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Occupational Exposure to Vegetable Oil: a Risk Factor of Blood Lipid Disorder

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ABSTRACT

Introduction: Few pieces of evidence are available about the association between occupational exposure to vegetable oil and the risk of blood lipid problems. This study was aimed to investigate the relationship between exposure to vegetable oil and blood lipid profile in a vegetable oil factory.

Materials and Methods: This retrospective cohort study was carried out on 30 male workers exposed to vegetable oil as an exposed group and 30 male office workers as an unexposed group in a vegetable oil factory. Blood lipid profiles as total cholesterol, triglycerides, Low-Density Lipoprotein (LDL), and High-Density Lipoprotein (HDL) were measured by analyzing the blood samples in both groups in a clinical laboratory.

Results: There were no significant differences between the two groups in terms of age, body weight, height, Body Mass Index (BMI), and physical activity. The results showed significantly higher mean levels of triglyceride and LDL in the exposed group compared to the unexposed group ($P < 0.001$), while HDL mean levels in the exposed group were significantly lower than the unexposed group ($P < 0.001$).

Conclusion: The findings revealed the possible association between blood lipid disorders and occupational exposures to vegetable oil. Further researches are proposed to study the mechanisms of occupational respiratory and skin lipid absorptions in different types of vegetable oils.

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Introduction

Although cardiovascular diseases are among the most important factors in the mortality rate, they can be prevented[1]. Based on the reports, cardiovascular diseases have a growing trend in the United States[2], China[3], and Iran[4]. Lipid disorders are essential factors that contribute to the development and progression of cardiovascular diseases and are often associated with increased levels of triglycerides, Low-Density Lipoprotein (LDL), and High-Density Lipoprotein (HDL) levels[5]. Therefore, controlling these disorders is considered necessary to reduce the risk of heart diseases in patients. One way to control blood lipids level is to use proper diets [6,7].

Few studies have been conducted on the relationship between blood lipids levels and occupational exposure to vegetable oil mist or fumes. In a study conducted on employees in the kitchen of restaurants exposed to frying oil mist, the levels of cholesterol, LDL, White Blood Cell (WBC), mononuclear cells, and Malondialdehyde (MDA) were significantly higher than the unexposed group[8]. According to Bin's study, cooking oil fumes may disrupt the oxidation-antioxidation system and have genetic toxicity. It also may depress immunity function[8]. Therefore, vegetable oil mist exposure during cooking can be a risk factor for undesirable effects on sleep quality[9]. Epidemiological studies have indicated that exposure to cooking oil fumes may be an important factor in lung cancer for nonsmoking females in China [10].

The vegetable oil factories have different units that extract oil from oily seeds in different stages. In the different production stages, the workers have been exposed to the vegetable oil mists through inhalation and skin exposures. However, there were a few studies on the effect of occupational exposure to vegetable oil fumes on blood parameters related to lipids, such as cholesterol, triglycerides, LDL, and HDL. Therefore, the current study was aimed to investigate whether occupational exposure, including respiratory and skin exposure, to vegetable oil, could cause to change the level of blood lipids or not.

Materials and Methods

This study was a retrospective cohort study, and the exposure group consisted of all workers (30 male workers) in the Nazgol vegetable oil factory who were occupationally exposed to vegetable oil mists. Moreover, 30 office workers who had no work experience in vegetable oil mists were randomly selected as an unexposed group. A simple questionnaire on demographic characteristics and the prevalence of some related subjective symptoms were used.

Regarding the fact that blood lipid levels can be effectively influenced by diet, the dietary information was collected from all participants using the Food Frequency Questionnaire (FFQ) questionnaire. The obtained data were recorded and compared by using SPSS 21 statistical software. To assess the participants' level of physical activity, the International Physical Activity Questionnaire (IPAQ), whose validity and reliability had been confirmed by Fesharaki et al. [11] was used. The participants were classified according to the obtained total met scores by this questionnaire.

To assess the blood lipid profile, including total cholesterol, triglycerides, LDL, and HDL, 5 ml of fasting blood was drawn from each participant in both groups. After serum separation, the samples were kept frozen at -40°C; the samples were then sent to the laboratory under the same conditions. Standard kits purchased from Pars Company was used to measure lipid profiles using the photometric method and a Monobind kit.

SPSS software version 21 was used for statistical analysis: Kolmogorov-Smirnov test was used to assess the normality of the data distribution. Independent t-test, Chi-square, Fisher exact tests, and Mann-Whitney U test were also used to analyze obtained data. Statistical significance was set at $p < 0.05$.

Results

The results showed no significant difference between the two groups in terms of age, body weight, height, Body Mass Index (BMI), and physical activity (Table 1). Moreover, all of the individuals in both groups were male; therefore, the gender effect was eliminated in this study.

Table 1: Demographic characteristics in the exposed and unexposed groups

Variable	Exposed group	Unexposed group	P-Value
Age (year)	39.7 ± 4.7	39.2 ± 8.4	0.791
Body weight (kg)	80.5 ± 11	82.1 ± 11.1	0.571
Height (cm)	176.5 ± 5.2	177.7 ± 7.3	0.453
BMI	25.8 ± 3.4	25.9 ± 3	0.916
Low physical activity	6 (20%)	9 (30%)	0.371

Considering the effect of diet on blood lipids level, the nutritional status of the two groups was evaluated using a FFQ. Independent t-test showed that the total fat intake in the unexposed group was significantly higher than the exposed group (P = 0.003) (Table 2).

Table 2: The dietary intake of fat groups in the exposed and unexposed groups.

Variable	Exposed group	Unexposed group	P-Value
Saturated fat	18.89 ± 5.2	24.84 ± 9.42	0.005
Unsaturated fatty acids with one double bond	16.81 ± 3.43	20.03 ± 5.48	0.009
Unsaturated fatty acids with 2 or more double bond	8.73 ± 1.31	9.77 ± 1.18	0.014
Total fat	48.26 ± 9.74	59.54 ± 17.1	0.003

As shown in Table 3, the LDL and triglyceride levels in the exposed group were significantly higher than in the unexposed group (P < 0.001). The HDL level in the exposed group was significantly lower than the unexposed group (P < 0.001). Moreover, the percentage of individuals with high cholesterol and triglycerides and low HDL levels in the exposed group were significantly higher than the unexposed group (Table 4).

The prevalence of some subjective symptoms such as headache, dizziness, and nausea in the exposed group was significantly higher than in the unexposed groups (Table 5).

Table 3: Blood lipid profile in the exposed and unexposed groups.

Variable	Exposed group		Unexposed group		P-Value
	Mean ± SD	Median	Mean ± SD	Median	
Cholesterol (mg/dl)	194.1 ± 31.7	200.5	179.4 ± 3	175.5	0.09
LDL (mg/dl)	97.9 ± 20.6	95.5	44.1 ± 7.6	42.5	0.001
HDL (mg/dl)	47.1 ± 2.1	42.5	171.3 ± 136.4	129	0.001
Triglyceride (mg/dl)	161.2 ± 80.1	127.5	97.9 ± 25	93.5	0.001

Table 4: Blood lipid status in the exposed and unexposed groups (based on ATP III standard) [12].

Variable	Exposed group	Unexposed group	P-Value	Relative Risk
High Cholesterol (> 200)	15 (50%)	7 (23.3%)	0.032	2.15
High LDL (> 130)	2 (6.7%)	0 (0%)	0.492	2.07
Low HDL (< 40)	8 (26.7%)	0 (0%)	0.002	8.27
High Triglyceride (> 150)	10 (33.3%)	0 (0%)	0.001	10.33

Table 5: Prevalence of some subjective symptoms in the exposed and unexposed group

Subjective symptoms	Exposed group	Unexposed group	P-Value	Relative Risk
Headache	24 (80%)	13 (43.3%)	0.003	1.85
Dizziness	22 (73.3%)	10 (33.3%)	0.002	2.2
Nausea	18 (60%)	10 (30%)	0.038	1.8

Discussion

The results showed that LDL and triglyceride in the exposed group were significantly higher than in the unexposed group. Moreover, the HDL level in the exposed group was significantly higher than in the unexposed group. Also, the percentage of participants with high cholesterol and triglyceride levels was significantly higher than the unexposed group. Thus, the fat intake (including total fat, saturated, and unsaturated fatty acids) through food in the exposed group was lower than in the unexposed group. This means that despite the lower fat intake in the exposed group, the exposed group's blood lipid levels were much higher than the unexposed group. Reviewing the literature, there were no similar studies conducted in vegetable oil manufacturing plants. The level of blood cholesterol, LDL, WBC, single-core cells, and serum MDA in the occupationally exposed workers to cooking oil fumes during the cooking process were significantly higher than the unexposed group [8]. These findings confirm the results of the present study. In the study conducted on food suppliers, the reported levels of triglycerides (177 ± 6.2) and LDL (170.7 ± 20.1) were higher than the results obtained in this work.

Moreover, the reported results for the mean level of HDL (40.1 ± 7.5) were lower than the current work results [13]. According to the result, it seems that occupational exposure to vegetable oil (through skin and inhalation) could be considered a risk factor for blood lipid disorders. However, due to the lack of similar studies, more studies are necessary.

In our study, the prevalence of subjective symptoms such as headache, dizziness, and nausea in the exposed group was significantly higher than in the unexposed group. The findings from the study conducted by Juntarawijit revealed a minimal increase in the risk of "cough" and "wheeze" related to every 10 h of staying in the kitchen area with occupational exposure to oil mist [14]. It seems that there are symptoms associated with occupational exposure to vegetable oil and high triglyceride and cholesterol levels in the blood.

Limitations and recommendations

Dietary components such as dietary energy and carbohydrate intakes might also affect the lipid profile. These components were not assessed in the present study. Therefore, more studies with a large sample size considering all possible variables influencing the blood lipid are recommended in the future.

Conclusion

According to the results, the LDL levels, triglyceride, and HDL in the exposed group were significantly higher than in the unexposed group. The obtained results were not related to diet. Furthermore, it seems that occupational exposure to vegetable oil (through skin and inhalation routes) could be the main reason for these changes. Then, occupational exposure to vegetable oil could be considered as a risk factor for blood lipid disorders. However, due to the lack of similar studies, more studies in large groups are proposed.

Authors' contributions

All authors participated in the statistical analysis. All authors contributed to the design and

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data analysis and assisted in the preparation of the final version of the manuscript. All authors read and approved the final version of the manuscript.

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Ethics approval and consent to participate

The Ethics Committee of Kermanshah University of Medical Sciences approved the study protocol. Furthermore, participation was voluntary, and participants were fully debriefed about the study's aims and objectives and signed the informed written consent form. In the present work, before data collection and collecting samples, researchers explained the questionnaires' namelessness, study objectives, and the confidentiality of the study data for the workers.

Conflict of interests

The authors declare that they have no competing interests.

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