

INFLUENCE OF WORKING CONDITIONS OF TANDIR WORKERS ON THE DYNAMICS CARDIOVASCULAR SYSTEM INDICATORS

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Annotation. A hygienic assessment revealed that tandoori workers' work is classified as a Class 3, Level 3 hazardous work environment. The main adverse factors are elevated air temperatures, high-intensity infrared radiation (up to 1090 W/m²), and severe physical stress. A hemodynamic study of tandoori workers revealed significant strain on the circulatory regulatory mechanisms by the end of the work shift: increased heart rate is accompanied by a decrease in stroke volume, minute volume, decreased pulse pressure, and increased peripheral vascular resistance. These changes indicate depletion of the cardiovascular system's functional reserves.

Key words. tandoor, working conditions, cardiovascular system.

How to cite this article: Slavinskaya NV, Nurullaev EE, Romanova LH, Sabirova GA, Mirayubova ShR, Shakhmurov NA., Influence of Working Conditions of Tandır Workers on the Dynamics Cardiovascular System Indicators. Int J Drug Deliv Technol. 2026;16(86s): 740-743; DOI: 10.25258/ijddt.16.86s.79

The development of the food industry in Uzbekistan poses a pressing problem -A comprehensive study of the hygienic situation at food industry enterprises, identification of harmful production factors, analysis of the impact of working conditions on the functional state of various body systems of workers, assessment of the risk of developing work-related diseases and development of scientifically based recommendations for the protection of workers' health.

There is information in the literature that employees of public catering organizations are exposed to various harmful and hazardous production factors during their work [2, 3, 4, 5, 7, 12]. First of all, these are physical factors: increased temperature and relative humidity [14, 15], mechanical impacts (sharp edges of cutting tools); increased noise levels [1, 6, 11], increased vibration levels; risk of electric shock; infrared (IR) and ultra-high-frequency (UHF) radiation [10]. Increased temperature and relative humidity are most pronounced in hot, confectionery shops, and washrooms [9]. A hot and humid environment in the kitchen is a cumulative factor that negatively affects health, worsens the well-being and productivity of cooks, which can hinder the achievement of thermal comfort and reduce the quality of the cooks' work [13].

In Uzbekistan, there is a high demand among the population for flour products made in tandoor, which they are a vital part of the population's diet. Despite the high level of automation in the food

industry, the work of a tandoori maker remains manual. The available literature does not provide enough information about the working conditions of tandoor makers. There is no data on the presence of harmful production factors when working on a tandoor. On the influence of unfavorable production factors on the physiological reactions of various body systems of tandoori workers, no patterns of formation of unfavorable shifts in the functional state of the body were identified.

The aim of the research The purpose of this study was to provide a comprehensive assessment of the working conditions of tandoori workers and their impact on the dynamics of the functional state of the cardiovascular system.

The study involved 29 tandoori bakeries in Tashkent, where flatbreads and samsa were baked. Cardiovascular health indicators were measured in 30 tandoori bakers, aged 25 to 40, with 5 to 15 years of experience.

Working conditions were studied using traditional methods, using a combined TKA-PKM device for determining temperature, relative humidity, air velocity and illumination levels, an ANT-3M gas analyzer for determining gas contamination, an IR meter for measuring the level of infrared radiation, and an Assistant Combi Total Plus kit for measuring noise.

The cardiovascular system parameters were studied by palpation of the pulse rate and sound measurement of arterial pressure with subsequent calculation of hemodynamic parameters [8]: the pulse

pressure (PP), systolic (SB) and minute blood volumes (MBV) were determined using the Starr formula, the mean dynamic pressure (MDP) was calculated using the Hickam formula, as well as the peripheral resistance in the capillaries (PR):

$$PD = BP_{max} - BP_{min}$$

$$CO = 100 + 0.5 \times PD - 0.6 \times BP_{min} - 0.6 \times$$

Age

$$IOC = SO \times NP$$

$$SDD = PD / 3 + AD_{min}$$

$$PS = SDD \times 1333 \times 60 / MOK.$$

The research was conducted as part of a research project on the topic "Features of working conditions and assessment of risk factors for food industry workers, development of measures to prevent the adverse effects of production factors on the body."

Research results. The nature of the work of tandoor cooks, who specialize in preparing dishes in a traditional clay oven, falls into the category of heavy

physical and monotonous labor with an increased level of harm and danger, related to manual labor, requiring endurance and skill.

A tandoori baker spends almost the entire work shift on their feet. The design of a classic vertical tandoor requires the baker to lean deeply into the heated oven to attach the dough ("seal" the flatbread or samsa) to the clay walls and then remove the finished product. This places enormous strain on the lower back, spine, and back muscles. Working with dough and flour requires physical effort: lifting sacks, moving heavy mixing bowls, and handling large portions of ingredients.

Baking flatbreads or samsa requires a continuous cycle—rolling, shaping, placing in the oven, monitoring the baking process, and removing. A delay of just 30-60 seconds can ruin (burn) the entire batch.

Table 1 presents the results of the study of working conditions of tandoor makers.

Table 1. Indicators of production factors in tandoors

Production factor	M±m	Maximum permissible concentration, maximum permissible concentration	% of shift time	Degree of harmfulness
Noise, dB	67.1±2.2	80	100	2
Illumination, lux	569.2±120.1	400	100	2
Air temperature, 0 C	34.0±0.8	24-31	100	3.1
Relative air humidity, %	25.4±2.2	40	100	2
Infrared radiation inside the tandoor/near the tandoor W/m2	1090.3±48.84/ 454.3±26.3	100/100	30/80	3.2/3.2
Gas contamination, mg/m3				
- carbon monoxide	10.4±0.3	20.0	80	2
- nitrogen oxides	2.7±0.1	5.0	80	2
-carbon dioxide	1206.8±58.0	9000	80	2
The severity of the labor process	Standing work posture more than 80% of the time	Standing work position up to 40% of the working time	-	3.2
	Stereotypical working movements involving the muscles of the arms and shoulder girdle up to 3000	Stereotypical working movements involving the muscles of the arms and shoulder girdle up to 1000	-	3.1
	Forced body bending more than 300 to 200 times per shift	Forced body bending more than 300 51-100 times per shift		3.1
The intensity of the work process	Attention span of more than 75% of working time	Attention span up to 25% of working time	-	3.3
	Increased responsibility for the final result of work	Responsibility for individual elements of work	-	3.2
General assessment of working conditions				3.3

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The research materials show that in the tandoor ovens surveyed, the working conditions were characterized by the following indicators: the overall noise level created by burning gas burners was on average equal to 67.1 ± 2.2 dB, the illumination of work surfaces was on average equal to 569.2 ± 120.1 lux, air temperature ranged from 28 to 39°C , averaging $34.0 \pm 0.8^\circ\text{C}$ with a relative humidity of $25.4 \pm 2.2\%$ and still air. When loading baked goods into the tandoor, tandoor operators are exposed to infrared radiation from the gas burners – the level inside the tandoor averages 1090.3 ± 48.84 W/m², and near the tandoor 454.3 ± 26.3 W/m². The air in the working area in tandoor ovens is polluted by gas combustion products. Air sampling revealed the presence in the breathing zone of tandoori workers of carbon monoxide at a concentration of 10.4 ± 0.3 mg/m³, nitrogen oxides at a concentration of 2.7 ± 0.1 mg/m³, and carbon dioxide at a concentration of 1206.8 ± 58.0 mg/m³.

The severity of the work process is due to the forced working posture of standing for more than 80% of the working time, the performance of

stereotypical working movements involving the muscles of the arms and shoulder girdle up to 3000 times per shift when working with dough, forced bending of the body more than 300 to 200 or more times per working day.

The intensity of the work process is associated with the duration of concentration of more than 75% of the working time and increased responsibility for the final result of the work.

Based on the totality of production factors, the working conditions of tandoor operators are classified as class 3, 3rd degree of harmfulness. harmful, difficult working conditions, characterized by such levels of harmful and hazardous production factors that lead to the development, as a rule, of occupational pathology in mild and moderate forms during the period of work activity, an increase in chronic general somatic pathology, including an increase in high levels of morbidity with temporary loss of ability to work.

Table 2 presents the results of the study of cardiovascular system indicators in tandoori makers.

Table 2. Dynamics of cardiovascular system indicators in tandoor cooks

Indicators hemodynamics	Measurement time				Reliable nost
	At the beginning of work		At the end of the work		
	n	M± m	n	M± m	P3-5
1	2	3	4	5	6
Pulse rate, beats per minute	30	73.4±0.4	30	87.0±0.4	<0.001
Blood pressure, mmHg:					
- maximum					
- minimum	30	113.6±3.9	30	104.8±3.3	<0.05
- pulse	30	68.5±0.6	30	74.6±0.8	<0.01
- mid-dynamic	30	45.6±0.2	30	28.8±0.3	<0.001
	30	84.7±0.1	30	115.2±13.0	<0.001
Systolic volume of the heart, ml	30	58.5±0.5	30	46.0±0.3	<0.001
Minute blood volume, ml	30	4303.2±52.8	30	4131.2±53.0	<0.05
Peripheral resistance in capillaries, dyn	30	1583.2±16.0	30	1642.0±38.9	>0.05

The presented data show that from the beginning to the end of the working day, the tandoor masters showed a reliable increase in pulse rate from 73.4 ± 0.4 to 87.0 ± 0.4 beats per minute (<0.001), a reliable decrease in maximum arterial pressure (AP) from 113.6 ± 3.9 mmHg, pulse AP from 45.6 ± 0.2 to 28.8 ± 0.3 mmHg, as well as an increase in minimum AP from 68.5 ± 0.6 to 74.6 ± 0.8 mmHg and average dynamic AP from 84.7 ± 0.1 to 115.2 ± 13.0 mmHg. This was accompanied by a decrease in the systolic volume (SB) of the blood: if before work the SB of the blood was equal to 58.5 ± 0.5 ml on average, by the end of work it was up to 46.0 ± 0.3 ml ($p < 0.001$). Despite the increase in pulse rate, a decrease in the minute volume of blood (MBV) was noted during the working day. Thus, if at the beginning of work the MBV was equal to 4303.2 ± 52.8 ml, then by the end of work it was on average 4131.2 ± 53.0 ml ($p < 0.001$). PS in the capillaries in the dynamics of work tended to increase from 1583.2 ± 16.0 to 1642.0 ± 38.9 dyn ($p > 0.05$).

Consequently, when working on a tandoor, workers develop reactions in the cardiovascular system that indicate a significant weakening of the functional reserves of the cardiovascular system, which may cause the development of subsequent pathological changes. The observed trend toward increased peripheral capillary resistance (from 1583 to 1642 dynes) and decreased cardiac output are early physiological markers of the risk of developing hypertension and ischemic changes. Systematic repetition of such shifts during the workday leads to the development of work-related cardiovascular pathology in the medium term.

Conclusions:

1. The working conditions of tandoor operators are classified as Class 3, Level 3 hazardous (harmful, severe). The main adverse factors are: microclimate (air temperature in the working area reaches $34.0 \pm 0.8^\circ\text{C}$, which exceeds the permissible limits, with low humidity (25.4%); thermal radiation: the most hazardous factor (its level inside the tandoor is 10 times higher than the maximum permissible level

and affects the master during the dough loading); the severity of the work process (forced standing position for more than 80% of the shift, frequent body bending (more than 200 times) and stereotypical arm movements (up to 3000 per shift).

2. During the work shift, tandoori workers exhibit significant hemodynamic changes, indicating the development of a stress response and a decrease in adaptive reserves: an increase in heart rate (HR), indicating compensatory myocardial strain; a paradoxical decrease in maximum blood pressure and an increase in minimum blood pressure, leading to a sharp decrease in pulse pressure and clinically assessed as a sign of deteriorating vascular elasticity; and a decrease in systolic and minute blood volume against a background of increased heart rate, indicating that the heart is operating in overload mode and its pumping function is declining.

The identified shifts create the basis for the development of occupational cardiovascular risks. To maintain the health of tandoor operators, it is necessary to develop preventative measures, including regulating the time of uninterrupted contact with the tandoor, organizing scheduled breaks in a comfortable microclimate, and mandatory pre-shift medical examinations.

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