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Study of hs-CRP Level in Prisoners in Mashhad and Their Relation to Demographic Factors

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Abstract

Background: Prisoners are a certain part of the population. Prisoners are kept in a closed environment for a long period of time and are prone to various diseases. Inflammatory biomarkers, including hs-CRP, are new risk factors for cardiovascular disease.
Objectives: The aim of this study was to compare hs-CRP levels in male and female prisoners and investigate the relationship between hs-CRP levels with related factors.
Methods: In this cross-sectional study, 316 prisoners in Mashhad Prison were investigated. A blood sample (7ml) was taken from each subject. Enzyme-linked immunosorbent assay (ELISA) technique was used to measure serum levels of highsensitivity C-reactive protein (hs-CRP). Descriptive statistics, chi-squared test, T-test, Pearson and Spearman's correlation coefficients were used. P<0.05 was considered to be the level of significance.
Results: 316 prisoners were investigated of whom 211 (66.8%) were male and 105 (33.2%) were female. Mean hs-CRP level was 5.72±7.93 µg/ml in men and 7.48±8.39 in women. The difference between the two genders were statistically significant (p<0.001). The mean hs-CRP level was significantly higher in prisoners who did injection drug use compared to those who inhaled or consumed drugs (p<0.001). A significant correlation was observed between age, systolic blood pressure, frequency of imprisonment, height and BMI and hs-CRP levels.
Conclusion: Since hs-CRP is an important biomarker for non-communicable diseases, considering these factors and other risk factors for chronic diseases in the high-risk and vulnerable groups of prisoners, prevention and control measures can be planned by this group of people.

Keywords: Addiction, Biomarkers, Prisoners

1. Background

In terms of health, prisoners represent a certain part of the population as they often have a history of family dysfunction, low socioeconomic status, drug abuse, low education, and risk of many health problems. Prisoners are kept in a closed environment for a long period of time and are prone to various diseases due to crowding, poor nutrition, lack of medical care, and same-sex sexual contact (1). On the other hand, prisoners have legal or illegal behaviors that may be harmful to health (2). Therefore, they suffer from a higher number of acute and chronic diseases than the general population with an average of 3 diseases per prisoner after the age of 50. Overcrowding in prisons also makes them more at risk of infectious diseases (3).

Although the rise of drug use in industrialized countries has somewhat fallen, it seems that substance abuse has had an increasing trend in Iran, particularly among young people (1).

According to official statistics, more than two million addicts live in Iran. In addition, 11 million people are dealing with substance abuse problems caused by themselves or others. This leads to numerous health and psychosocial and social problems as suicide, homicide, violence, and diseases. According to statistics, 60% of all prisoners in Iran are in prison for drug-related reasons (4). The prevalence of drug use among prisoners has been reported between 20 to 80 percent in the studies (5).

Heart disease and cancer risk factors include serum lipids, blood glucose, physical inactivity and overweight, blood pressure, smoking, and drug use (6, 7). Inflammatory biomarkers, including hs-CRP, homocysteine, lipoprotein A, fibrinogen and infectious agents are new risk factors for cardiovascular disease whose relationship has been somewhat studied (8).

Several studies have been conducted worldwide on inflammatory biomarkers and their relationship with many non-communicable diseases such as cancer and cardiovascular disease in prisoners including studies by Arries et al. and Jergovic et al. However, no similar study has been done in Iran.

2. Objectives

The aim of this study was to compare hs-CRP

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levels in male and female prisoners and investigate the relationship between hs-CRP levels with related factors.

3. Methods

In this cross-sectional study, 316 prisoners in Mashhad Prison were investigated. The study was approved by the Ethics Committee and conducted in coordination with Khorasan Razavi Prisons Organization. Initially, 350 prisoners were randomly selected from the list of prisoners. Prior to the study, the research objective and the procedure were explained to the subjects, and those willing to participate were included. Demographic and socioeconomic information and data concerning the history of smoking and drug use, the number of previous prison terms, and the length of prison stay was collected and examined. A blood sample (7ml) was taken from each subject. Enzyme-linked immunosorbent assay (ELISA) technique was used to measure serum levels of high-sensitivity C-reactive protein (hs-CRP). The classification below was used to categorize the serum levels of hs-CRP based on the level of risk :Low risk: <1 µg/ml, normal: 1- 3µg/ml, high risk: >3µg/ml (9).

The collected data and laboratory results were analyzed with SPSS, 11.5. Descriptive statistics, including central tendency, dispersion and frequency distribution were used to describe the research variables. The categorical variables were compared using the chi-squared test. T-test and its equivalent non-parametric one (in case of non-normal distributions) were employed to compare the quantitative variables in two groups. Based on the distribution type, Pearson and Spearman's correlation coefficients were used to investigate the correlation between serum levels of hs-CRP and the research variables. In all calculations, $p<0.05$ was considered to be the level of significance.

"Mashhad University of medical science ethics committee" approved our study.

4. Results

In this study, 316 prisoners were investigated of whom 211 (66.8%) were male and 105 (33.2%) were female. Demographic and epidemiological characteristics of the subjects are presented in Table 1. As can be seen, except for drug abuse, significant differences were observed between the male and female prisoners in all other factors. About 70% of prisoners also reported a history of drug use.

Mean hs-CRP level was 5.72±7.93 µg/ml in men and 7.47±8.39 in women. The difference between the two genders were statistically significant ($p<0.001$).

Mean hs-CRP levels in the prisoners by history of smoking are presented in Table 2. As can be seen, the mean hs-CRP levels in prisoners who used drugs were greater than those with no history of drug use. However, the difference was not significant. The mean hs-CRP level was significantly higher in prisoners who did injection drug use compared to those who inhaled or consumed drugs ($p<0.001$).

The hs-CRP values in the two groups of male and female prisoners by the risk values are also presented in Table 3. As can be seen, high risk levels are most evident among female prisoners ($p=0.001$).

Table 4 shows the correlation of hs-CRP levels with age, number of cigarettes smoked per day,

Table 1. demographic and epidemiological characteristics in prisoners based on sex

Characteristics	Group	Male	Female	Total	P value*
Age (year) M±SD		33.81±9.8	40.43±14.3	36.07±11.93	<0.001
Number of imprisonment M±SD		3.27±4.93	1.46±2.12	2.67±4.29	0.001
During of stay in prison (month) M±SD		61.39±54.54	43.37±38.99	55.38±50.56	0.005
Marital status N(%)	Single	65 (30.8)	0 (0)	65 (20.6)	<0.001
	Married	146 (69.2)	105 (100)	251 (79.4)	
Education N(%)	illiterate	36 (17.1)	46 (43.8)	82 (25.9)	<0.001
	Elementary	83 (39.3)	38 (36.2)	121 (38.3)	
	High school	69 (32.7)	16 (15.2)	85 (26.9)	
	Diploma	15 (7.1)	4 (3.8)	19 (6)	
	Bachelor	7 (3.3)	0 (0)	7 (2.2)	
	Bachelor's Degree or higher	1 (0.5)	1 (1)	2 (0.6)	
Smoking N(%)		165 (79.3)	65 (61.9)	230 (73.5)	0.002
Drug abuse N(%)		148 (70.5)	69 (65.7)	217 (68.9)	0.44
Systolic blood pressure (mmhg) N (%)		11.03±1.11	12.70±2.29	11.59±1.78	<0.001
Diastolic blood pressure (mmhg) N (%)		7.28±0.6	7.63±1.38	7.39±0.93	0.004
BMI		23.77±3.54	27.55±5.85	25.03±4.78	<0.001

M±SD:Mean±Standard Deviation
N (%):Number(percent)
* : t test and chi-squared test
BMI : Body mass index

Table 2. mean of hs-CRP in prisoners based on smoking and drug abuse history

Character		Hs-CRP mean±SD	P value*
Smoking	yes	8.59±6.70	0.18
	no	6.72±5.32	
Drug abuse	yes	8.53±6.64	0.27
	no	7.14±5.58	
Method of drug use	Injection	11.37±11.52	<0.001
	Eatable and inhalation	8.45±6.51	

* : t test and chi-squared test

Table 3. distribution of risk status frequency based on hs-CRP in prisoners

character	Hs-CRP		
	Low risk	normal	High risk
sex			
male	69 (32.9)	53 (25.2)	88 (41.9)
female	15 (14.3)	29 (27.6)	61 (58.1)

Table 4. hs-CRP correlation with anthropometric and epidemiological characteristics in prisoners

character	Low risk	normal	High risk	r	P value*
Age(year)	32.25±10.19	36.53±12.52	37.95±12.11	0.23	<0.001
Number of cigarette(daily)	15.45±6.27	18.98±12.71	18.99±12.71	0.07	0.34
Systolic blood pressure	110.54±10.2	110.55±10.5	110.8±20.2	0.14	0.01
Diastolic blood pressure	70.3±65.3	70.4±10	70.45±10.1	0.08	0.19
Number of imprisonment	2.92±2.61	3.95±5.7	3.97±4.14	0.12	0.05
Length of prison stay	49.33±54.01	56.12±44.15	58.63±51.96	0.1	0.09
Weight (Kg)	69.64±10.85	68.48±12.77	70.51±13.72	-0.01	0.99
Height (cm)	171.1±10.21	167.1±11.05	165.46±10.27	-0.21	<0.001
BMI	23.81±3.1	24.62±4.59	25.94±5.47	0.14	0.01

* : Pearson and Spearman's correlation test
BMI : Body mass index

diastolic and systolic blood pressure, frequency of imprisonment, weight, height, and body mass index (BMI) in the prisoners. A significant correlation was observed between age, systolic blood pressure, frequency of imprisonment, height and BMI and hs-CRP levels.

5. Discussion

Prison is generally a controlled environment with its own culture of violence, threat, coercion and substance abuse, in addition to specific rules such as classification of people, discipline and discrimination. In the prison environment, safety is often overlooked for the sake of other concerns. As a result, the vulnerable become more vulnerable, and the healthy soon becomes unhealthy (1). In this study, we investigated the inflammatory biomarker hs-CRP, as new risk factors for non-communicable diseases, in male and female prisoners in Mashhad, Iran. The mean hs-CRP level was 5.72±7.93 µg/ml in the male prisoners and 7.48±8.39 µg/ml in the female prisoners. The difference between the sexes was significant. Higher risk levels were observed in the female prisoners.

In recent years, the number of female prisoners has increased dramatically. Studies in the U.S. show that the number of female prisoners increased by 55% between 1986 and 1991. These women are more at risk of mental disorders, substance abuse and physical or sexual abuse compared to a woman in the general population. In addition, compared to male prisoners, female prisoners are more likely to develop mental disorders and have lower self-esteem. There is also an obvious link between the history of trauma, PTSD and substance abuse (10). A relationship was reported between exposure to traumatic stress and biomarkers of inflammation phase (over a 5-year follow-up). In this study, the relationship between stress and high levels of CRP was statistically significant (11). This relationship can explain the higher level of hs-CRP in female prisoners as well as higher levels of hs-CRP with high risks in the individuals in our study.

In our study, 70% of prisoners reported a history of smoking and drug use. Kaufman et al. (2011) showed that use of tobacco products was higher among prisoners than the general population (60 to 80%). In this study, the history of smoking before imprisonment was 77.5%, while it was 81% during

imprisonment (12).

Studies have reported the prevalence of drug use among prisoners at 20 to 80% (5). According to the study by Jamshidi-Manesh et al. that investigated the relationship between socioeconomic condition and drug abuse of prisoners, 60% of prisoners in Iran are in prison for drug-related reasons (4). In a study by Fazel et al. aimed at determining the prevalence of drug use among male and female prisoners, prevalence of drug use was reported as 10-48% among men, and 30-60% among women (13).

In our study, mean hs-CRP level in prisoners who smoked or used drugs was higher than those with no such history; however, the difference was not significant.

In a study on drug addiction and risk of cardiovascular disease, Asgari et al. reported significantly higher hs-CRP levels in drug users compared to non-addicts (14). In a study by Rees et al. (2012) aimed to compare hs-CRP levels in two groups of drug users and non-users, it was shown that hs-CRP levels were significantly higher in drug users. In this study, even after classification of hs-CRP in four groups of less than 1, 1 to 3, 3 to 10 and more than 10, levels of this inflammatory biomarker in all 4 levels were higher in drug users (15). In a study on the effect of smoking on new cardiovascular risk factors by Bazanno et al., after adjustment for conventional risk factors for cardiovascular disease, smoking was associated with increased hs-CRP levels (OR=1.6) (16).

Ghazavi et al. studied serum levels of several inflammatory markers in opium consumers. Subjects had been used at least 2 grams of opium for at least one year. The hs-CRP levels were shown to be significantly higher in addicts (17).

Another study reported significantly higher hs-CRP levels in opium consumers compared to the control group. It was concluded that acute phase proteins have an increase in opium consumers with low to moderate inflammation (18). Studies have also shown that quitting smoking reduces hs-CRP and, thereby, risk of heart disease (19).

Frahlich et al. investigated the relationship between smoking and systemic inflammation in men. Duration of smoking was shown to be significantly associated with increased levels of hs-CRP biomarker (20).

In another study that examined exposure to smoking and cardiovascular risk factors in healthy elderly people, a positive association was observed between hs-CRP levels and number of packs of cigarettes smoked per year (21).

In our study, mean hs-CRP levels in prisoners who had injection drug use were significantly higher than those who inhaled or consumed drugs. Drug use chronically stimulates the immune system profile. Injection drug users are at increased risk for blood-borne diseases. Immune stimulation by drug use is an important immune suppression factor. Some stem cells are also suppressed in drug users. Drug use is a systemic disease complex in chronic immune stimulation (15). This could explain the higher level of hs-CRP in injecting drug users in our study.

In our study, a significant correlation was found between prisoners' systolic blood pressure and hs-CRP levels. Batista et al. (2001) showed a significant relationship between hs-CRP levels and blood pressure, suggesting that CRP may be an independent risk factor for hypertension (22). In a study that examined inflammation markers in 52 hypertensive individuals, hs-CRP levels were significantly higher in hypertensive patients than those with low blood pressure. It was concluded that inflammatory markers are associated with changes in blood pressure in hypertensive patients. Findings suggested that inflammation may be a mediator of the significant relationship between blood pressure and target organ damage (23).

In this study, a significant correlation was found between BMI and hs-CRP levels in prisoners. Rason et al. examined the effects of BMI and previous and recent physical activity on hs-CRP in healthy men and women. In that study, hs-CRP levels were shown to be significantly associated with the average BMI ($r=0.5$-$p<0.001$). After classification of BMI, it was shown that hs-CRP levels in obese and overweight subjects were higher than those of normal weight. After entering age, BMI, gender, and smoking in the statistical model, only BMI was significantly related with hs-CRP levels ($p<0.001$) (24). A study by Reedcare et al. (2005) showed that weight loss reduces hs-CRP level so that it can reduce the risk of cardiovascular diseases (19).

Our findings also revealed a significant relationship between the frequency of imprisonment and hs-CRP levels so that increased amount of imprisonment increased the hs-CRP levels. This relationship may be due to the cumulative effects of risk factors that increase the hs-CRP levels, such as stress, infectious diseases, smoking and drug use and the risk of non-communicable diseases.

The strength of our research was to study female addict prisoners, as well as the inflammatory marker hs-CRP in prisoners considering that few studies have been conducted in this area.

A limitation of this study was the small sample size due to lack of access to sufficient samples. We suggest that a study with a larger sample size and also with two groups of prisoners and control (and comparison in these two groups) carried out.

6. Conclusion

Since hs-CRP is an important biomarker for non-communicable diseases, considering these factors and other risk factors for chronic diseases in the high-risk and vulnerable groups of prisoners,

prevention and control measures can be planned by this group of people.

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