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Original

The Study of the Incidence of Metabolic Syndrome and its Indices in Welders in Rafsanjan in 2018 (A Descriptive Study)

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Abstract

Background: Welders are exposed to different chemical damaging factors such as fumes, gases and dusts caused by welding. Some studies have referred to a possible association between occupational exposure and engaging with metabolic syndrome. Metabolic syndrome is a set of factors such as abdominal obesity, high blood pressure (hypertension), high blood sugar, high triglycerides and High-density lipoprotein (HDL) levels that are a fundamental risk factor for diabetes, cardiac disease and stroke. Hence, we accordingly decided to investigate the incidence of metabolic syndrome among welders in Rafsanjan. **Methods:** This is a cross-sectional descriptive study performed on 78 door and window welders in Rafsanjan in 2018. Data collection was carried out at two stages, first stage was based on a checklist containing demographic information and the second one included laboratory tests, and finally by recording data in SPSS software, quantitative data was reported as "mean ± standard deviation" and qualitative data was reported as "number (percent)". **Results:** 43 out of 78 welders were tested by anthropometric and blood tests, 29 (67.4%) had central obesity. Of these 29, 15 (51.7%) had at least two of four conditions, indicating their metabolic syndrome. After central obesity, the most common factors among these 43 patients respectively were hypertension (55.8%), high triglyceride (37.2%), and high fasting blood sugar (20.9%). **Conclusion:** The findings of the present study revealed that about half of the studied welders had at least two metabolic syndrome indices. In future studies, implementation of partnership building strategies and increased collaboration incentives to achieve a larger sample size are recommended.

Keywords: Metabolic Syndrome; Central Obesity; Welders; Rafsanjan

Introduction

Metabolic syndrome refers to one of the risk factors for chronic diseases such as cardiovascular disease determined by indicators of obesity, hypertension, high triglyceride level, high fasting blood sugar (FBS), and high-density lipoprotein (HDL) cholesterol.[1] Based on the most recent definition of the International Diabetes Federation, the central obesity (waist circumference

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over 90 cm in South Asian men and over 80 cm in South Asian women) along with at least two factors of the other four factors indicate individual metabolic syndrome.[2] Various studies have reported the high prevalence of metabolic syndrome in developing and developed countries; this value is increasing and it is a major public health threat.[3-5] In general, the prevalence of this syndrome in Iran is 32%.[6] Nevertheless, there is no comprehensive data on the prevalence and incidence of metabolic syndrome in high-risk occupational groups such as welders. Welding industry is widely used in different industries including shipbuilding, oil and gas, aluminum sheet forming, as well as automobile assembly and manufacturing, but less has been addressed in the health and safety issues of welders.[7]

Based on the definition of International Standard Classification of Occupations provided by the International Labor Organization (ILO), welders are workers cutting or welding metals using various heat sources, such as flame heat and electric arc.[8] The welding process is associated with the production of fumes containing various types of particles in different dimensions and the welders are exposed to inhalation of large volumes of these particles.[9] Indeed, the gradual accumulation of metals attracted to the body over time may produce high levels of toxicants, disrupting the activity of antioxidant enzymes and increasing free radical production, resulting in the breakdown of cellular redox and imbalance in oxidants and antioxidants. This alteration in redox balance and its shift to oxidative state may induce oxidative stress along with effects like changes in processes related to apoptosis and cell death.[10-12] Oxidative stress and inflammation play a significant role in the pathogenesis of chronic diseases like cardiovascular disease, diabetes, and cancer.

On the other hand, the production of various reactive oxygen species will result in biological damage to the organism and potentially exacerbate the side effects. Investigations have revealed that increasing levels of reactive oxygen species in both chronic and acute forms and under pathophysiological conditions is critical for the development of cardiovascular disease. Reactive oxygen species lead to proatherogenic events such as impaired endothelial function, LDL oxidation as well as their proliferation and migration into vascular smooth muscle. Thus, oxidative stress may be considered as a mechanism for the risk of cardiovascular disease.[13] In the study by Li et al., they also found that hypertension in welders exposed to welding particles might increase the risk of cardiovascular disease.[13] Hence, given the high prevalence of metabolic syndrome that is an indicator for chronic diseases such as cardiovascular disease,[14] and on the other hand, due to the high incidence of cardiovascular risk factors among welders, it was decided to study the incidence of metabolic syndrome among welders in Rafsanjan city.

Methods

This is a descriptive study performed on 78 door and window welders in Rafsanjan in 2018. Data were collected in two stages after coordination with the welders' union and providing them with a brief description of the purpose of this study and considering the inclusion criteria (two years of work experience) and exclusion criteria (dissatisfaction of welders to cooperate and those with a family history of hypertension, diabetes and high cholesterol). The studied sample was specified by two methods. At first, the welders' list was prepared from the union and it was estimated to be about 60 considering the welders' apprentices. At the same time as referring to the welders in the list, other welders in the city were identified and included in the study. The data were collected after providing the welders with a brief description of the project objective in two stages:

The first step involved data collection based on a checklist including demographic information such as age, work experience, daily work hours, smoking

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history (cigarette and hookah), experience in training of dust protection in welding, regular exercise, family history of cardiovascular disease, and history of hypertension and diabetes. In addition, all participants were examined by the trained researcher to measure their height, waist circumference, weight and blood pressure. Their weight was measured by a digital scale model Seca 813 made in Germany; their height was measured using a tape measure in a position standing by the wall and without shoes with a precision of 1 cm and waist circumference (midline between the lowest rib and hip edge at standing position (in umbilical midline) was measured with the same meter and all were recorded. Moreover, the welders' blood pressure was measured using a standard and calibrated Diplomat 1002 mercury blood pressure monitor after a 10-minute rest.

In the second stage, laboratory tests including fasting blood sugar (FBS), blood urea nitrogen (BUN), cholesterol, creatinine, triglycerides, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) were performed after the welders referred to the laboratory and 43 welders totally participated in the blood tests. Finally, in SPSS software, the quantitative data were recorded as "mean ± standard deviation" and qualitative data were reported as "number (percent)". Moreover, to diagnose the metabolic syndrome as defined by the International Diabetes Association,[2] central obesity (waist circumference greater than 90 in South Asian men) was the main indicator of metabolic syndrome, which after categorizing welders into two groups of central obesity and healthy; four other factors in this syndrome were studied in people with central obesity. According to the definition of International Diabetes Association, people with at least two of these four factors (with central obesity) were diagnosed with metabolic syndrome. This research project was implemented after being approved by the Research Council of the Research Center for Workplace and the approval by the Research Deputy and licensed by the Ethics Committee under code IR.RUMS.REC.1394.135.

Results

The frequency of metabolic syndrome and its indices in 78 door and window welders in Rafsanjan was studied in 2018. Among the participants of this study, 18 (21.1%) had an average of 3.22 hours of regular exercise per week. Twenty (25.6%) were smokers and 13 (16.7%) smoked hookah. Four (5.1%) patients had hypertension and one (1.3%) had diabetes for 10 years. Based on body mass index (BMI), nine (11.5%) had obesity type 1, 33 (42.3%) were overweight, three (3.8%) were underweight and the rest were normal. Moreover, Table 1 presents the information on height, weight, waist circumference, as well as the systolic and diastolic blood pressure. It is noteworthy that in this study, blood pressures above 140 mmHg systole and above 90 mmHg diastole were considered as hypertension, and based on standard values of Pathobiology Laboratory of Rafsanjan University of Medical Sciences, having FBS above 115 mg/dl suggested the patient with diabetes mellitus wand the body mass index categorization was according to the standard of WHO.[15]

According to WHO standard, people with a BMI of less than 18 were considered to be as thin, people with a BMI of 18-24.9 as normal, people with a BMI of 24-29.9 as overweight, and those with a BMI larger than or equal to 30 were considered as obese.[12] The waist circumference of 54 (69.2%) of these subjects was more than 90 cm, considered as patients with central obesity. They were compared with the group without central obesity in terms of mean age, history, number of working hours, weight and height, blood pressure, and cigarette and hookah smoking. Information on these two groups is presented in Table 2.

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Table 1. Descriptive indices of demographic specifications of door and window welders in Rafsanjan in 2018

Variable		N (%)	Mean (SD)
Age (year)		78(100)	36.67(9.35)
Work experience (year)		78(100)	16.63(9.67)
Working hours (day)		78(100)	6.90(1.94)
Weight (kg)		78(100)	77.73(13.99)
Height (cm)		78(100)	174.22(7.23)
Systolic blood pressure (mmHg)		78(100)	12.49(1.51)
Diastolic blood pressure (mmHg)		78(100)	7.30(1.49)
Exercise activity per week (h)		18(21.1)	3.22(1.77)
Smoking per day (N)		20(25.6)	17.85(11.15)
Smoking per day (min)		20(25.6)	57.55(35.92)
Smoking hookah per week (times)		13(16.7)	2.62(2.36)
Smoking hookah per week (min)		13(16.7)	62.31(44.56)
Hypertension duration (year)		4(5.1)	1.12(0.63)
Diabetes mellitus duration (year)		1(1.3)	10(0)
BMI	Underweight	3(3.8)	25.57(4.15)
	Normal	33(42.3)	
	Overweight	33(42.3)	
	Obesity type 1	9(11.5)	

Table 2. Frequency distribution of cigarette and hookah smoking in two groups with and without central obesity (n = 78)

Variable		With central obesity (n=54)	Without central obesity (n=24)	Total (n=78)	Significance level*
		Mean (SD)	Mean (SD)	Mean (SD)	
Age (year)		38.44(9.36)	32.67(8.80)	36.67(9.52)	0.012
Work experience (year)		17.94(9.58)	13.67(9.41)	16.63(9.67)	0.072
Working hours (day)		6.93(1.82)	6.83(2.22)	60.90(1.94)	0.847
Height (cm)		174.9(6.54)	172.7(8.54)	174.2(7.23)	0.221
Systolic blood pressure (mmHg)		12.58(1.32)	12.27(1.85)	12.49(1.51)	0.401
Diastolic blood pressure (mmHg)		7.38(1.28)	7.13(1.88)	7.30(1.49)	0.495
Variable		N (%)	N (%)	N (%)	Significance level**
Cigarette smoking	Yes	24.1(13)	29.2(7)	25.6(20)	0.390
	No	66.1(33)	66.7(16)	62.8(49)	
	Given up	14.8(8)	4.2(1)	11.5(9)	
Hookah smoking	Yes	14.8(8)	20.8(5)	16.7(13)	0.773
	No	74.1(40)	66.7(16)	71.8(51)	
	Given up	11.1(6)	12.5(3)	11.5(9)	

* Independent t-test ** Chi-square test

Given the results of independent t-test, the two groups with and without central obesity had a significant difference in terms of mean age (p = 0.012) and mean weight (p<0.001). Furthermore, according to the results of chi-square test, the proportion of people who smoke cigarette or hookah is similar in these two groups (p <0.05). Central obesity or waist circumference above 90 cm is the most important diagnostic factor for metabolic syndrome and among 43 welders entered the second phase, 29 (67.4%) had central obesity. After central obesity, the most common factors among these 43 patients included hypertension (55.8%), high triglyceride (37.2%), increased FBS (20.9%) and decreased lipoprotein concentration with high cholesterol (8%). According to the International Diabetes Association, people with central obesity who have two out of four factors have metabolic syndrome, and from these 29 people, 15 (51.7%) had at least two of the four conditions, indicating their metabolic syndrome.

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Also at this stage, the two groups with and without central obesity were compared in terms of mean age, history and number of working hours, weight and height, blood pressure, cigarette and hookah smoking, as well as the number of metabolic syndrome factors (except central obesity). Table 3 reports the information on these two groups.

In the second phase of the study, only 43 (55.1%) out of 78 welders of the first stage agreed to go to the laboratory and perform the relevant tests. Table 4 reports the mean and standard deviation of some of blood factors.

Given the results of the independent t-test, the two groups with and without central obesity (tested subjects) had a significant difference in terms of mean number of working hours per day p = 0.014) and average weight (p <0.001) and considering the results of chi-square test, the proportion of people smoking hookah is identical in these two groups (p <0.05). Moreover, frequency distribution of the number of metabolic syndrome factors was similar in two groups with and without central obesity (p <0.05). Nevertheless, the two groups were not the same (p = 0.048) in terms of smoking, since 21% of smokers with central obesity had to quit smoking. Fifteen (51.7%) out of the 29 patients with central obesity had metabolic syndrome. At this stage, two groups with and without metabolic syndrome were compared in subjects with central obesity in terms of the mean age, history and number of working hours, weight and height, blood pressure, as well as BMI. Table 5 represents the information on these two groups.

Table 3. Comparison of the two groups with and without central obesity in terms of number of working hours per day and other metabolic syndrome conditions in the tested subjects (n = 43)

Variable		With central obesity (n=29)	Without central obesity (n=29)	Significance level*
		Mean (SD)	Mean (SD)	
Age		36.8(8.66)	32.5(7.47)	0.120
Working hours (day)		6.48(1.86)	7.86(1.03)	0.014
Work experience (year)		16.8(9.05)	1.29 (7.16)	0.213
Height (cm)		174.4(6.74)	172.0 (8.75)	0.309
Systolic blood pressure (mmHg)		12.6(1.27)	1.21 (1.88)	0.429
Diastolic blood pressure (mmHg)		7.67(1.50)	7.26(1.87)	0.438
Variable		**N (%)**	**N (%)**	**Significance level ****
Number of syndrome factor	Zero	17.2(5)	42.9(6)	0.301
	One	31.0(9)	28.6(4)	
	Two	34.5(10)	2.4(3)	
	Three	17.2(5)	7.1(0)	
Smoking cigarette	Yes	6.9(0)	28.6(4)	0.048
	No	72.4(21)	71.4(10)	
	Given up	20.7(10)	0.0(0)	
Smoking hookah	Yes	13.8(4)	35.7(5)	0.253
	No	75.9(22)	57.1(8)	
	Given up	10.3(0)	7.1(1)	

*Independent t test, **Chi square test

Table 4. Descriptive indicators of blood factors in door and window welders in Rafsanjan in 2018

Variable	N	Normal level	Mean (SD)
Blood sugar (mg/dl)	43	70-115	95.35(19.99)
Urea (mg/dl)	43	10-50	32.63(6.43)
Creatinine (mg/dl)	43	0.4-1.5	1.13(0.11)
Cholesterol (mg/dl)	43	<200	189.12(33.60)
Triglyceride (mg/dl)	43	<200	155.23(105.52)
HDL (mg/dl)	43	>35	48.02(10.69)
LDL (mg/dl)	43	<130	103.67(21.63)
S.G.O.T (mg/dl)	43	5-40	25.79(7.99)
S.G.P.T (mg/dl)	43	5-40	30.14(18.96)

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Table 5. Comparison of the two groups with and without metabolic syndrome in people with central obesity in terms of different variables (n = 29)

Variable	With metabolic syndrome (n=15)	Healthy(n=14)	Significance level*
	Mean (SD)	Mean (SD)	
Age (year)	36.27(8.39)	37.36(9.23)	0.742
Work experience (year)	16.99(8.89)	16.57(9.55)	0.903
number of working hours (day)	2.13(6.40)	6.57(1.60)	0.810
Weight (kg)	86.87(10.07)	79.5(6.56)	0.029
Height (cm)	175.1(7.32)	173.6(4.81)	0.545
Systolic blood pressure (mmHg)	13.07(1.33)	12.11(1.04)	0.041
Diastolic blood pressure (mmHg)	8.20(1.82)	7.11(0.79)	0.047
BMI	28.35(3.03)	26.34(1.68)	0.038

*Independent t test

Given the results of the independent t-test, there are significant differences between the two groups with and without metabolic syndrome (in individuals with central obesity), in terms of mean weight (P = 0.029), systolic blood pressure (p= 0.041), diastolic blood pressure (p= 0.047) and BMI (p= 0.038). Furthermore, the frequency distribution of people using different means of work in two groups with and without metabolic syndrome in those with central obesity was compared. There was not any significant difference between the two groups except for the use of work shoes (p =0.033) (p <0.05).

Discussion

In the current study, among 43 welders who participated in the laboratory tests after measuring anthropometric indices, after central obesity (67.4%), the most prevalence of metabolic syndrome components respectively included hypertension (55.8%), high triglyceride (37.2%), increased FBS (20.9%), and decreased lipoprotein with high cholesterol concentration (8%). In addition, the incidence of metabolic syndrome among the studied welders was estimated to be 15 (51.7%). There may be many complex biological mechanisms involved in the development of metabolic syndrome components;[16] however, according to the results of the current study, obesity and overweight seem to play a key role in the development of other metabolic syndrome components. In other words, it is assumed that significant higher mean weight in welders with metabolic syndrome 86.87 (10.07 kg) than that in healthy welders 79.5 (6.56 kg) may result in the incidence of hypertension in them. Consistent with our study, in the study by Li et al., hypertension has been stated to be the most common risk factor for cardiac diseases among welders and indicated that hypertension is associated with overweight and obese in welders.[13] In line with the present study, in the study by Sjögren et al. (2006), the risk of metabolic syndrome symptoms and cardiac diseases in Scandinavian welders was respectively estimated 2.3 and 3.6 (OR) higher than the employees of the same city.[17]

Another important hypothesis that could justify the high systolic blood pressure of the welders in the present study is that the exposure to Particular matters (PM) due to welding process may result in arterial contraction and consequently elevate blood pressure of the welders while welding. Hence, a meta-analysis study by Fang et al., pointing to the function of this contractile pathway in enhancing blood pressure of welders, emphasizes that the synergistic effect of tobacco use on the increased blood pressure and risk of cardiovascular disease in welders should not be ignored.[18] In this regard, Brook et al. express that exposure to PM may also increase blood pressure in healthy individuals by 1–5 mmHg. Thus, due to the exposure of welders to higher levels of PM and fume, they will be at increased risk for hypertension and consequently cardiovascular risks.[19] In the present study, an important issue concerning the welders' blood pressure measurement is that since the participants rested for 10 minutes before the blood

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pressure measurement, the chance of a random error due to intra-subject variation in blood pressure was reduced,[13] and this seems to enhance the validity of the results compared to similar studies.[20-22]

Twenty-nine (67.44%) out of the 43 studied welders had central obesity (waist circumference larger than 90 cm). Moreover, the number of working hours per day in welders with central obesity (6.48 ± 1.86) was significantly less than the daily working hours of welders without central obesity 7.86 (1.03). Having or not having central obesity may to be affected by daily work hours or even physical activity, and the role of working hours is suggested as an effect modifier. In other words, the extent that central obesity can play a role in the development of metabolic syndrome can be increased or decreased depending on the number of daily work hours or physical activity of welders. Of course, final comment and judgment in this regard necessitates analytical studies and consideration of a control group of qualified welders without metabolic syndrome. In a cross-sectional study, the incidence of myocardial infarction (MI) in welders with more than 5 years of work experience was significantly higher than those with less than 5 years ($p < 0.001$).[23] while in the present study, no significant difference was observed between welders with metabolic syndrome and healthy welders in terms of work experience per year.

One of the challenges proposed in comparing similar occupational and epidemiological studies is the issue of homogeneity of the criterion of exposure to risk factors in different studies.[11] For instance, the health risks of welding vapors and fumes may vary from study to study, depending on many factors like the exposure time, type of welding process, working environment conditions, as well as the protective measures at work. Hence, it is recommended to consider these factors in further studies. Considering the widespread prevalence of metabolic syndrome among welders, it seems necessary for the Ministry of Labor to develop work guidelines to reduce the workload among welders working in the informal sector. Moreover, welders must receive additional training and skills in the use of protective equipment during work to minimize the risk of occupational injuries.[14, 24]

One of the constraints of our study is the small sample size as well as the low percentage of cooperating welders for laboratory tests. Implementation of strategies to attract participation and increase motivation for collaboration in future studies is recommended. Furthermore, it is suggested that analysis and investigation of variables such as family history of cardiac disease, dietary habits, and physical activity of welders also be considered in future studies,[14] since comments on obesity, overweight, and other metabolic syndrome components may be influenced by the abovementioned variables.

Conclusion

The findings of this study revealed that about half of the studied welders had at least two metabolic syndrome indices. Given the complications of metabolic syndrome besides the high prevalence of central obesity as the key indicator of this syndrome in the present study, it may be possible to contribute to the reduction of complications of the syndrome and increase the health level of occupational groups such as welders through increasing the awareness of individuals and formulating plans to change their lifestyle, as well as providing annual occupational care and checkups.

Conflicts of Interest

The authors of this paper declared no conflict of interest.

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