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Research Article

Night Shifts as a Predictor of Arterial Hypertension and Abdominal Obesity

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Abstract

In recent years, there has been a growing interest in research related to sleep disorders and sleep quality. This is because insufficient sleep is associated with many acute and chronic metabolic diseases and cardiovascular events that leads to increased mortality. Early diagnosis of sleep disorders is essential to prevent adverse health effects. Lifestyle changes are the first and main stage in the prevention and treatment of various cardiometabolic diseases.

Aim and Objective: To study the effect of night shifts on the formation of arterial hypertension and abdominal obesity.

Material and Methods: The study involved 32 men who worked in two medical institutions in Rostov-on-Don. All participants were divided into 2 groups based on the work schedule. The first included persons with a night schedule (n = 16), the second - with a day schedule (n = 16).

Results: When comparing the incidence of hypertension between the two groups, it was found that hypertension prevails among people with a night work schedule (34.4% versus 27.4% among participants who worked on a daytime schedule, $p < 0.01$). Abdominal obesity was much more often detected with a night-time nature of work than with a standard work schedule (42.3% versus 19.3%, $p < 0.001$). The risk of developing hypertension in persons working on night shifts was significantly higher than that in persons who had a daytime work schedule: OR = 4.3 (95% CI: 0.3-5.8). The risk of developing abdominal obesity in night shift workers was OR = 1.35 (95% CI: 0.9-2.0). Conclusion: Night shifts can be considered one of the risk factors for the development of hypertension and abdominal obesity in men. In our study, men with night work hours were more likely to suffer from hypertension and abdominal obesity than those who worked during the day.

Context: This article presents the results of our pilot study, the main task of which was to identify the relationship between working night shifts and the formation of cardiometabolic complications such as arterial hypertension and abdominal obesity.

Aims: to study the effect of night shifts on the formation of arterial hypertension and abdominal obesity.

Settings and Design: Our study is a pilot, open and observational. The study consisted of four stages. The first stage is the definition of the topic, goals and objectives. The second stage is the analysis of the literature on this topic using international databases. The third stage is a questionnaire and a physical examination. The fourth step is analyzing the data and formulating conclusions.

The study involved 32 men who worked in two medical institutions in Rostov-on-Don. The study was conducted from September 2019 to July 2020. Inclusion criteria: male gender and work experience of at least 6 years with a night or day work schedule.

Exclusion criteria: use of diuretics, glucocorticosteroids, β-blockers for more than one month before the study; a history of heart attacks, strokes, oncological diseases, chronic kidney disease (CKD) with impaired nitrogen excretion function; chronic heart failure, clinically significant hypercortisolism, hypothyroidism, symptomatic arterial hypertension.

All participants were divided into 2 groups based on the work schedule. The first included persons with a night schedule (n = 16) and the second, individuals working a day schedule (n=16). The participants were interviewed using a developed questionnaire to collect anamnesis. Determination of the blood pressure was carried out according to the recommendations of the Russian Society of Cardiology (2019). Abdominal obesity was diagnosed with a waist circumference of more than 94 cm in men. Arterial hypertension was considered verified at a blood pressure of more than 140/90 mm Hg, calculated as the average of the last two measurements (with three consecutive measurements at intervals of 1-2 minutes) or in the presence of constant antihypertensive therapy. Abdominal obesity was diagnosed when the waist circumference in men was more than 94 cm. The waist circumference was measured in a standing position. The measurement point was the midpoint of the distance between the apex of the iliac crest and the lower lateral edge of the ribs during the horizontal course of the centimeter tape. Patients were weighed on a standardized, calibrated electronic balance with an empty bladder. At the time of weighing, the patients were not wearing heavy shoes and clothes.

The study was conducted in accordance with the principles of the Helsinki Declaration, (October 2013). The study protocol was approved at a meeting of the Local Independent Ethics Committee of the Federal State Budgetary Educational Institution of Higher Education "Rostov State Medical University" of the Ministry of Health of Russia on September 19, 2019, No. 14/19. Informed consent was obtained from the subjects (patients).

Statistical Analysis Used: Statistical processing of the results at each stage was carried out with the calculation of the number of observations (n) required to find reliable mean and relative values $n = t2 \times \sigma 2/\Delta 2$, n - number of observations, t - validity criterion, σ - standard deviation, Δ - confidence interval (marginal error). According to the Kolmogorov-Smirnov criterion, the sample was checked for normal distribution. Parametric Student's t-test for 2 independent samples was used for samples with normal distribution. In other situations, comparison of relative values with an assessment of the statistical significance of differences was performed using the Pearson test (χ^2). Differences were considered statistically significant when $p < 0,05$. By calculating the OR with finding the confidence limits (95.0% CI), the relative and total intragroup risk, the statistical risk of a positive or negative outcome of the event under study was assessed. The risk (chance) of an outcome in the study group was considered higher than in the control group with OR > 1. Statistical processing was carried out using IBM SPSS Statistics 26 and Microsoft Excel 2019 programs.

The average age of patients in the study group was 45 ± 8 years. The prevalence of hypertension among all surveyed was 31.3%. Abdominal obesity was found in 32.2% of the subjects in the study. When comparing the incidence of hypertension between the two groups, it was found that hypertension prevails among people with a night work schedule (34.4% versus 27.4% among participants who worked on a daytime schedule, $p < 0.01$). Abdominal obesity was much more often detected with a night-time nature of work than with a standard work schedule (42.3% versus 19.3%, $p < 0.001$). The risk of developing hypertension in persons working night shifts was significantly higher than that in persons who had a daytime work schedule: OR = 4.3 (95% CI: 0.3-5.8). The risk of developing abdominal obesity in night shift workers was OR = 1.35 (95% CI: 0.9-2.0).

Conclusions: Night shifts can be considered as one of the risk factors contributing to the development of hypertension and abdominal obesity in men. In our study, men with night work hours were more likely to suffer from hypertension and abdominal obesity than those who worked during the day.

Keywords: Night Shifts; Arterial Hypertension; Abdominal Obesity; Risk Factors

Key Messages

This study provides an important practical conclusion about the need for early detection and correction of sleep disorders. Apparently, work in night shifts should be considered as a potential risk factor for the development of cardiometabolic disorders, such as arterial hypertension and abdominal obesity. In our study, men with night work hours were more likely to suffer from hypertension and abdominal obesity than those who worked during the day.

Introduction

In recent years, there has been a growing interest in research related to sleep disorders and sleep quality. This is because insufficient sleep is associated with many acute and chronic metabolic diseases and cardiovascular events that leads to increased mortality. Early diagnosis of sleep disorders is essential to prevent adverse health effects. Lifestyle changes are the first and main stage in the prevention and treatment of various cardiometabolic diseases.

Cardiovascular disease (CVD) is the leading cause of death worldwide: for no other reason as many people die each year as from CVD. An estimated 17.9 million people died from CVD in 2016, accounting for 31% of all deaths worldwide. 85% of these deaths were due to heart attack and stroke. More than 75% of CVD deaths occur in low- and middle-income countries. Of the 17 million deaths from noncommunicable diseases under the age of 70, 82% of cases occur in low- and middle-income countries, and 37% are caused by CVD. Most cardiovascular diseases can be prevented by addressing risk factors such as tobacco use, unhealthy diet and obesity, physical inactivity and the harmful use of alcohol through population-wide strategies [1].

The combination of arterial hypertension with abdominal obesity, impaired lipid and/or carbohydrate metabolism is interpreted as a metabolic or cardiometabolic syndrome that increases the likelihood of developing cardiovascular complications.

There is enough epidemiological data that suggests that working the night shift is associated with many chronic diseases, including cardiovascular diseases [2]. There is also evidence of an adverse effect of working night shifts on BMI [3]. Disruption of circadian mechanisms underlies the link between night work and obesity [4-6].

Unfortunately, the modern environment and lifestyle, such as increased light and activity at night, the widespread use of electronic media, deprive people of a full regular sleep [7]. Night shifts are necessary to ensure the continuity of medical care in hospitals and boarding schools. However, these shifts are one of the most common causes of circadian rhythm disorders, causing significant changes in sleep and biological functions that can negatively affect people's physical and psychological well-being [8].

Consequently, this problem is of interest and is relevant both for modern health care and for society as a whole. In this regard, we conducted a pilot study, the main task of which was to identify the relationship between night work and the occurrence of arterial hypertension, as well as abdominal obesity.

Subjects and Methods

The study involved 32 men who worked in two medical institutions in Rostov-on-Don. The study was conducted from September 2019 to July 2020. Inclusion criteria: male gender and work experience of at least 6 years with a night or day work schedule. Exclusion criteria: use of diuretics, glucocorticosteroids, β-blockers for more than one month before the study, a history of heart attacks, strokes, oncological diseases, CKD with impaired nitrogen excretion function, chronic heart failure, clinically significant hypercortisolism, hypothyroidism and symptomatic arterial hypertension.

All participants were divided into 2 groups based on the work schedule. The first included persons with a night schedule (n = 16) and the second, individuals working a day. The participants were interviewed using a developed questionnaire to collect anamnesis. Determination of the blood pressure was carried out according to the recommendations of the Russian Society of Cardiology (2019). Abdominal obesity was diagnosed with a waist circumference of more than 94 cm in men. Arterial hypertension was considered verified at a blood pressure of more than 140/90 mm Hg, calculated as the average of the last two measurements (with three consecutive measurements at intervals of 1-2 minutes) or in the presence of constant antihypertensive therapy. Abdominal obesity was diagnosed when the waist circumference in men was more than 94 cm. The waist circumference was measured in a standing position. The measurement point was the midpoint of the distance between the apex of the iliac crest and the lower lateral edge of the ribs during the horizontal course of the centimeter tape. Patients were weighed on a standardized, calibrated electronic balance with an empty bladder. At the time of weighing, the patients were not wearing heavy shoes and clothes.

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Results

The average age of patients in the study group was 45±8 years. The prevalence of hypertension among all surveyed was 31.3%. Abdominal obesity was found in 32.2% of the subjects in the study. When comparing the incidence of hypertension between the two groups, it was found that hypertension prevails among people with a night work schedule (34.4% versus 27.4% among participants who worked on a daytime schedule, $p < 0.01$). Abdominal obesity was much more often detected with a night-time nature of work than with a standard work schedule (42.3% versus 19.3%, $p < 0.001$). The risk of developing hypertension in persons working night shifts was significantly higher than that in persons who had a daytime work schedule: OR = 4.3 (95% CI: 0.3-5.8). The risk of developing abdominal obesity in night shift workers was OR = 1.35 (95% CI: 0.9-2.0).

Discussion and Conclusion

In our pilot study, the relationship between the occurrence of hypertension, abdominal obesity and night shifts was confirmed. However, the pathophysiological processes of this connection are still unclear to this day. Circadian misalignment has previously been implicated as a mechanism underlying the association between shift work and obesity [9-11].

Among the major types of shift work, irregular shifts are thought to be the most detrimental to the alignment of circadian rhythms since an irregular working schedule can induce acute sleep disruption, thereby leading to chronic circadian misalignment [12].

The currently known mechanism is the deterioration of metabolic processes during sleep deprivation (restriction). So, there is evidence that sleep restriction results in an insulin-resistant state in human adipocytes. Sleep may be an important regulator of energy metabolism in peripheral tissues [13,14]. As well as short sleep duration was associated with an elevated risk of insulin-like growth factor. Insulin resistance appears to mediate this association [15].

The study by Peplonska., *et al.* involving 724 female nurses and midwives, aged 40-60 years (354-night shift workers and 370 day workers). Cumulative night shift work showed significant associations with body mass index (BMI), waist circumference (WC), hip circumference (HC) and Waist to Height Ratio (WHtR), with BMI increasing by 0.477 kg/m^2 per 1000 night duties and by 0.432 kg/m^2 per 10000 night shift hours, WC increasing respectively by 1.089 cm and 0.99 cm, HC by 0.72 cm and WHtR by 0.007 cm for both metrics. The results of the study support the previously reported relations between night shift work and development of obesity [16].

The meta-analysis by Sun M., *et al*. confirmed the risks of night shift work for the development of overweight and obesity with a potential gradient association as suggested for abdominal obesity [17].

In a meta-analysis, Manohar S., *et al*. showed the effect of night shifts on the development of arterial hypertension [18].

While human-based laboratory studies have identified that circadian misalignment causes alteration in the diurnal variation of blood pressure within 24 hours of shift work [19].

Thus, from the facts presented above, an important practical conclusion follows that the need for early detection is necessary for the correction of sleep disorders. Since, apparently, work in night shifts should be considered as a potential risk factor for the development of cardiometabolic disorders.

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