

ORIGINAL ARTICLE

Association of Depression and Body Mass Index with Inflammation Markers in Tehran Oil Refinery Shift Workers

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Received August 02, 2020; Revised October 20, 2020; Accepted November 18, 2020

This paper is available on-line at <http://ijoh.tums.ac.ir>

ABSTRACT

Shift working with the sleep disturbance may lead to an increased body weight, depression levels, and inflammation. The purpose of this study was to determine the association between depression scores, Body Mass Index (BMI) and inflammation markers among rotational shift workers in one of the Iranian Oil Refineries. A cross-sectional study was conducted among 189 shift workers aged 21-52 years old with mean 30.58(±6.970) in one of the oil refineries in Tehran city. Studied population was in an 8 hours backward shift (from night to morning). Demographic characteristics were gathered by a general questionnaire and anthropometric variables including weight and height were measured for calculating body mass index (BMI), were calculated. 21-items Beck Depression Inventory, which was translated in Persian, was used to assess the depressive symptoms. Level of Cortisol, IL-6 and hs-CRP was measured by 8 ml fasting blood sample, using RIA kit in radioimmunoassay method, R&D (Germany) kit in enzyme-linked immunosorbent method and quantitative diagnostic kit in immunoturbidimetry method produced by Pars Azmoon Company, respectively. The results of the current study showed that IL-6 and hs-CRP were higher, in workers with depression scores more than 9 in comparison with workers by depression scores equal or below 9 measured by the 21- Item Beck depression inventory. Although there were not statistically significant. There was inverse association between cortisol level and BMI (P-Value<0.01) and positive association between CRP and BMI (PV<0.01) and borderline positive association between IL-6 concentration with BMI (P-Value<0.05). The results of the study revealed that there was a direct association between inflammation factors with Body Mass Index in Tehran oil refinery shift workers. But, the significant relationship between cortisol level, IL-6 and CRP with Shift Work experience were not found.

KEYWORDS: Depression, BMI, Shift work, Oil Refinery, Inflammation

INTRODUCTION

Shift working is mentioned as one of the occupational factors and about 15 to 20% of workers are working as shift workers [1]. It has been linked to some chronic diseases and health problems, such as sleep disorder due to the circadian system being disrupted [2-3] 10% to 90 % of shift workers are considered in range of insufficient sleep [4-6]. This condition increases stress and depression and consequently increases pre-inflammatory cytokines [7] such as IL- 6 (Interleukin-6) cytokines that can activate the immune system, in a role of activator, and consequently C-reactive protein (CRP) level is increased [8].

High sensitive C-reactive protein (hs.CRP) and IL-6 are among inflammatory and pre-inflammatory markers considered the risk factor of many diseases including depression [9-10]. Overweight and obesity is associated with a high prevalence of comorbidities, such as metabolic syndrome (MS) Based on past results there was a positive relationship between shift work and increased body mass index [11]. Also some studies have suggested that there was a relationship between inflammatory markers in general, and CRP in particular and obesity [12-17].

According to a few related studies in Iran, this study was conducted with the aim of determining the relationship between Body Mass Index with depression among shift workers in an oil refinery [18-19].

MATERIAL AND METHODS

Research Participants:

This cross-sectional study was performed on oil refinery workers whose work schedule was shift work (8 hours rotating shift work) and also scored more than 9 on the Persian version Beck Screening questionnaire that contains 21 questions with depression scores ranging from 0 to 29. Based on the self-administered questionnaire score, people are grouped into three categories: without any depression symptoms (0-9) mild (10-18) and medium (19-29). To enter the study, individuals had to sign a

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written consent and not have a history of using antidepressants. Exclusion criteria in our work is the presence of chronic diseases diagnosed by a physician such as history of thyroid diseases, liver diseases, kidney diseases, diabetes, cardiovascular diseases, cancer, autoimmune disorders, hypertension, and smoking.

All 456 potentially eligible candidates were enrolled at the study. Nearly 3% of workers did not return the general and Beck questionnaires. Finally, based on the inclusion and exclusion factors, only 189 workers participated in the study. Demographic variables were gathered by general questionnaires. To calculate BMI, weight was measured using standard tools with light clothing without shoes and with an accuracy of 100 grams and height was measured in standing position without shoes with an accuracy of 0.1 cm using standard tools.

Assessment of health condition:

A history of chronic diseases was collected through physical examination in the clinic.

Evaluation of inflammation markers:

To measure the level of IL-6, hs-CRP and cortisol, Fasting blood samples were taken in the morning before starting work from the vein anterior to the elbow at sitting position.

Cortisol, IL-6, hs-CRP were measured in Tehran Nour Research Center. Cortisol, IL-6 and hsCRP were measured using RIA kit in radioimmunoassay method, R&D (Germany) kit in enzyme-linked immunosorbent method and quantitative diagnostic kit in immunoturbidimetry method produced by Pars Azmoon Company, respectively.

Statistical analyses:

Statistical analysis was performed by software SPSS version 22 (IBM Corp., 2011, IBM SPSS Statistics for Windows, NY, EUA). Descriptive statistics were derived for all variables of interest in this study. Mean and standard deviation (SD) were calculated for quantitative variables.

Mean and standard deviation were examined by descriptive statistics and the relationship between the studied variables was analyzed by analytical statistics (regression to study the relationship between depressions and shift work, ANOVA to study the difference between groups). $P < 0.05$ was considered statistically significant.

Ethical consideration:

This research was accepted by the ethics committee of Tarbiat Modares University and data is gathered as part of the research with Registration number: IRCT201202189056N1

RESULTS

Overall, 189 male shift workers aged 21-52 enrolled in the study. The mean age (\pm SD) of all participants was 30.58 ± 6.97 years.

About educational level, 60.3% of participants were in high school diploma and 37% of participants were in higher than high school diploma. Regarding marital status, 64.6% of participants were married.

About type of work, 81% of participants were operational workers and 19% were firefighters. The work experience of 63% of participants were less than 6 years, 22.8% were between 6 to 15 years, 12.7%

were between 16 to 25 years and 1.6% were for more than 25 years.

On the Shift work experience, about 70.4% of participants were less than 6 years, 16.9% were between 6 to 15 years and 11.6% were between 16 to 25 years. Mean and standard deviation was 5.82 ± 6.06 years.

About Para Clinical Examinations, our results showed the mean depression score was 11.33 (± 5.61). Of all participants, 28% were without any depression symptoms, 65.1% were categorized as having mild depression and 6.9% were categorized as having medium depression.

The participants' BMI ranged from 15.9 to 34.3; the mean BMI of the participants was 24.82 kg/m^2 ($\pm 3.81 \text{ kg/m}^2$). Mean of hs.CRP was 0.93 (± 1.36) (mg/L), mean of IL-6 was 1.17 (± 1.12) (pg/ml) and mean of cortisol was 12.98 (± 3.87).

Table 1 shows a negative association between age with the cortisol concentration ($P=0.007$). Also there was a strongly significant correlation between BMI with hs.CRP ($P=0.000$) and cortisol concentrations ($P=0.001$) and slightly with IL-6 ($P=0.048$). But there was not any association between shiftwork experiences with inflammation biomarkers

Table 1. Correlation between age, body mass index and shift work experience and depression score with inflammation biomarkers

Inflammation Biomarkers	Depression scores	Age (year)	BMI(kg/m ²)	Shiftwork experience (year)
hs.CRP (mg/L)	$r=0.114$ $P=0.118$	$r=0.101$ $P=0.167$	$r=0.272$ $P=0.000$	$r=0.071$ $P=0.335$
IL-6 (pg/ml)	$r=0.085$ $P=0.245$	$r=0.009$ $P=0.902$	$r=0.144$ $P=0.048$	$r=0.027$ $P=0.71$
Cortisol ($\mu\text{g/l}$)	$r=-0.002$ $P=0.983$	$r=-0.197$ $P=0.007$	$r=-0.244$ $P=0.001$	$r=-0.085$ $P=0.242$

According to results of this study there was not a significant difference between mean of

inflammation markers in workers with difference depression scores (Table 2).

Table 2. Biomarker concentration at different depression groups in shift workers

Par clinical factors	BMI(kg/m ²)		PV
	<19 (n=13)	19-25 (n=84)	
hs-CRP (mg/L)	0.69(±0.80)	1.02(±1.52)	0.05
IL-6 (pg/ml)	1.00(±0.76)	1.24(±1.23)	0.20
Cortisol (µg/l)	12.65(±3.73)	13.11(±3.93)	0.4

All Values are mean (±SD) all obtained from t-test by comparing the components of biomarkers concentrations (hs.CRP, IL-6 and Cortisol) between

different BMI groups. It shows that there was a significant difference in mean value of Cortisol, CRP between groups (P=0.003, P=0.006 consequently) (Table 3).

Table 3. Biomarker concentration at different BMI groups in shift workers

Par clinical factors	BMI(kg/m ²)			PV
	<19 (n=13)	19-25 (n=84)	25≤ (n=92)	
hs-CRP (mg/L)	0.34(0.59) ^d	0.65(1.07) ^e	1.26 (1.58) ^f	0.003*
IL-6 (pg/ml)	0.79(0.39)	1.17(1.22)	1.23(1.10)	0.433
Cortisol (µg/l)	15.60(4.28) ^a	13.38(3.35) ^b	12.26(4.09) ^c	0.006*

All Values are mean (SD)

*the mean difference is significant at the PV<0.01 between a and c, between d and f, between e and f

DISCUSSION

Depression and inflammation factors is one of the most attractive studies in shift workers in Iran that were conducted. Field studies in shift workers have shown increased inflammatory markers during or following night work compared with day work or days off [1-2]. The current study investigated an association of depression and body mass index with inflammation markers (IL-6 and CRP as indicators of inflammation) in shift workers in one of the most important industries at Tehran Oil Refinery, Iran to develop the national experience in this subject.

This study showed that there wasn't correlation between depression score and investigated inflammation biomarkers (see Table 1). But, hs.CRP concentrations were higher in depressed workers (the score of depression was higher than 10) compared to non-depressive workers but there was not significant deference because of assumption $\alpha < 0.05$ in this study (Table 2). According to past studies the link between the immune system and psychological responses occurred in the context of cytokine-induced sickness behavior and immunotherapies such as interferon alpha (IFN α) in the context of hepatitis C treatment.

Cytokine-induced sickness behavior is a syndrome characterized by decreased activity, depression, and loss of energy because of the increased circulating levels of proinflammatory cytokines [3]. Furthermore, the association between depression and inflammatory markers were shown (CRP and IL-6) among patients with cardiac disease or cancer [4-6]. A large, nationally representative database in the USA showed that major depression was associated with elevations of CRP level in men. The findings were indicative of a graded association between CRP level and depression when the data were analyzed by the time since the depression was active or by the number of episodes of depression [7].

In present research, the population was workers who were not clinically depressed and they did not have major depression. The mean depression score was 11.33(\pm 5.61), with no medication and they did not have any clinical disease like cardiac disease or cancer, so it could be the probable cause that we could not find correlation between depression score and IL-6 and CRP concentrations in our study (Table 1). Some other

studies showed that the associations between depression and IL-6 and CRP concentration were strong in clinically depressed patients but when adjusting for body mass index (BMI) showed smaller level of associations [8], because serum concentrations of CRP and IL-6 are significantly correlated with weight, BMI [9].

The results of this study show some positive correlation between BMI with CRP, and IL-6 concentration and negative correlation between BMI and cortisol. Based on, with increasing the BMI, the hs.CRP increased but this association about cortisol was reversed so that, with increasing BMI, the cortisol decreased. Also the results in this study showed that Biomarker Concentration was significantly different in various BMI Groups in shift workers. (Table 1 and 3).

Some other studies indicated a positive relationship between inflammatory process and Body Mass Index Each degree of obesity was related directly to CRP, regardless of ethnicity characteristics and sex [10-11]. Regarding this finding, other studies analyzing cortisol levels in relation to obesity markers have yielded mixed results, yet. Some prior studies demonstrated a negative linear relationship between BMI and morning serum or salivary cortisol [12-14].

The result showed CRP, cortisol and IL-6 concentration did not have correlation with shift work experience.

The mean and standard deviation of shift work experience in this study was 5.82 \pm 6.06, which is not long work experience. Several limitations should be kept in mind in interpreting of our data. First, this is a cross-sectional design, which prevents us from determining whether the associations between cortisol, IL-6 and hs-CRP measures and BMI. Second, the sample size was not large enough. Third, we just measure BMI but not abdominal obesity.

ACKNOWLEDGMENT

This research was supported by Tarbiat Modares University also, we appreciate cooperation of Tehran oil refinery shift workers.

CONFLICTS OF INTEREST

There is no conflict of interest in this study.

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