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**Introduction.** In conditions of shortage of labor resources, strengthening and preserving the health of the economically active population of Russia is of particular importance, and among the priorities of health care development is the task of reducing the level of labor losses, including due to temporary disability (TD) of workers due to diseases and injuries.

**The study aims** to study the dynamics of age and gender characteristics of temporary disability among workers as an essential source of data on the health status of the working population of Russia.

**Materials and methods.** The authors analyzed the dynamics of indicators of the frequency of cases of TD and the average duration of one point of temporary disability of employees for 2014–2018. Also, the scientists analyzed the intermediate data on temporary disability for five years for the leading causes of diseases, depending on age and gender. In addition, the experts conducted research based on data from the Ministry of Health of the Russian Federation (form 16-TD) and information from Rosstat.

**Results.** During 2014–2018, the incidence of TD due to diseases decreased by 1.5% in men and 3.3% in women while reducing the average duration of one case of the disease (by 1.5% and 2.4%, respectively).

The frequency of TD due to injuries decreased by 14.2% in men and 8.3% in women, with a slight increase in the average duration of one case. In the structure of TD in men and women, four classes of diseases (diseases of the respiratory system, musculoskeletal system, circulatory system, and digestive organs) accounted for 70–80% of the total number of cases of TD. For most classes, experts recorded the frequency of temporary disability in men 1.1–1.5 times less than in women with higher average duration of temporary disability.

**Conclusions.** Researchers established significant age and gender differences in the frequency and duration of temporary disability due to diseases and injuries, which must be considered when developing preventive programs.

**Ethics.** The authors conducted the study by Ethical standards.

**Keywords:** temporary disability; average duration of one case of temporary disability

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**Introduction.** For more than ten years in Russia, we have observed a deterioration in the population's age structure due to a decrease in the proportion of people of working age and an increase in the ratio of the post-working age population [1–3]. Currently, due to the annual increase in the demographic burden on the able-bodied population of Russia, the working-age for women is up to 60 years, and for men — 65 years [4, 5]. In these conditions, the strengthening and preservation of the health of the economically active population of Russia are of particular importance, and the priority tasks of health care development include the study of reducing the level of labor loss, including due to temporary disability.

During 2014–2018, from 24.5 to 25.1 million cases of TD per year were registered in the Russian Federation [6]. Diseases ranged from 17.6 to 17.9 million cases, that is, more than 70%. Injuries, poisoning, and other consequences of exposure to external causes ranged from 7.7% to 8.5%, and social reasons (childcare, patient care, spa treatment, etc.) — about 20%. Thus, temporary disability mainly characterizes the state of health of the working population — morbidity and the effects of external causes.

During these years, the total duration of disability due to illness and accidents ranged from 301.0 to 320.0 million

days per year. Thus, temporary disability (TD) due to diseases, injuries, and poisoning, in addition to the medical aspect, is of great economic importance and is associated with significant financial losses of society. For example, only the expenses of the Social Insurance Fund of Russia for the payment of TD benefits ranged from 194.3 to 251.6 billion rubles<sup>1</sup> [7]. And the total amount of direct costs and indirect losses (equipment downtime, non-productive gross domestic product, expenditures of the healthcare system for providing medical care to a patient, etc.) can reach 4.5% of GDP [8, 9].

For developing effective preventive measures aimed at preserving the health of employees and reducing economic losses, it is essential to have information about the structure of TD caused by diseases, the frequency of occurrence of certain types of pathology depending on the gender and age of employees, the average duration of one case of the leading classes of diseases, etc.

**The study aims** to learn the dynamics of gender and age characteristics of TD workers as an essential source of data on the health status of the working population of Russia.

**Materials and methods.** The sources of information for calculating the TD indicators due to diseases, injuries,

<sup>1</sup> Federal Law No. 335-FZ of 16.10.2019 "On the Execution of the Budget of the Social Insurance Fund, Russian Federation for 2018"

poisoning and some other effects of external causes were the official data of the Ministry of Health of the Russian Federation (form 16-TD: "Information on the causes of temporary disability") and data on the number of employees in the economy of the Russian Federation provided by the Federal State Statistics Service (Rosstat) [10]. According to the definition of Rosstat, persons aged 15–72 years who performed any activity (at least one hour per week) related to the production of goods or the provision of services for payment or profit during the surveyed week are employed.

It is important to emphasize that it is advisable to calculate all indicators characterizing TD due to diseases or accidents separately for men and women. As the frequency of cases of disability, its structure, and the average duration of one point of disability in men and women differ. This remark does not exclude the possibility of calculating indicators for the two sexes together. Still, the value of the results obtained will be lower in terms of the possibility of their use in the development of preventive measures.

Researchers calculated following indicators of TD due to diseases:

- The frequency of cases of TD due to diseases per 100 employed separately for men and women:

$$C_{MDT} = \frac{\text{The number of cases of TD in total for all classes of diseases}}{\text{The number of employees}} \times 100 \quad (1).$$

- The frequency of cases of HF by the studied class of the disease per 100 employed separately for men and women:

$$C_{MDT}^i = \frac{\text{The number of cases of TD by the studied class of the disease}}{\text{The number of employees}} \times 100 \quad (2),$$

$C_{MDT}^i$  —  $i$ th frequency coefficient of TD cases for the  $i$ -class of diseases in accordance with ICD-10

- Average duration of one case of TD due to diseases separately for men and women (in days):

$$\text{The average duration of one case of TD} = \frac{\text{The number of days of TD due to diseases}}{\text{The number of cases of TD due to diseases}} \quad (3).$$

The authors analyzed indicators of the frequency of TD due to diseases and the average duration of one case of disability in total for all classes of illnesses in men and women in the Russian Federation in dynamics over five years (2014–2018).

The different intensity of influenza and acute respiratory viral infection epidemics, as well as possible abnormal weather conditions that can provoke an exacerbation of chronic diseases, may be the reason for the high variability in the frequency of TD in some years. We calculated more stable indicators, the 5-year average (2014–2018) characteristics of TD for the leading classes of diseases separately for men and women.

The leading classes included those diseases that were most often the cause of disability:

- respiratory diseases (J00–J99),
- diseases of musculoskeletal and connective tissue (M00–M99);
- diseases of the circulatory system (I00–I99),
- diseases of the digestive system (K00–K93);
- other diseases.

The class "Other diseases" included those classes of diseases whose frequency did not exceed one case per year per 100 male workers and two points per 100 female workers.

Researchers analyzed for the listed classes the TD indicators in the five-year age groups for each of the sexes.

In the analysis, we drew attention to the first age group (15–19 years), in which there is an inadequately high incidence rate, both in comparison with the group (20–24 years) and in contrast with the average indicators for men and women (exceeding 3.5 times). We had strong fluctuations in indicators in some years. On the one hand, to the relatively small number of employees aged 15–19 years (in all the surveyed years, which ranged from 0.4 to 0.7% of the total number of working men and women), and on the other, to a possible systematic error associated with different approaches to the examination of TD. Up to and including 18, pediatricians give sick leave to working teenagers. It was the reason for excluding the age group of 15–19 years from further statistical analysis of age-related data on TD due to diseases.

Due to the absence of data on the distribution of days of temporary disability by age in the form of 16-TD, the researchers analyzed the indicators of the average duration of one case of disability without taking into account the age aspect.

At the second stage of the study, the authors analyzed TD indicators due to injuries, poisoning, and other consequences of exposure to external causes according to a similar scheme.

We carried out the data processing using the Microsoft office 2013 package spreadsheets.

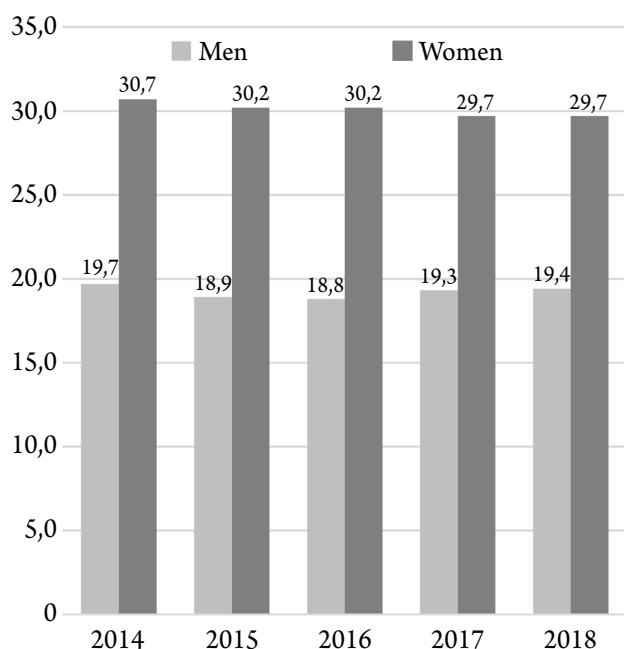
**Results. TD due to diseases.** The analysis of the dynamics of the frequency of TD in connection with illnesses per 100 employed during 2014–2018 testified to decline by 1.5% in men (from 19.7 to 19.4 per 100 employed men) and 3.3% in women (from 30.7 to 29.7 per 100 employed women), although differences in some years was more pronounced (**Fig. 1A**).

The average duration of one case of MTD in the specified period also decreased (**Fig. 1B**). In 2014–2018, the indicator decreased by 1.5% in men and 2.4% in women.

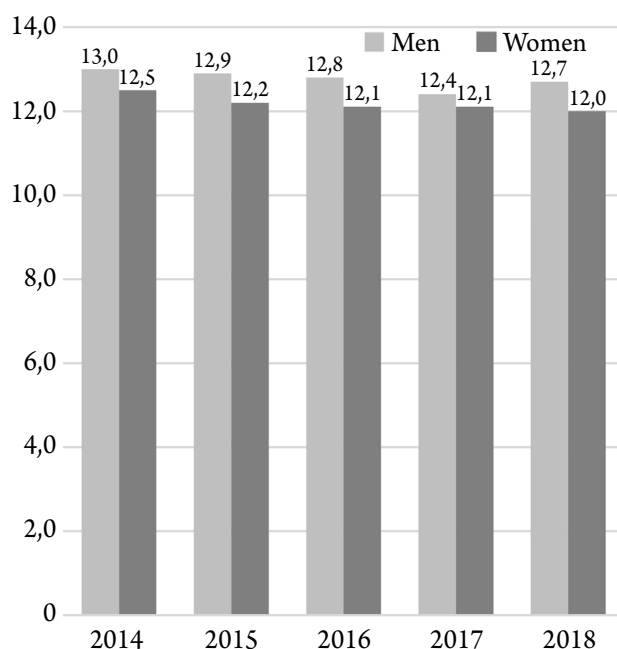
The incidence of temporary disability among women was about 1.5 times higher than men. However, on the contrary, the average duration of one case of disability was higher in men, although the differences were not so pronounced and ranged from 2.4% to 5.5% in different years (**Fig. 1B**).

As mentioned earlier, to obtain more stable morbidity characteristics with temporary disability in the Russian Federation, scientists conducted further analysis using averaged data for five years (2014–2018). We evaluated the parameters of the incidence of diseases were assessed separately for men and women by leading classes of conditions and 5-year-old age groups.

The structure of TD due to diseases in both men and women (70–80%) consists of four classes — diseases of the respiratory system, diseases of the musculoskeletal system, diseases of the circulatory system (DCS), and conditions of the digestive system. The share of other diseases classified



**Fig. 1A. Dynamics of the frequency of MTD cases due to diseases in men and women in Russia for 2014–2018 (per 100 employees).**



**Fig. 1B. Dynamics of the average duration of one case of MTD in men and women in Russia for 2014–2018 (days).**

as "other" classes accounted for 17.5% in men and 29.8% in women.

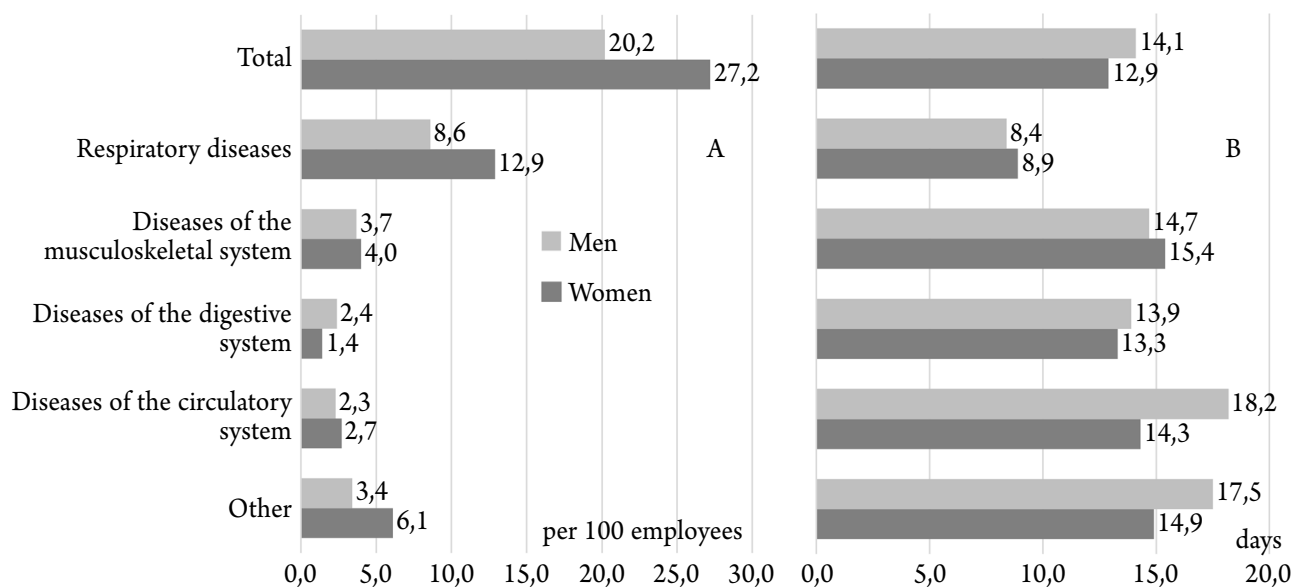
The structure of TD by classes of diseases in men and women was similar. In the first place were respiratory diseases, which accounted for 44.6% in men and 43.0% in women. Diseases of the musculoskeletal system occupied second place. Their specific weight was 19.1% for men and 13.4% for women. The third and fourth most important causes of disability were DCS and digestive system diseases.

Figure 2 shows the indicators of the frequency of cases of high blood pressure due to diseases (A) and the average duration of one case of high blood pressure (B) in men and women according to the data averaged over five years.

On average, 20.2 men and 27.2 women (per 100 employees of the corresponding gender) had at least one sick leave for the disease during the year (Figure 2 A). Respiratory diseases were the most common cause, respectively, 8.6 cases per 100 men and 12.9 points per 100 women. At the same time, the highest rates within the class of respiratory diseases were due to acute respiratory diseases (in men — 6.19 and women — 9.51 out of 100).

Diseases of the musculoskeletal system were in second place. Men have diseases of the digestive system and conditions of the circulatory system, and women have disorders of the circulatory system compared to digestive system diseases.

As indicated, in the section "Materials and methods", the frequency of TD due to diseases grouped into the "Other"



**Fig. 2. The frequency of cases of MTD (per 100 employees) (A) and the average duration of one case of MTD (days) (B) by the main classes of diseases in men and women in Russia on average for 2014–2018.**

group was significantly lower. Diseases of the genitourinary system occupied the most specific weight, the frequency of which was 0.6 cases per year per 100 employed men and 2.1 points per 100 employed women and a class of neoplasms, the corresponding indicators for which were 0.4 and 1.1 per 100 employees. On the other hand, the frequency of TD for all other courses of diseases included in the "other" group was significantly lower.

If we talk about the average duration of one case of high blood pressure in four classes of diseases, then the most extended sick leave for employees was for DCS — 18.2 days for men and 14.3 days for women (**Fig. 2B**). Due to musculoskeletal system diseases, the duration of one case of disability was slightly longer in women (15.4 days) than in men (14.7 days). Both for men and women, the shortest sick leave was registered due to respiratory diseases, respectively, 8.4 and 8.9 days.

We can explain the high average duration of disability due to illness for diseases included in the "other" group because many rare diseases have a more extended period of each case. Thus, the average time of one day of sick leave for neoplasms averaged 30.7 days for men and 24.6 days for women from 2014 to 2018. The sick leave for infectious and parasitic diseases averaged 27.2 days and 19.7 days, respectively, for blood and hematopoietic organs — 20.4 and 18.6 days, etc. However, as a cause of disability, these diseases were rare.

The next stage of the work was analyzing the incidence rate depending on age. **Figure 3** shows the coefficients of the frequency of TD in total from all causes for 5-year-old age groups on average for 2014–2018.

We recorded the highest rate in the younger age group (20–24 years). The researchers observed a sharp decrease in the incidence rate at the age of 25–29 years in both men and women, and it remained relatively stable for an extended period. Starting from the age of 50, workers get sick more often, and in the age group of 60 years and older, the frequency of cases of disability reaches a maximum.

The most common pathology in all age groups, without exception, in men and women were respiratory diseases. Workers often suffered from acute respiratory viral infections, influenza, and colds at the age of 20–24 years (14.7 cases per 100 employed men and 24.4 per 100 employed women)

(**Table**). However, in all subsequent periods, including the oldest, the incidence of diseases was lower in both sexes.

The authors identified the other trends during analyzing the age-related indicators of the frequency of cases of high blood pressure in connection with diseases of the musculoskeletal system (**Table**). There was a consistent increase in the incidence of diseases from younger to older groups with a maximum of 60 years or more. For example, if at the age of 20–24 the number of cases of high blood pressure was 2.2 per 100 working men and 2.0 — women, then in the older age group, the incidence rate was 2.9 times higher in men and 3.7 times higher in women.

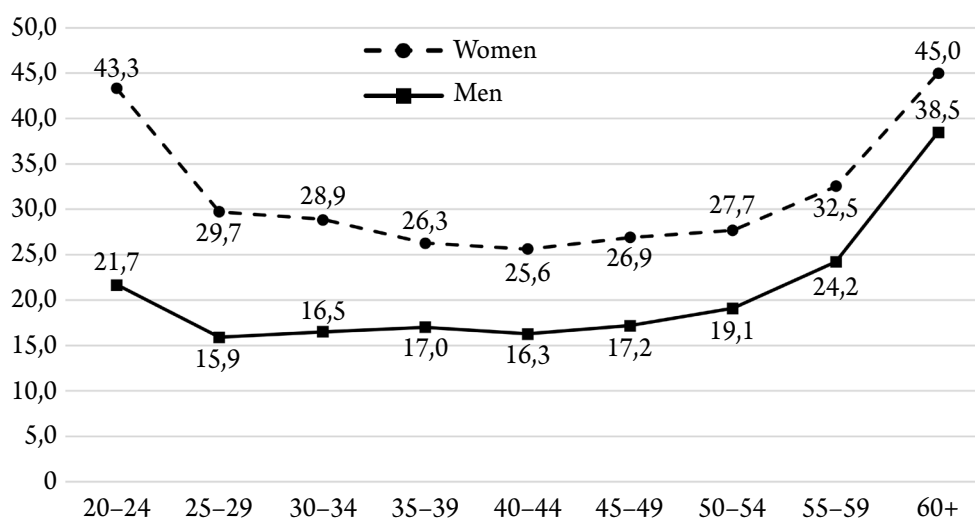
We observed the maximum differences in the levels of age-related TD coefficients when analyzing the indicators for the BSK class. The frequency of this pathology at the age of 20–24 years was 0.4 cases per 100 employees in men and 0.3 — in women, and at the age of 60+, respectively, 10.5 and 10.8 points, i. e., the increase was 25–35-fold. It reflects the general trends in this class of diseases (**Table**).

Another common cause of morbidity was diseases of the digestive system. We recorded the highest rates of high blood pressure in the youngest and two older age groups (**table**). By the age of 25–29 years, the incidence decreases by 1.5–2 times. In older age groups, both in men and women, the frequency of TD consistently increases due to the increasing spread of chronic pathology of the digestive organs.

**TD due to the effects of external causes.** The authors devoted a separate section of the study to TD due to injuries, poisoning, and other consequences of exposure to external causes. The analysis of the dynamics of the frequency of cases of disability due to external causes indicated a decrease in the indicator in Russia during 2014–2018. Despite the stagnation in the last 2–3 years, in 2018, the needle became lower compared to 2014 for men by 14.2%, for women by 8.3% (**Fig. 4A**).

As for gender differences, the frequency of temporary disability in men was 1.3–1.5 times higher than in women in all years.

The indicator of the average duration of one case of high blood pressure due to injuries and poisoning for the period 2014–2018 increased slightly (by 2% in men and by 2.9% in



**Fig. 3. The frequency of cases of MTD from all causes in the aggregate in men and women in Russia on average for 2014–2018 (per 100 employees).**

**Частота случаев временной нетрудоспособности у мужчин и женщин в отдельных возрастных группах по основным классам заболеваний в России в среднем за 2014–2018 гг, (на 100 занятых)**

Sex	Age, years								
	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60+
<b>Respiratory diseases</b>									
Men	14.7	9.7	8.8	8.5	6.8	6.3	6.2	7.1	10.7
Women	24.4	14.1	12.8	11.4	11.0	10.8	10.5	12.3	15.2
<b>Diseases of the musculoskeletal system</b>									
Men	2.2	2.3	3.1	3.5	3.8	4.0	4.4	5.2	6.3
Women	2.0	1.7	2.6	3.5	4.3	5.0	5.4	5.9	7.3
<b>Diseases of the digestive system</b>									
Men	1.5	1.1	1.2	1.2	1.2	1.3	1.3	1.6	2.4
Women	1.9	1.1	1.1	1.2	1.3	1.4	1.5	1.8	2.4
<b>Diseases of the circulatory system</b>									
Men	0.4	0.4	0.7	1.0	1.6	2.5	3.7	5.7	10.5
Women	0.3	0.4	0.7	1.2	2.1	3.2	4.4	6.2	10.8
<b>All diseases</b>									
Men	21.7	15.9	16.5	17.0	16.3	17.2	19.1	24.2	38.5
Women	43.3	29.7	28.9	26.3	25.6	26.9	27.7	32.5	45.0

women) (Fig. 4B). At the same time, in women, the duration of disability due to injury was, on average, two days longer than in men.

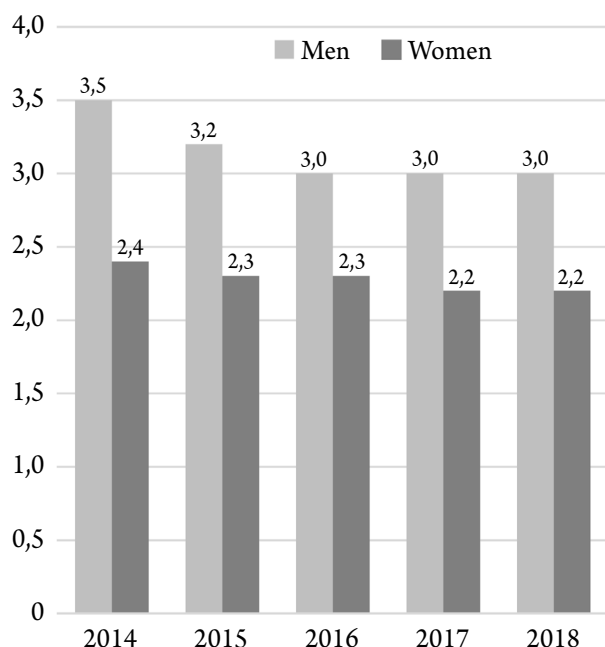
The following figure shows the age-related indicators of the frequency of HF on average for the period 2014–2018 (Fig. 5).

We recorded the highest incidence of high blood pressure in men due to accidents at 20–24 years. In subsequent age groups it decreased to a minimum at the age of 50–54 years, and then increased again, especially

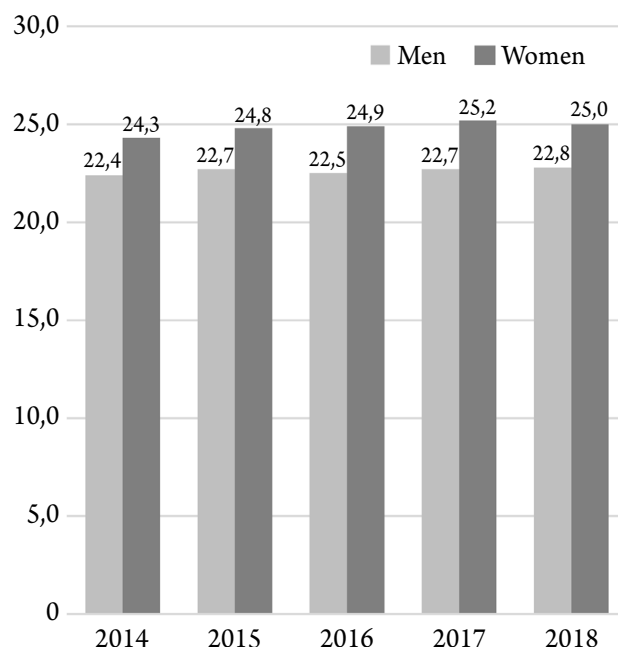
sharply after 60 years, but did not reach the initial level.

In women, as shown in Figure 5, the dynamics of age-related coefficients were different. First, it draws attention to the fact that, unlike morbidity, the frequency of disability due to accidents in women was significantly lower than in men.

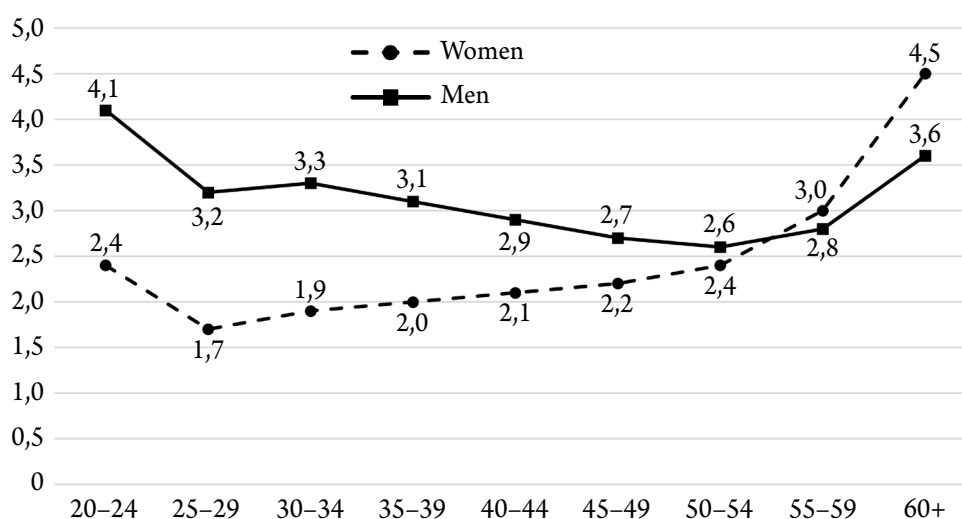
We observed the maximum differences at 35–39 years, where the female level of injury was about 1.5–2 times lower. Then the age curves consistently converged, and at the age of 60 years and older, the level of high blood



**Fig. 4A. Dynamics of the frequency of cases of TD due to injuries and poisoning in men and women in Russia in 2014–2018 (per 100 employees).**



**Fig. 4B. Dynamics of the average duration of 1 case of TD due to injuries and poisoning in men and women in Russia in 2014–2018 (days).**



**Fig. 5. Age-related indicators of TD due to injuries and poisoning in men and women in Russia on average for 2014–2018 (per 100 employees).**

pressure due to accidents in women was a quarter higher than in men.

**Discussion.** The study results of data on high blood pressure due to diseases in Russia from 2014 to 2018 indicated a slight decrease in the incidence of conditions and the average duration of one case of disability. The authors noted similar trends by other authors when studying the dynamics of TD indicators in previous years, both in Russia as a whole and in individual regions, as well as at several industrial enterprises [8, 11–16].

Literature data on the structure of morbidity with a temporary disability indicate its stability. In the past and present, diseases of the respiratory system, musculoskeletal system, circulatory system, and digestive organs make the most significant contribution to the structure of labor loss in men and women [8, 11]. The study also confirmed that in the Russian Federation, the listed four classes of causes account for 70–80% of the total structure of the TD for diseases.

Researchers revealed, when analyzing the indicators of temporary disability, significant gender differences. In addition, it draws attention to the fact that in all diagnosed years for all classes of diseases, except for diseases of the digestive system, the incidence of infections in men is recorded significantly less frequently than in women. At the same time, the duration of sick leave for chronic forms of pathology, on the contrary, is higher. On the one hand, the results obtained indicate that women are more active in visiting medical institutions [17]. On the other hand, this may mean "latent" disability prevalence among men [18]. Men seek medical help less often and later, which leads to an increase in the severity of the disease and, as a result, a longer time for treatment and recovery [19]. So, according to RLMS-HSE data for 2016, there was a statistically significant moderate association between the presence of health problems in the respondent and his seeking medical help. However, more than half (66%) of the respondents, experiencing any health problems, do not immediately consult a doctor, and most often, they are men [18].

We noted that the gap in the incidence rates of men and women was not the same in different age groups.

The most significant discrepancies were observed in young workers aged 20–24 years for all diseases. Women were 1.8–2.0 times more likely than men to take sick leave

at this age. Further, the gap in the health indicators of men and women consistently decreased, reaching a minimum at the age of 60 years and older. We obtained the similar results in other studies [11].

The age dynamics of individual classes of diseases had significant differences.

Thus, the most common cause of TD is respiratory diseases, mainly represented by ARVI and influenza, which were most often registered in the age group of 20–24 years, which may be due to a decrease in immunity at the beginning of work.

The adaptation period for young workers can be tricky. However, with increasing age, the frequency of TD due to respiratory diseases decreased, and in the following age groups was lower by 1.4–2.4 times in men and 1.6–2.3 times in women.

This is also noted by other authors [17].

Chronic forms of pathology, such as DCS and diseases of the musculoskeletal system, on the contrary, were characterized by a consistent increase in the frequency of infections with age and a maximum in the age group of 60 years and older, which confirms the high prevalence of chronic pathology in workers of pre-retirement and retirement age, and they are more frequently seeking medical help. Moreover, the results obtained are consistent with other researchers' data [18].

The curve of age-related TD indicators in connection with digestive system diseases occupied an intermediate position. On the one hand, this class of diseases was characterized by a high incidence in the younger age group, and on the other hand, as the age increased, it increasingly became the cause of TD and other chronic diseases.

The high incidence of digestive diseases in young people may be associated with unhealthy food (fast food) and drinks. In addition, young women often have problems with the state of the gastrointestinal tract against the background of experiments with various diets aimed at losing weight. The high level of high blood pressure at the age of 60 years and older is due to the increasing prevalence of chronic pathology in workers of pre-retirement and retirement age.

TD indicators due to accidents and other consequences of exposure to external causes had distinctive features. For example, the frequency of cases of disability during

2014–2018, in contrast to the TD for diseases, decreased faster and was accompanied, albeit slightly, by an increase in the average duration of one sick leave for both men and women. Another feature was that the frequency of accidents was significantly higher in men, which may be explained by their riskier behavior, especially at a young age. This is due to extreme sports and entertainment, confidence in their physical abilities, preliminary assessment of the danger, etc. This feature of male behavior is also noted by other authors [19].

After the age of 60, there was a sharp increase in the frequency of TD due to injuries and accidents, which is due to aging, expressed in men in a decrease in the accuracy and accuracy of the movements performed, which should be especially considered in the conditions of extending their working-age to 65 years. On the other hand, in women in the oldest age groups, the level of injuries increases sharply, exceeding by a quarter the same indicator in men, mainly

due to age-related changes, increased bone fragility due to a decrease in bone density, and other reasons.

Employers, occupational safety, and preventive medicine authorities should consider the gender and age characteristics of morbidity and injury and step-up efforts to reduce the risks of disability and labor loss by both young workers and workers of older age groups [18].

**Conclusion.** Thus, the data obtained during the analysis of the internal health of workers of the Russian Federation due to diseases, as well as due to injuries and other consequences of exposure to external causes, can be an essential information base that contributes to improving the effectiveness of programs aimed at preventing diseases, their timely detection and treatment, reducing periods of disability, preserving the health of workers and the labor potential of the country. In addition, given the differences in the levels of morbidity of workers by gender and age, it is necessary to intensify efforts to reduce the risks of disability by young workers, especially men.

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