SERUM LIPID PROFILE AND ASSOCIATED HEALTH RISK INDICATORS AMONG BLUE AND WHITE-COLLAR WORKERS

By

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Abstract

Introduction: Worksite health risk screening is a useful method for the surveillance of health risk indicators (HRIs) for chronic diseases, which, according to the World Health Organization, have a rising trend, particularly in less developed countries like Egypt. **Aim of Work:** To measure the frequency and possible association between abnormalities in the serum lipid profile, HRIs, and occupational class (blue-collar vs. white-collar jobs) among Egyptian workers. **Materials and Methods:** Medical records of 526 blue-collar workers and 114 white-collar workers who underwent medical examination at Alexandria University, Faculty of Medicine's Occupational Medicine Unit were reviewed to obtain data about smoking, physical activity, perceived health, occupational class, shift work, blood pressure, anthropometric measurements, and lipid profile results. Multivariate logistic regression was done to model abnormalities in the lipid profile as a function of potential HRI. **Results:** Smoking and physical inactivity were associated with blue-collar jobs, while perceived poor health was associated with white-collar jobs .No relation was found between occupational class and abnormalities in lipid profile, hypertension, or anthropometric indicators. Shift work, hypertension and obesity were independently associated with lipid profile abnormalities. Workers with high levels of triglycerides were 1.6 times more likely to be shift workers and workers with suboptimal levels of HDL-C were two times more likely to be shift workers. The odds of high triglycerides and cholesterol levels were 1.8 and 1.7 times higher in hypertensive workers compared with normotensive workers. Obesity was associated with suboptimal HDL-C levels. **Conclusion and Recommendations:** The current study revealed an association between occupational class and smoking, physical inactivity, and health perception, but not with serum lipid profile abnormalities. Worksite intervention planning targeting obese, hypertensive, and shift workers is advised. Targeting blue-collar workers with smoking cessation and fitness programs is also recommended

Keywords: Blue collar, White collar, Health risk indicator and Lipid profile.

Introduction

Worldwide, the epidemiological burden of chronic noncommunicable diseases (NCDs) is increasing particularly in less developed countries (WHO, 2018a). In Egypt, NCDs are responsible for 82% of all deaths and 67% of premature deaths. The 2011/12 STEP wise survey conducted in Egypt in collaboration with the World Health Organization (WHO) revealed a significantly high prevalence of risk factors for NCDs among Egypt's adult population (WHO, 2018b).

Worksite health risk screening is a useful method for the surveillance of risk factors for chronic NCDs since it helps to identify populations at-risk. A few studies have examined the association between the occupational class (blue-collar vs. white-collar jobs) and health risk indicators (HRIs) and shown varying results. In some studies, blue-collar workers had higher blood pressure measurements, a higher prevalence of smoking, and a lower probability of being obese than white-collar workers (Aginsky et al., 2017). Contradictory results were also reported (Prihartono et al., 2018). In addition, there is limited and inconsistent data about the prevalence of dyslipidemia in different occupational class groups (Ghahramani et al., 2020). The varied studies' results would possibly explain the variation in the prevalence of chronic diseases reported among blue- and white-collar workers (Davis-Lameloise et al., 2013; Zaitsu et al., 2019).

To our knowledge, no studies have examined HRIs associated with the occupational class among Egyptian workers. Identifying a possible association would help to decide whether worksite health intervention should target certain occupational class groups identified with the highest risk (Aginsky et al., 2017). Given the wide variation in the findings of previous studies already mentioned; the fact that the burden of chronic NCDs is increasing, with a major impact in less developed countries like Egypt (WHO, 2018a; WHO, 2018b), the current study was conducted to evaluate HRIs among Egyptian workers.

Aim of Work

To measure the frequency and a possible association between abnormalities in the serum lipid profile, health risk indicators (HRIs), and the occupational class (blue-collar vs. white-collar jobs) among Egyptian workers.

Material and Methods

Study design: A retrospective record review research was conducted.

Place and duration of the study: The study was carried out at the Occupational Medicine Unit (OMU), one of the specialized units affiliated to Alexandria University and located at the Faculty of Medicine in Alexandria, Egypt. It offers medical services to employees who are exposed to workplace hazards. The OMU is mostly visited by male workers employed in Alexandria's primary and secondary industries to get their periodic medical examinations. However, some companies require additional examinations and investigations for their workers to check for possible cardiac, metabolic, or liver disorders. For those workers, lipid profile measurements are carried out, and detailed personal, occupational, and medical data is obtained from them; therefore, detailed data was included in their records. Regarding the current study, during the period from May to July 2023, a review of the medical records of workers who had medical examinations at the OMU in the previous two years took place.

Study sample

Using the Open-Epi calculator, the sample size was calculated (Open-Epi online calculator, Version 3.3a, OpenEpi, Atlanta, GA, USA). At a confidence level of 95%, absolute precision of 5%, and an assumed prevalence of the lipid profile abnormalities among workers of 65.56% (Jankowska et al., 2020), the minimum required sample size would be 347.

Workers between the ages of 20 and 60 who were in active employment and whose medical records contained information on their lipid profile measurements were eligible for this study. Workers on lipid-lowering therapy or with conditions considered to be dyslipidemia confounders (such as chronic liver disease or occupational exposure to heavy metals) were excluded. In addition, the total number of women workers (No = 29) was insufficient for statistical evaluation; thus, they were not included. Moreover, medical records that were missing more than 10% of the essential data needed for the analysis in the current study were not included. Accordingly, the data of 640 eligible workers was included in this study.

Study methods

The medical records were reviewed for workers' sociodemographic and medical data.

I-Classification of workers according to the occupational class

The eligible workers (No = 640) were distributed into two occupational class groups: white-collar workers (No = 114) who typically worked in office settings to perform clerical, administrative, supervisory, managerial, professional or semiprofessional, and business owner roles; and blue-collar workers (No = 526) whose jobs required a greater degree of physically demanding work, including manual labourers and skilled trade roles (ILO, 2012; Lips-Wiersma et al., 2016).

II- Serum lipid profile

Data about measurements of fasting lipid parameters [total cholesterol, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides] were extracted from the records. According to the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), a total cholesterol level less than 200 mg/dl, a LDL-C level less than 100 md/dl, a HDL-C level equal to or higher than 60 mg/dl, and a level of triglycerides less than 150 mg/dl were defined as the desirable (optimal) levels in adults aged 20 years or older (NCEP Expert Panel third report, 2001).

III- Health risk indicators (HRIs):

a- Perceived health and lifestyle indicators

Self-rated health was reported in the records as very good, good, fair, or poor (OECD, 2009). The studied workers were categorized according to the smoking habit into three groups: never been smoker, which referred to a worker who has never smoked or smoked less than 100 cigarettes in his lifetime; current smoker, which referred to a worker who has smoked more than 100 cigarettes in his lifetime and who currently smokes cigarettes; and ex-smoker, which referred to a worker who had quit smoking at the time of examination (CDC, 2023).

Physical activity was reported as Yes or NO according to WHO recommendation of at least 150–300 minutes of moderate-intensity (such as walking

at a moderate or brisk pace of 3 to 4.5 mph on a level surface inside or outside) or 75–150 minutes of vigorous-intensity physical activity (such as race- or aerobic walking for 5 mph or more, jogging, running, or climbing briskly up a hill) each week (US Department of Health and Human services, et al., 1999, Bull et al., 2020). In order to determine whether the worker's physical activity fulfils the WHO recommendation or not, a number of questions were asked to pinpoint the type of physical activity, degree (intensity), and overall duration per week. Then, the final response (Yes or NO) was recorded.

b- Work-related indicators

Workers were categorized according to the work schedule into daytime workers, who never work at night, and shift workers, whose work schedule involved at least three night shifts per month in addition to day and evening shifts in that month with a rotating pattern (Sun et al., 2018).

c- Anthropometric and blood pressure indicators

At OMU, the body weight and height were obtained using standard measures (Glynn and Drake, 2017). A Body Mass index (BMI) of 25 to 29.9 kg/m^2 denoted overweight, and a BMI equal to or greater than 30 kg/m^2 signified obesity. Workers with a BMI less than 25 kg/m^2 were classified as either normal weight (18.5 to 24.9 kg/m^2) or underweight (less than 18.5 kg/m^2) (WHO, 2021). The WC (waist circumference) is measured in a standard way using constant tension tape. According to the European guidelines, a WC of 94 cm or more was considered an increased WC (central obesity) for men (Reiner et al., 2011). The worker's blood pressure was measured at OMU after 10 minutes of seated rest by a mercury sphygmomanometer according to a standard procedure. Hypertension (stage 2) was defined as systolic blood pressure equal to or higher than 140 mmHg and diastolic blood pressure equal to or higher than 90 mmHg without receiving antihypertensive medication (Flack and Adekola., 2020).

Consent

Non applicable. The confidentiality of the data was ensured throughout all stages of the study.

Ethical Approval

The study received an ethical approval from the Research Ethics Committee at the Faculty of Medicine

affiliated with the Alexandria University (Serial Number: 0306143). All methods were carried out in accordance with relevant guidelines and regulations.

Data Management

The SPSS version 22 (IBM Corp. Released 2011. IBM SPSS Statistics for Mac, Armonk, NY, USA) was used for analysis. Descriptive statistics were presented for qualitative variables as frequencies, percentages, and the 95% confidence interval (CI) of the percent. Cross-tabulation analysis was used to present the workers' characteristics in terms of the occupational class groups. In cross-tabulations, the Chi square test and the Monte Carlo test were used to examine associations. For quantitative variables, the Kolmogorov–Smirnov test was used to test data normality (Mishra et al., 2019). Accordingly, anthropometric, blood pressure, and serum lipid profile measurements were presented as median and interquartile range (IQR). The Mann-Whitney test was used to detect any significant differences between occupational class groups.

Univariate and multivariate logistic regression analyses were conducted among all workers (No = 640) to model lipid profile abnormalities (a dependent variable) associated with potential HRIs to examine for independent associations. The Hosmer and Lemeshow goodness-of-fit test was used to determine the adequacy of models in data fitting. All statistical analyses in this study were judged to have a level of significance of 5% ($p = 0.05$).

Results

Table 1: Characteristics of the studied workers (No = 640), stratified by the occupational class.

Characteristics	All workers (No = 640)		Occupational class				
			Blue-collar (No = 526)		White-collar (No = 114)		
	No. (%)	95% CI	No. (%)	95% CI	No. (%)	95% CI	p value[a]
Age (years)							
< 40	466 (72.8)	69.2, 76.2	390 (74.1)	70.4, 77.8	76 (66.7)	58.0, 75.4	0.104
≥ 40	174 (27.2)	23.8, 30.8	136 (25.9)	22.2, 29.6	38 (33.3)	24.6, 42.0	
Residence							
Urban	477 (74.5)	71.1, 78.2	377 (71.7)	67.9, 75.4	100 (87.7)	81.3, 93.5	**<0.001***
Rural	163 (25.5)	21.8, 28.9	149 (28.3)	24.6, 32.1	14 (12.3)	6.5, 18.7	
Marital status							
Never been married	95 (14.8)	12.0, 17.8	77 (14.6)	11.6, 17.7	18 (15.8)	9.3, 22.7	0.754
Married/divorced	545 (85.2)	82.2, 88.0	449 (85.4)	82.3, 88.4	96 (84.2)	77.3, 90.7	
Education							
Primary or basic	48 (7.5)	5.5, 9.5	45 (8.6)	6.3, 11.0	3 (2.6)	0.0, 5.8	**0.029***
Higher education	592 (92.5)	90.5, 94.5	481 (91.4)	89.0, 93.7	111 (97.4)	94.2,100.0	
Work schedule							
Daytime work	171 (26.7)	23.3, 30.5	96 (18.3)	14.7, 21.9	75 (65.8)	57.3, 74.0	**<0.001***
Shift work	469 (73.3)	69.5, 76.7	430 (81.7)	78.1, 85.3	39 (34.2)	26.0, 42.7	
Smoking habit							
Never been smoker	231 (36.2)	32.4, 39.6	170 (32.3)	28.3, 36.4	61 (53.5)	44.5, 62.5	
Ex-smoker	56 (8.8)	6.5, 10.9	43 (8.2)	5.9, 10.6	13 (11.4)	5.8, 17.6	**<0.001*b**
Current smoker	353 (55.1)	51.2, 59.0	313 (59.5)	55.3, 63.4	40 (35.1)	26.7, 43.6	
Physical activity#							
NO	595 (93.0)	90.9, 94.9	495 (94.1)	91.9, 96.0	100 (87.7)	81.1, 93.6	**0.016***
Yes	45 (7.0)	5.1, 9.1	31 (5.9)	4.0, 8.1	14 (12.3)	6.4, 18.9	
Perceived health							
Poor or fair	139 (21.7)	18.7, 24.8	105 (20.0)	16.7, 23.6	34 (29.8)	21.2, 37.8	**0.021***
Good or very good	501 (78.3)	75.2, 81.3	421 (80.0)	76.4, 83.3	80 (70.2)	62.2, 78.8	

CI: Confidence Interval of the percent. [a]: Chi square test . [b]: Monte Carlo test. [#]: Physical activity was reported according to the WHO recommendation of at least 150–300 minutes of moderate-intensity, or 75–150 minutes of vigorous-intensity physical activity each week. [^]: Self-reported physician diagnosis of diabetes mellitus/receiving medications for diabetes mellitus. [*] : Statistically significant (p value ≤ 0.05).

Table (1) demonstrated workers' characteristics, perceived health, and lifestyle behavior. Compared with white-collar workers, a significantly higher percentage of blue-collar workers lived in rural areas had not attained high school or higher education, had shift work, and perceived their health as good or very good. Smoking was significantly higher among blue-collar workers (59.5%) compared to white-collar workers (35.1%) (p <0.001), whereas white-collar workers reported fulfilling the WHO recommendation of physical activity (12.3%) more than blue-collar workers (5.9%) (p = 016)

Table 2: Serum lipid profile, anthropometric and blood pressure measurements of the studied workers, stratified by occupational class.

Measurements	All workers (No = 640)		Occupational class				
			Blue-collar (No = 526)		White-collar (No = 114)		
	Median (IQR)	95% CI	Median (IQR)	95% CI	Median (IQR)	95% CI	p value[a]
Height (meters)	1.73 (0.07)	1.73, 1.74	1.73 (0.07)	1.73, 1.74	1.73 (0.09)	1.72, 1.75	0.620
Weight (kg)	90 (19)	88, 90	90 (19)	88, 90	90 (19.25)	87, 92	0.712
BMI (kg/m^2)	29.6 (5.37)	29.0, 29.9	29.6 (5.39)	29.0, 29.9	29.4 (5.93)	28.7, 30.5	0.737
WC (cm)	96 (16)	95, 98	96 (17)	95, 97	99.5 (18.25)	97, 101	0.128
SBP	120 (20)	120, 120	120 (20)	120, 120	120 (20)	120, 120	0.840
DBP	80 (10)	80, 80	80 (10)	80, 80	80 (10)	70, 80	0.935
Total cholesterol	188 (56.75)	183, 190	186 (56)	182, 189	194 (75.5)	180, 198	0.365
LDL-C	112 (52)	108, 115	110 (53)	106, 114	118.5 (60.3)	109, 125	0.194
HDL-C	43 (14)	42, 45	43 (13)	42, 45	48 (18.25)	41, 50	0.094
Triglycerides	138 (64)	133, 142	139 (62.25)	135, 145	128 (88.25)	112, 139	0.516

All lipid parameters were measured as mg/dl
BMI: Body mass index; WC: Waist circumference; SBP: Systolic blood pressure measured in mmHg; DBP: Diastolic blood pressure measured in mmHg; LDL-C: Low-density lipoprotein cholesterol; HDL-C: High-density lipoprotein cholesterol; IQR: Inter-quartile range, CI: Confidence interval of the median. a : Mann-Whitney Test

Table (2) showed that the anthropometric, blood pressure, and lipid profile measurements of the studied workers. No significant difference was found between the blue- and white-collar workers regarding the above-mentioned measurements.

Table 3: Lipid profile abnormalities, anthropometric indicators, and hypertension among the studied workers, stratified by occupational class.

Measurements	All workers (No = 640)		Occupational class			
			Blue Collar (No =536)	White Collar^ (No = 114)		
	No. (%)	95% CI	No. (%)	No. (%)	OR# (95%CI)	p value
Obesity (BMI ≥30kg/m²)						
NO	349 (54.5)	50.5, 58.6	286 (54.4)	63 (55.3)	1.03 (0.6,1.5)	0.863
Yes	291 (45.5)	41.4, 49.5	240 (45.6)	51 (44.7)		
Increased WC (≥94 cm)						
NO	253 (39.5)	35.5, 43.6	213 (40.5)	40 (35.1)	0.8 (0.5, 1.2)	0.285
Yes	387 (60.5)	56.4, 64.5	313 (59.5)	74 (64.9)		
Hypertension&						
NO	574 (89.7)	87.1, 92.0	476 (90.5)	98 (86.0)	0.6 (0.3, 1.1)	0.152
Yes	66 (10.3)	8.0, 12.9	50 (9.5)	16 (14.0)		
Total cholesterol (mg/dl)						
< 200	422 (65.9)	62.4, 69.4	349 (66.3)	73 (64.0)	0.9 (0.5, 1.3)	0.636
≥ 200	218 (34.1)	30.6, 37.6	177 (33.7)	41 (36.0)		
LDL-C (mg/dl)						
< 100	250 (39.1)	35.5, 42.9	209 (39.7)	41 (36.0)	0.8 (0.5, 1.2)	0.455
≥ 100	390 (60.9)	57.1, 64.5	317 (60.3)	73 (64.0)		
HDL-C (mg/dl)						
< 60	570 (89.1)	86.7, 91.4	475 (90.3)	95 (83.3)	1.8 (1.05,3.2)	**0.033***
≥ 60	70 (10.9)	8.6, 13.3	51 (9.7)	19 (16.7)		
Triglycerides (mg/dl)						
< 150	386 (60.3)	56.6, 64.3	315 (59.9)	71 (62.3)	1.1 (0.7, 1.6)	0.636
≥ 150	254 (39.7)	35.7, 43.4	211 (40.1)	43 (37.7)		

BMI: Body mass index; WC: Waist circumference; HDL-C: High density lipoprotein cholesterol; LDL-C: Low density lipoprotein cholesterol; CI: Confidence Interval of the percent; OR: Odds Ratio. & : measured blood pressure ≥140/90 mmHg. #: Univariate logistic regression analysis was done to compute the odds of lipid profile abnormalities (level of total cholesterol ≥200 mg/dl, LDL-C ≥100 mg/dl, HDL-C <60 mg/dl, or triglycerides ≥150 mg/dl) as a dependent variable associated with the occupational class (independent variable). ^: Reference category. *: Statistically significant (p value ≤ 0.05).

Table (3) showed a significantly higher percentage of blue-collar workers had suboptimal levels of HDL-C (90.3%) compared with white-collar workers (83.3%); a worker with a suboptimal level of HDL-C was 1.8 times more likely to be a blue-collar worker than a worker with an optimal HDL-C level (95%CI= 1.05,3.2) .

Table 4: Lipid profile abnormalities, anthropometric indicators, and hypertension among the studied workers (No = 640), stratified by work schedule.

Measurements	Work schedule			
	Daytime^ (No = 171)	Shift work (No = 469)		
	No. (%)	No. (%)	OR# (95% CI)	p value
Obesity (BMI ≥30kg/m²)				
NO	96 (56.1)	253 (53.9)	1.1 (0.7, 1.5)	0.622
Yes	75 (43.9)	216 (46.1)		
Increased WC (≥94 cm)				
NO	65 (38.0)	188 (40.1)	0.9 (0.6, 1.3)	0.635
Yes	106 (62.0)	281 (59.9)		
Hypertension&				
NO	144 (84.2)	430 (91.7)	0.4 (0.2, 0.8)	**0.007***
Yes	27 (15.8)	39 (8.3)		
Total cholesterol (mg/dl)				
< 200	115 (67.3)	307 (65.5)	1.1 (0.7, 1.5)	0.672
≥ 200	56 (32.7)	162 (34.5)		
LDL-C (mg/dl)				
< 100	75 (43.9)	175 (37.3)	1.3 (0.9, 1.8)	0.134
≥ 100	96 (56.1)	294 (62.7)		
HDL-C (mg/dl)				
< 60	141 (82.5)	429 (91.5)	2.2 (1.4, 3.8)	**0.002***
≥ 60	30 (17.5)	40 (8.5)		
Triglycerides (mg/dl)				
< 150	115 (67.3)	271 (57.8)	1.5 (1.03,2.1)	**0.031***
≥ 150	56 (32.7)	198 (42.2)		

BMI: Body mass index; WC: Waist Circumference; HDL-C: High density lipoprotein cholesterol; LDL-C: Low density lipoprotein cholesterol; CI: Confidence Interval of the percent; OR: odds ratio. &: measured blood pressure ≥140/90 mmHg. #: Univariate logistic regression analysis was done to compute the odds of lipid profile abnormalities (level of total cholesterol ≥200 mg/dl, LDL-C ≥100 mg/dl, HDL-C <60 mg/dl, or triglycerides ≥150 mg/dl) as a dependent variable associated with the occupational class (independent variable). ^: Reference category. *: Statistically significant (p value ≤ 0.05). Optimal HDL-C level (95% CI = 1.05, 3.2)

Table (4) demonstrated that a worker with a triglyceride level equal to or greater than 150 mg/dl was 1.5 times more likely to be a shift worker than a worker with an optimal level of triglycerides, and the odds of having a suboptimal level of HDL-C were 2.2 times higher in shift workers compared with daytime workers. Shift workers were less likely to be hypertensive than daytime workers.

Table 5: Multivariate logistic regression of health risk indicators (HRIs) associated with abnormalities in lipid profile among the studied workers (No =640).

Triglycerides (≥ 150 mg/dL)				
Indicators	**Coefficient**	**Adjusted OR†**	**95% CI**	**p value**
Age (≥ 40 years)	-0.203	0.817	0.55, 1.19	0.296
Smoking	-0.121	0.886	0.63, 1.23	0.472
Physical inactivity	0.217	1.243	0.64, 2.38	0.514
Physically demanding job	-0.096	0.908	0.56, 1.45	0.690
Shift work	0.471	1.601	1.05, 2.42	**0.025***
Hypertension (BP≥140/90 mmHg)	0.611	1.842	1.06, 3.17	**0.028***
Obesity (BMI ≥ 30 kg/m^2)	0.339	1.403	0.93, 2.09	0.098
Increased WC (≥ 94 cm)	-0.053	0.948	0.62, 1.43	0.800
HDL-C (< 60 mg/dL)				
Indicators	**Coefficient**	**Adjusted OR†**	**95% CI**	**p value**
Age (≥ 40 years)	-0.210	0.810	0.45, 1.43	0.471
Smoking	-0.277	0.758	0.44, 1.28	0.304
Physical inactivity	-1.250	0.287	0.06, 1.23	0.094
Physically demanding job	0.361	1.435	0.73, 2.81	0.293
Shift work	0.697	2.008	1.11, 3.60	**0.019***
Hypertension (BP≥140/90 mmHg)	-0.387	0.679	0.30, 1.49	0.338
Obesity (BMI ≥ 30 kg/m2)	0.645	1.906	1.002, 3.62	**0.049***
Increased WC (≥ 94 cm)	0.009	1.009	0.54, 1.87	0.978
LDL-C (≥ 100 mg/dL)				
Indicators	**Coefficient**	**Adjusted OR†**	**95% CI**	**p value**
Age (≥ 40 years)	0.270	1.310	0.89, 1.92	0.166
Smoking	-0.064	0.938	0.67, 1.30	0.706
Physically demanding job	-0.333	0.717	0.44, 1.15	0.168
Shift work	0.449	1.567	1.05, 2.33	**0.027***
Hypertension (BP≥140/90 mmHg)	0.497	1.643	0.90, 2.97	0.101
Obesity (BMI ≥ 30 kg/m^2)	0.363	1.438	0.96, 2.14	0.076
Increased WC (≥ 94 cm)	-0.181	0.834	0.55, 1.25	0.381
Total cholesterol (≥ 200 mg/dL)				
Indicators	**Coefficient**	**Adjusted OR†**	**95% CI**	**p value**
Hypertension (BP ≥140/90 mmHg)	0.560	1.750	1.03, 2.95	**0.036***
Obesity (BMI ≥ 30 kg/m^2)	0.372	1.450	0.95, 2.19	0.078
Increased WC (≥ 94 cm)	-0.215	0.806	0.52, 1.23	0.318

HDL-C: high density lipoprotein cholesterol; LDL-C: low density lipoprotein cholesterol; BMI: body mass index; W0C: waist circumference; Bp: blood pressure; OR: odds ratio; CI: confidence interval. †: OR adjusted for the independent variables in the above table (all independent variables are dichotomous variables). * : Statistically significant p value ≤ 0.05

Table (5) demonstrated the HRIs associated with lipid profile abnormalities. According to the multivariate logistic regression, shift work was independently associated with abnormalities in the serum lipid profile. A worker with a triglyceride level equal to or higher than ≥150 mg/dl or a LDL-C level equal to or higher than 100 mg/dl was 1.6 times more likely to have been a shift worker than a worker with optimal levels of triglycerides or LDL-C. A worker with a suboptimal level of HDL-C was twice more likely to have been a shift worker than a worker with an optimal HDL-C level.

Compared with normotensive workers, the odds of having a triglyceride level equal to or greater than 150 mg/dl or a cholesterol level equal to or greater than 200 mg/dl were 1.8 and 1.7 times higher in hypertensive workers. A worker with a suboptimal HDL-C level was two times more likely to be obese than a worker with an optimal HDL-C level.

Discussion

According to the WHO, a considerably high prevalence of risk factors for chronic non communicable diseases (NCDs) was reported among Egyptian population (WHO, 2018b). Worksite identification of population at-risk helps plan interventions that target the working group identified with the highest health risk indicators (Aginsky et al., 2017). The present study measured the frequency and examined a possible association between abnormalities in the serum lipid profile, health risks indicators (HRIs), and occupational class among Egyptian workers.

In the current study, poor health perception was associated with white-collar jobs (Table 1). In the contrary to the study done by Burr et al., 2013 on general health status by occupation and age in the labor force in Germany who found that white-collar workers had a lower risk of perceived poor health, while service and unskilled manual workers had the highest risk. The way people perceive their health might be influenced by lifestyle behavior, health conditions, and other environmental and social factors.

About 55% of the studied workers were current smokers and significantly higher prevalence of smoking was reported among blue-collar workers compared with white-collar ones (Table 1). This figure was much higher than the WHO, 2018b which reported that smoking prevalence among Egyptian adult population was (24%). It has been reported by Chin et al., 2012, that blue-collar workers smoke at higher rates than white-collar workers and general populations. The same results was obtained by Ghahramani et al., 2020 in their study on the association between occupational categories and incidence of cardiovascular events in Iran .

The disparities in the prevalence of smoking by occupations were suggested to be due to occupational factors as exposure to chemicals and dust, and stressful working conditions (Radi et al., 2007).

In line with the WHO report stating that three quarters of Egypt's population is not involved in vigorous activity (WHO, 2018b), physical inactivity was the lifestyle indicator among the studied workers; with the highest overall prevalence among 93% of workers; it was more prevalent among blue-collar workers compared with white-collar ones (Table 1). Similarly, Gilson et al., 2019 reported high levels of sedentary

time and insufficient physical activity as health issues among blue-collar workers. Kirk and Rhodes, 2011; found that white-collar workers had a higher amount of leisure time physical activity compared with blue-collar workers. This has been described as a "compensation effect", which indicates that white-collar workers try to counteract the long setting time at work.

The frequency of obesity among the studied workers was (45.5%) (Table 3) which was considered higher than the obesity prevalence among Egyptian adult male population (29.5%) as reported in the 2019 National Survey (Aboulghate et al., 2021). On the contrary, the frequency of hypertension (10.3%) (Table 3) was slightly lower than the prevalence of hypertension in Egypt as reported by a recent review (ranging from 12.1% to 59%) (Reda et al., 2021).

The present study revealed no association between the occupational class and hypertension or anthropometric indicators (Tables 2 and 3). Inconsistent findings in other studies might be due to variation in studies' methodology (self-reported vs. measured indices, variation in the cutoff points, and sample size). Also, in some studies, univariate analysis (without adjusting for potential confounders) was done to indicate a possible association (Schumann et al., 2011; Aginsky et al., 2017; Prihartono et al., 2018; Ghahramani et al., 2020).

The frequency of lipid profile abnormalities among the studied workers (Table 3) was similar to the results reported by Reda et al., 2021 in their review about Egyptian general population. Studies conducted on workers had various definitions and cutoff points for dyslipidemia, which would justify the wide-ranging findings (Jankowska et al., 2020 from Poland).

According to the univariate and multivariate regression analyses, occupational class was not found to be independently associated with abnormalities in lipid profile among the studied group, but, shift work was found to be an independent predictor of lipid profile abnormalities (Tables 3-5). Similarly, shift work was associated with dyslipidemia in several studies and meta-analysis (Fossum et al., 2013; Rashnoudi et al., 2022). It has been pointed out that shift workers are at high risk of physical pressures that disrupt the circadian rhythm. Long-term disruption of the circadian rhythm affects nutritional habits and lipid and

carbohydrate metabolism (James et al., 2017). In addition, shift work was found to cause unhealthy changes in lifestyle; it increases the rate of using unhealthy foods and drinks (Peplonska et al., 2017).

Hypertension and obesity were independently associated with abnormalities in the lipid profile among the studied group (Table 5). These findings are in total agreement with several studies that found dyslipidemia to be strongly associated with hypertension. It was hypothesized that both (dyslipidemia and hypertension) are involved in common pathophysiological mechanisms (Otsuka et al., 2016). As for obesity, decreased HDL-C level with dysfunction has been described in the typical dyslipidemia of obesity resulting from obesity-induced pathophysiological changes in lipoprotein metabolism. Furthermore, low levels of HDL are among the characteristics of atherogenic dyslipidemia, which is strongly associated with obesity (Klop et al., 2013).

Limitations of the study

The review of records might have resulted in under-coverage bias since women workers were not included. Furthermore, only healthy workers who tolerated work well continued working (were in active employment); thus, had records at the OMU and were included in the study. Moreover, it would have been beneficial to assess dietary habits and blood sugar levels as important indicators for chronic diseases; however, such information was not reported in the records.

Conclusion and Recommendations

Physical inactivity increased waist circumference (WC), obesity, and smoking were prevalent health risk indicators among workers (93%, 60.5%, 45.5%, and 55.1%, respectively), with physical inactivity and smoking associated with blue-collar jobs and perception of poor health associated with white-collar jobs. The occupational class was found to have no relation with abnormalities in lipid profile, hypertension, or anthropometric indicators for chronic NCDs (non-communicable diseases). It is recommended that worksite intervention planning targets obese, hypertensive, and shift workers. Targeting blue-collar workers for smoking cessation and exercise programs is also advised.

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Conflict of interests

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