

# Assessment of the factors of mental health of the elderly population of Russia on the basis of individual data

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## Abstract

Mental health is determined as a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community (WHO 2014, 2017). By taking the example of the elderly population of Russia the article reveals the existence and nature of ties between individual socio-economic characteristics of the older age people and the level of their mental health. The article presents the author's method of assessment of mental health of the elderly population, which is based on a brief scale of the Center for Epidemiologic Studies Depression Scale (CES-D). Individual data from the WHO International Study of Global Ageing and Adult Health (SAGE) conducted in the regions of Russia in 2002–2004 (wave 0) and in 2007–2010 (wave 1) are used as the empirical basis of the study.

## Keywords

mental health and well-being, the elderly population, the principal components analysis

**JEL Codes:** C10, J10, J14

## Introduction

Mental health is not merely the absence of disease (WHO 2004). Initially, mental health was seen as a condition of a person with a complete absence of mental illness (Sigerist 1941; WHO 1948). The incompleteness and limitations of this definition were overcome relatively recently, in 2004, when WHO defined mental health as a state of well-being in which the individual realizes his or her abilities, can cope with the normal stresses of life, can work pro-

ductively and fruitfully, be result-oriented, and contribute to his or her community (WHO 2004, 2017).

Scientific interest in the study of mental health increased significantly following the publication of the work of WHO researchers on measuring the burden of various diseases, including mental illness (Murray and Lopez 1996). The study shows that by the end of the 20th century the burden of mental disorders is not inferior to the burden of circulatory diseases and malignant neoplasms: depression was ranked the fourth among most important factors limiting the activities of the individual.

In Russia, studies of the influence of socio-economic characteristics on the level of mental health and well-being of the population have also begun to be actively carried out since the end of the 20th century. One of the first works in this field is the article of B. Kennedy and co-authors dedicated to the impact of social capital on the mortality rate of the Russian population (Kennedy et al. 1998). Researchers have shown a positive relationship between social capital and life expectancy, as well as a decrease in the overall mortality rate with rising social capital indicators. Special attention was paid to informal sources of social support — the closest environment of the individual: family and friends. Social cohesion of society was measured by the level of crime and presence of conflicts in the workplace of the individual, according to the polls of the Russian Public Opinion Research Center (VICOM). In a later article (Rose 2000), based on individual level data on physical and emotional health it was found that social capital and human capital have a significant impact on both physical and mental health. That research was based on individual characteristics of the assessment of the physical and emotional health obtained through the 1998 New Russia Barometer Survey. Social capital components that have a significant impact on mental health include: involvement in formal or informal networks and communities, presence of friends on which one can rely in the event of illness, control over one's own life, and confidence.

Research on mental health of the elderly population of Russia is mostly based on data from the cohort study of the urban population in Eastern Europe — “Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE)”, including Russia (Novosibirsk), Poland (Krakow), Czech Republic (Havířov, Hradec Králové, Jihlava, Kroměříž, Liberec, Ústí nad Labem). The survey has a number of significant limitations: namely, a sample of respondents from Russia (476 men and 467 women) represents the population of only one city. Nevertheless, this is the first study to make a cross-country comparison and it is the first use of the scale of the Centre for Epidemiologic Studies Depression Scale (CES-D) in Russia. The papers based on this survey present a negative relationship between mental health and loneliness, excessive alcohol consumption and low income (Bobak et al. 2006). There is also a differentiation by sex: in Eastern Europe, all other things being equal, women are more vulnerable to depression than men; however, the differences are blurred in more educated groups. The greatest gender differentiation of the risk of depression is observed in Russia (Nicholson et al. 2008).

The issues of mental well-being were examined on the example of the health of children and adolescents (Charman and Pervova 1996; Jose et al. 1998), as part of a survey based on methodologies for diagnosing mood disorders in children and adolescents, Child Depression Inventory (CDI) and Depression Self-Rating Scale (DSRS), as well as author's methods followed by analysis of the obtained indicators characterizing mental health of Russian and American children and adolescents. Regional analysis of socio-economic characteristics and mental health is partially presented in the work on the Republic of Udmurtia (Pakriev et al. 1998), mental health was measured via the interview method — Composite International Diagnostic Interview (CIDI), as well as in a similar study of the city of Arkhangelsk (Ave-

rina et al. 2005), in which the methodology for measuring mental health was taken from a similar study for Norway (Westlund and Søgaaard 1993; Nilssen et al. 1999). All studies show a positive relationship between mental health and high socio-economic status of the respondent, as well as a negative relationship with excessive alcohol consumption.

The results of the cohort study Stress Aging and Health in Russia (SAHR) conducted between December 2006 and June 2009, which includes a wide range of characteristics of Moscow's population (men and women over 55 years of age) in terms of health, socio-economic and demographic characteristics, cognitive abilities, exposure to stress/depression, as well as various biomarkers showed a high gap in life expectancy between men and women. It gave ground to suggest a negative relationship between stress accumulation and life expectancy (Shkolnikova et al. 2009; Oksuzyan et al. 2015).

Among the consequences of mental health disorders, mortality due to suicide among elderly people is to be emphasized. In Russia, the old-age people are regarded as a group with increased suicidal risk (Danilova 2014; Vishnevsky 2017). An important area of study is gerontopsychology and research of gerontologists. The first study of the attitude of elderly patients to depression and its treatment in Russia is presented in the work on the city of St. Petersburg (Jogerst et al. 2010). The study revealed a positive attitude to the treatment of depression, as well as the relationship of depressive disorders with income and excessive alcohol consumption.

Some works by Western and Russian authors are dealing with assessing the socio-economic burden of mental and behavioural disorders such as schizophrenia (Weiden and Olfson 1995; Lyubov and Yastrebov 2012), Alzheimer's disease (Fox et al. 2001), dementia (Wubker et al. 2015) and the class of mental and behavioral disorders in general (Gurovich et al. 2010; Yastrebov et al. 2014), as well as analysis of the effectiveness (benefit and cost analysis) of various measures to provide care for people with mental disabilities (Hoch et al. 2002), analysis of direct and indirect costs in the treatment of mental disorders (Oliva-Moreno et al. 2009), analysis of the impact of negative economic shocks on mental health (Urbanos-Garrido and Lopez-Valcarcel 2015).

The combination of modern methods of statistical and demographic analysis is presented in the work of German researchers (Raab et al. 2018) who use cluster analysis to separate the general sample by subgroups on physical and mental health.

Despite the fact that the issues of mental health and well-being of the elderly population of Russia are currently attracting more and more attention of researchers, there are few studies which offer assessments of the factors of mental health of the elderly population. That's why this paper is focused on the relationship between the socio-economic characteristics of the elderly people of Russia and their mental health.

## Definition of mental health

Historically, there are two approaches to the definition of mental health: hedonic and eudemonic, which were later added by the concept of social well-being, making it possible to present so-called "triangular models", which reflect all of the contemporary aspects of mental health (see Table 1).

According to the hedonic tradition, the key components of mental health and well-being include: a high level of positive emotions and level of satisfaction with life, as well as a low level of negative emotions and experiences. A significant contribution to the development of the hedonic approach was made by N.M. Bradburn (Bradburn 1969), G. Gurin, J. Veroff, S. Feld (Gurin et al. 1960), E. Diener (Diener 1984, 1985) et al.

**Table 1.** Approaches to the definition of mental health.

The hedonic approach (emotional well-being)	Positive emotions, interest in life, happiness
	Judgment on the quality of life (in general and in certain areas)
	Accepting yourself as a person
The eudemonic approach (psychological well-being)	Personal growth, self-development
	Goal-setting, sense of own importance, determination of life directions
	Social responsibility, decision-making
	Autonomy, confidence in the expression of own ideas, opinions and values
	Positive relations with others, high level of trust
Social well-being Keyes (1998)	Positive attitude towards others
	Social growth, activities aimed at the development of society and the environment Social inclusion
	A sense of unity, cohesion of society
	A sense of belonging to society, a sense of social support

**Source:** compiled by the author.

According to the hedonic approach mental health includes positive emotions, satisfaction with life, and happiness, and therefore, corresponds to the concept of emotional well-being. One of the most significant models in the framework of this approach is the model that reflects the relationship between life satisfaction and positive and negative external influence. This model highlights the factors that affect the well-being of the individual: factors that have a positive impact, factors that have a negative impact, and overall level of life satisfaction. The author attributed the first two factors to emotional evaluation and the latter to cognitive judgment (Diener et al. 1985).

In the works that define mental health through the concept of hedonic approach, researchers mainly rely on scales of individual questionnaires such as the Positive and Negative Affect Schedule (PANAS) (Watson et al. 1988) and The Subjective Happiness Scale (SHS) (Lyubomirsky and Lepper 1999).

According to the eudemonic tradition, the main signs of mental health are: a sense of self-worth, self-confidence, development and implementation of one's own potential, active goal-setting, interaction with the environment, a high level of trust — all this allows to define this concept as a concept of psychological well-being. A great contribution to the development of this direction was made by C. L. Keyes (1998), C. D. Ryff (1989) and others.

In order to measure the mental health indicator, the studies based on the eudemonic approach often uses the scale of one of the founders of this approach, the Ryff's scale (1989).

Within the frames of the eudemonic approach to mental health, the concept of social well-being is developed (Keyes 1998). According to this concept, mental health depends on a person's attitude towards others, his/her position in society and the perception of society as a whole. A scale of 34 questions was proposed for measurement (Keyes 1998).

Three approaches to the definition of mental health provide an opportunity to make a many-sided analysis of the key aspects of mental health: emotional problems resulting from dissatisfaction with life; problems of contacting with the society and living in the society; problems of the absence of life aims and interest to life.

The purpose of this paper is to combine the existing approaches to understanding the mental health and assess the relationship between mental health and socio-economic characteristics of the elderly population.

## Data

This paper uses data of the longitudinal international study of the elderly population, Study on Global Ageing and Adult Health (SAGE), conducted by WHO in Russia in 2002–2004 (wave 0) and 2007–2010 (wave 1). Subsequent waves of study: 2014–2015 (wave 2) and 2017 (wave 3) for Russia are combined into one and are currently unavailable.

Wave 0. A complete sample of individual data includes 4,422 respondents aged between 18 and 100 years.

Wave 1. A complete sample of individual data includes 436 respondents aged 18 to 49 and 4,511 respondents aged 50 to 100 years.

The initial cohort of respondents participating in the SAGE study was formed during the first wave in 2002–2004, however, every subsequent wave was supplemented by new participants in the survey. The sample is representative over the country.

Both individual and household data were used to build the model. Both datasets were compared by the assigned household *ID* field. For modeling, there were selected complete interviews with the population of retirement age, i.e. responses from men over 60 years and women over 55 years who participated in both the first and the in the second wave of research.

In both waves both urban and rural inhabitants of regions of Russia were interviewed. The questionnaires are voluminous and cover many important aspects of life: social and economic characteristics of the respondent, employment, health status, health services, exposure to risks (including alcohol and tobacco consumption), issues regarding the respondent's lifestyle. The second wave, unlike the first, also contains the results of various tests (verbal, mathematical, vision, etc.), questions about the presence of chronic diseases, as well as social connections and satisfaction with the standard of living. The geographical coverage of respondents is wide enough to justify the representativeness of the sample used: at the time of the survey, the respondents lived in Moscow, Nizhny Novgorod, Tver, Yaroslavl, St. Petersburg, Lipetsk, Chelyabinsk, Omsk, Volgograd, Krasnodar, etc.

The disadvantage of individual questionnaires data is the subjectivity of the respondents' answers, on the basis of which estimates of physical health, satisfaction with life, etc. are made. In addition, when completing the questionnaire, respondents from different countries and social groups may have different understanding of well-being, satisfaction, trust, etc. (Bertrand and Sendhil 2001).

The global trend of population ageing means that the elderly population is becoming more important and more significant in the age structure of society. Interest in the study of the elderly population is also based on the fact that in old age there are various significant life events — sharp decline in income, loss of spouse, worsening level of physical health, reduction of social contacts, etc., which distinguishes this age group from the younger population (Lindeboom et al. 2002).

## Methods

When including different characteristics of the social, cultural, economic and other aspects of the life of the individual in the indicator of mental health and well-being, scientists note

the dependence of this indicator on characteristics of the sample being studied. These differences highlight the difficulty of comparing different groups of population in terms of mental health and well-being (Roberts et al. 1997).

Thus, the methods used in the analysis of mental health and well-being often depend on the economic, social and cultural characteristics of a particular region, and therefore, present a subjective assessment of mental health and well-being of the population (Diener et al. 1999). Such an assessment makes cross-country comparisons difficult, as mental health and well-being can also be influenced by hidden, unobserved characteristics that affect the quality of long-term monitoring of individual mental health.

In this paper, the index of assessment of the mental health of elderly people on the basis of individual data is proposed.

In order to choose the strategy of building the mental health index, methods most commonly used in scientific research were considered:

- WHO (Five) Well-Being Index — the method was first presented in 1998 in Stockholm by the WHO Regional Office for Europe as part of the DEPCARE project on welfare measures in primary healthcare. During the period of use of the methodology, both clinical and psychometric validity were confirmed in a number of studies. The index is based on 5 questions, the answers to which are measured on a scale from 0 to 5, where 0 is “never”, 5 is “always”.
- The Center for Epidemiologic Studies Depression Scale. The Center was established in 1977 (Radloff 1977) and its main task is to measure a large depressive episode, the evaluation methodology of which was first used in mental health evaluation surveys in the 1970s and in national health and nutrition surveys. The index is based on 20 questions relying on the state over the past week; the answers are evaluated on a scale from 0 to 3 (4) depending on the category of the question.
- The Depression Anxiety Stress Scale focuses on three characteristics, mainly determining the mental health of the individual: depression, anxiety and stress. The index was developed by the researchers from the University of New South Wales (Australia) (Lovibond and Lovibond 1995) and is an estimate of 42 symptoms on a scale of 1 to 4. The authors emphasize that the test can be used exclusively for educational purposes, while for clinical diagnosis it is necessary to refer to other tools.
- The Short Depression-Happiness Scale (SDHS) (Joseph et al. 2006) is a short version of the basic scale of “depression/happiness”; it consists of 6 questions (the full version contains 25), reflecting three positive and three negative states, respectively, to assess over the past two weeks. The index passed empirical testing on a sample of respondents from the USA and the UK, which confirmed the reliability of its use to reflect the mental health of the population.
- The Warwick-Edinburgh Mental Well-being Scale (WEMWBS). The methodology was developed by researchers from the universities of Warwick and Edinburgh, funded by the Scottish National Health System to measure adult mental well-being in the United Kingdom. The index is based on 14 questions, the answers to which are evaluated on a scale of 1 to 5.
- The General Health Questionnaire (GHQ-12) is a measurement of psychological well-being. This technique is suitable for all ages. The questions are focused on determining whether there is an inability to manage daily affairs and the occurrence of a previously unencountered disturbed state. The questionnaire is presented in four variants consisting of 60, 30, 28 or 12 questions respectively.

In addition to the above-mentioned methods of assessing mental health, others were considered — the Montgomery-Asberg Depression Scale, Hamilton Scale, SF-36, Positive and Negative Affect Scale, Satisfaction With Life Scale, Global Life Satisfaction Scale, Scale of Psychological Well-being, EQ-5D Thermometer, Emotional Intelligence Scale, etc. However, all the indices presented have a high correlation (Stewart-Brown et al. 2007), which enables concentrating on the most relevant and applicable SAGE to the WHO study.

The Geriatric Depression Scale (GDS-15) was developed directly for self-assessment of the mental health of the elderly population. The scale is one of a few universally accepted scales used in working with the elderly population.

The limitations of existing methods of assessment of mental health and well-being of the elderly population as a separate group give reasons for development of the author's method of estimation of this indicator.

Based on the results of earlier studies, we analyze the relationship between mental health and the following groups of individual characteristics of the elderly population of Russia:

- demographic characteristics (sex, age, marital status) and state of health characteristics (level of physical health);
- social characteristics (education, intra-group and interpersonal trust, presence of a close relative in need of support (including emotional));
- economic characteristics (is the available money enough for everyday needs?).

On the basis of the analysis of scientific literature, for the studied sample of the elderly population of Russia (men and women of pension ages) the following hypotheses were formulated:

**H<sub>1</sub> Hypothesis.** Other things being equal, women in Russia on average are more susceptible to mental health deterioration than men.

**H<sub>2</sub> Hypothesis.** Other things being equal, the loss of a spouse is negatively related to the mental health of the respondent.

**H<sub>3</sub> Hypothesis.** Other things being equal, having a higher education is positively related to the state of mental health.

**H<sub>4</sub> Hypothesis.** Other things being equal, the level of both intra-group and interpersonal trust is positively related to the state of mental health of the respondent.

The CES-D-10 methodology is the basis for comparative analysis and adaptation of WHO SAGE data. The choice of this methodology is justified by the following provisions:

1. Compared to the traditional CESD-20 method, CESD-10's short version excludes issues related to somatic disorders, which are often the result of the natural ageing process of the body. (Ivanets et al. 2016).
2. The Scales of the Center for Epidemiological Studies (CES-D-20, CES-D-10) are the most commonly used tool for measuring mental health and well-being in authoritative scientific publications selected in accordance with the requirements for the scientific publications used in this work.
3. The paper introduces a premise about the possibility of application of the international methods for measuring mental health and well-being to the analysis of mental health of the elderly population of Russia.

## **Adaptation of CESD-10 survey questions to WHO SAGE research questions**

The adaptation of CESD-10 survey questions to the WHO SAGE wave 1 survey (2007-2010) was to select similar questions to comply with a key set of categories and relevant indicators, which are part of the indicator of mental health and well-being (see Table 2).

**Table 2.** Comparison of CESD-10 questions and WHO SAGE questions, wave 1 (2007–2010).

	<b>CESD-10</b>	<b>WHO SAGE, wave 1</b>
1	I was bothered by things that usually don't bother me	<i>no analogue</i>
2	I had trouble keeping my mind on what I was doing	Difficulties in daily household activities (Q2001)
3	I felt depressed	Feeling sad, low or depressed (Q2018)
4	I felt that everything I did was an effort	Not feeling rested or refreshed during the day (Q2017)
5	I felt hopeful about the future	<i>no analogue</i>
6	It seems to me that my life has failed	Assessments of satisfaction with the state of health, oneself, life, relationships with other people, living conditions (Q7003-Q7007)
7	I feel fearful	Presence of worry and anxiety (Q2019)
8	My sleep was restless	Presence of sleep disorders (Q2016)
9	I was happy	Do you feel happy/unhappy (Q7010)
10	I felt lonely	<i>no analogue</i>

**Source:** compiled by the author on the basis of CESD-10, WHO SAGE-2007/10 (wave 1).

Most CESD-10 questions (seven out of ten) managed to find analogs in the WHO SAGE study. A complete match of the wording was found for four questions of the CESD-10 questionnaire: “I feel depressed”, “I feel fearful”, “I have a bad night’s sleep”, “I feel happy”.

The following assumptions were introduced for the three questions:

- “I had trouble keeping my mind on what I was doing” - it is assumed that the individual faces some difficulties in doing daily household tasks because the wording of the issue is more of routine work than of achievement of any goals;
- “I felt that everything I did was an effort” - assumes the dependence of the result of work, achievement of goals, etc., not only on the existing individual competencies and skills, but also on additional costs (including physical, temporary, etc.), therefore, we will introduce the premise of fatigue, loss of energy by the respondent;
- “It seems to me that my life has failed” — for this question we will use indicators of satisfaction with different areas of life: oneself, relationships with others, living conditions and life in general, trying to reflect to a maximum extent the individual attitude and the degree of satisfaction with life.

For the following questions, no analogues were found in the WHO SAGE study:

- “I was bothered by things that usually don't bother me”;
- “I felt hopeful about the future”;
- “I felt lonely”

Thus, the indicator of mental health and well-being of the elderly population of Russia used in this work includes responses to eleven questions from the WHO study (see Table 2).

The answers to the questions do not require standardization, as they are measured in a single five-point scale system (see Table 3).

Descriptive statistics of indicators are presented in Table 4.

Currently, the following methods are used to construct indicators of mental health:

The *Summarized indicator* - the most commonly used method for generating an indicator of mental health and well-being of a respondent based on surveys.

**Table 3.** Survey questions used in constructing an indicator of mental health.

	<b>Survey question</b>	<b>Measurement scale</b>
<b>Q2001</b>	Difficulties in managing daily household activities ( <b>Disability</b> )	1 - no (difficulties, disorders...)
<b>Q2016</b>	Presence of sleep disorders ( <b>Insomnia</b> )	2 - minor ((difficulties, disorders...)
<b>Q2017</b>	Fatigue, energy loss ( <b>Fatigue</b> )	3 - average (difficulties, disorders...)
<b>Q2018</b>	The presence of sad, depressive states, feelings of devastation ( <b>Depression</b> )	4 - considerable (difficulties, disorders...)
<b>Q2019</b>	Presence worry and anxiety ( <b>Anxiety</b> )	5 - extreme difficulties, (very severe disorders)
<b>Q7003 - Q7007</b>	Assessments of satisfaction with <b>Health, Yourself, Life, Relationships, living Conditions</b>	1 — very much satisfied 2 — satisfied 3 — not clear 4 — not satisfied 5 — not satisfied at all
<b>Q7010</b>	Do you feel happy/unhappy ( <b>Happiness</b> )	1 — very happy 2 — happy 3 — not clear 4 — unhappy 5 — very unhappy

**Source:** WHO SAGE-2007/10 (wave 1).

**Table 4.** Descriptive statistics of indicators used.

<b>Variable</b>	<b>Mean</b>	<b>Median</b>	<b>Min</b>	<b>Max</b>
Disability	2.66	3	1	5
Insomnia	2.35	2	1	5
Fatigue	2.32	2	1	5
Depression	1.68	1	1	5
Anxiety	1.81	2	1	5
Health	3.06	3	1	5
Yourself	2.51	2	1	5
Relationships	2.17	2	1	5
Conditions	2.34	2	1	5
Happiness	2.72	3	1	5
Life	2.58	2	1	5

**Source:** author’s calculations.

$$Mental\_Health_i = \sum_{i=1}^{11} Q_i$$

For example, the summarized indicator is used in the formation of the indicator of mental health and well-being according to the WHO-Five Well-being Index questionnaire, CES-D-20, CES-D-10.

Arithmetical mean is less common, but is also a popular measure of mental health and well-being of the surveyed:

$$Mental\_Health_i = \frac{\sum_{i=1}^{11} Q_i}{11}$$

For example, the arithmetic mean indicator is used to generate mental health and well-being indicators from The Short Depression-Happiness Scale (SDHS).

The indicator developed and used in this work is based on the Principal components analysis (PCA). PCA was chosen for the following objective reasons of use:

1. The mental health indicator requires indirect evaluation, taking into account the variance of the indicators used;
2. It is assumed that the answers of the eleven selected questions can be strongly correlated among themselves.

The principal components analysis enables forming new features, which are linear combinations of old ones, and at the same time retain the maximum amount of information contained in the original features. The linear combination is designed to maintain the maximum variance in the data, optimally reducing data dimension, thus decreasing the risk of

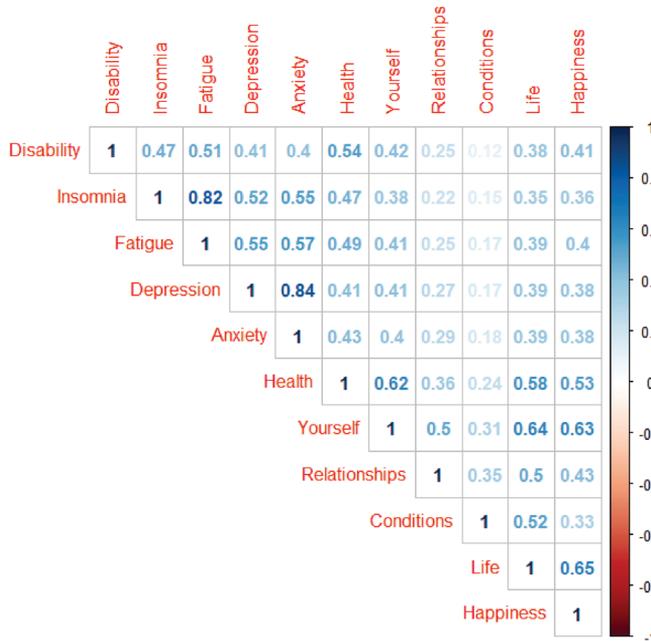


Figure 1. Correlation matrix of mental health indicators. Source: author’s calculations.

multicollinearity, preserving the possibility of convenient interpretation of the obtained results.

To start, it is necessary to characterize the dependence of certain features by means of correlation analysis (see Figure 1). The correlation matrix of indicators in the definition of mental health demonstrates high correlation of answers to questions on the presence of sleep disorders and feeling of fatigue (the correlation of these indicators is 0.82); satisfaction of life and feeling of happiness (0.65), and satisfaction with one self (0.64). The least correlation is the answers to questions on satisfaction with living conditions and difficulties in daily activities (0.12), sleep disorders (0.15), fatigue (0.17) and depression (0.17). Also note that all considered indicators are positively correlated among themselves.

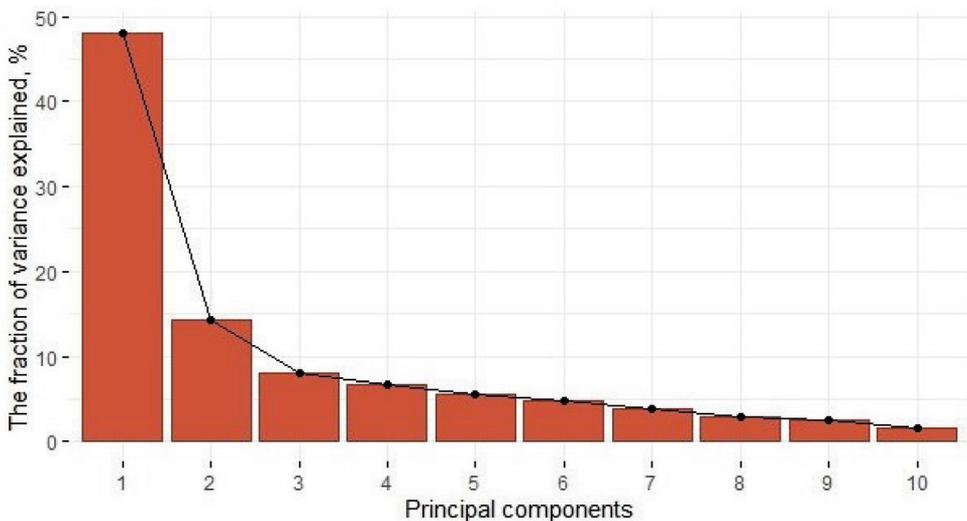
The number of principal components corresponds to the number of indicators used. Let's build 11 principal components (K1,... K11) (see Table 5).

Figure 2 demonstrates graphical display of the calculated principal components.

**Table 5.** Principal components.

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11
Standard deviation	2.13	1.11	0.90	0.81	0.70	0.61	0.56	0.48	0.44	0.43	0.38
Proportion of the variance explained	0.49	0.13	0.09	0.07	0.05	0.04	0.03	0.03	0.02	0.02	0.02
Cumulative fraction of variance explained	0.49	0.63	0.72	0.79	0.84	0.88	0.92	0.94	0.96	0.98	1.00

**Source:** author's calculations.



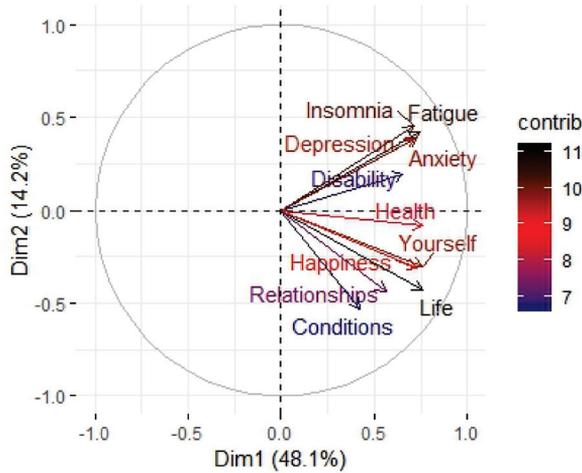
**Figure 2.** Principal components. Source: author's calculations.

The first principal component explains 49% of the variance, the proportion of the explained variance by the other main components can be considered insignificant. In the empirical study, we will use the results obtained for the first principle component.

Figure 3 shows the characteristic vectors of the initial two principal components by using the intensity colour scale, which shows the direction and significance of the contribution of certain indicators.

To assess the contribution of each indicator, we take the calculated value of the first principal component for the individual level of mental health and well-being of the elderly person.

The characteristic vector of the first principal component is represented in the Table 6. The lowest contribution is reflected by the indicator characterizing satisfaction with living



**Figure 3.** Contribution of indicators to the initial two principal components. Source: author's calculations.

**Table 6.** Contribution of indicators to the first main component (K1).

Indicator	Interpretation	Weight
<b>Yourself</b>	Satisfaction with yourself	0.3303
<b>Health</b>	Satisfaction with state of health	0.3303
<b>Life</b>	Life satisfaction	0.3297
<b>Fatigue</b>	Fatigue, energy loss	0.3243
<b>Happiness</b>	Happiness	0.3173
<b>Anxiety</b>	Presence of worry and anxiety (Q2019)	0.3160
<b>Depression</b>	Feeling sad, low and depressed (Q2018)	0.3119
<b>Insomnia</b>	Presence of sleep disorders	0.3088
<b>Disability</b>	Presence of difficulties in daily household activities	0.2846
<b>Relationships</b>	Satisfaction with relationships with other people	0.2447
<b>Conditions</b>	Satisfaction with living conditions	0.1838

**Source:** author's calculations.

conditions (0.18), the highest is satisfaction with general health (0.33) and self-satisfaction (0.33).

The maximum value of the mental health indicator obtained in the sample is 16.41, the minimum is 1.52.

### Model

We shall take into account the fact that many respondents avoided the question on household income. As a proxy variable of income, we shall use the answer to the question of the second wave of the study (Q0002): “Do you have enough money to cover your daily needs?” (*Money*) (see Table 7).

**Table 7.** Description of additional variables.

Variable		Variable description
Money	income	1., absolutely enough to cover daily needs
		2, practically enough
		3, enough on the average
		4, practically not enough
		5, not enough at all

**Source:** WHO SAGE, 2007–2010.

Thus, the estimated model, which includes a variable reflecting the sufficiency of money to cover daily needs, instead of disposable household income, will take the form of:

### Basic specification

#### Model 1.

$$\begin{aligned}
 \text{Mental\_Health}_{it} = & \beta_1 + \beta_2 * \text{Sex}_i + \beta_3 * \text{Age}_{it} + \beta_4 * \text{Married}_{it} + \\
 & + \beta_5 * \text{Cohabiting}_{it} + \beta_6 * \text{Divorced}_{it} + \beta_7 * \text{Widowed}_{it} + \beta_8 * \text{Secondary}_i + \\
 & + \beta_9 * \text{University}_i + \beta_{10} * \text{PhD}_i + \beta_{11} * \text{Money}_i + \beta_{12} * \text{Health}_{t-1,i} + \\
 & + \beta_{13} * \text{Generalized\_Trust}_{t,i} + \beta_{14} * \text{Person\_Needed\_Care}_{t,i} + \varepsilon_i
 \end{aligned}$$

To get additional specifications, we construct models with less number of indicators (Model 3) and we will use the level of interpersonal trust instead of generalized trust (Model 2, “long” and Model 4 “short”, as the indicators of interpersonal and intra-group levels of trust are strongly correlated).

#### Model 2.

$$\begin{aligned}
 \text{Mental\_Health}_{it} = & \beta_1 + \beta_2 * \text{Sex}_i + \beta_3 * \text{Age}_{it} + \beta_4 * \text{Married}_{it} + \\
 & + \beta_5 * \text{Cohabiting}_{it} + \beta_6 * \text{Divorced}_{it} + \beta_7 * \text{Widowed}_{it} + \beta_8 * \text{Secondary}_i + \\
 & + \beta_9 * \text{University}_i + \beta_{10} * \text{PhD}_i + \beta_{11} * \text{Money}_i + \beta_{12} * \text{Health}_{t-1,i} + \\
 & + \beta_{13} * \text{Person\_to\_Trust}_{t,i} + \beta_{14} * \text{Person\_Needed\_Care}_{t,i} + \varepsilon_i
 \end{aligned}$$

**Model 3.**

$$\begin{aligned} \text{Mental\_Health}_{it} = & \beta_1 + \beta_2 * \text{Sex}_i + \beta_3 * \text{Age}_{it} + \beta_4 * \text{Widowed}_{it} + \\ & + \beta_5 * \text{University}_i + \beta_6 * \text{PhD}_i + \beta_7 * \text{Money}_i + \beta_8 * \text{Health}_{t-1,i} + \\ & + \beta_9 * \text{Generalized\_Trust}_{t,i} + \beta_{10} * \text{Person\_Needed\_Care}_{it} + \varepsilon_i \end{aligned}$$

**Model 4.**

$$\begin{aligned} \text{Mental\_Health}_{it} = & \beta_1 + \beta_2 * \text{Sex}_i + \beta_3 * \text{Age}_{it} + \beta_4 * \text{Widowed}_{it} + \\ & + \beta_5 * \text{University}_i + \beta_6 * \text{PhD}_i + \beta_7 * \text{Money}_i + \beta_8 * \text{Health}_{t-1,i} + \\ & + \beta_9 * \text{Person\_to\_Trust}_{t,i} + \beta_{10} * \text{Person\_Needed\_Care}_{it} + \varepsilon_i \end{aligned}$$

**Results**

According to the achieved results, the most significant relationship with mental health comes from age, income and physical health of the respondent. The Hypothesis  $H_1$  is fully confirmed: all other things being equal, women in Russia are on average more susceptible to deterioration of mental health status.

On the basis of the set of approaches presented in the theoretical part of the article we can emphasize the importance of the emotional state of the respondent at the time of questioning. However, the time lag between the emotionally severe events and the time of survey are to be taken into consideration.

The Hypothesis  $H_2$  about negative correlation between the loss of a spouse and the state of the mental health of the respondent, is partly confirmed.

The suggestion about strong influence of the level of education (the Hypothesis  $H_3$ ) is not confirmed. Only the full higher education in the “long” specifications of the models is of importance.

The level of interpersonal trust and generalized level of trust do not differ in their impact on mental health, however, the presence of a close person is more closely related to a higher level of mental health of the elderly than the general level of trust in people. Therefore, the Hypothesis  $H_4$  is confirmed but with a note to different degree of the influence of the used characteristics.

With the increase in age, all other things being equal, on average, there is a deterioration in mental health (with the increase in age by 1 year, mental health deteriorates by 0.01 conventional units of measurement. Sufficiency in money, measured by the question of income adequacy to cover daily needs, suggests more stable mental health and well-being. Good physical health determines good mental health and well-being in the future.

*Subsampling of observations*

In dividing the totality of respondents into sub-samples by gender, the objective was to identify differences in factors related to mental health for men and women. It turns that for men, the greatest influence is the absence of a spouse (divorced or widowed status), contributing to 3.12 and 2.23 units respectively, which is significant in the five-point measurement of the dependent variable. In addition, there is a strong correlation between the mental health of

men and the sufficiency of available money, the generalized level of trust and the presence of a close relative in need of the respondent's support (including emotional).

For women, unlike men, there is a significant correlation between the level of education and the level of mental health, namely, completed secondary education, among other things being equal, improves mental health and well-being of women by 0.5 on average (the result is similar in both models for a this sub-sample). In addition, the presence of a trustworthy person as well as a generalized level of trust are more important for women when compared to men. Both for women and men, physical health and sufficient money to cover daily needs are important factors for mental health and well-being. It is worth mentioning that the presence of a relative in need of support (including emotional support) has a larger negative impact on the level of mental health and well-being for women.

Mental and behavioral disorders deteriorate the quality of life of the respondent and his/her environment. Thus, by identifying the key socio-economic determinants of mental health and well-being of the elderly population of Russia and the main risk factors of mental health disorders, it is possible to elaborate the mechanisms, which would positively affect mental health and therefore, improve the quality of life of the elderly population. As a result, it will contribute to increasing the life expectancy, on the one hand, and improving the social and economic well-being of society as a whole, on the other hand.

## Limitations

It is necessary to note some limitations that need to be taken into account in further interpreting the calculations and the received correlations.

### *Selection of the sample*

In such kind of studies, the selection effect is considered from several perspectives. First of all, it should be emphasized that health surveys often involve healthier people than the general health of the entire population. Secondly, some authors note a decrease in the prevalence of mental illness (depressive episodes) with an increase in the age of the individual; in other words, persons with a more stable mentality who are less susceptible to mental disorders survive to older ages (Bobak et al. 2006).

### *Subjectivity of evaluations*

The SAGE study presents self-reported indicators of health, social activity and lifestyle. To measure the of health level we have to use proxy-variables. It can result in shifted assessment of the health state. Therefore, the use of subjective methods can result in over-estimation of the health state. However, in this case the shifted assessment does not affect the presence or absence of differences in mental health between particular socio-demographic groups of population.

### *Comorbidity*

Comorbidity manifests itself in the difficulty of identifying certain mental (depressive) disorders due to the presence of multiple concomitant diseases in this age group. The elderly

people usually have a set of chronic diseases (diabetes, asthma, bone and muscular diseases, etc.), which can also affect the state of mental health. Investigation of relationships between chronic diseases and mental health can be the development of this study.

## Conclusion

This paper presents a method for assessing mental health and well-being of the elderly population of Russia and its testing on the data of the WHO Study on Global Ageing and Adult Health (SAGE). The implementation of the empirical strategy allowed to make conclusions about the close connection of mental health and well-being with the age of the respondent, sex, the sufficiency of money to cover daily needs, confidence, physical health, and stress.

The author agrees with the authoritative opinion of other researchers on the need for further research in order to better understand the existing links between socio-economic characteristics and mental health.

Application of the principal components analysis instead of aggregated index for calculation the mental health indicator allows to maximize the variance in the original data, reducing their dimensionality in an optimal way.

Despite the fact that the concept of mental health and well-being at present has not yet found proper representation in the works of Russian researchers, the author suggests that this issue will become one of the most relevant in the near future, because the problems of mental health and well-being under the conditions of population ageing are problems of a global level.

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## Appendix

**Table A.** Results. Full sample models.

<b>Dependent variable: Mental Health (PCA)</b>								
	<b>Model 1</b>		<b>Model 2</b>		<b>Model 3</b>		<b>Model 4</b>	
<b>const</b>	0.5242		0.4706		0.8375		0.9995	
	(0,823)		(0,8462)		(0,6816)		(0,7138)	
<b>Sex</b>	0.0584	*	0.4212	*	0.3934	*	0.4281	*
	(0,01)		(0,2247)		(0,2151)		(0,2189)	
<b>Age</b>	0.3819	***	0.0586	***	0.055	***	0.0549	***
	(0,2208)		(0,0101)		(0,0097)		(0,0098)	
<b>Married</b>	0.1721		0.3744					
	(0,4274)		(0,4235)					
<b>Cohabiting</b>	0.2697		0.7307					
	(0,5586)		(0,562)					
<b>Divorced</b>	0.3401		0.5033					
	(0,493)		(0,4872)					
<b>Widowed</b>	0.3358		0.5404		0.1317		0.1573	
	(0,4215)		(0,4142)		(0,1798)		(0,1846)	
<b>Secondary</b>	-0.4335	**	-0.4451	**				
	(0,1889)		(0,1884)					
<b>University</b>	0.2203		0.1865		0.3234	*	0.3013	
	(0,1846)		(0,1874)		(0,1816)		(0,1847)	
<b>PhD</b>	0.0293		-0.0313		0.1397		0.1036	
	(0,4002)		(0,4157)		(0,3985)		(0,4216)	
<b>Money</b>	0.406	***	0.3894	***	0.4023	***	0.3826	***
	(0,0748)		(0,0755)		(0,075)		(0,0759)	
<b>Health</b>	0.4863	***	0.5199	***	0.4849	***	0.5112	***
	(0,1194)		(0,1195)		(0,1202)		(0,1205)	
<b>Generalized Trust</b>	-0.478	***			-0.4814	***		
	(0,183)				(0,1827)			
<b>Person to Trust</b>			-0.4583	**			-0.4361	
			(0,1967)				(0,1947)	
<b>Person needed care</b>	0.1735	***	0.6654	**	0.1699	***	0.6638	**
	(0,0315)		(0,2735)		(0,03)		(0,2737)	
<b>R-squared</b>	0.2307		0.2322		0.2217		0.2211	
<b>adj. R-squared</b>	0.2122		0.2137		0.2094		0.2086	
<b>F</b>	13.26		13.28		19.77		20.03	
<b>P</b>	0		0		0		0	
<b>Log-likelihood</b>	- 1019,06		-1016.70		-1022.22		-1020.39	
<b>AIC</b>	2064.11		2059.41		2062.04		2058.79	
<b>BIC</b>	2119.23		2114.48		2100.20		2096.92	
<b>N</b>	513		511		513		511	

**Source:** author's calculations

*Ramsey Test*

The Ramsey test proves that the model specification is correct. All constructed models are correctly specified, but at different levels of significance. The most reliable models for interpretation are Model 1 and Model 3.

The results of the Ramsey test are presented in Table B.

**Table B.** Ramsey Test Results for Full Sample Models (1)–(4).

<b>Model 1</b>	p-value = $P(F(2.497) > 0.58628) = 0.853$
<b>Model 2</b>	p-value = $P(F(2.495) > 0.84713) = 0.429$
<b>Model 3</b>	p-value = $P(F(2.502) > 0.318008) = 0.728$
<b>Model 4</b>	p-value = $P(F(2.500) > 2.31234) = 0.1$

**Source:** author’s calculations.

*Wald Test*

The Wald test enables comparing “short” and “long” regressions. So we can compare models 1, 3 and models 2, 4. In both cases, the test shows the correctness of the choice of a longer regression, which is correlated with the results of the Ramsey test.

The results of the Wald test are presented in Table C.

**Table C.** Wald Test Results for Full Sample Models (1)–(4).

<b>Models 1, 3</b>	Test statistics: $TR^2 = 73,481884$ , p-value = $P(\text{Chi-square}(31) > 73,481884) = 0.000026$
<b>Models 2, 4</b>	Test statistics: $TR^2 = 102,650918$ , p-value = $P(\text{Chi-square}(57) > 102,650918) = 0.000200$

**Source:** author’s calculations.

Using the advantage of individual data, we divide the initial sample into two sub-samples by gender — a sub-sample of males (“M”) and a sub-sample of females (“F”) of retirement ages.

Table D presents the model evaluation results for sub-sample “M”; and Table E for sub-sample “F”.

**Table D.** Results. Sub-sample “M”

<b>Dependent variable: Mental Health (PCA)</b>				
	<b>Model 1</b>		<b>Model 2</b>	
<b>const</b>	1.6786 (2,1399)		1.6594 (2,244)	
<b>Age</b>	0.0206 (0,0288)		0.0132 (0,0308)	
<b>Married</b>	2.3398 (0,5669)		2.5236 (0,5952)	
<b>Cohabiting</b>	1.0626 (0,6417)		1.2033 (0,7236)	
<b>Divorced</b>	3.1247 (1,0154)	***	3.349 (1,0252)	***
<b>Widowed</b>	2.227 (0,5424)	***	2.3689 (0,5798)	***
<b>Secondary</b>	-0.3609 (0,4304)		-0.3718 (0,4259)	
<b>University</b>	0.7208 (0,4369)		0.6986 (0,4365)	
<b>PhD</b>	-0.0138 (1,2756)		0.0002 (1,39)	
<b>Money</b>	0.3095 (0,1641)	*	0.3 (0,1723)	*
<b>Health</b>	0.3331 (0,3165)		0.4799 (0,3408)	
<b>Generalized Trust</b>	-0.6923 (0,3636)	*		
<b>Person to Trust</b>			-0.3312 (0,4772)	
<b>Person needed care</b>	1.4063 (0,7014)	**	1.3401 (0,6981)	*
<b>R-squared</b>	0.1794		0.1617	
<b>adj. R-squared</b>	0.0819		0.0611	
<b>F</b>	8.2508		562683	
<b>P</b>	0		0	
<b>Log-likelihood</b>	-228.9312		-228.6191	
<b>AIC</b>	483.8624		483.2381	
<b>BIC</b>	519.43		518.69	
<b>N</b>	114		113	

**Source:** author's calculations.

**Table E.** Results. Sub-sample “F”.

<b>Dependent variable: Mental Health (PCA)</b>				
	<b>Model 1</b>		<b>Model 2</b>	
<b>const</b>	0.5278 (0,8068)		0.6503 (0,8229)	
<b>Age</b>	0.0653 (0,0104)	***	0.0661 (0,0104)	***
<b>Married</b>	-0.1014 (0,4572)		0.1031 (0,4463)	
<b>Cohabiting</b>	0.3707 (0,6051)		0.8504 (0,5906)	
<b>Divorced</b>	0.0647 (0,5206)		0.2173 (0,509)	
<b>Widowed</b>	0.13 (0,4468)		0.351 (0,4312)	
<b>Secondary</b>	-0,5353 (0,2076)	**	-0.544 (0,2047)	***
<b>University</b>	0.0827 (0,2038)		0.0546 (0,2058)	
<b>PhD</b>	0.1324 (0,3175)		0.1016 (0,3056)	
<b>Money</b>	0.4301 (0,8387)	***	0.404 (0,0842)	***
<b>Health</b>	0.5127 (0,1228)	***	0.5226 (0,1215)	***
<b>Generalized Trust</b>	-0.3874 (0,2082)	*		
<b>Person to Trust</b>			-0.5502 (0,2162)	**
<b>Person needed care</b>	0.645 (286)	**	0.6535 (2868)	**
<b>R-squared</b>	0.2822		0.2925	
<b>adj. R-squared</b>	0.2618		0.2723	
<b>F</b>	14.3596		15.26	
<b>P</b>	0		0	
<b>Log-likelihood</b>	-778.62		-775.33	
<b>AIC</b>	1581.24		1574.66	
<b>BIC</b>	1629.11		1622.50	
<b>N</b>	399		398	

**Source:** author’s calculations.

Similar to the previous models, the Ramsey test was applied (see Table F, G).

The models constructed for corresponding sub-samples of males and females are correctly specified. However, the most reliable results are shown by models that include a generalized rather than interpersonal level of trust.

**Table F.** Ramsey Test Results for Models (1)–(2) for sub-sample “M”.

<b>Model 1</b>	p-value = $P(F(2.99) > 0.0463085) = 0.955$
<b>Model 2</b>	p-value = $P(F(2.98) > 0.175306) = 0.839$

**Source:** author’s calculations.

**Table G.** Ramsey Test Results for Models (1)–(2) for sub-sample “F”.

<b>Model 1</b>	p-value = $P(F(2.385) > 0.0766401) = 0.926$
<b>Model 2</b>	p-value = $P(F(2.384) > 1.31087) = 0.271$

**Source:** author’s calculations.