

УДК: 616-036.86:614.8.067.1:616-001.28

В. О. Сушко✉, О. О. Колосинська

*Державна установа «Національний науковий центр радіаційної медицини Національної академії медичних наук України», вул. Юрія Ілленка, 53, м. Київ, 04050, Україна*

## СТРУКТУРА ТА ХАРАКТЕРИСТИКА ПОСТРАЖДАЛИХ ВНАСЛІДОК АВАРІЇ НА ЧОРНОБИЛЬСЬКІЙ АЕС ЗА МАТЕРІАЛАМИ МЕДИЧНОЇ ЕКСПЕРТИЗИ ЩОДО ПРИЧИННО-НАСЛІДКОВОГО ЗВ'ЯЗКУ ЗАХВОРЮВАНЬ З ДІЄЮ ІОНІЗУЮЧОГО ВИПРОМІНЮВАННЯ У ВІДДАЛЕНИЙ ПІСЛЯАВАРІЙНИЙ ПЕРІОД (2023 рік)

Втрата здоров'я та працездатності, а також смертельні випадки внаслідок шкідливого впливу Чорнобильської катастрофи (у тому числі радіаційного опромінення) під час виконання професійних, військових чи службових обов'язків та/або проживання на радіаційно забруднених територіях, що є додатковим опроміненням не з власної вини, а внаслідок радіаційної аварії, зумовили розвиток особливої форми медичної експертизи як складової системи медичного соціального захисту для цих постраждалих контингентів.

**Мета.** Дослідити та охарактеризувати структуру постраждалих категорій (учасників ліквідації наслідків аварії та потерпілих) внаслідок Чорнобильської катастрофи за матеріалами експертних справ Центральної міжвідомчої експертної комісії МОЗ України (ЦМЕК) у віддалений післяаварійний період (2013–2023 рр.).

**Матеріал і методи.** Робота виконана в дизайні ретроспективного дослідження, що базується на аналізі структури всіх категорій постраждалих внаслідок аварії на Чорнобильській АЕС (ЧАЕС) протягом 2008–2023 років та вивченні матеріалів більше 57 000 медичних експертних справ, що розглядалися ЦМЕК протягом 2013–2022 рр. для встановлення причинно-наслідковий зв'язок між захворюванням і впливом радіаційного опромінення та іншими шкідливими факторами і умовами під час аварії на ЧАЕС.

**Результати.** Загальна кількість постраждалих дорослих громадян станом на 01.01.2023 р., порівняно з 2008 р., зменшилася на 511 877 осіб, або на 27,90 % (з 1 834 536 до 1 322 659 осіб). Кількість учасників ліквідації наслідків аварії зменшилася з 276 327 (2008) до 162 180 (2023 рік), або на 114 147 осіб (41,30 %), тобто – за останні 15 років помер майже кожен третій-другий учасник робіт з ліквідації наслідків аварії на ЧАЕС. Кількість дорослих постраждалих зменшилася з 1 558 209 у 2008 році до 1 160 479 у 2023 році, або на 25,52 % (397 730 осіб). У структурі медичних експертних справ протягом 2013–2023 років провідне місце за причинами захворювань, інвалідності та смерті займають онкологічні захворювання – 60,3 %, цереброваскулярні захворювання та їх ускладнення складають 10,00 %, захворювання серцево-судинної системи – 19,6 %.

**Висновок.** У віддалений післяаварійний період (2013–2023 рр.) зростає потреба в експертизі причинно-наслідкового зв'язку інвалідності та причин смерті з впливом наслідків аварії на ЧАЕС для медико-соціальної підтримки постраждалих. Впродовж 2013–2023 років мало місце прискорене скорочення чисельності всіх категорій постраждалих внаслідок аварії на Чорнобильській АЕС. У структурі медико-експертних справ протягом 2013–2023 років провідне місце як причина захворювання, інвалідності та смерті займають онкологічні, серцево-судинні та цереброваскулярні захворювання.

**Ключові слова:** іонізуюче випромінювання, учасники ліквідації наслідків аварії та потерпілі внаслідок аварії на Чорнобильській АЕС, медична експертиза, Чорнобильська катастрофа.

*Проблеми радіаційної медицини та радіобіології. 2023. Вип. 28. С. 424–430. doi: 10.33145/2304-8336-2023-28-424-430*

✉ Сушко Віктор Олександрович, e-mail: [pulmorad@gmail.com](mailto:pulmorad@gmail.com)

V. O. Sushko✉, O. O. Kolosynska

State Institution «National Research Center for Radiation Medicine of the National Academy of Medical Sciences of Ukraine», 53 Yurii Illienka Street, Kyiv, 04050, Ukraine

## STRUCTURE AND CHARACTERISTICS OF THE CHORNOBYL NPP ACCIDENT VICTIMS ACCORDING TO THE MATERIALS OF MEDICAL EXPERTISE OF THE CAUSAL RELATIONSHIP OF DISEASES WITH THE EFFECT OF IONIZING RADIATION IN THE REMOTE POSTACCIDENTAL PERIOD (2023 year)

Loss of health and workability, as well as deaths due to harmful influence of the Chernobyl catastrophe (including radiation exposure) during performance of professional, military or official duties and / or living on radiation-contaminated areas, additional exposure not through their own fault but due to a radiation accident, caused the development of a special form of medical expertise as part of the of medical social protection system for these suffered contingents.

**Objective.** To study and characterize the structure of the affected categories (clean-up workers and victims) of the Chernobyl catastrophe based on the materials of expert cases of the Central Interdepartmental Expert Commission of Ministry of Health of Ukraine (CIEC) in the remote post-accidental period (2013–2023).

**Material and methods.** The work was performed in the design of a retrospective study that based on analysis of the structure of all categories of Chernobyl NPP accident (ChNPP) victims during 2008–2023 years and studying of more 57 000 medical expert cases, which were considered by CIEC during 2013–2022 to establish a causal relationship between the disease and influence of radiation exposure and other harmful factors and conditions during ChNPP accident.

**Results.** The total number of affected adult citizens as on 01.01.2023, compared to 2008, decreased by 511,877 persons, or by 27.90 % (from 1,834,536 to 1,322,659 persons). The number of clean-up workers of the accident decreased from 276,327 (2008) to 162,180 (2023), or by 114,147 people (41.30 %), that means – during the last 15 years, almost every third-second clean-up worker who participated in the liquidation of the consequences of the accident at the ChNPP died. The number of adult victims decreased from 1,558,209 in 2008 to 1,160,479 in 2023, or by 25.52 % (397,730 persons). In the structure of medical expert cases during 2013–2022 the leading place as the reason of disease, disability and death is occupied by oncological diseases – 60.3 %, cerebrovascular diseases and their complications make up 10.00 %, diseases of the cardiovascular system – 19.6 %.

**Conclusion:** In the remote post-accidental period (2013–2023) has increased the need of expertise of the causal relationship of disability and the causes of death with the influence of the ChNPP accident consequences for medical and social support. During 2013–2023 period quick reducing for all categories of affected due to the Chernobyl NPP accident taken place. In the structure of medical expert cases during 2013–2023 the leading place as the reason of disease, disability and death is occupied by oncological, cardiovascular and cerebrovascular diseases.

**Key words:** ionizing radiation, clean-up workers and victims of Chernobyl NPP accident, medical expertise, Chernobyl catastrophe.

*Problems of Radiation Medicine and Radiobiology. 2023;28:424-430. doi: 10.33145/2304-8336-2023-28-424-430*

### INTRODUCTION

One of the key issues to minimize the consequences of the Chernobyl NPP (ChNPP) became the problem of medical and social expertise of victims [1, 2] for determine losing of health, workability and life. The basis of social protection of the Chernobyl accident victims is till our days is the of the Law of Ukraine «On status and social protection of citizens affected by the

Chernobyl catastrophe» ratified by the Verkhovna Rada (Ukrainian Parliament) on April 1, 1991 with updating [3]. The 12<sup>th</sup> Article of this low is dedicated to «Establishing a causal link between the disease connected to the Chernobyl catastrophe, partial or complete disability of citizens affected by the Chernobyl catastrophe and the Chernobyl catastrophe». Of significant influence on making decisions in this issue are also

✉ Viktor O. Sushko, e-mail: pulmorad@gmail.com

articles 2, 14, 27 of these documents [4]. According to the decision of Government Commission № 539 from August 13, 1988 in agreement with the Trade-Unions and Goskomtrud of USSR the order of Ministry of Health No 731 from September 28, 1988 was issued «On the organization of the Central Interdepartmental Expert Council to establish causation of disease and disability with the works at the aftermath of ChNPP accident and their professional nature at the All-Union Research Center for Radiation Medicine Academy of Medical Sciences» [4].

**OBJECTIVE**

To study and characterize the structure of the affected categories (clean-up workers and victims) of the Chernobyl catastrophe and clinical pathology of those persons based on the materials of expert cases of the Central Interdepartmental Expert Commission (CIEC) in the remote post-accidental period (2013–2022).

**MATERIALS AND METHODS**

The work was performed in the design of a retrospective study that based on analysis of the structure of all categories of ChNPP accident victims during 2008–2023 years and studying of more 57 000 medical expert cases, which were considered by CIEC during 2013–2022 to establish a causal relationship between the development and progression of disease that leads to

disability and death and influence of radiation exposure and other harmful factors and conditions during ChNPP accident using a systematic analytical approach to assessing the medical and nonmedical parameters presented in medical expert documentation.

In accordance with the requirements of current regulations, the materials of expert cases included documents confirming the status (category) of the victim, passport data and information about the place of residence, professional history and experience, medical documentation regarding health before and after the ChNPP accident, results of outpatient and inpatient examination and treatment (if necessary – the results of morphological examinations, in case of death – autopsies), also a certificate of permanent disability [5–9]. The analysis of every cases was performed under the condition of the diagnosis verification by the members of the expert group, approved by the voting protocol of the CIEC members.

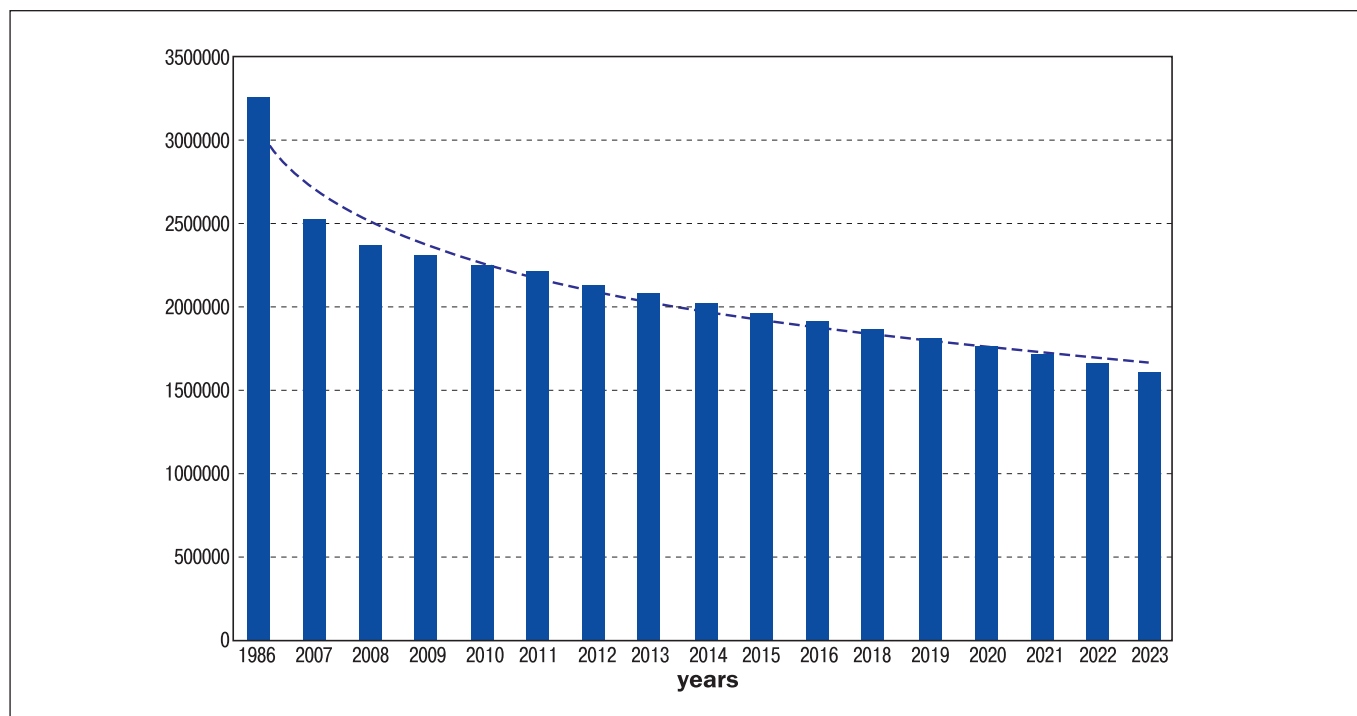
**RESULTS AND DISCUSSION**

On 01.01.2023 the status of victims of the Chornobyl catastrophe in Ukraine had 1,613,434 persons, including 290,775 children (Table 1).

Reducing the number of all categories of affected due to the ChNPP accident for the period of 1986–2023 shown in Fig. 1. The total number of affected adult citizens as on 01.01.2023, compared to 2008, decreased

**Table 1**  
**The number of people who have the status of affected under the Chornobyl Catastrophe on January 1, 2023**

Name of indicators	Number
<b>Total number of affected persons</b>	<b>1 613 434</b>
of them:	
► clean-up workers of the Chornobyl NPP accident including the following categories:	162 180
◆ category 1 «А» from the number of clean-up workers of the Chornobyl NPP accident (persons with disabilities i.e. invalids)	49 566
> I group of disability	1 928
> II group of disability	31 316
> III group of disability	16 522
◆ category 2 «А» from the number of clean-up workers of the Chornobyl NPP accident	89 621
◆ category 3 «А» from the number of clean-up workers of the Chornobyl NPP accident	22 993
► victims of the Chornobyl catastrophe including the following categories:	1 451 254
◆ category 1 «Б» («B») from the number of victims of the Chornobyl catastrophe (persons with disabilities (invalids):	49 188
> I group of disability	2 499
> II group of disability	25 651
> III group of disability	21 038
◆ category 2 «Б» («B») from the number of victims of the Chornobyl catastrophe	48 221
◆ category 3 «Б» («B») from the number of victims of the Chornobyl catastrophe	338 425
◆ category 4 «В» («V») from the number of victims of the Chornobyl catastrophe	723 393
◆ category 4 «Г» («G») from the number of victims of the Chornobyl catastrophe (persons who worked outside the exclusion zone in particularly harmful working conditions – ionizing radiation and open sources of ionizing radiation)	1 252
◆ series category «Д» (victim children)	290 775
> category «Д» («D») with disabilities (children-invalids):	1 181



**Figure 1.** The number of all categories affected under the Chernobyl NPP accident reducing for the period during 1986–2023

by 511,877 persons, or by 27.90 % (from 1,834,36 to 1,322,659 persons).

During 2008–2023, the number of clean-up workers of the accident decreased from 276,327 to 162,180, or by 114,147 people (41.30 %), that means – during the last 15 years, almost every third-second participant in the liquidation of the consequences of the accident at the ChNPP died.

The number of adult victims decreased from 1,558,209 in 2008 to 1,160,479 in 2023, or by 25.52 % (397,730 persons). The number of children affected by the ChNPP accident has decreased from 534,568 in 2008 to 290,775 in 2023, or by 243,793 (45.60 %). Regarding the reduction of the number of this category, it is necessary to take into account the loss of the status of victims by children upon reaching the age of majority according to the current legislation.

It is impossible to miss the characteristics of the victims of the ChNPP accident such a painful and socially important indicator as 41,629 people who have the status of wife / husband of the deceased citizen whose death was related to the Chernobyl catastrophe.

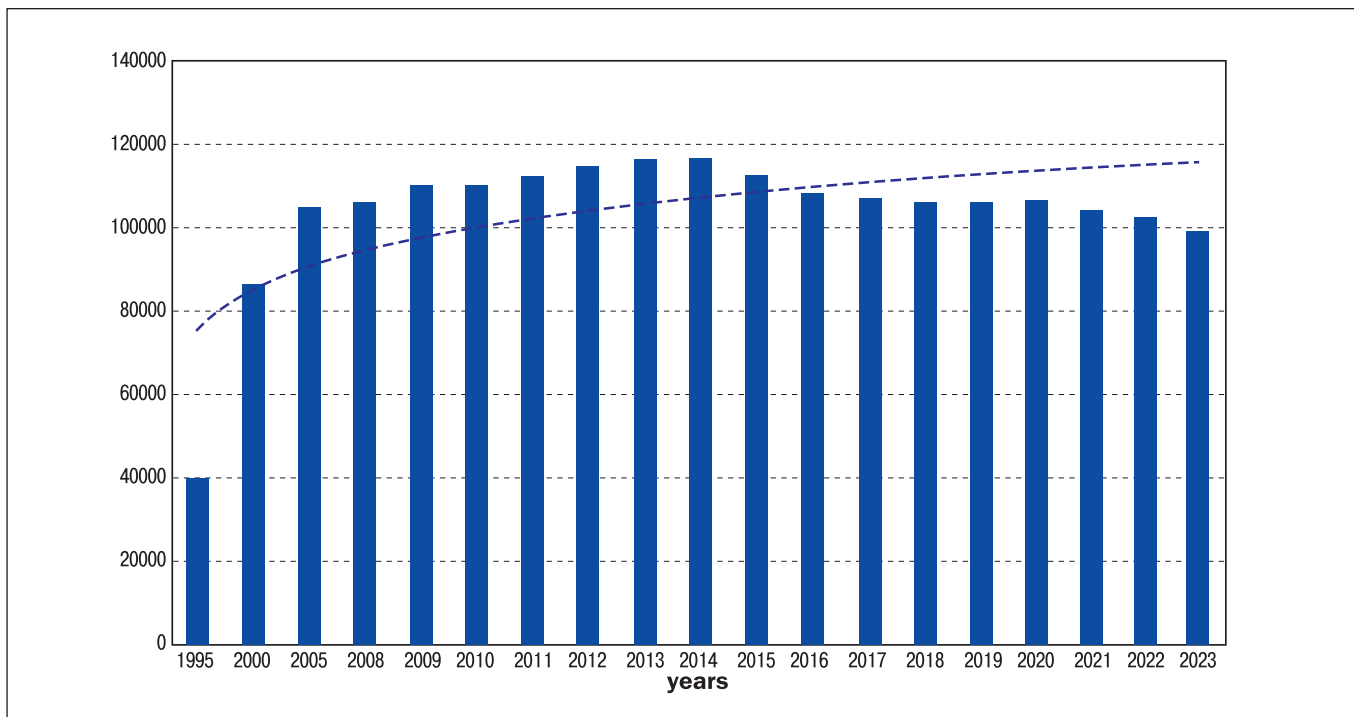
Expertise to establish the causal relationship of diseases, disabilities and causes of death with the action of ionizing radiation and other harmful factors of the ChNPP accident are persons who, according to current legislation, have the status of victims of the Chernobyl catastrophe [4].

CIEC provides medical expertise to establish causation of disease, leading to loss of health, disability and death with the action of ionizing radiation and other harmful factors of the Chernobyl catastrophe with the impact of the radiation and nonradiation consequences of the ChNPP accident for all citizens of Ukraine who have the status of victims of the Chernobyl catastrophe and performs the role of a conflict appeal commission [5–9].

Category 1 of victims of the accident at the Chernobyl NPP is the most critical in terms of loss of health and work capacity, as it consists of persons who have the status of victims of the accident at the Chernobyl NPP and have lost work capacity due to diseases for which has been established a causal relationship with the impact of the consequences of the ChNPP accident.

During the period 1995–2014, there was a fast increase in the number of victims of category 1 (from 40,106 to 117,158). During 2015–2023 there is a gradual decrease in the number of victims of this category from 113,268 on January 1, 2015 to 99,225 on January 1, 2023 (Fig. 2).

When significant decrease in the total number of clean-up workers of ChNPP accident taken place from 243,456 persons in 2013 to 162,180 in 2023 (or by 81,276 persons, 33.38 %), the number of clean-up workers who have the 1st category decreased by 17,943 persons (from 67,509 in 2013 to 49,566 in 2023, or by



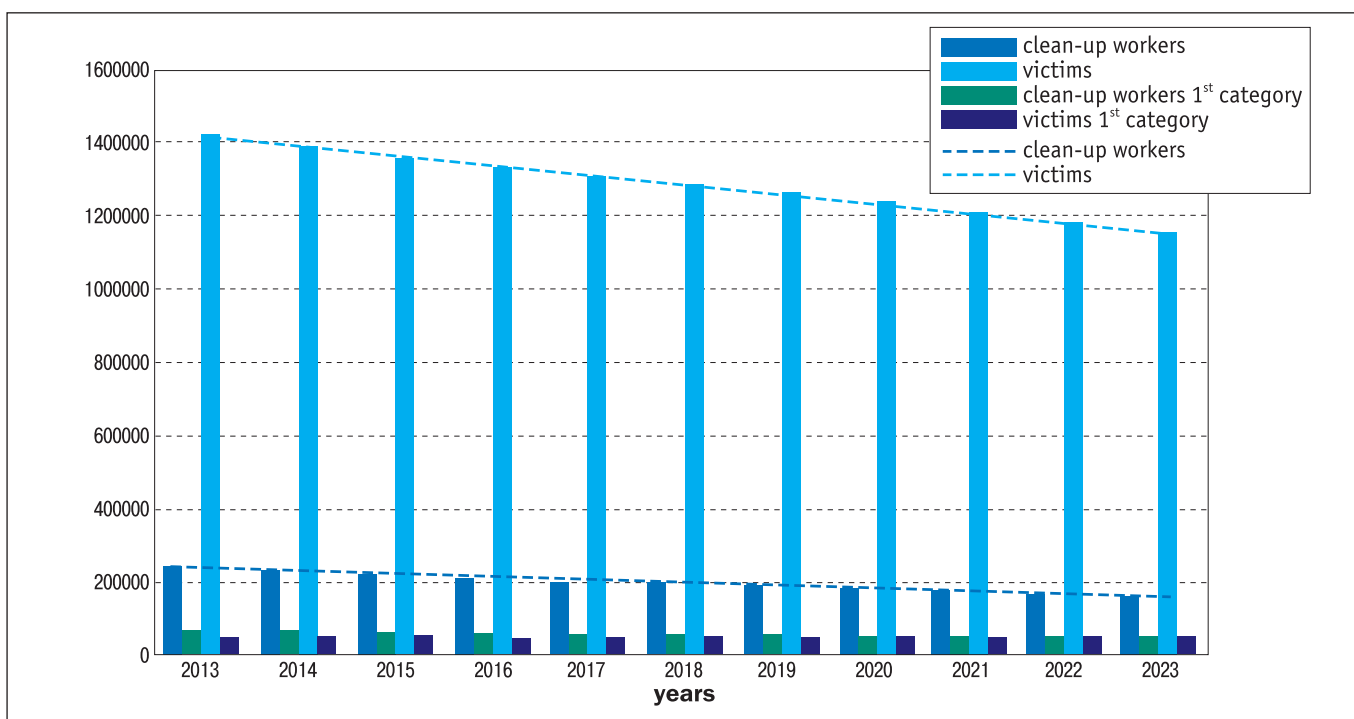
**Figure 2. Number of ChNPP accident victims of the 1<sup>st</sup> category during 1995–2023**

26.58 %). At the same time the relative number of clean-up workers who have the 1st category was 27.73 % in 2013 and 30.56 % in 2023 (Fig. 3).

The total number of adult victims also significantly decreased during 2013–2023: from 1,426,427 persons in 2013 to 1,160,479 in 2023 (or by 265,948, 18.64 %). At the same time the absolute number of victims of the 1<sup>st</sup> category significantly didn't change – decreased by

61 people (from 49,249 in 2013 to 49,188 people in 2023). The relative number of victims who have the 1<sup>st</sup> category was 3.45 % in 2013 and 4.23 % in 2023 (Fig. 3).

Thus, during 2013–2023, there is a fast decrease in the total number of all categories of victims with a significant reduction in the absolute number of clean-up workers of ChNPP accident who have the 1st category and the relative stability of the number of the cohort of



**Figure 3. The structure and ratio of the number of main categories of victims and number of victims who have the 1<sup>st</sup> category during 2013–2023**



adult victims of category 1. It should be taken into account that this relative stability of the number of victims of adult age who have the 1st category is formed from the ratio of losses of persons of this cohort and its replenishment due to the establishment of causation of disease, leading to loss of health, disability and death with the action of ionizing radiation and other harmful factors of the ChNPP accident in the remote post-accidental period from categories 2 А and 2 Б (B), 3 А and Б (B), 4B (V).

The average annual reduction in the absolute number of clean-up workers of ChNPP accident during 2013–2023 is about 8,125 people per year (9,424 during 2021 – highest point), adult victims – 26,595 people per year (28,922 during 2021 – highest point).

The main reasons leading to these changes are the increase in the incidence and prevalence of severe chronic disabling diseases, which quickly lead to a decompensated course and the development of complications, which, accordingly, leads to an increase in the mortality rate of the affected population [10].

In total, during 2013–2022, medical expert cases were considered: victims with disabilities – 36,845 cases, cancer patients – 26,876 cases, deceased – 17,680 cases.

Today, in the structure of medical expert cases, the leading place as the reason of disease, disability and death is occupied by oncological diseases – 60.3 %, cerebrovascular diseases and their complications make up 10.00 %, diseases of the cardiovascular system – 19.6 %, chronic diseases of the bronchopulmonary system – 1.6 %, endocrine diseases (without thyroid cancer) – 1.4 %, diseases of the digestive system – 1.1 %, other diseases in general – 6.0 %.

## CONCLUSIONS

1. In the remote post-accidental period (2013–2023) has increased the necessity of expertise of the causal relationship of disability and the causes of death with the influence of the ChNPP accident consequences for medical and social support. The CIEC provided more 57,000 medical expertise of the causal relationship of disability and the causes of death with the influence of the ChNPP accident consequences during this time.
2. During 2013–2023 period quick reducing for all categories of affected due to the ChNPP accident taken place. The total number of affected adult citizens as on 01.01.2023, compared to 2008, decreased by 511,877 persons, or by 27.90 % (from 1,834,536 to 1,322,659 persons).
3. The number of clean-up workers of the accident decreased from 276,327 (2008) to 162,180 (2023), or by 114,147 people (41.30 %), that means – during the last 15 years, almost every third-second clean-up worker who participated in the liquidation of the consequences of the accident at the ChNPP died.
4. The number of adult victims decreased from 1,558,209 in 2008 to 1,160,479 in 2023, or by 25.52 % (397,730 persons).
5. In the structure of medical expert cases during 2013–2022 the leading place as the reason of disease, disability and death is occupied by oncological diseases – 60.3 %, cerebrovascular diseases and their complications make up 10.00 %, diseases of the cardiovascular system – 19.6 %.

## REFERENCES

1. Bazyka DA, Tronko MD, Antypkin YuG, Serdiuk AM, Sushko VO, editors. Thirty-five years of the Chernobyl disaster: radiological and medical consequences, strategies of protection and revival: National Report of Ukraine. Kyiv; 2022. 286 p.
2. Sushko VO, Kolosynska OO, Tatarenko OM, Nezhovorova HA, Berestyana ZhM. [Medical expertise for diseases that cause disability and death as a result of radiation exposure in conditions of the Chernobyl catastrophe (remote postaccidental period)]. *Journal of the NAMS of Ukraine*. 2019;25(1):5-12. Ukrainian.
3. [On Status and Social Protection of Population Suffered from Chernobyl Catastrophe]. The Law of Ukraine No. 796-XII (February 28, 1991) with changes and additions (09.08.2019) (Available from: <http://zakon3.rada.gov.ua/laws/show/796-12>. Ukrainian.
4. Ministry of Health of Soviet Union. [On the organization of the Central Interdepartmental Expert Council to establish causation of disease and disability work on liquidation of consequences of the Chernobyl accident and their professional character]. Order No. 731 (Sept 28, 1988). Russian.
5. Ministry of Health of Ukraine. [On approval of normative documents on diseases for which an causal relationship with the radiation exposure and other harmful factors as a result of the Chernobyl accident can be certificated]. Order No. 150 (May 17, 1997). *Ofitsiynyi visnyk Ukrainy*. 1997, Oct 20;(40):57. Code act 4059/1997. Ukrainian.
6. Ministry of Health of Ukraine, Ministry of Emergencies of Ukraine. [On amendments to the order of the Ministry of Health of Ukraine and Ministry of Emergencies of Ukraine No. 166/129 (May 30, 1997)]. Joint order No. 789,1248 (Oct 10, 2012). *Ofitsiynyi visnyk Ukrainy*. 2012;(100):60. Art. 4060, code act 65171/2012. Ukrainian.

7. Cabinet of Ministers of Ukraine. [On increasing the level of social protection of citizens affected by the Chornobyl accident]. Decree No. 1210 (Nov 23, 2011). *Ofitsiyni visnyk Ukrainy*. 2011, Dec 05;(92):41. Art. 3343, code act 59330/2011. Ukrainian.
8. Ministry of Health of Ukraine, Ministry of Emergencies of Ukraine. [On amendments to the order of the Ministry of Health of Ukraine and Ministry of Emergencies of Ukraine No. 166/129 (May 30, 1997)]. Joint order No. 789,1248 (Oct 10, 2012). *Ofitsiyni visnyk Ukrainy*. 2012;(100):60. Art. 4060, code act 65171/2012. Ukrainian.
9. Ministry of Health of Ukraine. [On amendments to the Order of the Ministry of Health of Ukraine No. 150 from May 17, 1997]. Order No. 441 (Jun 14, 2012). *Ofitsiyni visnyk Ukrainy*. 2012, Sept 17;(68):90. Art. 2791, code act 63293/2012. Ukrainian.
10. Sushko VO, Tatarenko OM, Kolosynska OO, Hapieienko DD. The expertise of the causal relationship between the development of arterial hypertension with participation in works for liquidation of the consequences of Chornobyl NPP accident in remote post-accidental period. *Probl Radiac Med Radiobiol*. 2020;25:543-557. doi: 10.33145/2304-8336-2020-25-489-499.

### INFORMATION ABOUT AUTHORS

**Viktor O. Sushko** – MD, Doctor of Medical Sciences, Professor, Corresponding Member of NAMS of Ukraine, First deputy General Director of NRCRM for Research Work, Chief of Division for Medical Expertise and Treatment of Ionizing Irradiation Consequences, Institute for Clinical Radiology, NRCRM, Kyiv, Ukraine, ORCID ID: 0000-0001-6893-8642

**Olena O. Kolosynska** – MD, PhD, Senior Researcher, Head of The Department of Diagnostic and Treatment of Radiation-Induced Pathology of The Division for Medical Expertise and Treatment of Ionizing Irradiation Consequences, Institute for Clinical Radiology, NRCRM, Kyiv, Ukraine, ORCID ID: 0000-0002-2018-3380

---

*Received: 12.09.2023*