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The Role of Innovation in Solving the Demographic Problems of the Arctic: A Population Perception Study *

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Abstract. The decline in the birth rate, the increase in migration outflows and the deterioration of the health of the Russian Arctic population make it necessary to find innovative solutions to these issues. The scientific problem is to reveal the mechanisms of the influence of innovations and methods of their implementation in the sphere of the formation and realizing of the Arctic demographic potential. The aim of the article is to study the perception of innovation by the population of the Arctic territories when solving personal demographic issues and to assess the relationship between this perception with socio-demographic characteristics. The novelty of the study is in an attempt to link demographic and innovation processes in the Arctic. It was reflected in the substantiation of the theoretical model. The key element of the model is the zone of innovations perception by the population, formed on the basis of the interaction of demographic and innovation processes and combining the following directions of perception: population innovative activity, the desire to learn, the willingness to invest in innovations, the assessment of the innovations availability and willingness to use them, the inclusion of the population into the digital environment when solving demographic problems. The empirical basis was formed by the author's sociological survey of the Arctic municipalities population of the Arkhangelsk region, conducted in 2019. It was revealed that innovation perception is mainly influenced by the age and education and, to a lesser extent, by the level of their income. The results obtained can be used to develop a state regional policy for the demographic development of the Arctic territories based on the use of innovations.
Keywords: *perception of innovation, demographic process, Arctic territory.*

Introduction

The Arctic zone of the Russian Federation, which is home to about 5.3% of Russia's population (2019), loses about 1% of its permanent population every two years [1]. From 2000 to 2019, the loss amounted to 836.5 thousand people due to negative trends in the natural population movement and migration outflow. One of the demographic trends in the Russian Arctic is a decrease in the birth rate, which has been observed since 2015 and corresponds to the all-Russian one, but differs at a faster pace (Table 1). In 2018, the absolute birth rate (87.8 thousand births) practically returned to the 2001 level (88.7 thousand births). A characteristic tendency that complicates the processes of natural reproduction is an increase in the average age of mother at the birth of her

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[1] Unified interdepartmental information and statistical system. URL: https://www.fedstat.ru/indicator/31557 (accessed 14 June 2020).

first child. Despite the younger population (in 2018, the average age of the population in the Arctic was 37.4 years, in Russia — 40.0 years) [2], the average age of a mother at the birth of her first child corresponds to the average Russian value — 28.7 years.

Table 1

Key indicators of demographic processes in the Arctic [3]

Indicators	AZRF regions, average value					Russian Federation, average value				
	2000	2005	2010	2015	2018	2000	2005	2010	2015	2018
Total birth rate, ‰	10.5	12.3	14.1	14.4	11.7	8.7	10.2	12.5	13.3	10.9
The average age of mother at the birth of her first child, years	26.1	26.4	27.2	28.0	28.7	25.8	26.5	27.6	28.2	28.7
Total birth rate, births per woman	1.2	1.5	1.7	1.9	1.7	1.2	1.3	1.6	1.8	1.6
Abortions per 100 births	181	137	81	61	58	169	117	67	44	42
General mortality rate, ‰	12.2	13.4	12.3	10.9	10.7	15.3	16.1	14.2	13	12.5
Infant mortality rate, ‰	16.4	12.4	8.7	7.2	5.7	15.3	11	7.5	6.5	5.1
Mortality rate at working age, per 100.000 people employed age	746.1	932.1	809.4	642.9	588.9	723.5	826.5	634.	546.7	482.2
Primary morbidity rate, cases per 1000 people	933.7	1035.9	1115.9	1049.3	1095.1	730.5	743.7	780	778.2	782.1
The incidence of diseases with a high percentage of fatalities, cases per 1000 people	23.6	35.6	43.8	41.05	43.4	25.7	32.6	36.9	42.6	44.2
Life expectancy, years	63.6	63.1	66.3	69.6	70.4	65.3	65.3	68.9	71.4	71.4
Migration growth rate, ‰	-4.1	-3.4	-4.4	-4.7	-3.4	1.6	0.7	1.1	1.7	0.9

A negative factor influencing fertility processes is the high level of abortions, which exceeded the average Russian values in the Arctic regions over the past two decades, which is most typical for Arkhangelsk Oblast, Krasnoyarsk Krai and Chukotka Autonomous Okrug. While in the early 2000s, the abortion rate in the Arctic exceeded the national average by only 5–7%, by 2018 the gap had increased to 40%. The Arctic has a higher infant mortality rate, exceeding the national average by 10–15%, and in some regions — more than twice as high, for example, in the Chukotka Autonomous Okrug. The Arctic model of mortality is characterized by lower values of the total mortality rate along with a high mortality rate of the population of working age. In 2018, mortality in the Arctic regions was 15% lower than the national average, while mortality at working age exceeded the national average by more than 20%. High rates of premature mortality reduce reserves for increasing life expectancy, which is lower in the Arctic than in Russia.

A negative feature of public health in the Arctic is a very high level of primary morbidity, which exceeds the Russian average by 30–40%. As in the whole country, there has been an increase in the morbidity rate for some highly lethal diseases, such as neoplasms and diseases of the cardiovascular system.

[2] Demograficheskiy ezhegodnik Rossii. 2019: Stat. sb. [Demographic Yearbook of Russia. 2019: Stat. Col.]. Rosstat. M., 2019. 252 p.
[3] Compiled from data: UISIS. URL: https://www.fedstat.ru (accessed 14 June 2020).

The demographic processes in the Arctic are characterized by a constant migration outflow, which increased significantly in 2011, thereby repeating the all-Russian growth in the migration activity. In the Arctic, however, the migration balance is negative, in contrast to the positive migration balance in Russia as a whole.

Despite the insignificant share of the Russian Arctic population in the total population of the country, the preservation and expanded reproduction of the demographic potential of the Arctic territories is of great economic, geopolitical and cultural-historical significance [4]. First of all, from the position of ensuring territorial security, satisfying the need for human resources for the purposes of economic development through the involvement of the Arctic population adapted to the harsh climatic conditions, as well as preserving the cultural heritage of the indigenous Arctic population, including ethno-cultural nuclei of small peoples of the North.

The relevance, specificity and special acuteness of demographic problems in the Arctic determine the need to search for non-trivial innovative practices in the implementation of reproductive plans, health preservation, increase in the duration and quality of life, and the formation of migration attitudes. The intensity of the use of innovations depends on the personal perception of the available innovative technologies, methods and solutions. In this regard, the purpose of this article was to study the perception of innovations by the population of the Arctic territories when solving personal demographic issues and to assess the relationship of this perception with socio-demographic characteristics.

The object of the study is the population of the territories of the Russian Arctic. The subject of the research is a system of relations between the population and innovations, which reveals the nature of their perception by a person in the implementation of personal demographic plans and the formation of a personal strategy of demographic behavior.

Theory and methodology

S.A. Sukneva reveals the demographic potential of the territories as a set of resource opportunities of population reproduction through the interaction of such demographic processes as fertility, mortality and irretrievable migration, taking into account regional features of demographic behavior of the population (reproductive, matrimonial, self-preserving) [1, Sukneva S.A., p. 10]. Within the framework of this approach, the importance of innovations in addressing demographic problems if the Arctic will be considered from the standpoint of their positive impact on increasing the birth rate, reducing mortality and ensuring the migration balance.

In our study, we rely on the definition of innovation introduced by J. Schumpeter, which is interpreted as innovation, new combination, the best way of using, which ultimately affects the entire development process [2, Schumpeter J.]. In a similar way, the concept of innovation is re-

[4] Ob Osnovakh gosudarstvennoy politiki Rossiyskoy Federatsii v Arktike na period do 2035 goda: Ukaz Prezidenta RF ot 5 marta 2020 g. N 164 [On the Fundamentals of State Policy of the Russian Federation in the Arctic for the period up to 2035: Decree of the President of the Russian Federation of March 5, 2020 N 164]. URL: https://www.garant.ru/products/ipo/prime/doc/73606526/ (accessed 16 March 2020).

vealed by W. Thompson: "...the creation, adoption and implementation of new ideas, processes, products or services" [3, Thompson V.A., p. 2]. At the same time, innovation is such as long as people perceive the idea as a new one, even if it can seem like an "imitation" of something [4, Van de Ven A., p. 591]. In the middle of the 20 century, innovations abroad began to be perceived not only in terms of economic profit, but also as having social value with a positive impact on the quality of life [5, Tewksbury J., Crandall M.S., Crane W.E., p. 660]. The well-established opinion is that the environment for innovations is society as a whole [5]. This idea is supported by Russian researchers, noting the social role of innovation [6, Folomyev A.N. et al.]. The modern view of innovation allows us to perceive them not only as a product or service, but also as a process, a new organizational structure, plan, program [7, Baregheh A., Rowley J., Sambrook S.], or a form of management. The scope of application of innovations is also expanding [8, Franz H.W., Hochgerner J., Howaldt J.], when they can be in demand in the social [9, Mulgan G.], institutional, administrative and cultural environments [10, Sener S., Schepers S.].

Demographic processes in society are a special environment for the introduction of innovations, which are quite difficult to study in a complex way. The fundamental connection between demographic and innovation processes was established in the work of V.G. Dobrokhleb et al., in which it was shown that there are lower mortality rates in the innovatively active regions of the Russian Federation. Following the strategy of national saving, the authors develop the idea of necessity to introduce innovations not only in the economy, but also in the sphere of demography, in particular, in health preservation and increase of life expectancy [11, Dobrokhleb V.G., Medvedeva E.I., Kroshilin S.V.]. M.Yu. Arkhipova, on the basis of cross-country comparison, showed that the higher the innovative activity in the country, the higher the level of human development is [12, p. 94]. Based on the previously presented definition of the demographic potential, which is formed as a result of fertility, mortality, migration, we will give some examples of the influence of innovations on these processes, described in domestic and foreign sources, as well as the experience of their use in the Arctic.

Some Russian studies show that the innovative technologies, introduced in recent years in the field of maternal and child protection, have a confirmed socio-demographic effect, which is expressed in a decrease in maternal and infant mortality in Russia from 2005 to 2016 by 50% and 29%, respectively [13, Krivenko N.V., p. 1646]. The experience of integrating information and communication and organizational innovations in Canada as part of an innovative programme of remote obstetric care showed a positive effect by reducing the need for patients to travel to central hospitals from distant locations. The patient was able to receive expert advice from an on-call doctor by telephone through a nurse on a 24-hour basis [14, Dooley J. et al.].

The introduction of innovative technologies in healthcare sector contributes to the improvement of methods of diagnosis and treatment of diseases, increases the awareness of pa-

[5] Phills J.A., Deiglmeier K., Miller D.T. Rediscovering Social Innovation Stanford Social Innovation Review. 2008. № 6. URL: https://www.researchgate.net/publication/242511521_Rediscovering_Social_Innovation (accessed 18 March 2020).

tients about their state of health, and transforms the mechanism of interaction between doctors and patients, making it more convenient and effective. Examples of innovations in the field of healthcare include electronic maps, patient routing, telemedicine, health information infrastructure (medical databases, expert systems) [15, Shevtsova E.V., p. 60]. For example, information systems contribute to the efficient collection and reliable analysis of information, which allows us to provide patients with the highest quality services and get the best treatment results.

Telemedicine plays a special role among innovations in the organization of medical care, which solves the problem of providing emergency medical care in remote, sparsely populated and poorly developed territories. The practice of applying telemedicine technologies to provide medical care to seafarers and fishermen on voyages in the Arctic has shown a high demand for its individual areas, such as teleconsultation and telecardiology [16, Woldaregay A.Z., Walderhaug S., Hartvigsen G.]. Telemedicine as a tool for providing high-quality medical care in the shortest possible time and immediate on-site diagnostics is successfully used on oil rigs in the northern and arctic seas and is considered to be an effective way of providing assistance that avoids cases of unreasonable and costly evacuation [17, Anscombe D.L., p. 662]. At the same time, the effectiveness of this kind of medical care would be determined by the quality of professional training of nurses and doctors, the availability of appropriate equipment and medicines, the availability of complete medical information about the patient, the absence of language barriers [18, Horneland A.M.]. The development of telemedicine as an innovative form of medical care in the regions of the Russian Arctic is limited by the lack of a ubiquitous Internet. In terms of the density of channels formed by digital systems, the Nenets Autonomous Okrug (0.0005 thousand channel-km / km^2) and Chukotka Autonomous Okrug (0.01 thousand channel-km / km^2), Republic of Sakha (0.46 thousand channel-km / km^2) are in the worst position among the Arctic regions [6]. In the Murmansk Oblast, the five most remote Arctic municipalities are not covered by telemedicine, and in Chukotka — 5 out of 7 municipal districts are not included in the telemedicine network. In terms of the number of consultations carried out, the leaders are the Nenets Autonomous Okrug, Krasnoyarskiy Krai and the Republic of Sakha, where consultation in the formats “doctor-to-doctor”, “doctor-to-patient” is practiced and telemonitoring is introduced.

The provision of health care is complicated by the extremely uneven distribution of healthcare institutions across the Arctic. Therefore, the development of innovations in health care will be associated with the introduction of innovative methods of organizing medical care, ensuring its availability. A relevant example, in our view, is the use of innovative models of primary health care based on the continuum of care for patients with chronic conditions in remote, peripheral areas. The positive effect of providing treatment for patients with asthma and diabetes mellitus in remote rural areas is described. This model has resulted in reduced mortality, fewer admissions and re-hospitalisations, resulting in lower costs of treatment [19, Laurence C.O. et al.].

[6] Regions of Russia. Socio-economic indicators 2019. URL: https://www.gks.ru/folder/210/document/13204 (accessed 16 March 2020).

Innovations in healthcare will be developed in the direction of introducing new methods of diagnosis and treatment of diseases, for example, through the provision of high-tech medical care (HTMC). In the regions of the Russian Arctic, despite its acute demand, the volume of high-tech assistance is insignificant. On average, the need for this assistance within the Arctic regions is satisfied by 65%. At the same time, there is a fairly rapid growth in the volume of high-quality medical care in some regions of the Russian Arctic: in Karelia — in 5 times [7], in Yakutia — in 16 times during 2009–2017. This type of high-tech medical care, such as assisted reproductive technologies (ART), is developing in the Arctic due to the expansion of geography and an increase in the number of institutions providing these services (from 4 to 9 centers in 2016–2018). Neither ART, nor HTMC are currently available in the autonomous okrugs.

The introduction of innovations is also associated with educating the population about health-saving measures. The use of personal devices for assessing health indicators (tonometers, glucose meters, etc.), electronic applications for self-monitoring of vital signs, remote participation in online training and schools for healthy lifestyles, training in computer literacy courses are innovative ways of health-saving.

The implementation of environmental innovations into production processes contributes to the formation of an environmentally friendly lifestyle, ensuring the preservation of health. The Arctic is characterized by a low level of implementation of eco-innovations [20, Tortsev A.M., Tortseva T.V., p. 1586], and their role in health saving issues is still insignificant.

The scientific literature describes examples of the impact of innovation on the nature of migration processes, one of which is intellectual migration. Firstly, the development of scientific and educational centres with a modern material and technical environment and learning technologies attracts young people striving to get high-quality education in innovative conditions. Thus, Finland uses the mechanism of attracting educational immigrants from other countries to their universities to solve national demographic problems [21, Strielkowski W., Kiseleva L.S., Sinyova A.Yu., p. 37]. Secondly, an innovatively developed territory attracts educated and qualified personnel, thereby ensuring the migration inflow and development of the demographic potential of the region of entry [22, Voronina N.A.]. On the other hand, the use of innovative information and communication technologies in public life allows people to receive the benefits they needs without changing their place of residence. In this case, the possibility of employment, medical and educational services, communication opportunities, cultural enrichment are not the key factors in population migration [15, Shevtsova E.V., p. 60].

The increasing role of the educational process in the innovative development of the Arctic implies increased investment in the creation of new, highly productive jobs. The development of innovative industries encourages the recruitment of highly qualified specialists from other regions

[7] Doklad o sostoyanii zdorov'ya naseleniya i organizatsii zdravookhraneniya po itogam deyatel'nosti ministerstva zdravookhraneniya Respubliki Kareliya za 2017 god [Report on the state of health of the population and the organization of health care based on the results of the activities of the Ministry of Health of the Republic of Karelia for 2017]. URL: http://zdrav.gov.karelia.ru/ (accessed 15 March 2020).

and restrains the migration outflow of labor resources. The intensified industrial development of the Arctic and the influx of migrant labour predetermine the need to introduce innovations that ensure rapid human adaptation to harsh conditions and regulate the qualitative component of the migration flow. Examples include developments to identify genetic markers in the human body [23, Krivoshchekov S.G., p. 87], technologies to study the adaptation of internal metabolic processes to the conditions of a discomforting environment [24, Silin A.N.] to prevent people moving to polar regions, whose adaptation in high latitudes can cause premature aging and chronic diseases. The criteria for selecting migrants can be education level, qualifications, and health status. The State Migration Registration Information System with regional migrant databases and electronic migration cards is becoming an effective innovative tool in Russia.

In the study, we considered innovations as novelties, new ideas, without highlighting their specific types (product, service, technology) or stages of the innovation process, focusing on their social role, when society is the sphere of their implementation, and their use allows solve its problems, including demographic ones. Adhering to the approach to understanding innovation as a novelty, a new idea or a product used to solve demographic problems, the authors proposed the following grouping:

- *technological innovations*, including innovative processes and methods for improving the quality of the population (innovative methods of family planning, including modern contraception, high-tech care, educational technologies, individual devices for assessing health indicators);
- *management and organizational innovations*, representing new methods of organizing institutions and receiving services (telemedicine, personalized medicine, innovative psychological and pedagogical methods of working with the family, “silver volunteering”, forms of life placement and support for single citizens);
- *information innovations* related to the use of digital information technologies to solve demographic issues (unified information systems and databases (digital health care circuit, digital health care circuit), innovative educational platforms and resources, services for the provision of services in the field of medicine , education, migration);
- *marketing* (take-home tests, “patient-friendly registration”).

According to the object of influence, we will distinguish *social, economic* and *environmental* innovations.

According to the scale of distribution: *local* (individual health control), *large-scale* (innovative technologies used by specific socio-demographic groups), and *global* innovations (technologies in the field of environmental protection).

When investigating the issue of the population’s perception of innovation, we use J. Bruner’s classical interpretation of the term “social perception” — people’s understanding and assessment of the surrounding reality. The development of terminology has led to the selection of the

subject, object and the process of perception in this definition, in the course of which a holistic image of the environment is created. As a subject we mean the population of the Arctic region, as an object —innovations, the use of which can, in our opinion, improve the demographic situation.

The opinion that the success of innovation implementation in society is directly related to its positive perception by members of the social system appeared in the 1970s. [25, Zaltman G., Duncan R., Holbek J.]. The perception of innovations is influenced by a person's readiness for new innovations, the availability of knowledge and skills to adapt to new conditions, and activity [26, Zhuravlev A.L.]. S.A. Ilyinykh notes that the level of perception of innovations is determined by a person's ability and willingness to create, master and implement them, as well as the desire to acquire new knowledge [27, Ilyinykh S.A., Mikhailova E.V., p. 13]. According to E.E. Kuchko, the perception of innovation depends on gender and age characteristics, level of education, type of thinking, worldview, innovative disposition and level of innovation [28, Kuchko E.E., p. 66–67].

L. Gokhberg and V. Polyakova revealed that only a third of the country's population estimates innovation as a factor or source of economic growth. Men are more positive about new technologies, and among women, especially the elderly, a negative perception of innovations dominates. Researchers note the relationship between the perception of innovation and education, income level and the availability of electronic skills [29, Gokhberg L., Polyakova V., p. 96–97]. Ilyinykh S.A. confirmed that men are more receptive to technical innovations, and women are more receptive to social innovations [27, Ilyinykh S.A., Mikhailova E.V., p. 14]. A.S. Zaitseva and O.R. Shuvalova established a relationship between the level of perception of innovations and the inclusion of the population in the digital environment (Internet accessibility, computer skills) and in the process of continuous education [30, Zaytseva A.S., Shuvalova O.R., p. 17, 29].

According to studies to identify innovators capable of producing innovative ideas in society, there is a higher share of them (9.6%) in Russia [31, Fursov K., Thurner T., p. 14] than in foreign countries (Great Britain, Japan), where the figures vary from 3 to 6% [32, Von Hippel E., Ogawa S., de Jong J.P.J., p. 32; 33, Von Hippel E., de Jong J.P.J., Flowers S., p. 1676]. Depending on the motives of innovative behavior, two groups are distinguished: the population of large cities, which stimulates the desire for career growth, and the population of small, remote from the center cities with a lower level of income, whose innovative activity is aimed at solving everyday problems and improving the quality of life.

Studies on the perception of innovations used in solving demographic problems have shown that the employed population is not ready for technological changes at the workplace, low involvement in lifelong learning practices (39% of those employed at the age of 18–65), which can complicate adaptation in the labor market in the case of robotization of workplaces [34, Polyakova V.V., p. 3, 4]. Despite the rapid and necessary implementation of distance education, its perception remains quite complex, but, as the NRU HSE study conducted in April 2020 showed, 69% of Russian school teachers would continue to use online resources when returning to traditional education. The main challenge of implementation of the "distance" in education was the lack of sus-

tainable Internet connection and computers [8].

There is also an insufficient need for innovative health-saving technologies: services of remote communication with a doctor are in demand only in 45% of respondents, the use of fitness bracelets — in 31%, genetic tests that reveal the abilities and risk of diseases of the unborn child — in 30%. The respondents are wary or note the uselessness of their use [35, Voynilov Yu.L., Polyakova V.V., p. 199]. The degree of patient satisfaction with the quality of remotely provided medical services is important [36, Kim J., Alanazi H., Daim T.]. Research study of population perception of introduction of telemedicine services in Greenland showed that people are quite positive about this innovation, as they are concerned about the acquisition of acute or chronic diseases in conditions of insufficient constant and qualified medical care. They are particularly anxious about travelling to a distant hospital or lack of a suitable vehicle for transportation in complicated cases [37, Nielsen L.O. et al., p. 442–443].

The analysis of existing theoretical studies concerning the population's perception of innovation made it possible to formulate the assumption that the population of the Arctic territories has a certain level of perception of innovations, which is used in solving personal demographic issues and problems. At the same time, there is a connection between the perception of innovations by the population and its socio-demographic characteristics (gender, age, level of education, income).

Based on the idea of the interaction of demographic and innovative development, the authors propose a theoretical model of the population's perception of innovation in the Arctic territories. The key component of the model was the “innovation perception zone” by the population, which is formed in the process of implementation of demographic potential in the innovation environment (Fig. 1).

[8] Problemy perekhoda na distantsionnoe obuchenie v Rossiyskoy Federatsii glazami uchiteley: Laboratoriya media-kommunikatsiy v obrazovanii NIU VShE [Problems of transition to distance learning in the Russian Federation through The Eyes Of Teachers: Laboratory of Media Communications in Education, National Research University Higher School of Economics]. URL: https://icef.hse.ru/data/2020/04/15/1556221517/Дистанционное%20обучение%20глазами%20учителей.pdf (accessed 10 April 2020).

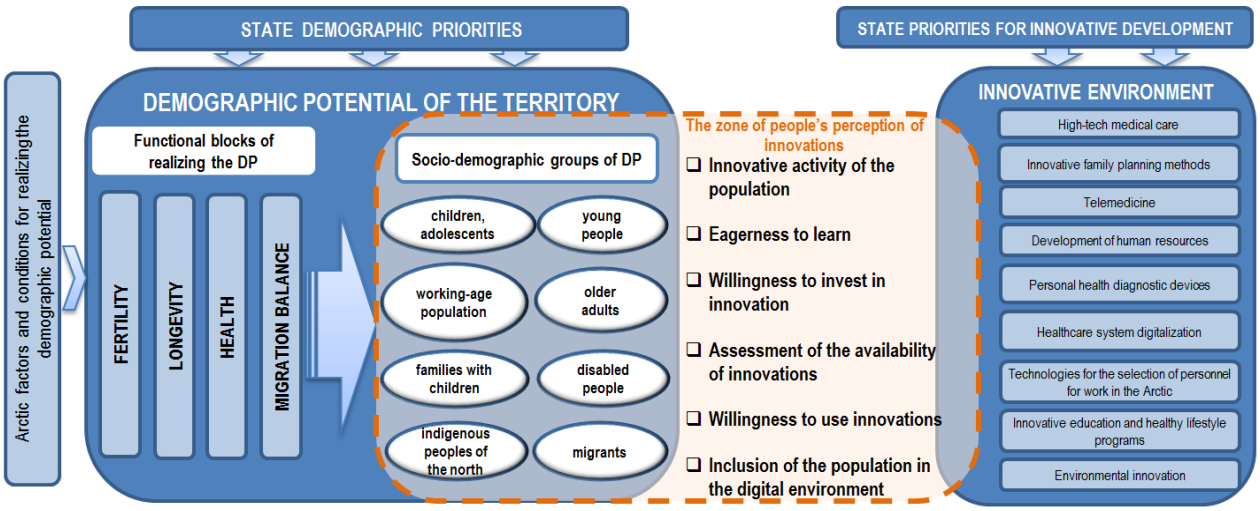

Fig. 1. Scheme of formation the model of innovation perception by the population of the Arctic territories in the aspect of realizing the demographic potential (compiled by the authors) [9].

The zone of population's perception of innovation, characterizing the relationship of demographic and innovation development, includes several areas of perception. The formation of these directions was based on a system of priorities for innovative and demographic development, defined at the level of state policy in the strategic documents of the Russian Federation [38, Gubina O.V., Provorova A.A., p. 388–389]. The priorities of the state demographic policy in the Arctic are increasing the birth rate, reducing mortality, ensuring healthy longevity and balancing migration flows. The state policy of innovative development in the Arctic is based on the following priorities: stimulating research and development, building professional innovative competences, creating conditions for innovation activities, modernizing the material and technical base, introducing and using innovations, organizing a common information space and digitalization. The idea is that the implementation of measures within the framework of the priorities of innovative development will help to improve the demographic situation: an increase in the birth rate, a decrease in mortality, and a migration balance. State innovation priorities, adapted to the level of perception by the population, were formulated as follows: innovative activity of the population (innovation), the desire to learn, the willingness of the population to invest in innovation, the assessment of the availability of innovations, the willingness to use innovations, the inclusion of the population in the digital environment (Table 2).

In order to study the perception of innovations in April 2019, the authors conducted a mass standardized survey of the population of the Arctic municipalities of the Arkhangelsk region (Arkhangelsk city, Severodvinsk city, Novodvinsk city, Primorskiy district, Mezenskiy district, Onezhskiy district, Novaya Zemlya urban district) by online questionnaire using Google Forms application. The sample consisted of 406 people with a maximum error of 5%. Its representativeness is ensured by the proportionality of the distribution of questionnaires by municipalities in accordance with the size and sex and age structure of the population. The survey results were processed in the IBM. SPSS. Statistics program (Ver. 21) using descriptive statistics and correlation analysis.

[9] Compiled by the authors.

Table 2

Methodological basis of a sociological study of people's perception of innovations in relation to the priorities of innovative development and realizing the demographic potential

Priorities for innovative development	The essence of people's vision of innovations in relation to the realizing demographic potential	Directions of people's perception of innovations	Question in the questionnaire
Encouraging research and development	People's inclination to the emergence of new ideas and ways of their implementation is the basis of their innovative activity. The result of personal innovative activity in relation to the development of demographic potential is, for example, the choice of a non-standard individual strategy of demographic behaviour, the search for non-trivial methods of recovery.	Innovative activity of the population	How often do you have new ideas and ways to implement them?
Forming professional innovative competencies	People's desire to acquire new knowledge contributes to the growth of professional competencies, improving the quality of demographic potential.	Willingness to learn	How do you feel about the opportunity to acquire new knowledge, develop skills necessary in the modern world?
Creating conditions for conducting innovative activities	People's willingness and desire to take financial and organizational steps to introduce and use innovations in order to maintain health, to receive an education, to move, for example, labor mobility.	Willingness to invest in innovation	What would you do in order to receive medical, educational and other social services if they are provided at a high modern level using modern technologies and equipment?
Upgrading physical infrastructure	People's assessment of the availability of modern devices and technologies in the field of health care, education, information services as the results of innovative achievements contributing to the improvement of demographic potential (health, educational level, the possibility of having a healthy child).	Assessment of the availability of innovations	How satisfied are you with the availability of modern devices and technologies in institutions where you apply for treatment, education, and other social services?
Implementing and using innovations	People's readiness to use in everyday life existing innovative methods of diagnosis and treatment, education, ways to adapt to new living conditions while implementing personal demographic plans (having children, moving) and solving their own demographic problems (recovery).	Willingness to use innovations	How much are you prepared to use something new, modern (innovations) in your life in order to improve your health, get an education, and resolve migration issues?
Organizing a single information space and digitalizing	The development of the digital environment creates favorable conditions for stimulating human innovative activity and provides an effective solution to demographic issues.	Inclusion of the population in the digital environment	How often do you use the Internet? What do you use the Internet for?
Compiled by the authors			

Results and discussion

The results of a population survey conducted in the Arctic municipalities of the Arkhangelsk Oblast make it possible to assess the perception of innovations in terms of their use in solving personal demographic issues.

First of all, the general level of the population's perception of innovation is determined by individual creative, innovative activity. The question of how often a person has new ideas and ways of their implementation allows us to assess whether a person is aware of himself/herself as a

creative person, whether he/she is inclined to innovate or passive with regard to the generation of new ideas. As a rule, it is a creative idea that becomes the beginning of future innovation [39, Luecke R.]. We assume that an innovatively active person will be more inclined to make non-standard decisions when choosing a strategy of demographic behavior, and focused on the search for original methods of recovery, treatment, and education. The survey revealed a fairly high activity of the population in relation to the production of new ideas: 41% of the population have ideas very often. About 35% of the respondents are not inclined to the production of ideas at all, or do it very rarely, trying to solve problems using standard methods (Table 3).

Table 3

Distribution of answers to the question "How often do you have new ideas and ways to implement them?" (% of the number of respondents, N=406) [10]

	I often have new ideas, and I start to actively think about how to realize them	I have new ideas quite often, but I rarely think about how to realize them	I rarely have new ideas, I try to solve problems in standard ways	I never have new ideas, I like the usual way of life	Total:
Overall distribution of responses	41	25	21	13	100
Age					
15-29 years old	44	40	10	6	100
30-59 years old	46	25	21	8	100
over 60 years old	24	9	34	33	100
Gender					
Male	44	24	22	10	100
Female	38	25	21	16	100
Education					
Basic general	17	33	17	33	100
Secondary general	38	29	21	12	100
initial vocational	20	30	40	10	100
Secondary vocational	31	24	21	24	100
incomplete higher	38	38	19	5	100
Higher	47	20	22	11	100
Postgraduate	53	34	13	0	100
Income level					
Very high	41	32	9	18	100
High	47	22	22	9	100
Average	39	23	23	15	100
Below the average	34	33	20	13	100
Low	46	18	9	27	100

A peculiarity of the population's innovation activity indicator is its negative age dynamics, which becomes evident after age 60. While the percentage of respondents aged 15–29 and 30–59 years who considered themselves capable of generating ideas and willing to take steps to implement them was 44% and 46% respectively, only 24.2% of people over 60 consider themselves creative. The gender distribution showed that men are most inclined to innovate and implement their ideas, while women are more likely to prefer the usual way of life. Assessment of the correlation between innovation activity and the level of education of the population suggests

[10] According to the author's sociological research in the Arkhangelsk region, 2019.

that higher education is the main factor of such differentiation. The correlation between innovation activity and income levels did not show a clear relationship.

The second direction of assessing the perception of innovations is the desire of a person to increase the level of education, which contributes to the improvement of the qualitative characteristics of the population as a carrier of demographic potential. This desire is manifested in a higher level of general and medical culture of the population, which determines a self-preserving way of life. Educated people have more developed skills in searching and analyzing information for the implementation of their own demographic plans in the field of health preservation, family planning, change of place of residence (Table 4).

Table 4

Distribution of answers to the question "How do you feel about the opportunity to acquire new knowledge, develop skills necessary in the modern world?" (% of the number of respondents, N=406) [11]

	I am willing to accept any opportunity to improve the level of education	I would like to learn, but I don't have time	I would like to learn, but I have no money	I would like to learn, but where I live there are no conditions for learning	I can only learn in case of ur-gent need	I don't want to get new knowledge	Total:
Overall distribution of responses	35	10	13	3	29	10	100
Age							
15-29 years old	45	6	15	9	23	2	100
30-59 years old	35	16	14	2	29	4	100
over 60 years old	22	1	10	1	33	33	100
Gender							
Male	34	11	10	4	32	9	100
Female	35	10	15	3	26	11	100
Education							
Basic general	8	8	25	0	42	17	100
Secondary general	32	9	6	15	20	18	100
initial vocational	10	0	0	0	20	70	100
Secondary vocational	18	9	15	2	39	17	100
incomplete higher	47	5	13	3	29	3	100
Higher	40	12	14	3	27	4	100
Postgraduate	60	13	7	0	13	7	100
Income level							
Very high	32	5	9	4	41	9	100
High	39	15	5	6	30	5	100
Average	35	9	15	3	27	11	100
Below the average	27	9	22	2	24	16	100
Low	18	0	18	9	46	9	100

The analysis of answers to the question "How do you feel about the opportunity to acquire new knowledge and develop skills necessary in the modern world?" has revealed, on the one hand, a fairly high readiness of the population to receive education, and on the other hand, we have identified factors significantly constraining this motivation. Out of 61% of those wishing to improve

[11] According to the author's sociological research in the Arkhangelsk region, 2019.

their education level, 26% cannot do this due to lack of time, money and conditions for obtaining education (lack of the Internet, the necessary educational courses). 29% of the respondents represent a passive part of society, who would study in case of urgent need.

It was found that as people grow older, their interest in acquiring new knowledge diminishes: among those aged 15–29 the share of respondents who expressed a desire to improve their level of education was 45%, and it was 22% among those over 60. A third of older people (33%) will study only if absolutely necessary, perhaps to stay in the labour market. Young people in their desire to learn are constrained by a lack of finance. For the middle-aged population, this factor is complemented by a lack of time for education. Naturally, there is a high need for acquiring new knowledge of the population with higher education. Among those who will study in case of urgent need, the population with a secondary vocational education prevails (39%).

The population's desire to learn is constrained by the lack of finance (13%). Among people with very high and high income levels, the categories of those who want to study at every opportunity (32% and 39%, respectively) and those who will study only in case of urgent need (41% and 30%, respectively) prevail. The population with a low level of income is less likely to find an opportunity to study, noting a lack of money (18%) and can afford education only in case of urgent need (46%). No statistically significant relationship was found between the desire to learn and gender.

The third direction of perception is a person's willingness to invest in their health, education in case of the possible receipt of medical, educational, and other social services through the use of innovations. According to the theory of human capital, the financial aspect of individual investment in relation to our research involves the costs of education, the purchase of modern devices and equipment for treatment and diagnostics, or the implementation of the costs of obtaining modern medical services, as well as labor mobility and relocation. The organizational and behavioral aspect of personal investment [40, Roshchina Ya.M.] consists in taking measures to implement individual demographic plans: a trip to obtain medical help, time spent on searching for information about new methods of treatment, education, and options for labor mobility. Based on the presented justification, the respondents were asked the following question (Table 5).

Table 5

Distribution of answers to the question "What would you do in order to receive medical, educational and other social services if they are provided at a high modern level using modern technologies and equipment?" (% of the number of respondents, N=406)

	I am ready to use all possible ways to take advantage of new modern methods of treatment, education	I am ready to spend money to take advantage of modern methods of treatment, education, if they find themselves in my locality	I am ready to travel, actively seek information about new methods of treatment, education, but I am looking for free ways	I am not ready to spend neither money nor time to take advantage new modern methods of treatment, education	Total:
Overall distribution of responses	16	24	37	23	100
Age					

15-29 years old	19	33	29	19	100
30-59 years old	19	23	40	18	100
over 60 years old	8	20	34	38	100
Gender					
Male	20	26	34	20	100
Female	14	23	39	24	100
Education					
Basic general	8	17	25	50	100
Secondary general	15	26	38	21	100
initial vocational	0	20	10	70	100
Secondary vocational	13	20	34	33	100
incomplete higher	10	32	32	26	100
Higher	19	26	40	15	100
Postgraduate	33	7	53	7	100
Income level					
Very high	32	22	23	23	100
High	25	37	25	13	100
Average	12	24	43	21	100
Below the average	7	11	38	44	100
Low	27	0,0	36	37	100

The results of the survey showed a low willingness of the population to invest in innovative methods of health improvement, education, and labor mobility. The reluctance to make financial investments became a significant limiting factor. The majority of the respondents (37%) prefer to use innovations for free.

Young people are distinguished by a high level of readiness to use innovations. The lack of financial constraints is explained by a poor awareness of financial costs, the lack of independent marriage and family relations and obligations within the family. Among those who are ready to invest only with their own time, there is a large proportion of people aged 30–59 years, whose desire to use innovations is limited by financial possibilities. The willingness to make financial and organizational investments decreases with age.

Men are more (26%) than women (23%) willing to invest in innovation. But men (34%) are more inclined to pay for innovations, while women (39%) are more inclined to spend time searching for them.

Analysis of the distribution of answers did not reveal a relationship between the willingness to invest and the level of education. Interestingly, people with a higher level of education prefer to apply their knowledge in order to find a cheaper way to use innovation, saving financial resources. The expected was a high willingness to invest in innovation, due to the high income of the population.

The fourth direction in the perception of innovations by the population concerns the assessment of the level of modernization of healthcare, education, and other social spheres, the development of which affects the dynamics of demographic processes (Table 6).

Table 6

Distribution of answers to the question "How satisfied are you with the availability of modern devices and technologies in institutions where you apply for treatment, education, and other social services?" (% of the number of respondents, N=406) [12]

	In the institutions where I apply for treatment, education, and the provision of other social services, modern devices and technologies are used…			Total:
	in sufficient quantities	not wide enough	extremely rare and few	
Overall distribution of responses	15	55	30	100
Age				
15–29 years old	25	50	25	100
30–59 years old	10	58	32	100
over 60 years old	18	50	32	100
Gender				
Male	15	56	29	100
Female	15	54	31	100
Education				
Basic general	25	42	33	100
Secondary general	20	59	21	100
Initial vocational	40	40	20	100
Secondary vocational	13	51	36	100
Incomplete higher	16	63	21	100
Higher	13	55	32	100
Postgraduate	14	73	13	100
Income level				
Very high	32	54	14	100
High	14	61	25	100
Average	13	56	31	100
Below the average	20	44	36	100
Low	9	45	46	100

The study showed a low level of population's satisfaction with the availability of modern devices, equipment, technologies in the field of the implementation of human demographic functions. The degree of dissatisfaction with the availability of innovations increases with age. Young people who do not feel an acute need for medical examinations, but rather widely use gadgets, including for receiving educational services, highly appreciate the availability of modern devices and technologies. The most economically active age group, which is the main consumer of innovations, and the age group from 30 to 59 years old, characterizes its accessibility as insufficiently broad (58%).

The distribution of answers to the question showed no relationship between the assessment of the accessibility level of devices and technologies and the level of respondent's education, which ensures the objectivity of the general opinion of the population.

Among the poor, the share of those who believe that modern devices and technologies are used extremely rarely and very little (46%) exceeds the share of the population with a high (25%) and very high income level (14%), who also assesses accessibility of innovations as low. This can be explained by the greater access to innovation of people with higher incomes. But wealthy people have a high level of requirements for innovations and the results of their use, in connection with which there is a larger percentage of them who are not sufficiently satisfied with their availability.

[12] According to the author's sociological research in the Arkhangelsk region, 2019.

The fifth direction of assessing the perception of innovation is the willingness of the population to use innovative technologies that will contribute to solving their own demographic problems (Table 7).

Table 7

Distribution of answers to the question "How much are you prepared to use something new, modern (innovations) in your life in order to improve your health, get an education, and resolve migration issues?" (% of the number of respondents, N=406) [13]

	I am ready to actively use innovations in my life	I am ready to actively use innovations in my life, if that's the only way to solve my problem	I use innovations if someone has a positive experience	I am not ready to use innovations in my life	Total:
Overall distribution of responses	16	23	41	20	100
Age					
15-29 years old	22	23	40	15	100
30-59 years old	14	26	43	17	100
over 60 years old	14	18	35	33	100
Gender					
Male	15	23	44	18	100
Female	16	24	39	21	100
Education					
Basic general	8	17	50	25	100
Secondary general	15	15	50	20	100
Initial vocational	0	40	30	30	100
Secondary vocational	15	25	32	28	100
Incomplete higher	21	24	47	8	100
Higher	17	23	41	19	100
Postgraduate	13	33	47	7	100
Income level					
Very high	18	23	41	18	100
High	15	20	49	16	100
Average	16	24	37	23	100
Below the average	17	27	38	18	100
Low	9	18	64	9	100

The survey results showed a low willingness of the population to use innovations in their lives. Only 16% of the population is ready for the unconditional use of innovations, while about 65% of the respondents realize the need to apply innovations only under certain conditions, for example, relying on someone's positive experience.

There is a twofold difference in the level of readiness to use innovations between the poorest and the richest categories of the population. At the same time, both rich and poor people, demonstrating practicality and frugality, are focused on the use of innovations, relying on the positive experience of other people. For the population with an average income, the main motive for using them is the impossibility of solving their demographic problems in a standard way. A statistically significant correlation between the willingness to use innovations and the level of income was not confirmed ($p > 0.05$). Consequently, even a financially unprepared person can show a high willingness to use innovations if they realize their benefits, seeking money, for example, to receive modern dental care or pay for an IVF procedure.

[13] According to the author's sociological research in the Arkhangelsk region, 2019.

An analysis of the distribution of answers to this question by age groups revealed, firstly, a decrease in the willingness to use innovations with aging. Secondly, the low level of readiness to use innovations by people aged 30–59 years, who are their largest consumers as the most numerous, economically and socially active category of the population. They are ready to use mostly "proven" innovations, which can be explained both by distrust of the possible effect of their application, and by the manifestation of financial savings within the family budget.

The distribution of the population by sex did not show a clear differentiation in terms of the willingness to use innovations, but men mainly rely on someone else's experience when deciding to use them.

Analysis of the distribution of responses showed no statistically significant relationship between the willingness to use innovations for the purpose of health, education and migration issues and the level of education of the respondents ($p>0.05$). The population with incomplete higher education (21%) and higher education (17%) expresses greater readiness to use innovation than people with basic general education (8%) and general secondary education (15%). The unwillingness to use innovations is more manifested in the population with primary and secondary vocational education (30% and 28%, respectively) compared with the population with incomplete and higher education (8% and 19%).

The sixth direction of assessment includes the study of the level of organization of digital environment in the aspect of population's perception (Table 8). The indicator characterizing the level of the population's involvement in the digital environment is the intensity of Internet use.

Table 8

Distribution of answers to the question "How often do you use the Internet?" (% of the number of respondents, N=406) [14]

	Every day	Few times a week	Few times a month	I do not use it because there is no internet connection	I do not use because I do not want / do not know how	Total:
Overall distribution of responses	81	8	1	2	8	100
Age						
15-29 years old	99	0	0	0	1	100
30-59 years old	92	6	1	0	1	100
over 60 years old	38	21	3	7	31	100
Gender						
Male	85	10	1	1	3	100
Female	79	7	1	2	11	100
Education						
Basic general	67	8	0	8	17	100
Secondary general	76	3	0	0	21	100
Initial vocational	30	0	10	10	50	100
Secondary vocational	72	11	1	3	13	100
Incomplete higher	97	3	0	0	0	100
Higher	85	10	1	1	3	100
Postgraduate	100	0	0	0	0	100
Income level						
Very high	73	5	5	4	13	100

[14] According to the author's sociological research in the Arkhangelsk region, 2019.

High	84	12	1	1	2	100
Average	83	8	1	1	7	100
Below the average	73	5	2	4	16	100
Low	82	0	0	0	18	100

The survey revealed a fairly high intensity of Internet use, with 81% of respondents using the Internet every day (in 2019), which is a prerequisite for developing a positive perception of the digital environment. In Russia, 60.6% of residents used the Internet daily or almost every day in 2017, and in 2018 — 68.8%. On average, in the Arctic regions, the share of such a population was 69.3% in 2017, and 75.3% in 2018 [15]. Our research has shown that age is the main factor determining the intensity of Internet use. Older people are characterized by unwillingness or inability to use the Internet, which may be due to a lack of knowledge. The second reason may be the low income level against the background of the high cost of Internet services in the Arctic. The population uses the Internet mainly for information search, communication in social networks and for leisure purposes (Fig. 2).

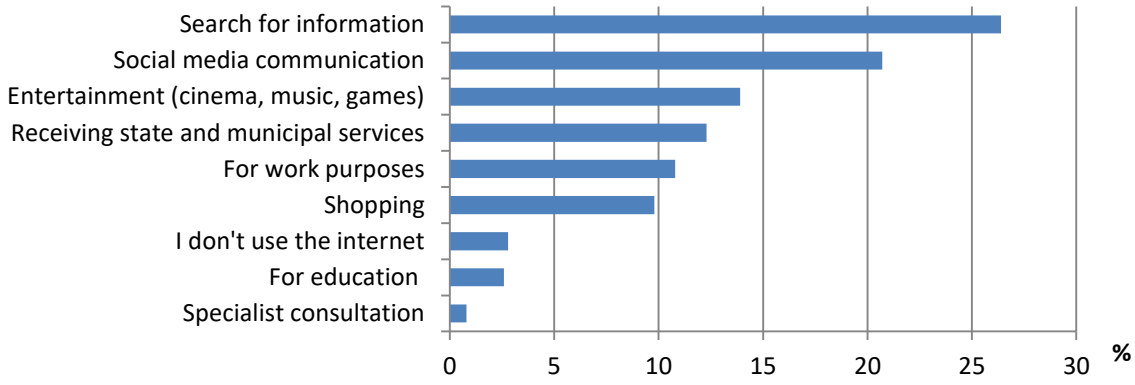

Fig. 2. Distribution of answers to the question "What do you use the Internet for?" (% of the number of responses received, N=406.

The use of Internet technologies as an innovative means of teaching, obtaining medical care, state and municipal services, organizing the work process has not found widespread use, which allows us to conclude that the resources of the digital environment are insufficiently used for the development of demographic potential. In order to determine the closeness of the relationship between the socio-demographic characteristics of the population and the directions of perception of innovations, a correlation analysis was performed using the rank correlation coefficients τ-Kendall and r-Spearman (Table 9).

Table 9

Correlation coefficients between the directions of innovations perception and socio-demographic population characteristics of the Arkhangelsk region [16]

Directions of people's perception of innovations	Correlation coefficients	Age	Gender	Education	Income
Innovative activity of the population	τ-Kendall	0.242	-	0.141	-
	r-Spearman	0.300	-	0.166	-

[15] Tsifrovaya ekonomika: 2020: kratkiy stat. sb. [Digital Economy: 2020: A Brief Stat. Col.]. Moscow, NRU HSE, 2020. 112 p.

[16] Calculated by the authors.

Eagerness to learn	τ-Kendall	0.150	-	0.189	0.100
	r-Spearman	0.192	-	0.226	0.118
Willingness to invest in innovation	τ-Kendall	0.151	0.090	0.156	0.248
	r-Spearman	0.187	0.098	0.184	0.280
Assessment of the availability of innovations	τ-Kendall	-	-	-	0.087
	r-Spearman	-	-	-	0.096
Willingness to use innovations	τ-Kendall	0.083	-	-	-
	r-Spearman	0.102	-	-	-
Inclusion of the population in the digital environment	τ-Kendall	0.456	0.092	0.194	-
	r-Spearman	0.523	0.094	0.216	-

- moderate association (0.3 – 0.5) - weak association (0.1 – 0.3)

Table 9 shows only statistically significant correlation coefficients (at p≤0.05). It was found that the main socio-demographic characteristic most closely related to the perception of innovation is the age of the population. The closest (moderate on the Chaddock scale) relationship with age is manifested in relation to the inclusion of the population in the digital environment. The relationship between innovation activity, desire to learn, willingness to invest in innovation, and age is characterized as weak. The level of education and income have less influence than age on the level of perception of innovation, but the degree of closeness of the relationship is outside the lower boundary of the scale taken as a basis. Correlation analysis showed no significant difference between men and women in the perception of innovation.

Conclusion

Extreme climatic conditions, remoteness and underdevelopment of the territory, uneven development of social infrastructure in the Arctic create a special environment for the generation and use of innovations [41, Zamyatina N.Yu., Pilyasov A.N., p. 204]. As noted by A. Petrov, the development and implementation of innovations in the periphery can have a significant impact on the socio-economic development of the Arctic communities [42, Petrov A., p. 161]. To solve demographic problems in the Arctic regions, the use of innovative technologies and methods is of particular importance, for example, high-tech medicine, medical and diagnostic “health trains”, mobile laboratories, telemedicine, distance learning, modern methods of selecting labor migrants.

The theoretical model proposed by the authors made it possible to substantiate the existence of a connection between the directions of innovative and demographic development of the Arctic territories of Russia. This connection can be established in the course of assessing the perception of innovations that people use in their daily life when solving their own demographic issues, thereby improving the demographic situation in general in the Arctic regions. The scientific novelty of the model, which is of theoretical significance, lies in a special approach to disclosing the structure of the perception of innovations by the population, the directions of which were determined on the basis of the priorities of the region’s innovative development. This model was laid in the basis for assessing the perception of innovation by the population through a sociological survey. The results of the study showed that the population has a certain level of perception of innovations in relation to solving demographic issues. A positive fact is the high innovative activity of the population, which determines non-standard solutions in the strategy of their demographic behavior. The population of

the surveyed Arctic territories is ready to improve their skills and acquire new knowledge; they are characterized by wide involvement in the digital environment. At the same time, the population is not ready to make financial investments in the use of innovations, shows a low willingness to use them in their lives, and is also not satisfied with their availability. A statistically significant relationship between the perception of innovations and the age of a person, his education and income level was revealed, which manifested itself in the fact that the population at a younger age perceives and uses innovations better. Growth in income and education also has a positive effect on perceptions and willingness to use innovation in addressing demographic issues.

The research results can be incorporated into the process of making managerial decisions in the development and adjustment of regional state programs in the field of health care, education, migration, development of the digital environment and innovation infrastructure. The practical significance of the results is confirmed by the fact that the Arctic territories, due to their inaccessibility and low population density, are often excluded from the objects of monitoring the country's population [25, Zaltman G., Duncan R., Holbek J.].

Prospective author's research can be aimed at studying the perception of innovations in relation to the demographic plans and life strategies of the Arctic population: migration intentions, reproductive plans, programs of self-preservation behavior and healthy longevity. Further research will help to obtain a much larger array of data on which innovations will be in demand in the implementation of the demographic potential in terms of the greatest effect for the Arctic.

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