

DYNAMIC HEALTH SURVEILLANCE ANALYSIS OF THE EMPLOYEES OF THE KIRGULIA INDUSTRIAL ZONE

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Abstract. *The scientific work presents the results of dynamic research to study the structure, level and dynamics of the general, professionally conditioned and professional morbidity of employees of SE “Ferghana Oil Refinery”, SE “Ferghana Heat and Power Plant” and JSC “Ferghanaazot”, which are part of the Kyrgyz Industrial Zone of the Ferghana region for 5 years (2010-2014). The main professional qualification groups working at the enterprises under research at the age of 19 to 40 years with the work experience from 1 to 20 years were surveyed. 6000 man-days of working observations were made. High morbidity rates were revealed among the employees of Ferghana Oil Refinery and JSC “Ferghanaazot” in the groups with the experience of up to 5 years and 11-20 years. The analysis of morbidity rate among age groups of workers showed high indices at the age above 35 years. In the structure of morbidity for the period of 2010-2014, the first leading places were occupied by diseases of respiratory organs, then by diseases of circulatory and digestive organs, traumas and poisoning, then by diseases of the nervous system, skin and subcutaneous tissue. High respiratory diseases are associated with long-term exposure to occupational risk factors, where chemical contamination is the most dangerous.*

Keywords: *morbidity, industrial zone, workers, production, occupational disease.*

Introduction. Early detection of the prepathological condition and active dynamic monitoring of the employees' sickness rate allows to carry out purposeful effective preventive measures to reduce it, to plan correctly the work of the attending medical personnel, workshop therapists, doctors of medical units, to successfully manage the treatment and diagnostic process. It is known that working conditions with its components of the production environment and the organization of the technological process objectively affect the health of the working team. One of the priority directions in industrial medicine is risk management at work, forecasting the risk of development of professional and professionally conditioned diseases [1, 2, 3, 4].

Objective: To make a forecast of the risk of development of occupational and occupational diseases [1, 2, 3, 4]. To reveal the structure, level and dynamics of the general, professionally conditioned and professional morbidity of the employees of the enterprises of the Kirgulia industrial zone in the Ferghana region.

Research materials and methods. The object of research were employees of the main professional groups of enterprises located in the Kirgulia industrial zone: Subsidiary Enterprise “Ferghana Oil Refinery” (FOR), Subsidiary Enterprise “Ferghana Heat and Power Plant” (Ferghana HPP) and JSC “Ferghanaazot.”

The research objects were the employees of the leading professional groups of the enterprises located in the Kirgulia industrial zone: Subsidiary Enterprise “Ferghana Oil Refinery” (FOR), Subsidiary Enterprise “Ferghana Heat and Power Plant” (Ferghana CHP) and JSC “Ferghanaazot.”

The major professional qualification groups working at the enterprises under research (welders, drivers, operators, drillers, repair workers, technologists, engineers, etc.) at the age of 19 to 40 years with the work experience from 1 to 20 years were surveyed. 6000 man-days of working observations were made.

The health condition of employees of the Kirgulia industrial zone was assessed based on the study of morbidity with a temporary disability (MTD) of year-round production workers based on treatment and preventive treatment facilities in dynamics for the period 2010-2014. The primary document was the lists of disability of workers, using the copying of which the analysis of morbidity with temporary loss of working capacity was carried out.

Two groups were selected for the analysis of the MTD. The first group included workers whose labor was associated with the impact of adverse industrial and professional factors, the levels of which in some cases exceeded the permissible values.

The second group (control group) was composed of employees of the administrative staff of the enterprise. A person who had one or more cases of illness per year was taken as a unit of accounting. The following indicators of the MTD were calculated:

- Temporary disability (TD) due to illness per 100 employees (number of TD/KP 100 cases);
- the average duration of one TD case (total number of days/number of cases);
- the number of TD days per 100 workers (sum of TD/KP 100 days);
- the structure and frequency of MTD by different forms of the disease;

During the research, we used the “Methodological recommendations for forecasting occupational health risk for workers by indicators of occupational morbidity with temporary disability” [5, 6, 7, 8]. An in-depth analysis of employee morbidity by sex, age, length of service and profession was carried out. The morbidity data were developed based on the “International Classification of Diseases, Injuries, and Causes of Death X” (1995). The obtained data were statistically processed with the determination of mean values, standard deviations and errors of mean values, which are presented as $M \pm m$ (mean \pm average error of mean value). The differences at $P < 0.05$ (by the Student’s criterion) were considered reliable.

Results and discussions. According to the tasks set, research on the structure and level of morbidity among workers of the Kirgulia industrial zone was conducted. The structure of occupational and professionally conditioned diseases was analyzed using the sick lists of the workers of the FOR for 5 years (2010-2014) in different age groups, considering sex and work

experience. Thus, a study of morbidity among workers in the period from 2010 to 2014 showed that the number and percentage of illnesses were increasing significantly ($P < 0.001$). Thus, by the end of 2014, the number of cases of illness reached 2,253 (Table 1). Considering gender, as the main workforce is composed of men, men who work are more often ill.

The next stage in the research of morbidity was the determination of often ill age groups. Thus, we defined conditionally 3 age groups: under 25, 25-35 and over 35.

Table 1: The morbidity rate dynamics of the FOR employees (over 5 years)

Gender	Years									
	2010		2011		2012		2013		2014	
	Q-ty	%	Q-ty	%	Q-ty	%	Q-ty	%	Q-ty	%
Male.	971	91,1	1016	86,69	497	81,5	1414	85,59	1924	85,49
Female	95	8,9	156	13,31	113	18,5	238	14,41	327	14,51
Total:	1066	100	1172	100	610	100	1652	100	2253	100

It has been established that FORs hire workers from the age of 19, but the sickest age group is the group over 35. Dynamic observation of morbidity from 2010 to 2014 by age groups also indicated a large number of patients in the age group - over 35 years in 2014 - 51.75% (Fig. 1).

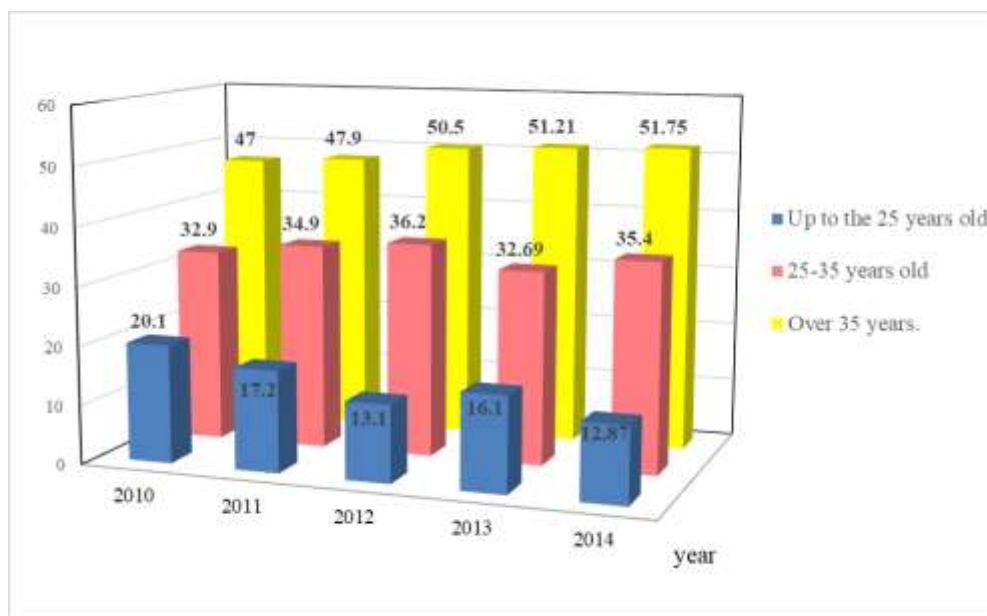


Fig. 1 The morbidity structure of FOR workers in age groups in the dynamics of 2010-2014.

The less sick workers in the age group 25-35 years old (32.69-36.2%) and the less sick workers in the age group under 25 years old 12.87-20.1%.

To study the morbidity among the seniority groups, we identified the following groups with the length of service: up to 5 years, 6 - 10 years, 11 - 20 years and over 21 years.

Thus, among the seniority groups, more often, the disease was in the group 11 - 20 years. The highest number of cases was recorded in 2011 and amounted to 38.5%. Further, the group with 6 - 10 years of experience is more often sick, and the lowest percentage in the group with more than 21 years of experience ranging from 6.66 to 14.69% (Fig.2).

Analysis of morbidity indicates the formation of unfavorable working conditions for workers over 35 years of age, who have 11-20 years of experience. Therefore, this factor indicates a correlation between the age of workers and their length of service. To identify the often ill professional and qualification groups of the FOR, studies have been carried out, which showed that the main group of the ill is the operators of technological units.

Thus, during 5 years, according to the number of cases among the employees of FOR, electricians who repair and maintain electrical equipment were more often ill - 1453, then electric and gas welders - 1099, then operators of technological units - 1046, then compressor plant operators - 650, Then locksmiths on the repair of technological installations - 624, commodity operators - 541, locksmiths on repair and installation of submersible pumps - 184, manufacturers of candles - 140, electromechanics - 132, loaders - 89, apparatuses of gas separation - 78, drainers - 71.

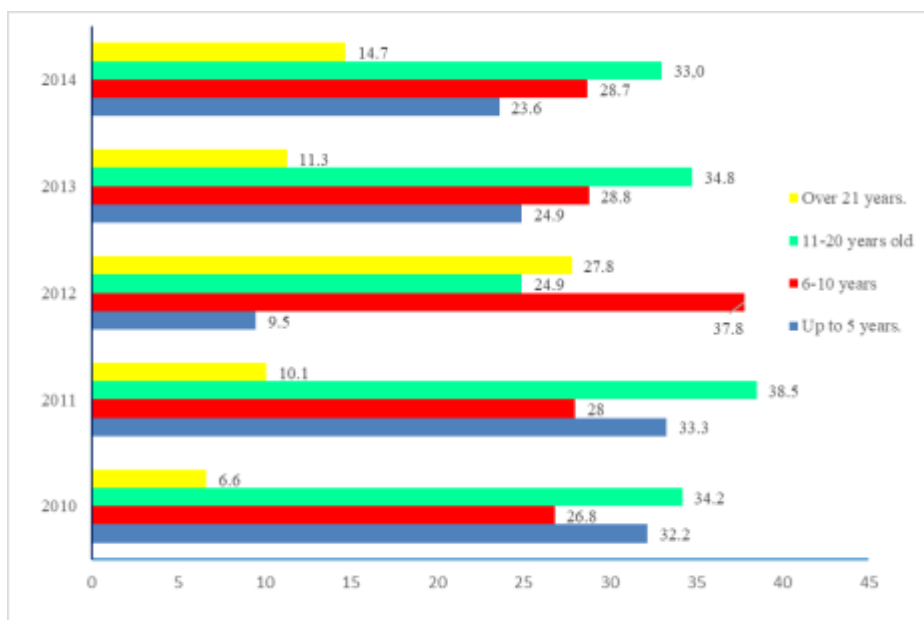


Fig. 2 Morbidity among employees of FOR by seniority groups, %.

This factor is explained by the fact that in the production shops of FOR, the technological process is carried out at numerous technological units and a considerable number of operators of technological units are employed to service them. The lowest or single cases were noted among turners, equipment engineers, electric welders of manual welding, commodity operators, plant mechanics, electric fitters, electric and gas welders (Table 2). The number of cases per 100 working years is increasing reliably ($P < 0,001$).

During the study of morbidity by groups of ICD X-analysis among the workers of FOR, it was found that the 1st place is occupied by diseases of respiratory organs (163,0 %), the 2nd place is occupied by diseases of circulatory organs (65,0 %), further by injuries, poisonings and

some other consequences of external causes (53,2 %), also by diseases of digestive organs (49,0 %) and diseases of the skin and mucous membranes (40,0 %) (fig. 3). Proceeding from this, it should be noted that frequently occurring respiratory diseases were mainly registered at workplaces whereby the number of employees there are more than 1000 - operators of technological installations.

The analysis of morbidity among workers of FOR showed that during 5 years, the morbidity rate didn't decrease, when studying age groups, they are more often ill at the age of more than 35 years, and considering the seniority group workers with 11-20 years of work experience.

Table 2: The morbidity cases among employees of the FOR of the main occupational and qualification groups in dynamics (over 5 years)

Occupations	2010	2011	2012	2013	2014	Total
Process plant operator	230	143	124	200	349	1046
Wizard for repair and maintenance of electrical equipment	2	-	4	22	28	56
Operator commodity (shop 1)	-	-	3	5	4	12
Compressor Unit Machine Manager	116	110	53	201	170	650
Installation mechanic	1	-	-	2	7	10
Operator commodity	73	92	103	117	156	541
Process Plant Repair Locksmith	97	101	63	135	228	624
Gas separation apparatus	7	16	3	19	33	78
Electro mechanic	19	23	15	26	49	132
Submersible pump repair and installation locksmith	30	44	20	40	50	184
Electrical installer for repair and maintenance of electrical equipment	202	312	119	400	420	1453
Equipment Engineers	5	3	1	11	7	27
Loader	17	14	6	21	31	89
Creamman filler	14	10	5	18	24	71
Tool locksmith	4	6	1	8	6	25
Manual electric welder	1	2	1	3	-	7
Electrical locksmith	-	-	-	2	2	4
electric gas welder	132	268	56	223	420	1099
Candle makers	20	-	16	52	52	140

Turner	-	-	-	1	1	2
Total	971	1046	595	1506	2039	6157

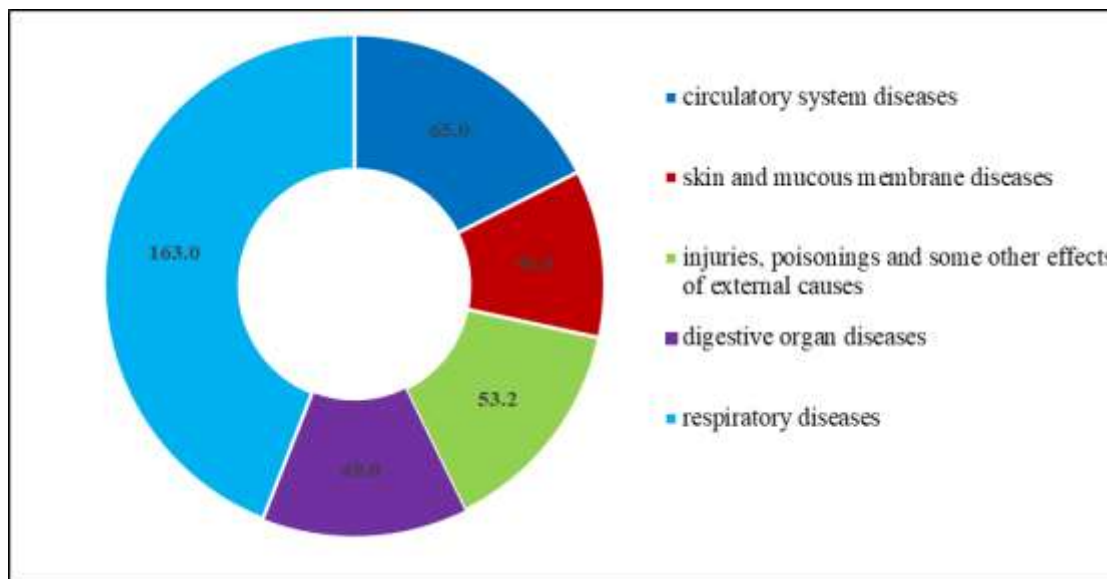


Fig.3 The morbidity structure by nosological forms of the FOR, %.

Operators of technological units, machinists of compressor units and locksmiths on the repair of technological units in comparison with other professional qualification groups of FOR were ill more often.

According to ICB X-version in the structure of morbidity for 5 years, the leading place was occupied by respiratory diseases (163,0%).

In the study of occupational morbidity by the results of medical examinations was found, in 5 years only in 2013 there were 4 cases of occupational morbidity, including 2 cases of bronchial asthma in the mechanic and electrician repair and 2 cases of toxic hepatitis in the masters of repair and maintenance of electrical equipment.

During 2010-2012, 3 groups of workers (electricians, mechanics and electric and gas welders) belonging to the D2 group were registered, i.e., with suspicion of occupational disease related to chemical factor exposure. Due to timely medical and health-improving measures, employment in other jobs where there is no contact with harmful production factors, in particular the chemical factor, the development of occupational diseases was prevented. Thus, considering that the above-mentioned groups of employees have risks of different magnitude, the identified occupational diseases prove the correlation between working conditions and the identified risks (>0.001).

The researches devoted to the study of the structure and morbidity level among the JSC “Ferghanaazot” employees showed that the morbidity level for 5 years (2010-2014) varied and

the highest indices were revealed in 2013 - 2580 cases (Table 3). The main contingent of patients is working men.

Table 3: Dynamics of JSC “Ferghanaazot” employees’ morbidity rate (for 5 years)

Gender	Years									
	2010		2011		2012		2013		2014	
	Q-ty	%	Q-ty	%	Q-ty	%	Q-ty	%	Q-ty	%
Male.	409	66,40	1004	64,2	132	50,19	1552	60,2	1028	60,7
Female.	208	33,77	556	35,5	131	49,81	1028	39,8	66	39,3
Total	617	100	1560	100	263	100	2580	100	168	100

When studying the incidence rate in different age groups, it was found that the most frequent cases are in the age group over 35 years. Dynamic observation of morbidity rates from 2010 to 2014 by age groups indicated a large number of patients in the age group - over 35 years old, but the highest rates were established in 2012 - 58.7% (Fig. 4).

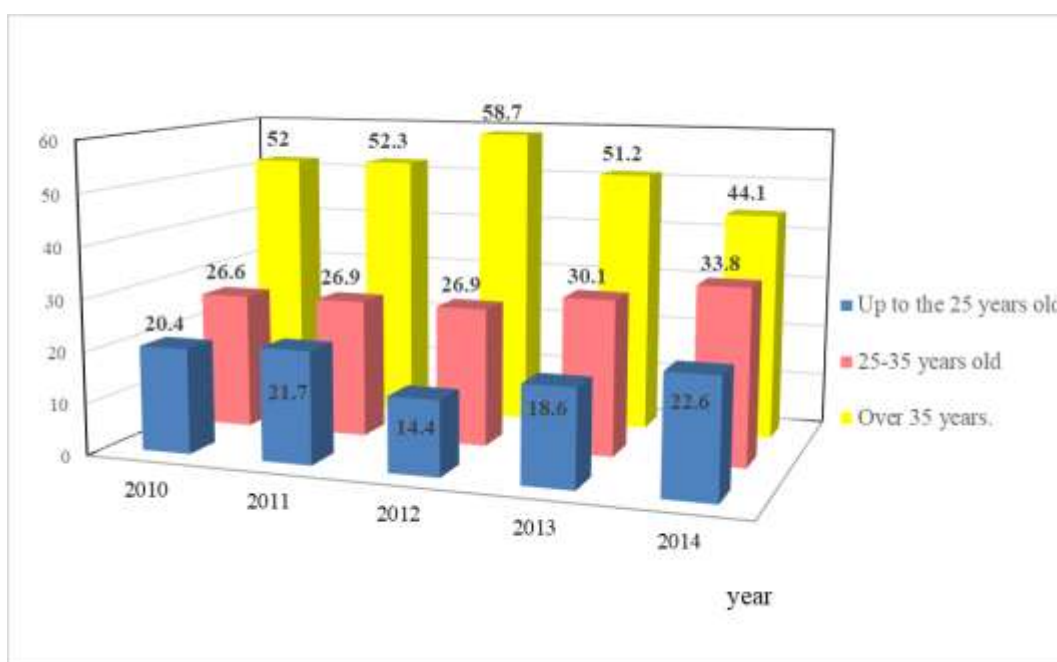


Fig. 4 The morbidity structure among the JSC “Ferghanaazot” employees in age groups in the dynamics of 2010-2014.

Comparatively, less morbidity is observed among workers in the age group 25-35 years old (26,6-33,8%) and low morbidity is observed in the age group under 25 years old - 14,4-22,6%.

The study of morbidity in the seniority groups indicated stable high morbidity among the groups with the experience of up to 5 years and in the group 11 - 20 years. The highest number of cases was noted in 2012 among employees with more than 21 years of service - 32.3, and in 2014 among employees with 11-20 years of service - 31.6% (Fig. 5). The lowest incidence rates were registered in the group with 6 to 10 years of service.

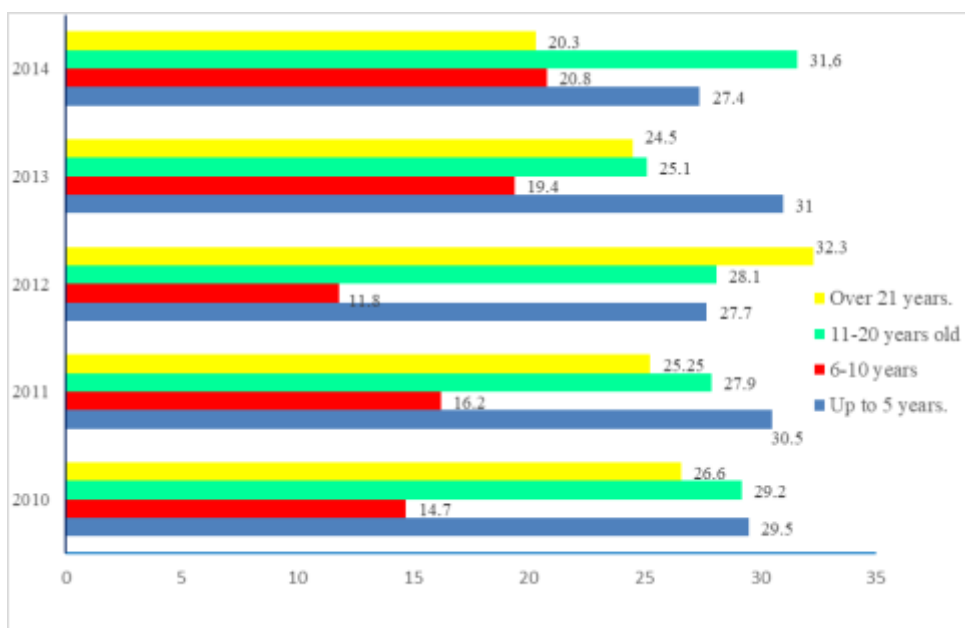


Fig. 5 Morbidity among employees of JSC “Ferghanaazot” by seniority groups, %

The analysis of morbidity rate among professional qualification groups of JSC “Ferghanaazot” showed that the main group of patients during 5 years was steadily occupied by electricians of power plant - 323, then electricians of ammonia shop - 241, apparatuses for raw materials preparation and electrolysis apparatuses had similar indicators - 131, 130, then loaders - 128, then with the same indicators apparatuses for filtration, granulation, neutralization and preparation of raw materials and mechanic-repair workers - 116. The lowest rates were recorded among evaporation, absorption and extraction apparatuses - 12 and laboratory assistants - 15 cases (Table 4).

Table 4: Cases of morbidity among employees of JSC “Ferghanaazot” for 5 years

Occupations	2010	2011	2012	2013	2014	Total
Tillers	16	37	2	68	8	131
Repair Mechanics	22	56	8	30	-	116
Ammonium Plant Electricians	38	66	9	124	4	241
Synthesis, Absorption, Desorption, Pelletizing And Evaporation Apparatus	14	19	2	36	-	71
Machinists	6	28	4	25	13	76
Laboratory Technicians	1	12	-	2	-	15
Washers	3	8	-	8	-	19
Batteries	2	7	3	11	1	24

Electric And Gas Welders	12	18	1	42	-	73
Power Plant Electricians	24	52	12	223	12	323
Machine Repairers	24	29	1	21	-	75
Repair Mechanics	5	1	2	12	-	20
Evaporation, Absorption And Extraction Apparatuses	3	1	-	7	1	12
Electrolytic Apparatus	14	73	1	41	1	130
Remote Control Operator	1	19	1	14	-	35
Filtration, Pelletizing, Neutralization And Raw Material Preparation Equipment	10	75	1	30	-	116
Movers	13	44	4	67	-	128
Absorbers	3	4	2	11	1	21
Repair Mechanics	-	4	2	16	2	24
Pumping Driver	9	28	4	34	-	75
Total:	220	581	60	822	43	1726

The number of cases per 100 employees per year is increasing reliably (P0.001). Incidence among 20 occupational groups was highest in 2013.

Consequently, high morbidity rates among locksmiths and repair workers are due to poor working conditions, combined with the severity of the work process and the impact of harmful factors in the working environment.

During the study of morbidity among the employees of JSC “Ferghanaazot” by groups of ICD X-examination, it was revealed that the 1st place is occupied by diseases of respiratory organs (154,0%), the 2nd place is occupied by diseases of digestive organs (80,2%), then by diseases of the nervous system (49%), injuries, poisoning and some other consequences of external causes (40%) and diseases of circulatory organs (36,6%) (Fig. 6).

Based on the results of medical examinations in the period 2010-2014, a group of observed workers (D2) was identified with suspected occupational diseases of an allergic nature and respiratory diseases.

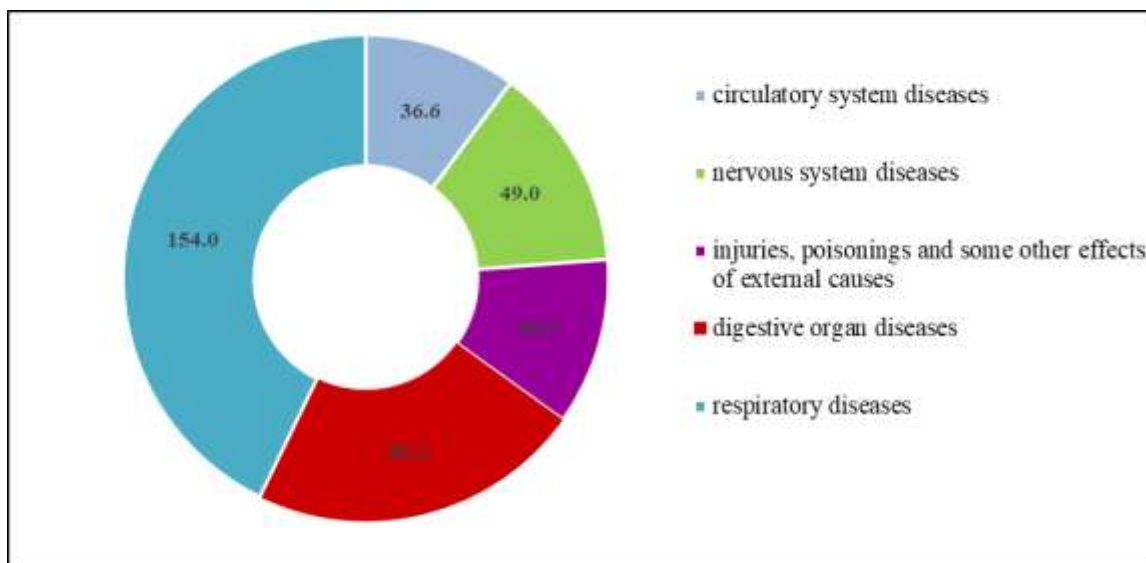


Fig.6 The morbidity structure by nosological forms of JSC “Ferghanaazot”, %

Dynamic observation showed that this group of workers (apparatuses at various stages of the technological process, electricians, repair fitters) had contact with a complex of chemical reagents during 5-8 years at the studied production. Conducting purposeful effective therapeutic and health-improving measures with further transfer to work with the absence of chemical agents' influence in working conditions contributed to improvement of health condition.

Considering that for these professional and qualification groups the risk value following the working conditions was estimated as very high (unbearable) risk, the probability of development of professional pathology was maximum (>0.001).

Studying the structure and morbidity rate for 5 years at Fergana HPP showed the following results: the morbidity rate remained stable and averaged from 357 to 394 cases (Table 5). The main contingent of the diseased were working men.

Table 5: The morbidity rate dynamics of employees of the Ferghana Heat and Power Plant (over 5 years)

Gender	Years									
	2010		2011		2012		2013		2014	
	Q-ty	%	Q-ty	%	Q-ty	%	Q-ty	%	Q-ty	%
Male.	215	58,27	231	64,7	281	71,3	252	66,32	256	65,6
Female.	154	41,73	126	35,3	113	28,7	128	33,69	134	34,5
Total	369	100	457	100	194	100	380	100	490	100

The study of the morbidity rate in the selected age groups showed that the most frequent morbidity is in the age group for over 35 years, which is between 42.3 and 51.1%. Workers in the age group of 25-35 years old (26.3-38.4%) are comparatively less ill, and low morbidity is found in the age group under 25 years old - 13.2-31.4%.

The study of morbidity in the seniority groups indicated high morbidity among groups with 11-20 years of experience. In other seniority groups, the incidence rates were registered with the same values, so the lowest values were found in the group under 5 and 6-10 years old. In the analysis of the morbidity rate in the seniority groups for 5 years, there is no stable upward or downward tendency (Fig. 8).

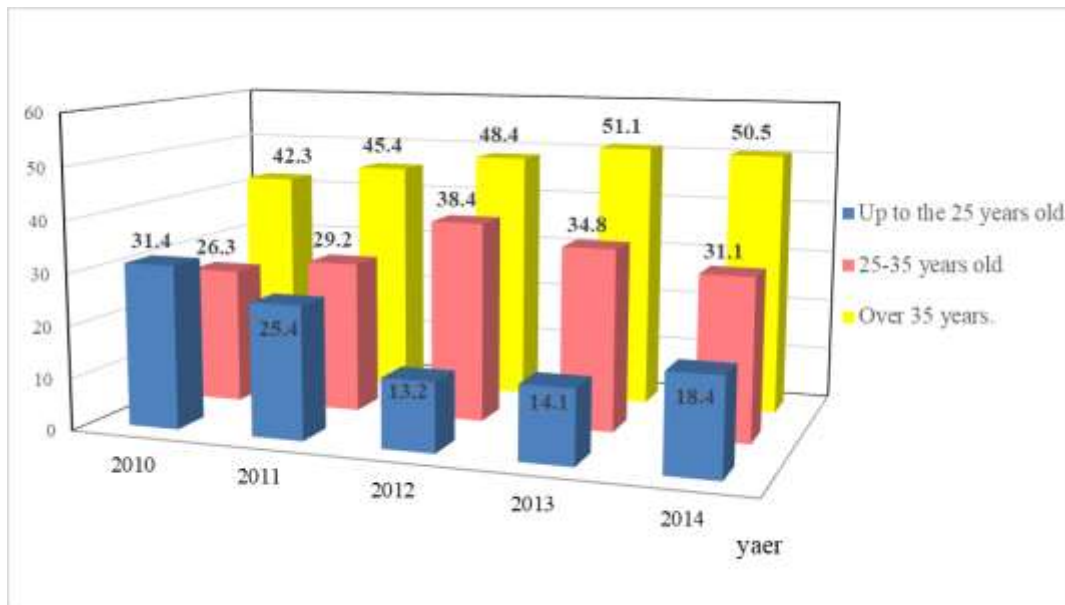


Fig. 7. The morbidity structure among workers of the Fergana HPP in age groups in the dynamics of 2010-2014.

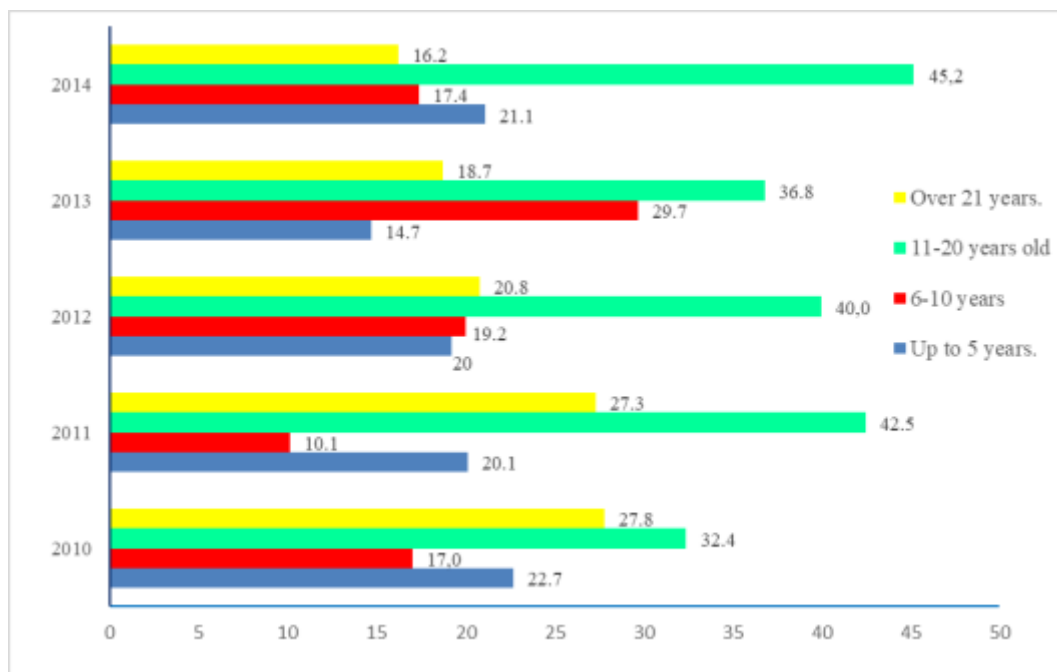


Fig. 8. Morbidity among workers of Fergana CHPP by seniority group, %

During the study of morbidity among 9 vocational qualification groups of Fergana CHPP, it was found that the main part of those who fell ill during 5 years were stable electric welders, electric and gas welders and machine operators. The lowest indicators were established for workers of the group of electricians and locksmiths of different profiles (Table 6). The results obtained indicate the impact of risk factors at the workplaces of electric welders, electric and gas welders and machinists. The number of cases per 100 employees per year is increasing reliably ($P < 0.001$). Thus, the incidence among 9 occupational groups showed that the highest rates were observed in 2010.

Table 6.: Cases of morbidity among employees of the Ferghana Thermal Power Plant in dynamics (over 5 years)

Occupations	2010	2011	2012	2013	2014	Total
Boiler Operators	56	37	22	38	48	201
Boiler Fitters	6	4	2	2	11	25
Turbo Locksmiths	18	6	19	14	4	61
Steam Turbine Operators	64	49	32	36	41	222
Electric Welders	54	28	24	35	30	171
Electric And Gas Welders	66	32	45	28	37	208
Service Fitters	3	5	-	8	10	26
Electric Locksmiths	14	10	1	11	7	43
Boiler Repairers	1	9	13	14	-	37
Total:	282	180	158	186	188	994

During the study of the morbidity by groups of the ICD X-analysis among the workers of the Ferghana HPP, it was found that the first place is occupied by diseases of the respiratory organs (150.4%), then by diseases of the circulatory system (48.5%), digestive organs (44.0%), diseases of the skin and mucous membrane (43.2%) and diseases of the nervous system (23.8%) (Fig. 9).

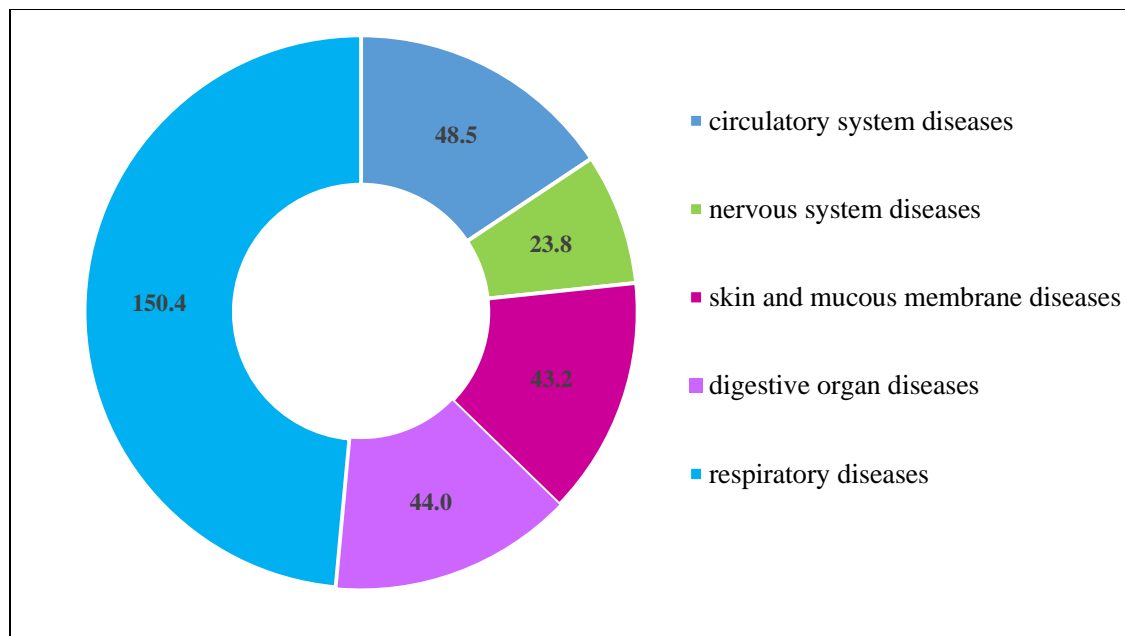


Fig.9 The morbidity structure by nosological forms of Fergana HPP, %.

To identify cases of occupational and professionally conditioned morbidity among workers, the results of medical examinations for the period 2010-2014 were analyzed, which showed the average level of workers with suspected occupational respiratory diseases group D2). This group mainly included machine operators and electric and gas welders whose work is related to exposure to a variable microclimate in combination with chemical factors and dust. Thus, within 3 years after their identification in the D2 group, they were provided with jobs not associated with the impact of chemical and physical factors of the production environment.

Conclusion: Thus, the study and analysis of morbidity among the workers of the Kirgulia industrial zone showed that during 5 years the morbidity rate among the FOR workers did not decrease, while studying the age groups they are more often ill at the age of more than 35 years, and taking into account the length of service workers with the length of service from 11 to 20 years. Operators of technological units, compressor plant operators and locksmiths for repair of technological units were more often ill than other professional qualification groups of FOR. The analysis of morbidity for 5 years among the employees of JSC “Ferghanaazot” has not revealed a steady increase or decrease in morbidity, but the highest indices were observed in 2012 and 2013. In the study of age groups, more often they were ill at the age of more than 35 years, in senior groups from 1 month to 5 years and from 11 to 20 years. Among professions, locksmiths and repair workers were more often ill - 413 cases, electricians - 241, as well as raw material preparation and electrolysis apparatus had similar indicators - 130. Analysis of morbidity for 5 years among workers of Fergana HPP has not revealed a sharp increase in morbidity, but the highest rates were observed in 2012 and 2014. In the study of age groups, the incidence was more frequent at the age of more than 35 years in the senior group from 11 to 20 years. Boiler operators, steam turbine operators, electric welders and electric and gas welders were the most common occupations.

When studying the morbidity structure at the 3 production facilities of the Kirgulia industrial zone, it was established that in all 3 production facilities the first place was occupied by respiratory diseases, then by diseases of the circulatory system and digestive organs, then by injuries and poisoning and some other consequences of external causes, then by diseases of the nervous system and skin and mucous membrane. A high percentage of respiratory diseases is associated with exposure to a chemical factor, combined with an adverse microclimate during the cold season (autumn, winter).

Analysis of the results of medical examinations for the period 2010-2014 has identified groups with the suspected occupational disease (D2) and occupational disease (D3) among employees of the FOR and JSC "Ferghanaazot." According to calculations, in 4 years after the allowed (harmless) experience in conditions typical for a certain profession, early signs of occupational disease develop.

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