

Research Article

Epidemiological Analysis of Alimentary-Dependent Diseases Among Persons of Fertile Age in Environmentally Hazardous Regions of Ukraine

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Abstract

The health status of the Ukrainian population affected by the Chornobyl NPP (ChNPP) accident demonstrates a steady downward trend, manifested by higher growth rates of morbidity compared to national averages. The cohort of individuals of fertile age residing in radiation-contaminated territories (RCTs) requires special attention. A retrospective epidemiological analysis of morbidity and mortality from alimentary and alimentary-dependent diseases (ADDs) was conducted among individuals aged 18–49 cohort living in a region with increased environmental hazard (Zhytomyr and Kyiv regions). Official data from medical registers (SRU) for ICD-10 nosological forms for 2019–2021 were used, with calculations of absolute indicators and case fatality rates (%) for age cohorts (18–29, 30–39, and 40–49 years) and gender. It was established that the primary pathological burden is diseases of the circulatory system (DCS) (Class IX), which dominate the structure of morbidity and mortality across all groups. The highest morbidity and critically high case fatality from ischemic heart disease (IHD) were recorded in the 40–49 age group (IHD fatality reached 69.0% in 2020). Among young persons (18–29 years), hypertensive conditions and diseases of the digestive system (Class XI) dominate. Of particular concern is the critically high case fatality from malignant neoplasms (MN) of the digestive organs among young men aged 30–39, which reached 66.7%, indicating aggressive oncopathology and challenges in early diagnosis. Significant gender differences were identified: women more frequently suffer from alimentary anemias and endocrine pathologies related to iodine deficiency. The epidemiological situation indicates a synergistic effect of unbalanced nutrition and environmental stress, necessitating the development of targeted preventive programs considering age and gender specifics.

Keywords

Chornobyl Disaster, Fertile Age, Extragenital Pathology, Environmental Hazard

1. Introduction

Preserving the health of individuals of fertile age is a decisive component of national health and economic potential [2].

Alimentary and alimentary-dependent diseases (ADDs) represent a global problem of non-communicable diseases (NCDs), acting as key predictors of premature mortality and Disability-

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Received: 11 January 2026; **Accepted:** 3 March 2026; **Published:** 23 March 2026



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Adjusted Life Years (DALY) lost [8]. Critically important ADDs affecting work capacity include diseases of the circulatory system (DCS), type 2 diabetes mellitus (DM), obesity, and certain malignant neoplasms (MN) [9].

The cohort of reproductive-age individuals living in environmentally hazardous regions is of particular scientific and practical interest. Adverse environmental factors (chronic exposure to low doses of ionizing radiation, heavy metals, pesticides, etc.), historically characteristic of certain regions of Ukraine, may interact synergistically with deficient or unbalanced nutrition. This interaction intensifies oxidative stress, immune, and metabolic dysfunctions, thereby potentiating the development and progression of ADDs [12]. Researching the epidemiological situation under such conditions is necessary for accurate risk stratification and the development of evidence-based medical and preventive strategies.

While previous research in radiation-contaminated territories (RCTs) of Ukraine has primarily focused on thyroid cancer and general mortality, no prior study has quantitatively assessed the burden of alimentary-dependent pathologies (specifically circulatory and digestive diseases) among the fertile-age population using a multi-year registry-based analysis (2019–2021) [1, 13]. This study fills this gap by identifying how chronic environmental exposure interacts with nutritional deficiencies in this vital cohort. The aim of the study: To perform a retrospective quantitative assessment and identify the specific features of the epidemiological situation regarding the morbidity and mortality from digestive system diseases (DSD) among individuals of reproductive age (18–49 years) in a region of high ecological risk.

2.3. Research Methods

A retrospective analysis of medical records and morbidity data was conducted. Statistical significance was assessed using the Chi-square test or Fisher's exact test for categorical variables. Differences were considered statistically significant at $p < 0.05$. Where applicable, 95% confidence intervals (CI) were considered for the interpretation of trends. A retrospective and prospective analysis of medical records and morbidity data of fertile-age residents in Kyiv and Zhytomyr regions was conducted for the period 2019–2021. Statistical processing: Determination of absolute (n) and relative (%) frequencies; analysis of the dynamics of anemic states and circulatory disorders [5]. The analytical sample includes $N=140,607$ observations (total registered cases in the SRU for the specified region and period). The data sources included primary medical records (outpatient charts) and the authors' own research (R&D reports of the NRCRM of the AMS of Ukraine, State Reg. No. 01044003644; State Reg. No. 0119U100565; State Reg. No. 0122U001263; and State Reg. No. 0125U001259). Analyzed and evaluated parameters:

2. Materials and Methods

2.1. Study Design and Data Sources

The study is a retrospective, non-interventional epidemiological analysis. The data source was the official medical statistical register (State Register of Ukraine – SRU) for 2019–2021.

Although the underlying research program included various methodologies, this specific paper focuses on the retrospective analysis of archival registry data to study long-term dynamics. Analyzed cohort: Men and women of fertile age (18–49 years), permanent residents of Zhytomyr and Kyiv regions.

2.2. Object and Analyzed Indicators

Object: Persons of fertile age, divided into age cohorts: 18–29 years, 30–39 years, and 40–49 years. Analyzed nosological forms (ICD-10):

- 1) DCS (Class IX): Ischemic heart disease (IHD), hypertension.
- 2) Diseases of the digestive system (Class XI).
- 3) Diseases of the endocrine system (Class IV): DM, obesity, thyroid pathologies related to iodine deficiency.
- 4) Diseases of the blood (Class III): Alimentary anemias.
- 5) Malignant neoplasms (MN) of digestive organs (C00–D48).

Indicators: Absolute number of morbidity and mortality cases. To assess the severity of the course, the case fatality rate (%) was used, calculated as:

$$\text{Case Fatality Rate (\%)} = \frac{\text{Number of cases of the disease}}{\text{Number of deaths from the disease} \times 100} \quad (1)$$

- 1) *Phenotypic traits:* Clinical assessment of non-specific manifestations of hypovitaminosis and microelementosis (weakness, dry skin, brittle nails, hair condition, GI disorders, etc [4])
- 2) *Hygienic assessment of nutrition:* Determination of actual food consumption, calculation of diet weight, energy value, and macronutrient/micronutrient content compared to official standards [3, 7].
- 3) *Statistical processing:* Determination of absolute (n) and relative (%) frequencies; analysis of the dynamics of anemic states and circulatory disorders; evaluation of iodine deficiency prevalence. Significance was determined using Student's t-test ($p \leq 0.05$).

3. Results and Discussion

3.1. Structure of Morbidity and Mortality

Analysis of the ADD structure indicates the dominance of DCS (Class IX) as the leading cause of morbidity and mortality.

Cardiovascular burden: DCS remains the most lethal pathology. The highest morbidity and mortality are concentrated in the 40–49 age group. In men of this cohort, 2,077 DCS cases were registered in 2019 with 42 deaths ($p < 0.05$ compared to younger groups). IHD fatality reached 69.0% in 2020 and 41.1% in 2021. These fluctuations in rates, while statistically significant, may be partially explained by the impact of the COVID-19 pandemic on diagnostics and treatment, as well as by small absolute numbers. However, this indicates a high risk of death among patients entered into the registry [6, 9].

Early development (18–29 years): The youngest cohort shows high morbidity for hypertension ($n=1282$ cases in men in 2019) and digestive diseases ($n=1124$ cases in men in 2019), primarily gastritis and ulcers, predominantly represented by gastritis, duodenitis, and ulcers [11]. This fact may serve as a marker of early cardiometabolic disorders and gastrointestinal stress, potentially mediated by both unhealthy nutrition and chronic environmental exposure.

3.2. Gender Features of Pathology

- 1) **Women (Classes IV and III):** Young women (18–29) suffer more frequently from endocrine diseases and alimentary anemias ($n=29$ cases in 2019) [10]. This underscores the problem of micronutrient deficiency and the potentially increased sensitivity of the female body to environmental factors (e.g., radionuclide contamination affecting thyroid function).
- 2) **Men (30–39 years):** Fatality from MN of digestive organs was statistically significant" (66.7% in 2020 and 2021), despite small absolute numbers, indicating a need for better screening [11].

3.3. Structure of Extragenital Pathology

Analysis revealed the dominance of extragenital diseases among pregnant women (Table 1).

Table 1. Extragenital morbidity patterns in the examined cohort of women. Data represents the average percentage across the study period (2019–2021) (total sample: $n=140607$).

Nosological Form	Average Indicator, %
Cholecystitis	24.5
Gastritis	16.0
Thyroid diseases	7.4
Pyelonephritis	5.8
Pancreatitis	3.9

The leading conditions were alimentary-dependent pathol-

ogies of the digestive system: cholecystitis (24.5%) and gastritis (16.0%) [14]. Significant prevalence rates were also noted for diseases of the urinary system (pyelonephritis – 5.8%) and the endocrine system (thyroid pathology – 7.4% on average across trimesters).

Diseases of the blood and blood-forming organs, as well as certain disorders involving the immune mechanism (Class III), affected 30 of the registered individuals aged 18–29 years. In women over 30, the frequency of this diagnosis was three or more times lower than in younger women. Notably, alimentary anemias, which fall under Class III, also more frequently affected women aged 18 to 29, with 29 cases registered.

An analysis of the general morbidity of women of fertile age (up to 2021) and those registered in the SRU (State Registry of Ukraine for persons affected by the Chornobyl catastrophe) revealed the following trends:

- 1) Diseases of the blood and blood-forming organs (Class III), including alimentary anemias, were more frequently recorded in women (18–29 years) – 30 cases, which is three or more times higher than the rates in older age groups;
- 2) Diseases of the endocrine system (Class IV): More frequently diagnosed in women aged 18–29 years, particularly thyroid pathology associated with iodine deficiency (hypothyroidism, thyroiditis);
- 3) Diseases of the digestive system (Class XI): Also prevailed in the 18–29 age group (gastric/duodenal ulcers, gallbladder diseases).

3.4. Details of Morbidity by Class and Age

Endocrine System (Class IV): Most frequent in women aged 18–29, particularly iodine-deficiency-related thyroid issues. Diabetes was more common in women aged 30–39 [3].

Circulatory System (Class IX): Most common in the 40–49 age category (5,116 cases) [9]. Women aged 18–29 most frequently suffered from hypertension (1,731 cases). Digestive System (Class XI): Most frequent in women aged 18–29 (gastritis, duodenitis, gallbladder diseases).

3.5. Analysis of Hemodynamic Disorders and Iodine Deficiency

Hemodynamic analysis (Table 2) showed a prevalence of hypotensive states over hypertensive ones.

Table 2. Prevalence of circulatory disorders among the studied women.

Disorder	Pregnancy period and maximum indicators
Hypotension	Most prevalent in the I trimester (29% during the winter-spring period of 2019).

Disorder	Pregnancy period and maximum indicators
Hypertensive disorders	Recorded significantly less frequently (15% in the II trimester of the winter-spring period of 2019).

Notes: * The maximum indicator was recorded during the winter-spring period. ** The value corresponds to the peak registration of the disorder during the year.

Analysis of seasonal dynamics showed that the peak prevalence of arterial hypotension (29%) occurred during the winter-spring period of 2019, which may be associated with weather sensitivity and alimentary deficiency in this group of patients.

Research results confirmed a significant prevalence of iodine deficiency (Table 3).

Analysis of the dynamics in subsequent periods (2019–2021) demonstrated a positive trend toward a decrease in the frequency of moderate and severe degrees of iodine deficiency.

In our opinion, this was a direct result of the intensification of sanitary and educational measures and the implementation of group and individual iodine prophylaxis programs among pregnant women in the studied region.

Table 3. Degree of iodine deficiency among the examined women ($n=100\%$).

Degree of iodine deficiency	Prevalence, %
Mild	22.0
Moderate	61.0
Severe	11.0
Total with iodine deficiency	94.0

Note: The remaining 6.0% of the subjects had a normal level of iodine supply.

3.6. Case Fatality Dynamics (Table 4)

Table 4. Case fatality rates for the main nosological forms among the examined contingent (2019–2021).

Nosological form	Age (years)	Sex	2019 abs. (%)	2020 abs. (%)	2021 abs. (%)
Ischemic heart disease	40–49	M	31/731 (4.2)	29/42 (69.0)*	23/56 (41.1)
	40–49	F	48/2069 (2.3)	49/123 (39.8)	50/211 (23.7)
MN of the digestive organs	30–39	M	2/11 (18.2)	2/3 (66.7)	2/3 (66.7)
Liver diseases	18–29	M	2/116 (1.7)	2/27 (7.4)	3/13 (23.1)

Notes:

- 1) The numerator indicates the number of lethal cases; the denominator indicates the total number of registered patients in that category.
- 2) *The high relative case fatality rate in 2020–2021 is due to a significant reduction in the number of registered cases of mild and moderate forms of the disease amidst the COVID-19 pandemic, which led to a statistical concentration of terminal states in the registries [6].
- 3) MN — malignant neoplasms.

4. Discussion

The obtained empirical data confirm the a priori hypothesis regarding the increased environmental and nutritional vulnerability of the health of fertile-age individuals residing in RCTs (Radiation-Contaminated Territories) [2, 14].

Sharp spikes in case fatality rates (e.g., IHD in men aged 40–49 years) indicate a decrease in the diagnosis and registration of non-lethal cases during 2020–2021 (likely due to the COVID-19 pandemic), which led to a relative increase in the mortality rate. However, these high values confirm that the diseases causing lethality are extremely aggressive. Similarly,

the rise in case fatality from liver diseases among young men (aged 18–29) is an alarming signal regarding the prevalence of risk factors such as non-alcoholic fatty liver disease (nutrition-related) and/or toxic influences [12]. Based on the descriptive data obtained, we hypothesize that the impact of low-dose ionizing radiation might have a stress-like character. While the registry data does not allow for direct mechanistic proof, the observed synergy of these potential radiation-induced adaptive disorders with chronic nutritional deficiencies may correlate with the manifestation and progression of alimentary-dependent conditions.

The high prevalence of diseases, particularly those of alimentary-dependent genesis (pathologies of the hepatobiliary and gastroduodenal systems), directly correlates with the

chronic imbalance of macro- and micronutrients in the diets of the examined cohort.

Anemic and iodine-deficient states, as well as hemodynamic disorders, are indicators and direct reflections of chronic polyhypovitaminosis and hypomicroelementosis. These conditions, which can rightfully be classified as pre-morbid, are characterized by a decrease in the body's adaptive-compensatory reserves and an increased predisposition to the development or exacerbation of morbid processes, especially against the background of the physiological load of pregnancy.

It was also established that the impact of low-dose ionizing radiation has a stress-like character, causing long-term functional strain on the neuroendocrine system (specifically the hypothalamic-pituitary-adrenal and thyroid axes) and the activation of lipid peroxidation processes. The synergism of these radiation-induced adaptive disorders with chronic nutritional deficiencies accelerates the manifestation and progression of alimentary-dependent and other morbid conditions [2, 7].

Thus, the radiation factor does not act in isolation but in complex with other negative environmental, social, and, most importantly, alimentary factors, forming a burdened pre-morbid background for the development of pathologies in individuals of fertile age, particularly during gestation [14]. Matasar IT. Hygienic assessment of the impact of a complex of radiation and non-radiation environmental factors on the health of women and children. *Hygiene of Populated Areas*. 2003;(41): 235–241. Ukrainian.

5. Study Limitations

Despite the significant results obtained, this study has several limitations that should be considered when interpreting the data:

- 1) Impact of the Pandemic: The analyzed period coincided with the COVID-19 pandemic, which placed a substantial strain on the healthcare system. The sharp increase in case fatality rates (notably from IHD in the 49 cohort group and liver diseases in young men) may be partially attributed to reduced access to routine diagnostics, hospitalization, and shifting priorities in disease registration. This potentially led to an artificial underestimation of the total number of diagnosed cases against a backdrop of stable or increasing mortality [6].
- 2) Data Source Reliability: The study relies on data from the State Registry of Ukraine (SRU). [13] While these are official records, they may contain inaccuracies related to the under-detection of pathologies in their early stages (especially in rural radioactively contaminated areas) or variations in the quality of ICD-10 diagnostic coding across different medical facilities.

Sample Size in Specific Subgroups: When analyzing specific nosologies within narrow age groups (e.g., malignant neoplasms in men aged 30–39), a small number of cases ($n < 5$ in some cells) was observed. This limits the statistical power of certain comparisons and results in wide confidence intervals,

requiring caution in generalization.

- 1) Exposure Assessment: Environmental impact was assessed based on the fact of residence in radioactively contaminated territories (Zhytomyr and Kyiv regions). The study did not account for individual internal and external radiation doses for each patient, which limits the ability to establish direct correlations between radiation levels and the severity of non-communicable diseases (NCDs).
- 2) Confounding Factors: Although the nutritional factor was identified as key, the analysis did not fully account for other risk factors, such as physical activity levels, tobacco smoking, and alcohol consumption, which also significantly influence the development of cardiovascular and gastroenterological diseases. [9]

6. Conclusions

- 1) Critical Cardiovascular Burden: Cardiovascular diseases (CVD) represent a key public health challenge for individuals of reproductive age in ecologically hazardous regions of Ukraine. The working-age cohort (40–49 year) demonstrates statistically significant high IHD case fatality rates, requiring immediate attention to secondary and tertiary prevention. [9]
- 2) Early Risk Markers: The high prevalence of hypertension and gastroenterological pathologies (gastritis, duodenitis) in the 18–29 age cohort indicates early onset of NCDs, potentially linked to nutritional imbalances and environmental stressors [11].
- 3) Gender and Nutritional Specifics: Women, especially younger ones, are more vulnerable to micronutrient deficiencies (anemia, iodine deficiency), highlighting the need for targeted nutritional correction. [10]
- 4) Mortality from Malignant Neoplasms (MN): The exceptionally high case fatality rate from MN of the digestive organs in men (30–39 years) necessitates a review and improvement of screening protocols [11].

7. Recommendations

- 1) Prioritize Cardiovascular Screening: Mandatory annual blood pressure and lipid profile checks for ages 18–39.
- 2) Targeted Nutritional Correction: Regional programs for iodine, iron, and vitamin supplementation for women.
- 3) Etiological Research: Comprehensive cohort studies to evaluate the association between environmental pollutants and ADD risk.

8. Prospects for Further Research

Future research should focus on the development of evidence-based, targeted nutritional correction programs for mi-

cronutrient deficiencies in individuals of reproductive age living in radioactively contaminated territories (RCT). Furthermore, priority should be given to the objective assessment of these programs' effectiveness in reducing the risk of extragenital diseases and improving perinatal outcomes.

Abbreviations

ADDs	Alimentary-Dependent Diseases
ChNPP	Chornobyl Nuclear Power Plant
DCS	Diseases of the Circulatory System
IHD	Ischemic Heart Disease
MN	Malignant Neoplasms
RCTs	Radiation-Contaminated Territories
SRU	State Registry of Ukraine

Acknowledgments

The authors would like to express their gratitude to the staff of the State Registry of Ukraine (SRU) for providing the anonymized statistical data necessary to conduct this study.

Author Contributions

Matasar Ignat Tymofiiiovych: Conceptualization, Methodology, Investigation, Resources, Data Curation, Writing – original draft, Writing – review & editing, Supervision, Project administration, Funding acquisition

Conflicts of Interest

The authors declare no conflicts of interest.

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