Research Article

Relationship between Rotating Night Shift and Lipid Profile in Minia mills, Egypt.

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Abstract
Background: The advent of the 24 hour society has resulted in a need for greater flexibility in working time patterns and, in many cases, an increase in night working. In the twentieth century, night working was associated with manufacturing in larger plants where three eight hour shifts tended to be a typical pattern with full time employees alternating between early, middle and late shifts. hift work exerts major influences on the physiological functions of the human body. Several studies have suggested that rotating night shift work is associated with an increased risk of obesity and metabolic syndrome. This study investigated the relationship between shift work and lipid profile. **Aim of the study:** to identify whether rotating shift workers are more prone to dyslipidemia than day shift workers in Minia mills. **Subjects and methods:** This is a descriptive cross-sectional study which carried out in Minia mills, Egypt, during the period from September 2018 to March 2019. This study was conducted among 107 workers who were agreed to be interviewed and participate in this study. Data were collected by a questionnaire included demographic data, anthropometric measurements and laboratory tests were performed. **Results**: This study found higher levels of all components of lipid profile (Total cholesterol, HDL and LDL) among shift workers compared to day workers but without statistical significance. Regarding LDL ≥130 mg/dl, percentage of rotating shift workers with LDL ≥130 mg/dl was significantly higher than percentage of daytime workers (34.5% compared to 15.4%), and the percentage of persons had TG ≥ 150mg/dl was significantly higher among shift workers, where 90.9% of them had TG ≥ 150mg/dl compared to 62.3% of day time workers (p=0.001). **Conclusion:** Shift work was associated with lipid profile disorders in Minia mills. **Recommendation:** Health system programs especially designed for shift-workers, including diet and exercise, must be stressed and regularly assessed.
Key words: Metabolic Syndrome; Prevalence; shift work

Introduction
Twenty-four hour services are a growing part of modern society. Essential services are provided without interruption, and several industries and business establishments operate on a 24 h basis so as to meet the constantly changing demands of the modern world (Moreno et al., 2003). As a result, companies and hospitals require employees to work continuously, creating a need for shift- and night-work schedules. Shift schedules allow companies to operate on a continuous basis by ensuring that positions are always filled by rotating employees.

The growing importance of shift and night work in meeting the demands of modern society creates an urgent need for research into the effects of such schedules on worker health. Recent findings suggest that such schedules may affect glucose tolerance and induce obesity and systemic arterial hypertension (Karlsson et al., 2001; Morikawa et al., 2005; Froy, 2007; Bacquer et al., 2009).

Human natural body rhythms are called circadian rhythms which are regulated by a “circadian clock”; located in the hypothalamus. This biological clock is synchronized by receiving the photic information from light-sensitive ganglion cells in the retina, thereby entraining individuals’ physiology and behavior to the external day–night cycle (Szosland, 2010; Golombek, 2010). Nearly all of the biological processes including the sleep-wake cycles, body temperature, energymetabolism, cell cycle and hormone secretion have a circadian rhythm and are controlled by this circadian clock (Kohyama, 2009; Golombek, 2010).

Shift work is recognized as a risk factor of many health outcomes by interrupting human circadian rhythm (Bjorvatn et al., 2009; Hublin et al., 2010). Circadian rhythm can have effect on sleeping and feeding patterns, and also in patterns of core body temperature, brain wave activity, hormone production and other biological activities (Gumenyuk et al., 2012). Recently, accumulating evidences have shown that shift work is related with cardiovascular diseases (Hublin et al., 2010; Vyas et al., 2012) and type 2 diabetes (Pan et al., 2011; Ioja et al., 2012) even in retired populations (Guo et al., 2013).

As there is a scarcity of research in Egypt about the lipid profile among workers working rotating shifts, the results of the present study may provide some clues about factors associated with abnormal lipid profiles among workers.

Aim of the study

to study the relationship between rotatory night shift and lipid profile in this mill.

Research design and methods:

Study design: This is a descriptive cross-sectional study which carried out in Minia mills during the period from September 2018 to March 2019.

Administrative and ethical consideration: The study was approved by the ethical committee of the Faculty of Medicine, Minia University. Prior to data collection, informed consent was obtained from all participants after supplying comprehensive information about the nature of the study and the procedural details of the blood investigations. An approval was taken from the mills administration to interview and examine the workers.

Study population and sample size:
All workers of Minia mills who aged 18-60 years old.

Daytime workers and shift workers:
Daytime workers were defined as those individuals who worked from 9am to 2pm only, while the rest - those who worked 3 shifts of 8 hours, from 7am to 3pm, from 3pm to 11pm and from 11pm to 7am- were considered shift workers.

Collection of data:
Data were collected by a structured interview questionnaire, included demographic data, working conditions, occupational history and health related behaviors.

Anthropometric measurements
Body weight (in kilograms): was measured by a standardized balanced scale with the participant stand on the center without touching anything else, bare feeted and in light clothing. Reading recorded to the nearest kg, adjust the scale to zero after each weighting.
Height (in centimeters): was measured by a standardized measuring tape, during the procedure the participants were bare feeted and were instructed to be fixed tightly to the wall at shoulders, back of knees and heels, the external auditory meatus and the lower border of the orbit in the plane parallel to the floor.
BMI was calculated by the use of the following equation:
BMI = weight (kg) / height (m^2) **(Bray, 1993)**.

- Waist circumference (in centimeters): was measured by using non stretchable measuring tape at the midway between the 12^{th} rib and the iliac crest, the person stands with abdomen relaxed, arms at sides, and feet together (**Han et al., 1995**).

Central obesity was diagnosed for waist circumference ≥ 94cm for men and ≥ 80cm for women according to the IDF recommendations for Mediterranean (IDF, 2006).

- Waist to hip ratio (WHR) (in centimeters): was measured by using non stretchable measuring tape to measure waist circumference and measure the distance around the largest part of hips (hip circumference) then calculated by dividing waist circumference by hip circumference (WHO, 2008).

Diabetes Screening Protocol

- Fasting finger prick blood glucose level was determined for workers, however, those who were not fasting on the test day were motivated to report in fasting state on the next day (fasting was defined as a minimum of 8 hours between the subject's last consumption of any calorie-containing food or drink and the time of the fasting plasma glucose (FPG) test. Participants with FPG levels ≥110 mg/dl were considered as abnormal (ADA,2013). Next post-prandial blood glucose (PPG) level after two hours was measured by using Rightest ™ GM100 Glucose Test strips and Rightest ™ Blood Glucose Meter GM100 supplied by BIONIME Co., Taiwan.

- Diabetes was considered if FPG value was >126 mg/dL and/or 2-hour PPG value was >200 mg/dL and/or the participant was a known diabetic. Pre-diabetes condition was diagnosed if FPG was 110-125 mg/dL and 2-hour PPG was >140 mg/dL in a person who was not a known diabetic (ADA, 2013).

Lipid profile Screening Protocol

A serum lipid profile, including total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol and triglyceride (TG), was ordered for subjects after fasting for 12 hours, and the laboratory results were assessed.

- **According to ATP III (2003), normal ranges of lipid profile are:**

Lipid Guidelines 2018: Updates from ACC/ AHA Guidelines 2013

- **Total cholesterol: <200**
- **LDL cholesterol: <100**
- **HDL cholesterol: >40**
- **Triglycerides: <150**

All the laboratory tests were taken by laboratory technician and were done in Minia University Hospital lab.

Statistical analysis

The Statistical Program SPSS for Windows version 19 was used for data entry and analysis. Graphics were done by Excel Microsoft office 2013.Quantitative data were presented by mean and standard deviation, while qualitative data were presented by frequency distribution. Chi Square test was used to compare between two or more proportions. Student t-test was used to compare two means.

Results

Table 1: General characteristics of the studied workers in Minia mills, Egypt, during the period from September 2018 to March 2019.

General characteristics	**N=107**
Age: Mean ± SD	24 - 60 (46.8±11.01)
Residence	
• Urban	60 (56.1%)
• Rural	47 (43.9%)
Marital status	
• Married	100(93.5%)
• Widow	7 (6.5%)
Total duration of occupation (years)	23.3 ± 13.1
Total duration of rotating shifts (years)	14.2 ± 10.8

N.B. Quantitative data were expressed as range (mean±SD) and qualitative data were expressed as No (%).

This study included 107 workers; whose ages ranged from 24 to 60 years with mean ± SD (46.8±11.01) years (table1). The majority (93.5%) of the participants were married, and 56.1% were urban inhabitants. The mean duration of occupation was 23.3 ± 13.1, while mean duration of night shifts throughout their job experience was 14.2 ± 10.8. In this study, 51% of studied workers were shift workers and 49% were daytime workers.

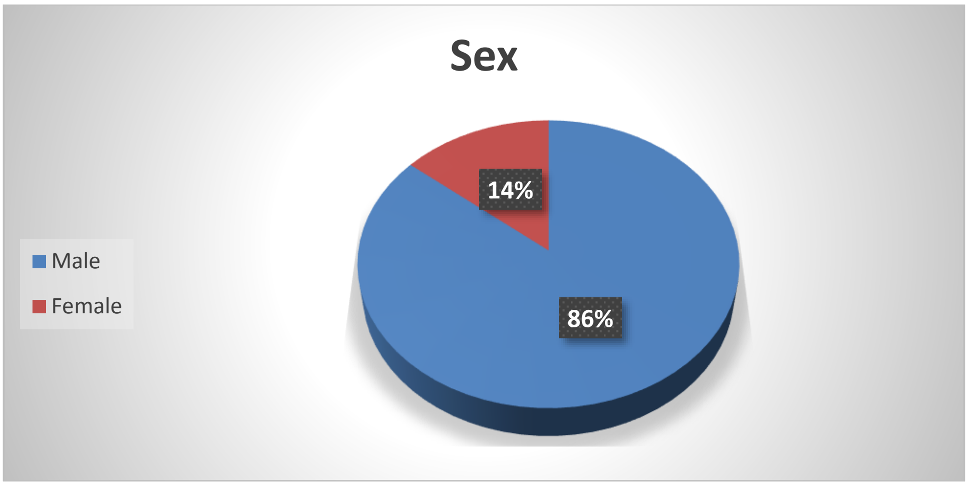

Figure 1 Gender distribution among the studied workers in Minia mills, Egypt, during the period from September 2018 to March 2019.

In this study, 86% of the studied workers were males and 14% were females.

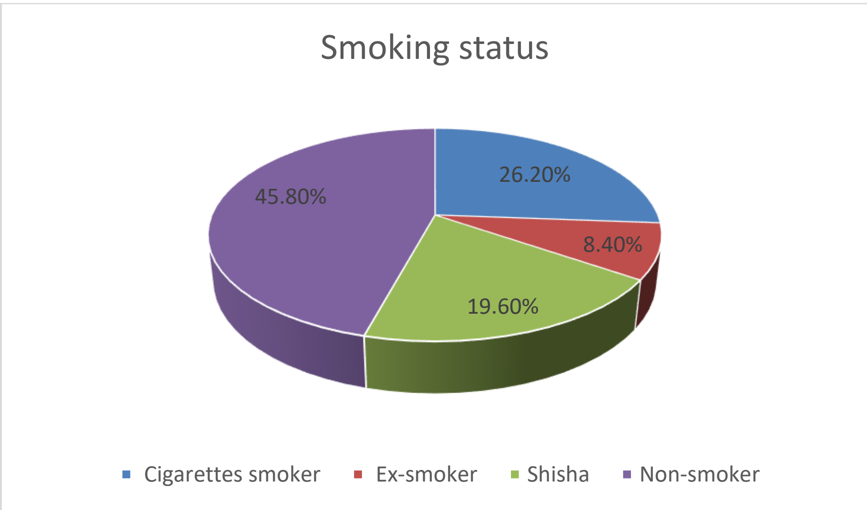

Figure 2 Smoking status of the studied workers in Minia mills, Egypt, during the period from September 2018 to March 2019.

As regard smoking status, 26.2% were cigarettes smoker and 19.6% were shisha smoker.

Table 2: Smoking status in the studied workers according to work schedules in Minia mills, Egypt, during the period from September 2018 to March 2019.

	Rotating shifts n=55	**Day time work n=52**	**P**
Smoking status			**<0.0001**
• Smoker	36(65.4%)	13(25%)	
• Ex-smoker	1(1.8%)	8(15.4%)	
• Non-smoker	18(32.7%)	31(59.6%)	
Smoking index of cigarette	٧٤٠,٧ ± 801.3	576.2±324.9	0.5
Duration of smoking (years)	٢٣,٤±13.8	20±8.5	0.6

There was significant difference between the shift workers and daytime workers regarding smoking status, (34.5% and 17.3%) cigarette smoker in both groups respectively. Regarding Shisha smoking there was significant difference between the shift workers and daytime workers as the prevalence of Shisha smoking was higher in nightshift workers than in daytime workers (30.9% and 7.7%) respectively (table 2).

Table 3: Physical activity of the studied workers according to work schedules in Minia mills, Egypt, during the period from September 2018 to March 2019.

	Rotating shifts n=55	**Day time work n=52**	**P**
Physical activity			**0.004**
• ≥0.5 hour /day	43(78.2%)	27(51.9%)	
• <0.5 hour /day	12(21.8%)	25(48.1%)	

It was shown that 78.2% of night shift workers are physically active while 51.9% of day time workers are physically active which was statistically significant (table3).

Table 4: Anthropometric measurements in the studied workers according to work schedules in Minia mills, Egypt, during the period from September 2018 to March 2019.

	Rotating shifts n=55	**Day time work n=52**	**P**	**t**
Waist circumference (cm)	102.4±9.9	100.9±9.4	0.4	0.7
Hip circumference (cm)	103.6±8.5	113.8±14.1	**<0.001**	4.6
W / H Ratio	0.99±0.06	0.89±0.06	**<0.0001**	6.9
BMI			0.9	**X^2**
• **≥25**	47(85.5%)	44(84.6%)		0.01
• **<25**	8(14.5%)	8(15.4%)		

In table 4, the mean of W/H ratio was significantly higher among shift workers compared to day workers (0.99±0.06 compared to 0.89 ±0.06) with p<0.0001. Also, the mean of waist circumference was significantly higher among shift workers compared to day workers (102.4±9.9 and 100.9±9.4) but without statistical significance. The percentage of persons had BMI ≥25 was higher among night shift workers than among daytime workers (85.5% compared to 84.6%) but without statistical significance.

Table 5: Laboratory measurements in the studied workers according to work schedules in Minia mills, Egypt, during the period from September 2018 to March 2019.

Characteristics	**Rotating shifts n=55**	**Day time work n=52**	**P**
Post-prandial blood sugar			0.3
• ≥140 mg/dl	38(69.1%)	31(59.6%)	
• <140 mg/dl	17(30.9%)	21(40.4%)	
LDL			**0.02**
• ≥130mg/dl	19(34.5%)	8(15.4%)	
• <130mg/dl	36(65.5%)	44(84.6%)	
TG			**0.001**
• ≥150mg/dl	50(90.9%)	33(62.3%)	
• <150mg/dl	5(9.1%)	20(37.7%)	
CHL	١٩٠,٢±44.6	191.3±64	٠,٩
HDL	٣٨,٣±٦,١	40.3±9.04	0.2

As regard laboratory measurements, table 5 shows higher levels of all components of lipid profile (Total cholesterol, HDL and LDL) among shift workers compared to day workers but without statistical significance. Regarding LDL ≥130 mg/dl, percentage of rotating shift workers with LDL ≥130 mg/dl was significantly higher than percentage of daytime workers (34.5% compared to 15.4%). The percentage of persons had TG ≥ 150mg/dl was significantly higher among shift workers, where 90.9% of them had TG ≥ 150mg/dl compared to 62.3% of day time workers (p=0.001).

Regarding post-prandial blood sugar ≥140 mg/dl, percentage of rotating shift workers with post-prandial blood sugar ≥140 mg/dl was higher than percentage of daytime workers (69.1% compared to 59.6%).

Discussion

As a result of the rapidly evolving 24-h society, about 15–30% of the workforce works outside normal business hours, with about half of them working rotating shifts (Puttonen, 2010).

Comparison of the TG levels among the shift workers and daytime workers revealed significant higher percentage of workers with TG ≥150 mg/dl in shift workers 90.9% compared with 62.3% of day-time ones, (table 6). Such results were similar to that of Karlsson et al., 2003 who investigate the relationship between metabolic risk factors for coronary heart disease (CHD) and type 2 diabetes in shift workers and day workers and found that high levels of triglycerides were significantly associated with shift work (OR: 1.40, 95% CI: 1.08–1.83). These results were consistent with the finding of Biggi et al., 2008 who examined the relationship between permanent night work and metabolic and cardiovascular risk factors in a retrospective longitudinal study of workers employed in a large municipal enterprise in charge of street cleaning and domestic waste collection and found that night workers smoked more and had significantly higher triglycerides than day workers.

Regarding LDL ≥130 mg/dl, percentage of shift workers with LDL ≥130 mg/dl was significantly higher than percentage of daytime workers (34.5% compared to 15.4%) it is shown in table 14. These results are similar to that of Gadallah et al., 2017 who found that the proportion of shift nurses with abnormal LDL (≥130 mg/dl) was significantly higher than the corresponding proportion among day shift nurses (43% compared to 26.6%).

In the present study, there was no significant difference in HDL levels between shift workers and daytime workers (table 14). These results come in accordance with the findings of a cross-sectional study on 319 Italian workers which examine the influence of shift work on metabolic and cardiovascular risk factors in subjects working in an industry sited in Apulia, Southern Italy, showed no significant difference in HDL between day and shift workers (Hameed Akbari, 2015). These results are similar to that of ALY et al., 2018 who found that HDL didn’t differ significantly between the 2 groups.

In this study, there was no significant difference in total cholesterol levels between shift workers and daytime workers (table 14). These results come in accordance with the findings of Costa et al., 2016 who analyze glycemic levels, total cholesterol, HDL-C, LDL-C, triglycerides and the anthropometric alterations that precede diabetes, considering their possible association with nigh work among a non-diabetic population in Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) comprises of 15,105 civil servants and found that no significant associations between night work and HDL-C and total cholesterol levels. These results are similar to that of Hameed Akbari, 2015 who evaluate the effect of shift work on cholesterol and triglyceride (TG) levels through a historical cohort on steel industry workers. This retrospective cohort study was performed on all the staff of Isfahan’s Mobarakeh Steel Company between years 2002 and 2011. There were 5773 participants in this study. Data were collected from the medical records of the staff using the census method and found that there was no relationship between shift work and changes in serum TG and cholesterol.

Comparison of the waist to hip ratio levels among the studied categories revealed significant higher levels in shift workers (0.99±0.06), than the day-time ones (0.89±0.06), (table 4). Such results were similar to that of Sookoian et al., (2007) who examined the effects of rotating shift work on biomarkers of metabolic syndrome and inflammation and found that rotating shift workers had elevated waist-hip ratio (0.95 ± 0.01 vs. 0.93 ± 0.01) in daytime workers. These results were consistent with the findings of Ghanbaryet al., 2016 who investigated the relationship between shift work, and body mass index and waist-hip ratio among military personnel in 2016 and found that mean body weight, waist circumference, hip circumference, BMI, and WHR were higher in shift workers than day workers. The findings showed that 80.3% of shift workers had a WHR of higher than 0.90. Another cross-sectional study was conducted among 724 female nurses and midwives, aged 40-60 years (354 rotating night shift and 370 daytime workers) in Poland, revealed both current and cumulative night work was associated with higher WHR (Peplonska et al., 2015).

The current study showed that there were no significant differences in BMI and waist circumference between shift workers and daytime workers (table 4). Consistent results from previous studies that were summarized in a review article by (Bøggild and Knutsson, 1999), who showed no significant difference in BMI among shift and daytime workers. Ghiasvand et al., (2006) evaluated the association between shift work and biochemical variables and blood pressure, in a total of 424 Iranian rail road workers. This study found that no differences were seen in obesity prevalence among shift workers (Ghiasvand et al., 2006).

Regarding to physical activity, in the present study, there were 78.2% and 51.9% of shift workers and daytime workers respectively, physically active (table 12), this can be explained by the shift workers are manual workers while the daytime workers are clerk. These results come in accordance with the findings of Gadallah et al., 2017 who evaluated the relationship between rotatory shift and lipid profile and studied factors associated with dyslipidemia among nurses in an Egyptian tertiary university hospital (Ain Shams University hospital) and found that 31.4% of shift nurses and 26.6% of day shift nurses reported moderate intensity exercise. Additionally, a study by Cathy et al., (2017) reported similar results that the shift workers more physically active than daytime workers in UK Biobank study with 277,168 employed participants.

In the current study, the percentage of smokers was higher in shift workers than in daytime workers (65.4% compared to 25%) (table 2).These results are similar to that of Buchvold et al., 2015 who found that smoking was more prevalent in shift Norwegian nurses. Another study concluded that cigarette smoking also appears to disrupt lipid and lipoprotein metabolism, leading to elevated plasma Cholesterol, Triglycerides and LDL-cholesterol, and lower HDL-cholesterol levels as compared to non-smokers (He B.M, 2013).

Conclusion and recommendation

Our study revealed that rotating shift work especially night shifts has negative effects on health as it contributes in developing of metabolic syndrome. So prevention programs should be implemented for high risk persons. Occupational health practitioners should be aware of this association and be able to advice to minimize hazards of rotating shifts.

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