SS, Denollet J, Daemen J, et al. Fatigue, depressive symptoms, and hopelessness as predictors of adverse clinical events following percutaneous coronary intervention with paclitaxel-eluting stents. J Psychosom Res. 2007;62(4):455-461.

[11] Andrechuk CRS, Ceolim MF. Sleep quality and adverse outcomes for patients with acute myocardial infarction. J Clin Nurs. 2016;25(1-2):223-230.

[12] Edéll-Gustafsson U, Svanborg E, Swahn E. A gender perspective on sleeplessness behavior, effects of sleep loss, and coping resources in patients with stable coronary artery disease. Heart Lung. 2006;35:75-89.

[13] PubMed. Accessed February 19, 2025. https://pubmed.ncbi.nlm.nih.gov/38685752/

[14] Mallon L, Broman J-E, Hetta J. Relationship between insomnia, depression, and mortality: a 12-year follow-up of older adults in the community. Int Psychogeriatr. 2000;12(3):295-306.

[15] Phillips B, Mannino DM. Does insomnia kill? Sleep. 2005;28:965-971.

[16] Carney RM, Freedland KE. Depression and coronary heart disease. Nat Rev Cardiol. 2017;14(3):145-155. doi:10.1038/nrcardio.2016.181

[17] Sowden G, Mastromauro CA, Januzzi JL, Fricchione GL, Huffman JC. Detection of depression in cardiac inpatients: feasibility and results of systematic screening. Am Heart J. 2010.

[18] Kaur I, Arora K, Dhalani M, Patel M, Nishkamni, Kaur G, Jain R. The synergy of percutaneous coronary intervention and lifestyle modification in reducing mortality and blockage prevention. Cardiol Rev. 2024. doi:10.1097/CRD.0000000000000658

[19] Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193-213.

[20] Flynn A. Sleep and myocardial infarction recurrence. The Scholarship at ECU. Accessed February 19, 2025. https://thescholarship.ecu.edu/server/api/core/bitstreams/413298a1-ec19-4c25-9070-93f0c9f19288/content

[21] Hayashino Y, Yamazaki S, Takegami M, Nakayama T, Sokejima S, Fukuhara S. Association between number of comorbid conditions, depression, and sleep quality using the Pittsburgh Sleep Quality Index: results from a population-based survey. Sleep Med. 2010;11(4):366-371.

[22] World Health Organization. Depression: A global public health concern. Geneva: WHO; 2012.

[23] PMC. Accessed February 19, 2025. https://pmc.ncbi.nlm.nih.gov/articles/PMC1495268/

[24] Parashar S, Rumsfeld JS, Spertus J, et al. Time course of depression and outcome of myocardial infarction. Arch Intern Med. 2006;166(18):2035-2043.

[25] Almamari RSS, Muliira JK, Lazarus ER. Self-reported sleep quality and depression in post-myocardial infarction patients attending cardiology outpatient clinics in Oman. Int J Nurs Sci. 2019;6(4):371-377. doi:10.1016/j.ijnss.2019.06.008

[26] Andrechuk CRS, Ceolim MF. Sleep quality in patients with acute myocardial infarction. Texto Contexto-Enferm. 2015;24(4):1104-1111.

[27] Larsen KK. Depression following myocardial infarction–an overseen complication with prognostic importance. Dan Med J. 2013;60(7):1-18.

[28] Matsuda R, Kohno T, Kohsaka S, et al. The prevalence of poor sleep quality and its association with depression and anxiety scores in patients admitted for cardiovascular disease: a cross-sectional designed study. Int J Cardiol. 2017;228:977-982.

[29] Fattah K, Zulfiqar F, Hafiz S, Hafizullah M, Gul AM. Effect of short-term psychotherapy on depression in post-myocardial infarction patients. Pak Heart J. 2016;49(1):24-28.

[30] Benyamini Y, Roziner I, Goldbourt U, Drory Y, Gerber Y. Depression and anxiety following myocardial infarction and their inverse associations with future health behaviors and quality of life. Ann Behav Med. 2013;46(3):310-321.

[31] Langvik E, Hjemdal O. Symptoms of depression and anxiety before and after myocardial infarction: the HUNT 2 and HUNT 3 study. Psychol Health Med. 2015;20(5):560-569.