

ОБЩЕСТВЕННОЕ ЗДОРОВЬЕ И ОРГАНИЗАЦИЯ ЗДРАВООХРАНЕНИЯ. СОЦИОЛОГИЯ И ИСТОРИЯ МЕДИЦИНЫ

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Cohort profile: The longitudinal study on the risk factors of non-communicable diseases in Russia

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This study developed a new approach to analyzing mortality and its associated risk factors in the Russian population. We have provided a way to use secondary data from an existing robust research dataset. To do this, we calculated the risk factors for death and assessed the influence of individual risk factors. Previously the datasets have been used earlier for socio-economic research. This paper presents opportunities for studying mortality and associated factors using secondary data to assess disease death outcomes based on the existing cohort — the open license R software to perform data engineering and Relative Risk calculations. There were no instrumental measurements in this study, and all indicators are based on the self-responses to two questionnaires. The data was derived from the Russia Longitudinal Monitoring Survey by the Higher School of Economics. It is a longitudinal, representative survey data from individuals and households from 1990 to 2021. We extracted data on 4063 deaths cases (2214 males and 1699 females) among respondents for further analysis. The lethal fatal outcomes data from the household questionnaires and the records have the proxy respondent's verbal

autopsy status. Thirty-two thousand twenty-three households (around 150,335 individuals) participated in the survey from 1994 to 2019 for 24 years of observations. The most common causes of death were as follows: 974 fatal cases from cerebrovascular disease (stroke), 934 from cardiac disease, and 756 fatal cases due to neoplasms, 1372 cases were registered in females, and 1978 cases were in males.

Keywords: non-communicable diseases, cohort profile, deaths, risk ratios, risk factors, population statistics.

Introduction

Non-communicable diseases are the world's leading cause of death. Much of the burden of NCDs is driven by behavioral risk factors, as evidenced by global studies and studies such as GBD [1; 2]. For example, in a study conducted in Germany, there were positive associations between socio-economic status and alcohol consumption over the life course, over time, and across birth cohorts [3]. But for the Russian Federation, we lack prospective cohort studies to get RRs and HRs for further use. One of the oldest and unique researchers in Russia is HSE RLMS.

There were several publications in the field of public health based on the HSE RLMS survey. Most of them aim to study microeconomics and some socio-economical features, exploring patterns of alcohol consumption and healthcare microeconomics [4–28]. We went a step further and conducted the Risk Factors of Noncommunicable diseases cohort data derived from the series of a nationally representative survey Russian Longitudinal Monitoring Survey (RLMS) [10]. It was initially designed to monitor the effects of reforms on households and individuals' health and economic welfare in the Russian Federation. The data from a longitudinal monitoring survey was received from the Higher School of Economics. The permission to use the data was obtained from the RLMS research team leader in January 2022. Data is available to researchers with minor access restrictions described in subsequent sections of this page: <https://www.hse.ru/en/rlms/availability>. Online registration is needed.

Key features:

- the study's frequency of follow-up: the survey is regularly repeated every year, once a year. There are two separate questionnaires for individuals with 472 questions, including health status and behavioral, environmental, and other risk factors variables;
- the complex variables were collected, such as alcohol consumption, tobacco use, food habits, and physical activity;
- direct measurement of weight, height and waist circumference obtained (rounds V–XIV and XX). Also, one-day 24-h recall dietary data were obtained in these rounds.

Why were the RLMS-HSE Non-Communicable Diseases (RLMS-NCD) cohort set up?

The reason was to challenge collecting leading causes of death from the proxy-reported respondents' using the RLMS-HSE data to open new capacities of RLMS research data. The secondary RLMS-NCDs database can be prepared for various analytical instruments such as survival analysis and Cox regression to derive the RRs of the risk factors of death from NCDs as causes of death.

Materials and methods

Who is in the cohort? A series of separate interviews were conducted with all possible household associates aged 14 years and over to accumulate data on their activity and the existence of illnesses. Youths aged less or equal 13 years old received details through responses from adults in their families. The design provides a probability sample of the Russian population without special weighting at baseline.

The numbers of participants invited and entering the cohort and differences between responders and non-responders at baseline is in Table 1, comparing the sex-age characteristics of responders.

Table 1. Phase and measurements of the cohort and follow-up

Phase	Measurements
Baseline 1992–2022	Self-reported socio-economic position Self-reported health status and diagnosis Anthropometric measures: weight, height (self-reported) Blood pressure, sugar in the blood (self-reported) Self-reported major behavioral NCD risk factors Dietary assessments
Follow-up	(Questionnaire only) Self-reported health status and diagnoses Self-reported socio-economic position and behaviors
Ongoing	All participants are flagged with routine data sources providing deaths since baseline and cancer registry entries since 1980

The number of participants at baseline: 56,559 discrete individuals and 16,307 household respondents (26,195 males and 30,364 females) were interviewed in 1994 and 2019. We extracted 4063 death cases (2214 males and 1699 females) among respondents (Fig. 1).

Composition of the study population, including age range: the cohort included participants aged 1–105 years who had information on mortality. The minimum age for males is 1, the maximum is 103, and the average is 59.65. The minimum age for females is 1, the maximum is 105, and the standard is 72.87.

How often have they been followed up? Data has been collected 29 times from 1992 till nowadays, and 25 waves represent the “RLMS Phase II”. The records of respondents were extracted from the primary database. Participants in the 10th–29th rounds of households and individuals’ key variables were aggregated to explore the cohort of participants with diseases and death outcomes. The cohort represents the derivative of a population-based panel survey, designed as an annual randomized survey. Two years were missed, 1997 and 1999, due to funding lapses between 1994 and 2014. The sample is described in more detail on the RLMS-HSE websites [29].

Continuity for getting survey respondents from one wave to the next wave of the survey was about 70%. Year by year, up to 70% of respondents who were attributable to the next wave of the study varied from 70 to 85%.

What has been measured? The panel data provides self-responses on morbidity, proxy-responses of mortality and partly its causes and other routine data variables, including behavioral, environmental and metabolic risk factors. We took out from the ini-

tial RLMS dataset a section with indicators that directly or indirectly indicate the state of health of the respondents and the same block of variables that indicate risk factors. The health-related section contains 472 questions, including diagnoses and conditions and behavioral questions, such as smoking, alcohol, nutrition, etc. The broad categories for each phase are presented in Table 2 below. The list of selected health and risk-factors-related variables is presented in the Table 3.

Table 2. Descriptive statistics: age of death by cause

Statistics	Mean (SD)	Q1; Median; Q3
Overall	66.4 (18.7)	55.0; 70.0; 80.0
Cerebrovascular disease	72.4 (14.0)	64.0; 75.0; 83.0
Cardiac disease	69.6 (15.1)	60.0; 73.0; 81.0
Neoplasms	66.0 (14.9)	58.0; 67.0; 76.0
Injuries/accident	46.2 (18.0)	33.0; 45.0; 58.0
Senility (old age)	87.1 (8.2)	83.0; 88.0; 92.0
Murder/Self-murder	41.4 (13.1)	32.0; 42.0; 49.0
Respiratory disease	66.7 (16.3)	55.0; 69.0; 80.0
Vascular disease	70.6 (14.3)	64.8; 73.5; 80.0

Unique and instrumental measurements:

1. There were no unusual measurements (e. g. specialized scans; individual assays) and/or measurements that have been undertaken in sub-groups of the cohort.

2. There were no instrumental measurements in this study; all indicators are based on the responses to two questionnaires: for individuals and households. The respondents used self-measurements to provide weight and height.

What has it found? Using proxy respondents to study causes of death for the first time in the Russian population, it has become possible now to derive risk factors and mortality risk factors for people with NCDs exposed to behavioral factors compared with participants who did not.

32,023 households (around 150,335 individuals) participated in the survey from 1994 to 2019. In the first analysis iteration, we found that in this period, 4942 fatal cases were registered (Fig. 1). Since 1995 there has been a significant jump in mortality growth and a sharp decline by 2001. By 2002 there was again a sharp increase in the number of deaths, which progressively decreased over 11 years. From 2013 to 2019 there was an increase in mortality again.

The most common causes of death were as follows:

- 974 fatal cases from 4942 due to Cerebrovascular disease (stroke);
- 934 fatal cases from 4942 due to Cardiac disease (heart attack; acute coronary insufficiency; acute heart failure; angina pectoris; heart failure; coronary artery disease; congenital heart disease);
- 756 fatal cases from 4942 due to Neoplasms (cancer; blood disease; lymphogranulomatosis).

Table 3. The list of health and risk-factors-related variables

No	Variable name	Type
1	How many kilograms do you weigh?	Quantitative
2	What is your height in centimeters?	Quantitative
3	How would you evaluate your health?	Ordinal
4	Do you have any kind of chronic illness? For example:	Qualitative
5	Heart disease	Qualitative
6	Lung disease, bronchus	Qualitative
7	Liver disease	Qualitative
8	Kidney disease	Qualitative
9	Gastrointestinal diseases	Qualitative
10	Spinal problems	Qualitative
11	Endocrine diseases, diabetes or high blood sugar	Qualitative
12	Hypertensive heart disease, high blood pressure	Qualitative
13	Joint diseases	Qualitative
14	ENT disease	Qualitative
15	Neurological diseases	Qualitative
16	Eye Diseases	Qualitative
17	An Allergy	Qualitative
18	Varicose Veins	Qualitative
19	Diseases of the skin	Qualitative
20	Oncological diseases	Qualitative
21	Gynecological diseases	Qualitative
22	Urogenital system disease	Qualitative
23	Other chronic illnesses	Qualitative
24	Are you assigned to any disability classification?	Qualitative
25	To what classification of disability are you assigned?	Ordinal
26	In the last 12 months have you had a surgical operation?	Qualitative
27	Has a physician ever told you that you had diabetes or increased sugar in the blood?	Qualitative
28	Have you ever been diagnosed with a "myocardial infarction"?	Qualitative
29	Have you ever been told by a doctor that you had high arterial blood pressure?	Qualitative
30	Has a doctor ever diagnosed you as having had a stroke-blood hemorrhages in the brain?	Qualitative
31	In the last 12 months, has a doctor told you that you had anemia?	Qualitative
32	Has a doctor ever told you that you had tuberculosis?	Qualitative
33	Has a doctor ever diagnosed you with hepatitis, Botkin's disease, or jaundice?	Qualitative
34	What type of hepatitis did you have? If you were diagnosed with it more than once, please name all types (A, B, C, Other).	Qualitative

No	Variable name	Type
35	In the last 12 months, have you had a serious nervous disorder or depression?	Qualitative
36	Do you wear glasses or contact lenses?	Qualitative
37	Do you use a hearing aid?	Qualitative
Block The Behavioral Risk Factors		
38	Do you now smoke?	Qualitative
39	Please recall: When did you start smoking? How old were you then?	Quantitative
40	In the last 7 days have you smoked anything?	Qualitative
41	What do you mainly smoke? I will list various types of tobacco products and you tell me, please, which you smoke most often.	Qualitative
42	How many individual cigarettes do you usually smoke in a day?	Quantitative
43	Have you ever smoked?	Qualitative
44	How many years ago did you quit smoking?	Quantitative
45	Please remember your age when you began smoking. How old were you then?	Quantitative
46	In the last 30 days did you drink non-alcoholic beer?	Qualitative
47	Do you consume alcoholic beverages, including beer, at least sometimes?	Qualitative
48	Recall, please, when you first consumed alcoholic beverages, including beer? How old were you then?	Quantitative
49	In the last 30 days have you consumed alcoholic beverages?	Qualitative
50	In the last 30 days have you consumed beer containing alcohol?	Qualitative
51	Which of these you drank in the last 30 days and, for those you drank, how many grams do you usually consume in a day?	Qualitative
52	In the last 30 days has any of the following happened to you as a result of alcohol intake?	Qualitative
53	Do you think that because of taking alcoholic drinks you personally have any problems:	Qualitative
54	On those days you did drink alcohol, approximately how many helpings did you usually take regardless of drink type?	Qualitative
55	Which of the following best describes your physical exercise?	Qualitative
56	I will now list various kinds of physical activities. Will you please tell me which of them you engaged in the last 12 months at least 12 times? For each activity, you engaged in, during how many months, how many times per month, and how many minutes per time did the activity last?	Qualitative
57	Which of the following best describes your physical exercise? Please do not count your physical activities at work	Qualitative
58	Please tell me, are you happy?	Qualitative
Block of Food & Nutrition questions		
59	Did your family get (the list of 57 products), how much?	Dichotomic/ quantitative
60	Do you eat out of home?	Quantitative
61	How much money do you spend to eat out of home for the last 30 days?	Quantitative
62	How much money do you spend to eat in and out of home for the last 30 days?	Quantitative
63	How many times a day do you eat?	Quantitative

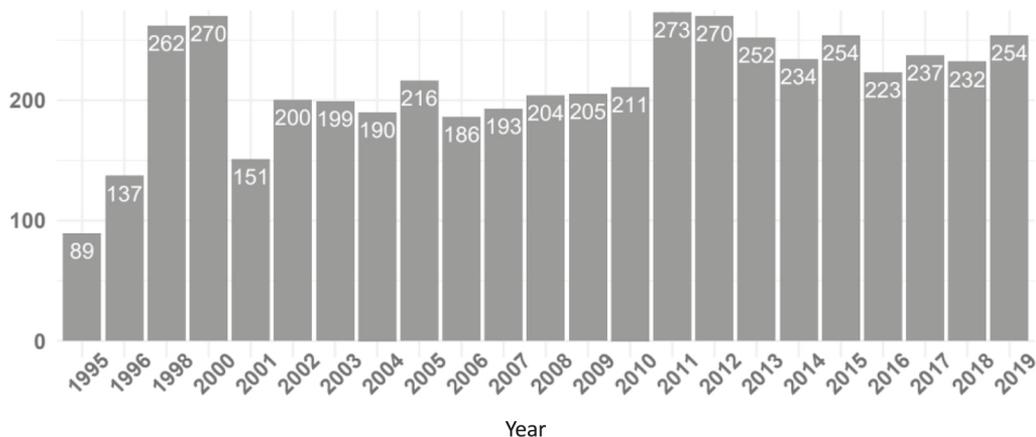


Fig. 1. The distribution of lethal cases over time 1995–2019 (absolute numbers)

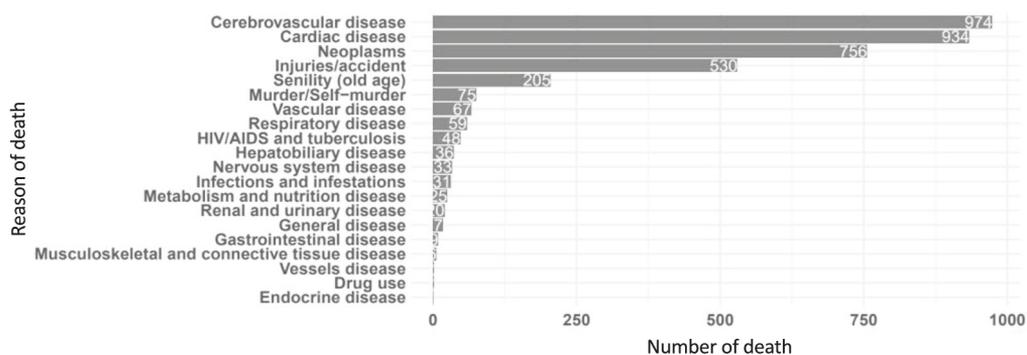


Fig. 2. The distribution number of casualties by cause (absolute number)

Out of 4942 deaths, 1372 cases were registered in females and 1778 cases — in males (Fig. 2). The number of deaths due to stroke (Cerebrovascular disease) was approximately the same among men and women, 310 and 307. The fatal cardiac disease and neoplasm cases prevailed in men (336 versus 237 and 302 versus 201). The number of deaths due to injuries/accidents among men was more than twice that among women (199 versus 70). The cases of murder/self-murder were observed principally among men, while the cases of senility (deaths from old age) were observed mainly among women.

The age patterns

We found a specific mortality trend by age strata (Fig. 3). The most deaths are observed after 66 years. And the mean death age is 66.4 ± 18.7 years (median 70 years, IQR: 55–80 years). The mean death age for women was 73.8 ± 17.1 (median — 78 years, IQR: 66.8–86.0), and for men — 60.8 ± 17.8 (median — 64 years, IQR: 49.0–74.0). It should be pointed out that the number of deaths before 75 years among men was around twice that among women. Among the top causes of mortality, the lowest mean death age was in murder/self-murder (mean: 41.4 ± 13.1 years) and injures/accident (mean: 46.2 ± 18.0 years). Among deaths associated with neoplasms, the mean death age was 66 ± 14.9 , which was

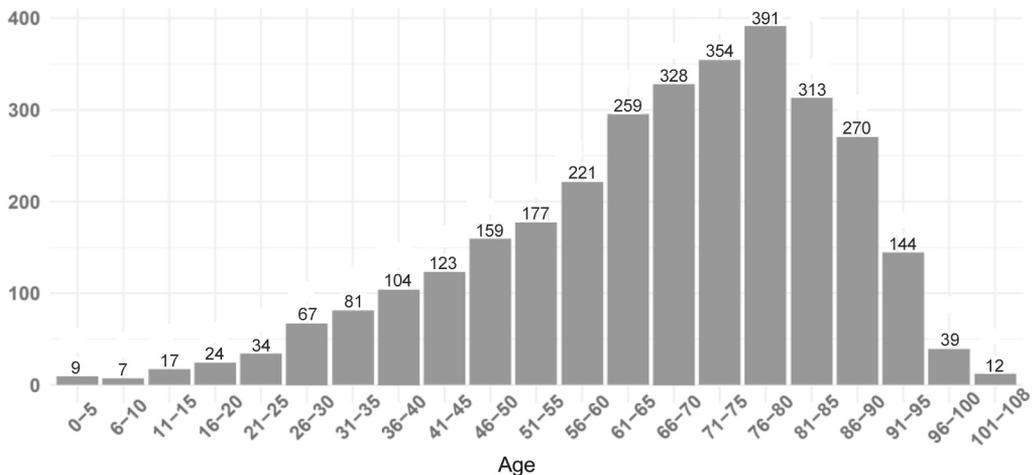


Fig. 3. Distribution of lethal cases by age (absolute numbers)

similar to the mean death age of the overall population participating in the survey. For cause-related cardiac and cerebrovascular disease, the mean death age was a little bit more than the mean death age of the overall population and was 69.6 ± 15.1 years and 72.4 ± 14.0 years, respectively. Interestingly, that were individuals in a survey, the main cause of death was senility/old age, whose mean death age was 87.1 ± 8.2 .

The median time to death was 89 age (95 % CI: 89–89) among women, and among men was 85 years (95 % CI: 85–86).

Sex patterns

Death numbers due to stroke are around the same among males and females. Deaths due to cardiac and neoplasms prevailed in males. Fatal cases due to injuries/accidents among males were more than twice that among females, same for murder/self-murders. The mean death age for cause-related neoplasm, cardiac, and stroke was around the general population — 66, 69, and 72 years old, and was more than 80 years in senility/old age.

Future studies should determine the risk of mortality from NCDs representatively for the entire population in Russia, separately by sex, three age cohorts, and leading causes of death. Additionally, this information would be presented by the region of Russia. The models can estimate the mortality risk coefficient depending on the Russian population's duration and intensity of exposure to risk factors by gender and three age cohorts.

Potential impact

The algorithm and methodology approach obtained from this analysis based on cohort study data can be applied to estimate the relative risk (RRs) for the most critical risk factors, including alcohol consumption, high blood pressure, and nutrition. It is possible now to calculate the probability of premature mortality and Disability-adjusted life years (DALYs). Future research can use derived relative mortality risks to calculate Population

Attributive Fractions (PAFs) and indirect economic losses from individual risk factors for every NCD by sex and age for the first time in Russia. Since the data source is patients and the control group is based on a representative sample for Russia, the received hazard ratio will be essential for future research.

Strengths of the cohort

The significant strengths of the RLMS-HSE are the national representativeness, high-quality sociodemographic and economic data collection, and extended follow-up. This cohort was set up because we found secondary data opportunities in joining together respondents and household databases from RLMS-HSE sets of data. One of the challenging ways of using this data is to collect the death cases for further research.

Weaknesses of the data

The data used to estimate risk factor exposure is, at times, sparse, and some measures, such as low physical activity, may benefit from a shift to direct measurements, as self-reported estimates are known to overestimate those with sufficient physical activity. The most significant weaknesses from the health side are the lack of biomarkers and the erratic collection of dietary and body composition data based on outside funding availability.

Important limitations of the cohort are associated with self-reported survey-based — recall bias, response bias, acquiescence bias, social desirability bias, and nonresponse bias, including the frequency and quantity of data collected, sample size, periodic resampling, and between-round attrition. The health system's main flaws are the lack of biomarkers and the rare collection of food and body composition data based on outside funding availability. Furthermore, as with any longitudinal survey, attrition overtime should be considered when interpreting the data.

Ethics approval

There was no need for ethics approval for the authors of this paper because of the use of secondary data.

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Профиль когорты: лонгитюдное исследование факторов риска неинфекционных заболеваний в России

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В данном исследовании разработан новый подход к анализу смертности и связанных с ней факторов риска в российской популяции. Мы предоставили способ использовать вторичные данные из существующего надежного набора исследовательских данных. Для этого мы рассчитали факторы риска смерти и оценили влияние отдельных факторов риска. Ранее эти наборы данных использовались для социально-экономических исследований. В этой статье представлен подход для изучения смертности и связанных с ней факторов риска с использованием вторичных данных для оценки смертности от болезней на основе вторично извлеченной когорты. Для обработки данных и расчетов относительных рисков использовалось программное обеспечение R с открытой лицензией. Инструментальные измерения в этом исследовании не проводились, и все показатели основаны на ответах респондентов и их родственников на два вопроса. Данные были получены из Российского долгосрочного мониторинга Высшей школы экономики. Это данные лонгитюдного репрезентативного опроса отдельных лиц и домохозяйств с 1990 по 2021 г. Мы извлекли данные о 4063 случаях смерти (2214 мужчин и 1699 женщин) среди респондентов для дальнейшего анализа. Данные о летальных исходах из вопросников домохозяйств и записей имеют статус вербальной аутопсии респондента. В опросе с 1994 по 2019 г. за 24 года наблюдений приняли участие

32 023 домохозяйства (около 150 335 чел.). Наиболее частыми причинами смерти были следующие: 974 летальных случая от цереброваскулярной болезни (инсульта), 934 летальных исхода от болезней сердца и 756 летальных исходов от новообразований. По полу: 1372 случая зарегистрировано среди женщин, 1978 случаев — среди мужчин.

Ключевые слова: неинфекционные заболевания, профиль когорты, смертность, отношения рисков, факторы риска.

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