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METABOLIC SYNDROME IN COLLECTION AND DISPOSAL OF SOLID WASTE SECTOR

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Abstract
Objectives: This study aims to assess the frequency and factors relevant to metabolic syndrome in workers employed in the collection and disposal of solid waste sector. **Materials and Methods:** This cross-sectional study was conducted in the major solid waste collecting and disposal company named İSTAÇ AŞ (İstanbul Environmental Protection and Waste Processing Corporation) in Istanbul, Turkey. All 715 male employees of the company were included in the study without sampling. The study was completed with 619 subjects. Since it was a small group, female workers were not taken into account in the study. Metabolic syndrome frequency was investigated according to the NCEP-ATP III criteria including the levels of systolic and diastolic blood pressure, waist perimeter, HDL, triglyceride, fasting blood glucose values. **Results:** Metabolic syndrome was present in 40.9% of participating employees. Metabolic syndrome was more common in those working in the excavation field (54.0%), such as caterpillar operators (56.5%), and less common in employees working in administrative offices, such as office staff or managers, who were under 35 years old and who had been working for less than 10 years ($p < 0.05$). Employees working in work stations other than administrative offices had a 2.60 times higher risk compared to those working in administrative offices. **Conclusions:** Metabolic syndrome may be related to work station, job, age and period worked by the subjects.

Key words:
Metabolic syndrome, Disposal, Solid waste workers

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INTRODUCTION

The aim of occupational medicine is to improve health capacity of employees, prevent hazards that may arise from the workplace environment and minimize the threats and hazards that cannot be prevented, as well as to install an employee in a job appropriate for his/her anatomic and psychological characteristics. Following that procedure, a series of processes, such as periodical examinations for risk factors is essential to make the health status of an employee even better. One of these risks is metabolic syndrome arising from a different set of cardiovascular risk factor components such as impaired insulin resistance and glucose intolerance, diabetes mellitus, obesity, abdominal fat accumulation, dyslipidemia and hypertension [1].

Eskil Kylin first defined metabolic syndrome as accumulation of cardiovascular risk factors naming them together in 1923 [2].

Gerald Reaven named this syndrome "syndrome X" in 1988. He emphasized the importance of a close relationship between the resistance of insulin and the gathering of the mentioned risk factors (hypertension, glucose intolerance, hypertriglyceridemia, low HDL values) [3].

Ferranrini stated that abnormalities which are components of this syndrome result from insulin resistance and thus, the syndrome was named the insulin resistance syndrome in 1991 [4].

Metabolic syndrome is a serious public health issue as it causes cardiovascular diseases, increases the risk of diabetes and has a relatively high prevalence [5]. Mortality and morbidity are significantly increased in cardiovascular diseases accompanied by metabolic syndrome [6]. Zeller found in his investigations metabolic syndrome defined by the NCEP ATP III criteria in 46% of 633 patients who had acute myocardial infarction (AMI) [7].

This study was conducted to explore the frequency and factors relevant to metabolic syndrome in workers employed in the collecting and disposal of solid waste sector, considered as one of the most dangerous jobs.

MATERIALS AND METHODS

This study is a cross-sectional study conducted between March and July, 2009. The study was conducted in the major solid waste collecting and disposal company ISTAÇ AŞ (İstanbul Environmental Protection and Waste Processing Corporation) of Istanbul Metropolitan Municipality. All 715 employees of the company were included in the study without sampling. Permission was taken from company managers and employees who volunteered in participating. 68 employees did not agree to participate and the study was completed with 619 employees. Since it was a small group, female workers were not included in the study and 5 employees quit their job for various reasons. Occupational classification of employees was as follows: office and administrative staff (office staff, advisor, lawyer, general manager, occupational physician, coordinator, unit manager, engineer, healthcare staff, specialist refectory supervisor); caterpillar operators and drivers (caterpillar operator, driver); security staff and field control employees (control overseer, control employee, shift supervisor) and unqualified-master workers. Solid waste storage areas (combustion facility, Asian and European storage areas, Hasdal energy field compost facility, coal storage room, machinery maintenance room), excavation, medical waste disposal area, administrative office (research and development, chieftaincies, security personnel, drivers [except caterpillar operators]), naval services (Port of Haydarpaşa and coast cleaning) and street-avenues scavenging (Asian and European main arteries) were classified as work stations. As for age groups (< 35, between 35 and 44, and > 45 years of age) and time worked (less than 10 years and more than 10 years), classifications were made as described above.

The NCEP-ATP criteria have been used as diagnostic criteria for metabolic syndrome in many studies. We, too, prefer to use the NCEP-ATP criteria for the diagnosis of metabolic syndrome, because the International Diabetes

Society uses them as well, and therefore, the comparisons can be more sound. In our study, the albumin/creatinine ratio in urine and waist/hip ratio were not measured [8,9]. The NCEP-ATP III criteria for metabolic syndrome diagnosis:

1. Blood pressure level at rest being ≥ 130/85 mmHg or receiving antihypertensive treatment,
2. Fasting glucose level being ≥ 110 mg/dl or the presence of diabetes mellitus,
3. HDL level being < 40 mg/dl in males, and < 50 mg/dl in females,
4. Triglyceride level being ≥ 150 mg/dl,
5. Waist perimeter being > 102 cm in males, and > 88 cm in females.

The presence of three or more of these five criteria has been considered as metabolic syndrome [1,10,11].

(In this study, 27 workers were taking antidiabetic and 38 workers were taking antihypertensive medication).

For the purpose of the research presented in this paper, mobile exploration vehicles were used while reaching the study sites and the obtained blood specimens were transferred within a short period of time to an established laboratory liable to an international audit (BIO-RAD EQAS). For biochemical investigations, blood samples were taken following a 12-hour fasting period and then assayed. Besides these, all measurements concerning the employees were completed in addition to blood pressure and waist perimeter measurements essential for defined metabolic syndrome diagnosis according to the NCEP-ATP III criteria. Blood pressure was taken following a 10- to 15-minute rest from the left arm with digital tensiometers (Omron M6 Comfort, Intelli-Sense, Omron Healthcare Co, Kyoto, Japan). The body weight was measured when the subjects were wearing light clothes with the use of the same digital gravimeter. Waist perimeter was measured on the line under the last rib and over the iliac crest following the normal expansion while the workers were undressed. Height was measured and recorded by us using a standard meter while the workers were standing bare-footed.

Ethics

We did not obtain any ethical approval since the study was a cross-sectional type of study and not an experimental one.

Statistics

Continuous variables are presented as average ±SD, while categorical variables are presented in percentages. As for statistical analyses, parametric independent samples t-test was used for the analyses between the two groups that showed appropriateness for normal distribution, Mann-Whitney U test was used for the groups that did not hold appropriateness for normal distribution and chi-square test was used for the comparison of categorical variables. An analysis with logistic regression was done while accepting the NCEP-ATP criteria as dependent variables and job, work station, age and the period worked as independent ones. Statistical significance was accepted as $p < 0.05$.

RESULTS

619 participants were males and the mean age was 40.01±7.17. 92.7% of workers in administrative offices were high-school graduates or had higher education, while just 30.6% of non-office workers were high-school graduates or had higher education. Anthropometric and biochemical features of the employees participating in the study are presented in Table 1.

Metabolic syndrome prevalence was found to equal 40.9% according to the ATP III criteria among the workers included in the study. Among metabolic syndrome components hypertriglyceridemia was the most frequent one (57.7%) (Table 2).

Table 1. Anthropometric and biochemical features of employees participating in the study

Variables	Workers
Study group [n (%)]	619 (96.4)
Age (years)	40.01±7.17
Systolic blood pressure (mm Hg)	127.50±18.60
Diastolic blood pressure (mm Hg)	82.33±12.87
Body mass index (kg/m^2)	28.72±4.02
Waist perimeter (cm)	98.05±10.95
Total cholesterol (mg/dl)	214.97±45.740
HDL cholesterol (mg/dl)	39.51±8.568
Triglyceride (mg/dl)	191.02±110.532
Fasting glucose (mg/dl)	87.16±29.293
Normal weight [n (%)]	106 (17.1)
Mildly overweight [n (%)]	295 (47.7)
Obese [n (%)]	177 (28.6)
Morbidly obese [n (%)]	41 (6.6)
Smoking (never) [n (%)]	351 (56.7)
Smoking (for smokers) (n)	17.43±7.225

Table 2. Dispersion of metabolic syndrome components

Variables	Workers N = 619 [n (%)]
High blood pressure	357 (57.7)
Low HDL cholesterol	357 (57.7)
Hyperglycemia	39 (6.3)
Abdominal obesity	230 (37.2)
Hypertriglyceridemia	366 (59.1)

While in 11.0% of the workers there was no metabolic syndrome component observed, 23.6% had three, 15.3% had four and 1.9% had five components (Table 3). As for the work stations of employees, metabolic syndrome (MS) was seen mostly in workers employed at excavation sites (54.0%). There was a statistically significant difference between work station and metabolic syndrome presence ($p < 0.05$) (Table 4).

Table 3. Dispersion of metabolic syndrome components

Number of components	Workers	
	n	%
Normal healthy	68	11.0
1 component	125	20.2
2 components	173	27.9
3 components	146	23.6
4 components	95	15.3
5 components	12	1.9
Total	619	100.0

Metabolic syndrome was detected in 45 % of the workers involved in the waste processing-related activities while, it equaled 26% in administrative staff. This difference proved to be statistically significant ($p < 0.05$) (Table 5). Employees working in work stations other than the administrative office had a 2.60 higher risk of metabolic syndrome compared to those working in the office (Table 6). Employees dealing with waste processing activities had 2.60 times more risk of developing metabolic syndrome than those working in the office (GA 95%) (Table 6).

Considering the occupation of employees, metabolic syndrome was mostly seen in those who worked as caterpillar operators (56.5%) (Table 4). As for the occupation of workers, there was a statistically significant difference concerning jobs and metabolic syndrome ($p < 0.05$), and office staff and managers had metabolic syndrome less frequently compared to others. Metabolic syndrome was more frequent among those under 35 years of age and those whose time worked was over 10 years ($p < 0.05$). Those who had worked for more than 10 years had a 1.41 times higher risk of developing metabolic syndrome compared to those who had been working for less than 10 years (Table 6).

Table 4. Dispersion of metabolic syndrome (MS) of the workers considering some components

Variables	MS status				p
	with MS		without MS		
	n	%	n	%	
Job					
office and administrative staff	51	30.1	118	69.9	0.003*
caterpillar operator	35	56.5	27	43.5	
driver	39	46.4	45	53.6	
security	9	28.1	23	71.9	
controller	52	43.0	69	57.0	
unqualified – master worker	67	44.4	84	55.6	
total	253	40.9	366	59.1	
Working station					
solid waste storage	110	47.4	122	52.6	0.000*
excavation	27	54.0	23	46.0	
medical waste	15	45.5	18	54.5	
administrative office	32	24.6	98	75.4	
naval services	17	34.7	32	65.3	
scavenging	52	41.6	73	58.4	
total	253	40.9	366	59.1	
Age groups (years)					
< 35	24	31.2	53	68.8	0.009*
35–44	85	47.2	95	52.8	
≥ 45	50	53.8	43	46.2	
Time worked (years)					
< 10	120	59.1	83	40.9	0.039*
≥ 10	71	48.6	75	51.4	

* Chi-square.

Table 5. The metabolic syndrome (MS) status of the workers

Job	MS status				p
	with MS		without MS		
	n	%	n	%	
Office and administrative staff	50	29.6	119	70.4	0.000*
Other workers	203	45.0	247	55.0	
Total	253	40.9	366	59.1	

Table 6. Results of logistic regression analysis

Variables in the Equation	B	SE	Wald	df	Sig.	OR	95% CI for OR	
Reference – office						1.00	lower	upper
Stations other than the office	0.96	0.22	18.17	1	0.000	2.60	1.68	4.04
Reference (< 10 years)						1.00		
Years worked (> 10 years)	0.35	0.17	4.18	1	0.041	1.41	1.01	1.97
Constant	–1.28	0.22	33.79	1	0.000	0.28		

B – Regression co-efficient, SE – Standard error, OR – Odds Ratio.

DISCUSSION

Metabolic syndrome constitutes a great risk not only for obesity and diabetes mellitus, but also for cardiovascular diseases. There has been a significant increase in metabolic syndrome cases around the world in the last two decades. In this worldwide increase, the effect of industrialization and modern life cannot be denied. Being an important public issue, metabolic syndrome shows differences between not only definitive groups of community but, between different countries as well [12–14].

In one of the studies conducted in Turkey, Onat and Şensoy have found metabolic syndrome prevalence to be 27% in males. Özşahin et al. have indicated metabolic syndrome prevalence to equal 33.4% (23.7% in males, 39.1% in females). Sanışoğlu et al. have reported metabolic syndrome prevalence on the level of 27.3% in their study [15–17]. Prevalence of metabolic syndrome has been reported to be 28% in males according to the research made by METSAR (Turkey Metabolic Syndrome Research Group) [18].

Lohsoonthorn et al. have found metabolic syndrome prevalence to equal 15.2% among workers in Bangkok. The percentage of males among the population with metabolic syndrome equaled 29.9%.

In a study conducted in Turkey among workers in İzmir Municipality, metabolic syndrome prevalence has been reported to be 4.4% among those under 35 years of age, 19% among those between 35 and 44 years of age, 22.7% among those between 45 and 54 years of age and 44.4% for those over 55 years of age [19].

In our study, in which we used the NCEP-ATP III diagnostic criteria, metabolic syndrome prevalence was 40.9%. The reason why our result is higher than the Turkey's average could result from the differences in lifestyle and health-related behaviors of solid waste sector workers.

In our study, one of the most important components of metabolic syndrome – i.e. hypertriglyceridemia was the most encountered one (57.7%). This value was higher than the value found in a study conducted by Sanışoğlu [17]. The percentage of hypertriglyceridemia cases equaled 35% in the study conducted by Kozan et al. [8]. While a high blood pressure level was the most often encountered abnormality (45%) in a study completed by Lonsoonthorn, in our study, the triglyceride level was the most frequent one [12]. In the study conducted with workers of İzmir Municipality, the triglyceride component was the most often noted component (47.1%) [19]. In our study, employees had buffet meals provided by the company to be protected from hazardous effects of their work environment. Employees had sufficient and satisfactory meals, but they could not perform physical exercise. The lack of regular physical exercises led to the accumulation of factors predisposing the subjects to metabolic syndrome.

While no metabolic syndrome component was found in 11.0% of the participating workers, 23.6% had three, 15.3% had four and 1.9% had five components. In

the study conducted with employees in İzmir Municipality, the percentage of those who had three components of metabolic syndrome was 12.2%, four components – 4.7% and five components – 0.9%. In the study by Lansonn, conducted among office employees, in workers with the body mass index of 25 and more, the percentage of those who had three components was 15.2%, while only 1% of the subjects had five components at the same time [12]. The ratio of components was also found to be higher because of the high prevalence rates of metabolic syndrome in our study.

Our results showed that metabolic syndrome prevalence equaled 31.2 % for subjects under the age of 35, while it was found to be as high as 53.8% in those over 45 and older. In Tek Harf study conducted in Turkey, metabolic syndrome prevalence in males between 40 and 49 years of age was found to equal 44%. The study conducted among workers of İzmir Municipality by Demiral et al. reported that those under the age of 35 had the prevalence rate of 4.4%, while those over 55 years of age had this rate at the level 44.4% [19]. Lohsoonthorn et al. showed that the metabolic syndrome prevalence was 6.8% in those under 30 years of age, while the prevalence rate equaled 35.1% for those over 50 years of age in the study they conducted among workers in Bangkok [12]. The prevalence of metabolic syndrome seemed to be lower in young subjects, and the prevalence rates tended to increase with age. In our study, prevalence rates for both younger and older ages were found to be higher, although prevalence seemed to increase with age compared to other studies. Age is an important factor for metabolic syndrome manifestations and its onset. Meanwhile, in solid waste collection and disposal sector, the risks generated by the nature of the job, the work station and the time already worked also play an important role**.** In our study, employees who had been working for over 10 years had a 1.41 times higher risk for metabolic syndrome compared to those who had worked for less than 10 years.

Considering the jobs of workers, metabolic syndrome was seen most frequently among caterpillar operators (employees who work as caterpillar operators – all of who worked at the excavation sites). There was a statistically significant difference between the work stations and metabolic syndrome. Employees working in stations other than administrative office had a 2.60 times higher risk for metabolic syndrome compared to those working in the office.

In our study, 92.7 % of office workers were high-school graduates or had higher education. It was noted that among the workers performing mental kind of work, who are better educated, prevalence of metabolic syndrome was lower than in less educated persons performing physical kind of work.

CONCLUSIONS

Metabolic syndrome prevalence is higher in employees of solid waste collecting and disposal plants compared to the results obtained for the rest of the community. A significant correlation was found between metabolic syndrome distribution in workers and work station, job, age and time already worked. Taking preventive precautions against risks coming from the workplace environment of workers will surely provide important contribution to public and especially occupational health.

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