Population diversification in demographics, health, and living environments: the Barents Region in review

Anastasia Emelyanova*, Arja Rautio**
* Arctic Futures Initiative / World Population Program, International Institute for Applied Systems Analysis, Austria.
e-mail: emelyan@iiasa.ac.at, anastasia.emelyanova@oulu.fi
** Centre for Arctic Medicine, Thule Institute, University of Oulu, Finland

Abstract: This paper provides updates on the geographical patterns in well-being of the population of the Barents region by applying indicators used in demography, public health, and environmental studies. In particular, we analyze recent demographic trends with regard to gender, age, ethnicity, and over time (1990−2015), considering depopulation, aging age structures, mortality and fertility patterns in connection with environmental changes. We investigate environmental effects on population health and living conditions of the Barents people, including the impact of air and water contamination, food insecurity, housing conditions, and new diseases driven by climate change. In addition, we highlight the importance of human capital (highest educational attainment of population) in tackling socio-economic challenges as well as adapting to climate and other sweeping changes occurring in the Barents region. Barents territories show inequalities in post-secondary educational attainment distribution between average nation-wide level and northern regions of Norway, Sweden, Finland, and Russia, based on the latest data available.
The results and discussion suggest a significant variability across regions in the context of the studied parameters, except for life expectancy. The causes and consequences of the diversification of these trends need to be further investigated; as does the spatial distribution of societal well-being in the Barents region, an important geographical alliance in the northernmost part of Europe. The evidence presented in this review may help in the planning of adaptive community programs which respond to stresses in society, health, and the environment in the Barents region.

Key words: Barents region, population health, demography, living environments

VERTAISARVIOITU
KOLLEGIALT GRANSKAD
PEER-REVIEWED
www.tsv.fi/tunnus

Introduction

In 2015, there were 5 million people living in the Barents Euro-Arctic Region (the Barents region), with around two thirds inhabiting the Russian side. This count, along with the human capital profile and health of the population is the key resource for economic, social, and environmental development of the northernmost frontiers of Russia, Finland, Norway, and Sweden. Educational and professional endowments are understood by human capital that refer to human resources and competencies, empowering interpersonal skills and leadership (Arctic Resilience Interim Report 2013). The Barents region, made up of 13 counties (Figure 1), is considered an important geographical alliance in the northernmost part of Europe. It has long history of human-to-human encounter and an enriching network of cross-regional cooperation. This region is especially important in light of prospective Arctic activities: discovery of resources, new shipping routes, commercial booms and busts, expanding tourism, environmental protection, and military concerns. The multiple cooperative projects in the region aid interregional exchange in many different fields, such as culture, indigenous well-being, youth, education, trade, environment, transportation, and health.

Despite this importance, the Barents region has achieved poorer performance in various economic, environmental and health indicators than the southern parts of the countries. This is particularly true for health related indicators such as family health, reproduction capacity, and mortality (Woodhall 2001) as well as in demographic megatrends such as aging, urbanization, and depopulation (Emelyanova 2015). The recent global and environmental changes have increased pressure on the Barents population. There are higher morbidity and suicide rates and decreasing fertility in comparison to average national and sub-national indicators in southern territories of these countries (data available from Russian Federation Federal State Statistical Service 2016; Statistics Finland 2016; Statistics Norway 2016; Statistics Sweden 2016).

In this review, we summarize the most recent evidence on the health, well-being and the living conditions of the

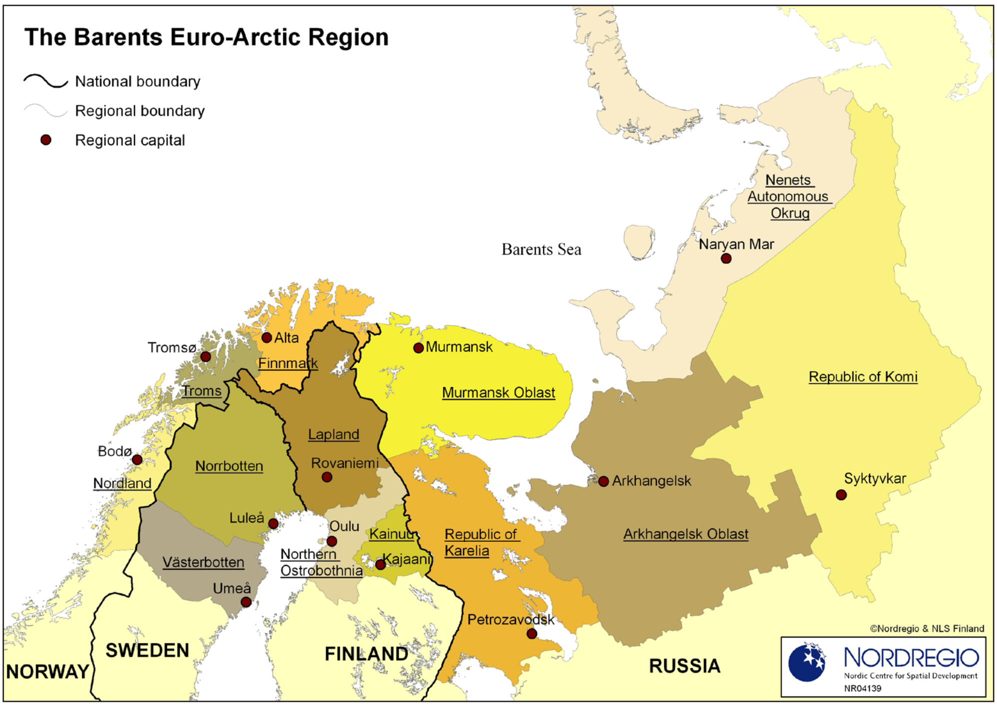

Figure 1. The constitutive parts of the Barents region. Source: Nordregio, http://www.nordregio.se/.

Barents populations in comparison to the 1990s. We also analyze the indicators used in demography, public health, and environmental studies. In particular, the aims of the analysis are:

1. To examine the latest data on geographical patterns in the well-being of the regional populations, including trends such as depopulation, aging, fertility, and mortality;
2. To analyze post-secondary or so-called tertiary education attainment (as key indicator of human capital) in the Barents region in comparison with average nation-wide rates;
3. To review the recent findings on environmental effects on health and living conditions of residents of the Barents region. This includes the impacts of air and water contamination, food insecurity, housing conditions, and new diseases driven by climate change.

By investigating these topics and comparing 1990 with 2014/15, we can estimate whether there is a growing population divide or more of a convergence trend across the Barents region for the indicators selected. Providing analysis of population development in the Barents region along the stated research aims may help informing decision-makers in their effort to initiate various programs in response to stresses to society, health, and the environment in the Barents region.

Losing locals and getting older

The Barents region is the most populated area in the Arctic. However, during the last two decades, population growth in the Arctic has only occurred in Alaska, Iceland, and the Canadian Arctic, whilst the Barents region has mostly been experiencing population decline. By January 2015, 5 106 048 people permanently resided in the area, a fifth lower than was recorded about two decades ago (6.5 million in 1990, a number calculated on the basis of data from national statistical banks). The losses were particularly noticeable in the north-west corner of the Russian Federation (Russian Federation Federal State Statistical Service 2016), whilst Lapland, Kainuu (Finland), and Norrbotten (Sweden) had declined, but only moderately (Statistics Finland 2016; Statistics Sweden 2016). The northern Norwegian population remained roughly at the same level (Statistics Norway 2016). The North Ostrobothnia (Finland) gained inhabitants in 1980−2015 (Statistics Finland 2016) and similarly Vesterbotten (Sweden) in 2000−2015 (Statistics Sweden 2016), partly because they developed as innovative educational and urban centers, in particular cities such as Oulu and Umea. In the 1990s, most of the northern regions of Norway, Sweden, Finland, and also throughout the 2000s the Russian North had slower population growth or faster decline than the rest of their respective countries. However, the populations of the US and Canadian Arctic grew faster than those countries as a whole (Larsen & Fondahl 2014).

Explaining in terms of demography, the decline in the Barents population overall is naturally caused by decreasing fertility rates, high emigration southward, and noticeable mortality, traced for the recent past according to national statistics (references cited above). Within the region, the increase of urbanization is caused by lack of infrastructure, employment, and educational opportunities in the countryside. The profound depopulation and aging of rural areas aggravate concerns about the future of municipalities suffering the heaviest impact of those two demographic processes.

The Barents population has relatively old age structure compared to the nation-wide situations in the relevant countries, because of high out-migration of people in all age groups, especially in younger ages. The proportion of people older than 60 years was 18.4% of the population in 2010. The highest figures were in the northern parts of Norway, Sweden, and Finland (24.7%) and the lowest at 12.6% average in the Russian Barents territories. In Russia, the proportion of people older than the age of 60 (Prop 60+) is noticeably lower than in Fennoscandia because of higher mortality and out-migration of retired people to the regions of Russia that have a milder climate and somewhat better health-care infrastructure. Leaving of younger people has also caused the potential loss of future newborns. The threat of depopulation was confirmed in national projections: the 2030 medium-scenario for Karelia, Komi, Arkhangelsk, and Murmansk regions forecasts a loss of 315 000 young and middle-aged people (Russian Federation Federal State Statistical Service 2016).

The Barents populations differ substantially in terms of aging status, signifying a possible need for locally-targeted health and social services. There is a growing body of scientific literature demonstrating the specific risks posed by the climate and other global changes to vulnerable older people in the northern latitudes (e.g. Filiberto *et al.* 2011; Begum 2012). Hence, precise forecasting of the number of older people is crucial to preparing response programs. New indices on aging based on "prospective" age, or the lifetime remaining until death, can provide more useful measuring because they are adjusted to increasing life expectances, changing human health, and characteristics of the particular population (see methodology in Sanderson & Scherbov 2013). Using this approach, the share of older people in the Barents region (estimated as those with a remaining life expectancy 15 years or less (Prop RLE 15-) was 12.3% (regional average, Figure 2), compared to the 18.4% calculated using the standard indicator Prop 60+ in 2010. This is quite a different result, suggesting a need to rethink decisions with regard to aging populations. In general, there is not much divergence in trends in aging among Barents people. Swedish regions are the oldest by far, but the Finnish North has been aging at the fastest rate and is quickly catching up. The Russian Barents areas are also aging, but at a slower rate and there is still a window of opportunity to adjust demographic and inter-sectoral welfare policies accordingly.

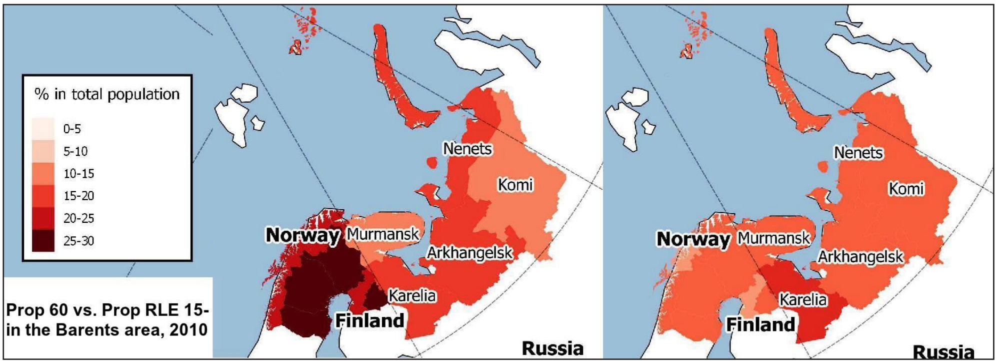

Figure 2. The proportions of the Barents' population aged 60+ years (Prop 60+) (left map) versus the proportions of people with remaining life expectancy 15- years (Prop RLE 15-) (right map), sexes combined, 2010, % of total population. Source: Emelyanova 2015.

Patterns in mortality, morbidity, and fertility in the Barents region

Mortality rates in the Russian part of the Barents Euro-Arctic region remain relatively high — around the level of less developed countries — whereas in Arctic Fennoscandia mortality rate (particularly child mortality) is among the lowest in the world. The mortality rates in 2014 varied from around 8‰ (total deaths) in the North Ostrobothnia/Troms regions to roughly 14‰ in Karelia and Arkhangelsk. Large cross-regional differences in mortality are shown in the differences in life expectancy at birth for males/females such as 63/76 years in Karelia, compared to 80/83 years in Vesterbotten in 2014 (Emelyanova 2015). Life expectancy at birth has remained below national average in the Barents region except for in North Ostrobothnia, Lapland, and Troms.

The life tables calculated by authors provide yearly regional information on survival rates as well as life expectancies at different ages (available on request from the authors). The data shows that throughout the period of 1990–2013, the fastest increase in life expectancy occurred in the Finnish Arctic (5.6 years of growth), while the lowest was in the Russian areas (1.6 years of growth averaged across its five Barents regions, Figure 3). At the same time, there is neither convergence nor divergence between the countries: life expectancy is mostly increasing at a similar speed and the relationship between indices remains the same as in the past.

Cardiovascular diseases remain the leading cause of death in the Barents population, with the highest number of incidences registered in Karelia and Arkhangelsk. As seen in Figure 4, the number of deaths due to ischemic heart disease was 464 per 100 000 inhabitants in the Arkhangelsk region in 2013, while in Troms and Nordland it was 70 deaths per 100 000.

Cancers are another common cause of death, lung cancer is especially high in men and breast cancer in women. In the Finnish North, cancer diseases and accidental poisoning by alcohol combine to

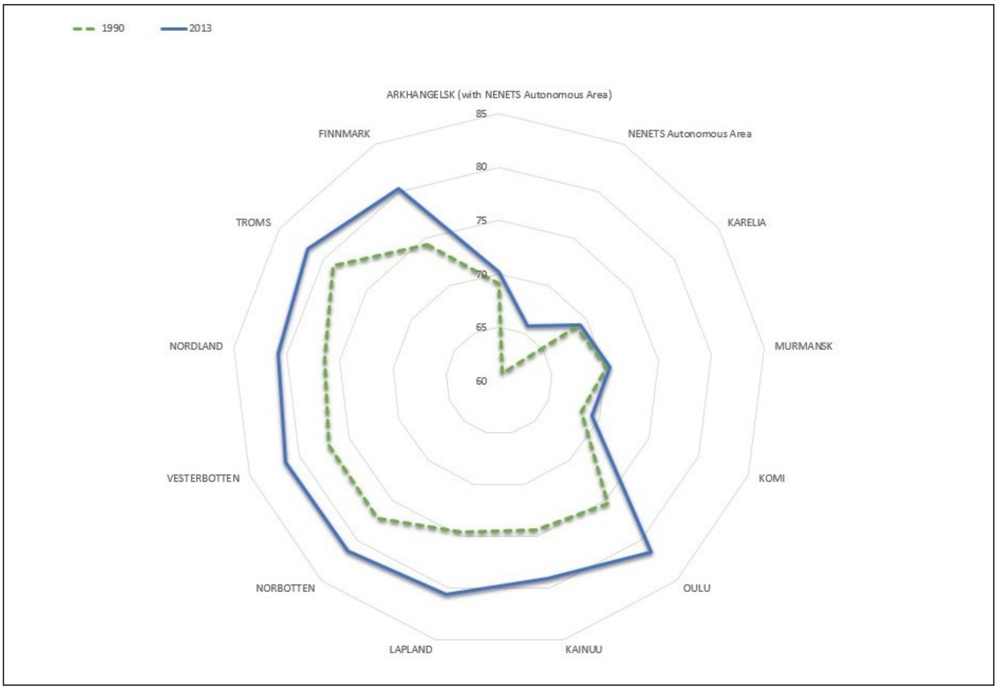

Figure 3. Life expectancies at birth throughout the Barents regions, sexes combined, 1990 vs. 2013, years. Source: authors' calculations based on baseline data from national statbanks (Russian Federation Federal State Statistical Service 2016; Statistics Finland 2016; Statistics Norway 2016; Statistics Sweden 2016).

form the leading cause of death, followed by cardiovascular diseases and malignant neoplasms. In the North of Norway, respiratory diseases are the primary cause of death, ahead of accidents and violent deaths. The lowest rates of external causes of death occur in Swedish Norrbotten and Vesterbotten, whilst cancers' prevalence is notably high there. In Finland and Norway the incidence of neoplasms are lower in Finnish and Norwegian Sami (indigenous people of Scandinavia) when compared to the non-Sami living in same region, however, the opposite is true for Swedish Sami women (Soininen 2015).

Certain effects of climate change can be seen in the seasonal statistics for mortality in the Russian Arctic. These statistics show that more deaths occur in the winter (cardiovascular, respiratory, circulatory, and skin diseases), and there are more traumas (frostbite and hypothermia) associated with cold weather (Climate change impact on public health in the Russian Arctic 2008). We assume that warmer winter months would decrease these cases. In northern Sweden, however, a one-degree increase in temperature has led to a steep rise in the number of cases of non-lethal, acute myocardial infarction, and other heart dysfunctions (Messner *et al.* 2002).

There are distinct minority groups within the Barents population—Sami, Nenets, and Vepsians (or Veps). Indigenous Nenets and

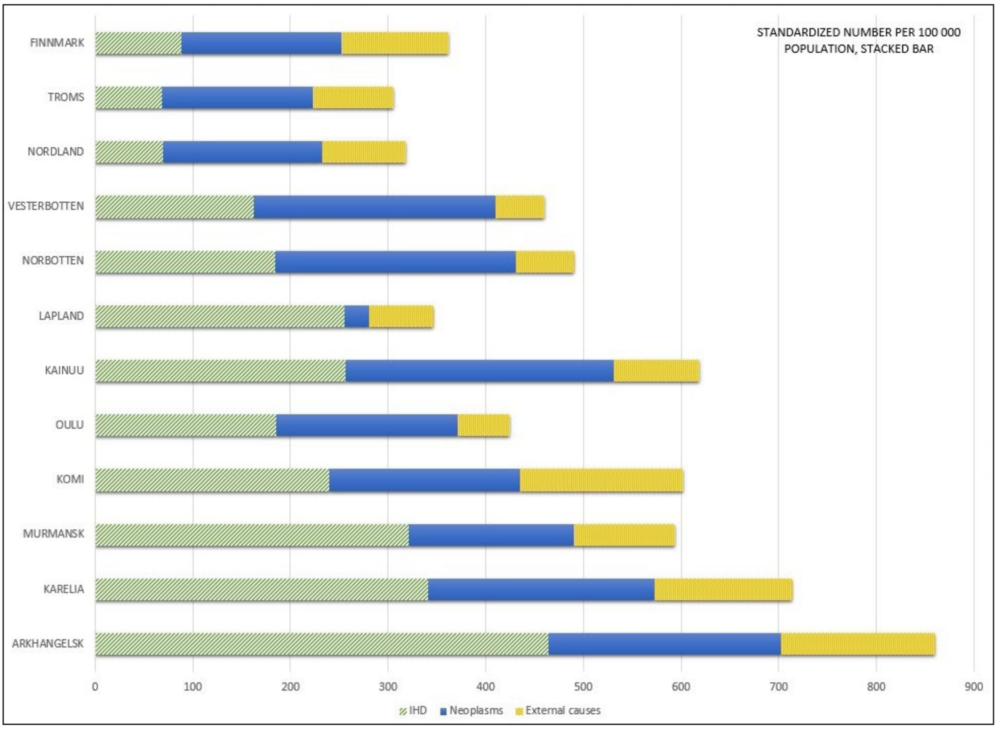

Figure 4. Number of deaths from selected causes in the Barents region standardized per 100 000 population, 2013 (2012 for Norwegian North). Note: IHD – Ischemic heart disease; external causes include accidents, injuries, and violence.

Vepsians have poorer health compared to the non-indigenous people residing in the Barents Russia. However, demographic and epidemiological data are rarely available for specific northern ethnicities and these gaps should be filled with proper monitoring.

Mortality numbers of the Finnish Sami were lower in the 1980s, but during the last 30 years these values became similar to the rest of the country and the other Barents territories. Cancer rates were especially low, however they are now equal to the average values in Finland and Lapland. This may be caused by changes in the habits and living environment of the Sami occurring in the period from 1970s up to nowadays, which are now similar to the majority of Finnish and western populations. Mortality due to accidents and violence is still significantly higher for the Sami than the national average. Non-fatal accidents and suicide attempts are also more common in Sami males (Soininen *et al.* 2015).

The suicide rate is highest in the Barents part of Russia mostly inhabited by the Nenets indigenous people. Table 1 demonstrates that suicide rates are several times higher in rural Barents settings, as well as noticeably more common among men. Suicide rates in the Nenets area were substantially higher among the indigenous Nenets population than the non-indigenous

Table 1. Number of suicides per 100 000 persons in the Russian parts of the Barents region, 2009. Source: Russian Federation Federal State Statistical Service 2016.

	Type of area	Total	Men	Women
Russian Federation	Urban	20.7	36.7	7.2
	Rural	42.0	74.7	12.1
Karelia Republic	Urban	26.3	44.6	11.2
	Rural	46.0	78.9	16.8
Komi Republic	Urban	29.7	50.7	11.2
	Rural	80.6	146.4	16.5
Arkhangelsk Region	Urban	31.6	56.2	10.7
	Rural	57.3	103.3	13.3
Nenets Autonomous Area	Urban	21.3	37.2	6.8

population in the period 2002–2012, partly explained in connections to a lack of a "sense of indigenous belonging," lack of cultural identity and problems of resilience, being single or divorced, and having lower education (Sumarokov *et al.* 2014).

An extreme example is the rural areas of the Komi republic, where the number of male suicides is around nine times higher than female suicides: 146.4 vs. 16.5 (2009). In 2014, all urban areas in the Russian Barents had a suicide rate that was half of those numbers, and four times lower in the Nenets area (22.7 urban vs. 88.7 rural, per 100 000). However, the trend from the first available data — from the year 2008 — shows a significant decrease in suicides in all the geographical groupings. For example, in the same Nenets area, the rate was 88.7 in 2014 in rural areas but was twice that (189.3) in 2008. In all other regions there was a decrease of a third over the period 2008–2014 (Russian Federation Federal State Statistical Service 2016).

A significant driver of population change in the Barents region is fertility. The Barents average Total Fertility Rate (TFR) decreased slightly from 1.94 in 1990 to 1.87 in 2014. This is below the level of replacement of a current cohort (demographers estimate it as around two children per woman, 2.1 TFR). Changes in fertility have not been homogeneous throughout the region, however, the North Ostrobothnia region (TFR: 2.17) and the Nenets autonomous area (TFR: 2.42) were above the replacement level. Thus, an actual rise in TFR was recorded in the Finnish North (except for Lapland) as well as indigenous Komi and Nenets areas of Russia. The most dramatic decrease was recorded in the Swedish North, from 2.2 children per woman in 1990 to 1.8 in 2014.

When examining various fertility ages in more detail (Table 2), a clear shift in the reproductive behavior of younger women can be seen. Younger women do not have as many children in 2014 as they did in 1990 (numbers in bold is a decline of Age-Specific Fertility rates). In the North of Russia, fertility in age group 15 to 24 has reduced the most. In Fennoscandia,

Table 2. Changes in fertility* in the Barents region territories, 1990 to 2014. Source: authors' calculations based on baseline data from national statbanks (Russian Federation Federal State Statistical Service 2016; Statistics Finland 2016; Statistics Norway 2016; Statistics Sweden 2016).

		TFR	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Barents region	2014	1.9	14.5	74.9	109.3	92.2	46.2	9.0	0.7
(average)	Growth rate**	**-0.1**	**-14.8**	**-36.5**	0.9	23.3	18.1	3.1	0.2
Russian part	2014	1.9	26.2	110.1	118.5	83.3	41.6	7.7	0.4
(average)	Growth rate	0.1	**-23.6**	**-45.7**	33.6	38.8	23.8	4.1	-0.1
Fennoscandia part	2014	1.8	7.2	52.9	103.6	97.7	49.1	9.9	0.8
(average)	Growth rate	**-0.2**	**-9.4**	**-30.7**	**-19.5**	13.6	14.6	2.4	0.4

* Fertility is measured by TFR (Total Fertility Rate) that refers to the average number of children per woman) as well as the Age-Specific Fertility Rates that measure the annual number of births to women of a specified age or age group per 1000 women in that age group. Source of primary data on fertility: national statistics (reference list).

**Growth rate is calculated in comparison with 1990-year data (1993 in case of Nenets autonomous area). Negative growth means a decline in indicator's value. Positive growth means an added value.

women show a similar decrease in the birth rates for the age group 25 to 29. Fertility in the age range of 15–29 in the Russian part of the Barents region remains two to three times higher, whilst fertility in the Nordic part is higher in older age ranges. There was an increase in live births for women aged 30 or over in recent decades, meanwhile the younger women in their 20s delayed childbearing. One reason could be associated with education attainment increasing over the studied period, as in the study by Skirbekk & KC (2012) the level of education has been confirmed to be a strong predictor of fertility reductions.

Education attainment as a factor of human capital

Education and training are crucial methods for building human capital. Woodhall (2001) shows that human capital affects various demographic components such as family health, fertility and child mortality. McMahon (1998) argues that human capital has an impact on both financial and non-financial social factors by lowering birth rates, increasing divorce rates, delaying retirement, increasing work after retirement, changing public health, democratization, increasing human rights and political stability, reducing poverty, decreasing crime rates, and by positive environmental effects and community service.

The post-secondary or tertiary levels of education have a considerable value for human and social capital growth and further mobility, and in the Barents region education attainment is relatively high by global standards. However, the example of the Barents region in Figure 5 shows that the tertiary-level education attainment (according to ISCED 2011) is relatively lower in the north in comparison to the Barents countries total (national averages).

Male population of the Barents North performs worse with regard to the attainment of the tertiary level of education, with women showing notably higher enrollment and graduation rates. Based on statistical data available in national statbanks, we find that there are up to 33% more women with completed tertiary education than men with the same level degrees (25% more in the Barents Finland, 27% more in Norwegian North, 33% in Swedish North). These gender differences in education lead to corresponding gender disparities in migration and growing sex-ratio imbalances in the population, when highly educated women became seeking more education and career opportunities elsewhere (Hamilton 2010). Fewer women in a community means fewer children, and declining school-age populations can potentially result in school closures and community abandonment (Martin 2009). This is already the case in some Barents communities (Autti & Hyry-Beihammer 2014). Moreover, school closures may reduce the attraction of the

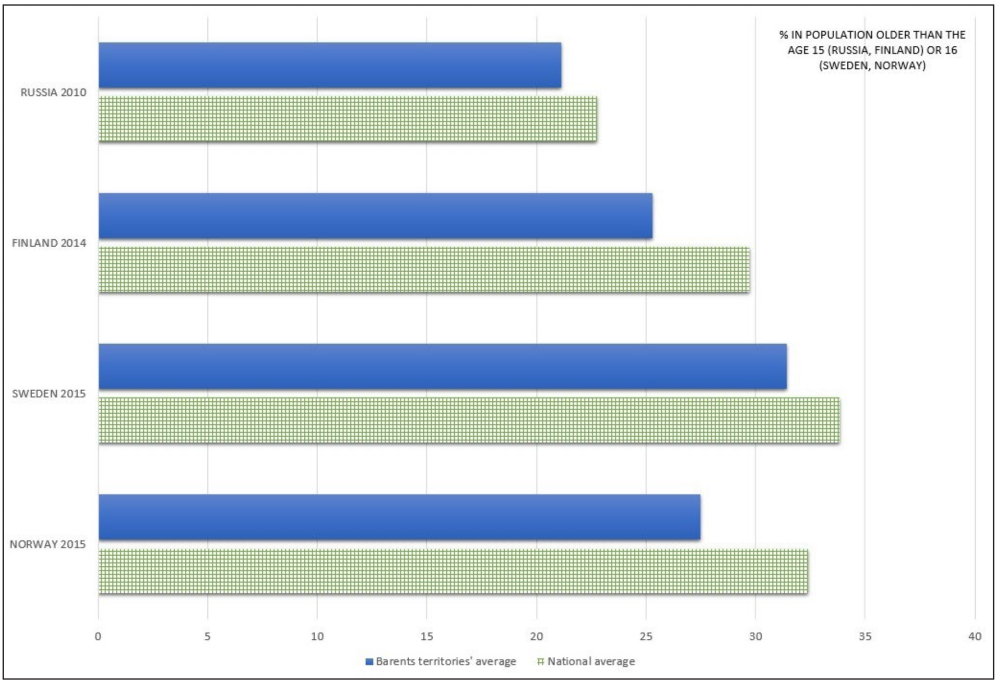

Figure 5. People with post-secondary or tertiary education (ISCED 2011 levels 5 to 8) in the Barents region, % in population older than the age 15 (Russia, Finland) and 16 (Norway, Sweden), 2010 to 2015. Source: authors' calculations based on baseline data from national statbanks (Russian Federation Federal State Statistical Service 2016; Statistics Finland 2016; Statistics Norway 2016; Statistics Sweden 2016).

area, potentially causing further population decline and out-migration. At the same time, the findings of Striessnig and Lutz (2013) suggest that education (especially of women) is a key determinant of the local capacity to adapt to natural disasters, and hence climate change. If this is true, considerable efforts need to be made to attract highly educated women to stay and live in their community/region. In general, providing better education opportunities in the Barents region may bring multiple benefits to enhance resilience to climate change, however, the correlation needs to be further investigated.

Living environments in the Barents region

Healthy living is an essential component for the well-being of individuals and communities. This means at least clean water, food and air but also security. Water security is a particular challenge in the Barents region, since the quality of tap or well water is not regularly assessed in all municipalities. Another challenge is the lack of a standard protocol for water security assessment (Dudarev *et al.* 2013b). In the Russian Barents area, in particular, water supply systems are in a poor state. There is a shortage of water purification facilities and disinfection systems, and drinking water is of low quality. In these regions the sanitary–chemical and microbiological indicators of drinking water quality did not meet hygienic requirements (in fact they were more than 1.5 times higher than the acceptable limit) (Dudarev *et al.* 2013b). Warming climate and changes in environment and land use may worsen food and water security across the whole Arctic region including Arctic Russia (Nilsson *et al.* 2013).

Metal levels in household water in six cities in the Murmansk region (Nikel, Zapolyarny, Olenegorsk, Montchegorsk, Apatity, Kirovsk) showed that some Russian Barents cities lack sanitary protection zones for water sources. In fact, although most cities require preliminary water processing, water disinfection involves only chlorination (Dudarev 2013a). High levels of aluminium in Kirovsk and nickel in Zapolarny and Nikel have been found. Springwater in the Petchenga region has relatively low levels of metals, except for strontium and barium (Dudarev *et al.* 2015). Levels of harmful atmospheric pollutants have been growing in some areas of the Barents region, Komi republic and the Nenets autonomous area in particular. However, air pollution has tended to decrease over the last several years (2010−2014 data) in the neighboring Karelia and Arkhangelsk (Russian Federation Federal State Statistical Service 2016).

Community remoteness and high latitude can sometimes restrict the access to fresh and nutritious foods, causing food insecurity in many northern regions. Improvement of the food supply and food accessibility in various northern regions, including the Barents, is an urgent issue to address (Egeland *et al.* 2010; Dudarev 2013c). Interactions between the environment, wildlife, and human health must be better accounted for (One Health concept, see more *http://www.onehealthinitiative.com/about.php*), since many water, air, and food borne diseases have already increased in the Arctic Russia and Fennoscandia

(AMAP 2015). It is important to adopt Barents-wide adaptation strategies based on an understanding of the determinants of food and water security, associated with demographic, cultural and other societal factors.

Incidences of infectious and parasitic food- and water-borne diseases are very high in the population of the European North of Russia (Dudarev *et al.* 2013c). However, the greatest concern in Arctic countries is the increase of the water-borne infections (Parkinson & Butler 2005). There is an urgent need to monitor measurable quantitative indicators of food and water security in the Arctic over time, especially as climate and environmental changes, in combination with increasing industrial activities – including mining and shipping – are creating potentially big challenges for human health (Nilsson *et al.* 2013).

Long-term studies on small mammals and use of national databases have been used to trace the occurrences of vector-borne diseases, such as tularemia and epidemic nephropathy in Fennoscandia's part of the Barents region. These ecological time series and databases show the connections between animal and human health (One Health Initiative 2016). The main reservoir hosts of zoonotic pathogens are small mammals, mainly voles and lemmings (Henttonen 2000) and ticks, mosquitoes and fleas are important vectors for diseases such as the Puumala virus. The health of reindeer and moose is especially important for local economies, and the warming climate, with more rainy weather and new species of vectors, may have impact on their health.

Climate warming and increased migration of species have already introduced new infections and viruses in the North America e.g. West Nile Virus (Parkinson & Butler 2005) as well as influx of tularemia, brucellosis, anthrax and other diseases in the Russian Arctic (Revich *et al.* 2012). It is possible the same to happen in the Barents region. The adverse health impacts of Arctic warming will especially impact wildlife populations and indigenous peoples dependent upon subsistence food resources from wild plants and animals (One Health Initiative 2016).

Food costs in the Arctic regions are high. In the Russian Barents, for example, 23−43% of household income is spent on food (Dudarev *et al.* 2013a). As a result of climate change, many wildlife species previously used as a food source have disappeared. In addition, the reduction in snow-cover in winter has impacted hunting, travel and other transportation. There have also been high levels of biological and chemical contamination of food in many regions (Dudarev *et al.* 2013a). For instance, Dudarev *et al.* (2015) studied the toxic metal levels in local food items like fish, mushrooms, berries and game in the Pechenga district. They found high cadmium, nickel and copper concentrations in mushrooms, and high nickel levels in wild berries.

A Finnish food monitoring program found elevated levels of environmental contaminants (dioxins and polychlorinated biphenyls) in the muscle of reindeer calves fed in natural pastures in the North of Finland (Holma-Suutari 2014). Despite the elevated contaminant levels (measured in fat) Holma-Suutari concluded that it is safe to eat reindeer and moose meat since the overall concentrations of dioxins are rather insignificant because of the low fat content of these animals. Reindeer liver had high levels of dioxin-like compounds and Holma-Suutari recommended that eating it, at least on a regular basis, should be avoided. However, in Sweden during the 20-year follow-up program (1986−2006) only very low levels (or below the level of detection) of environmental contaminants were found in reindeer and moose (Danielsson *et al.* 2008). Similarly, in Norway the levels of persistent environmental contaminants have been low. However, recently there have been some high cadmium levels measured/recorded in reindeer and moose meat in northern/Barents Norway (Hassan *et al.* 2013).

Conclusions

We have reviewed the geographic patterns and inequalities in the well-being of the Barents region's inhabitants, confirming substantial variability and further diversification of trends in the recent decades. We discussed several meaningful indicators of demographic development, population health, and living environments between 1990−2015 in the northern Barents areas, spanning the dimensions of gender, age, and ethnicity. We also made comparisons of the Barents North with the national dynamics of Barents countries for several considered indicators.

There is clear evidence of depopulation in the Barents region, particularly in rural settings. Only in the North of Norway, Swedish Vesterbotten and Finnish North Ostrobothnia the population count has been moderately increasing, but for different reasons. In the north of Norway, death rates went down by 10−20% (1990−2014) similarly to Vesterbotten. The North Ostrobothnia region experienced a modest rise in fertility rates. However, reductions in mortality and relatively high fertility cannot prevent depopulation, as another Barents setting shows. Noticeable out-migration in the high-fertility areas of Komi and Nenets areas led to the decrease of population count.

The North Ostrobothnia is quite unique in the Barents region, with more positive trends for many population statistics than other areas. For example, life expectancy in this region is higher than the national average of Finland, and it has the highest average education attainment across the Barents region. In general, the average highest education attained in North Ostrobothnia showed a striking difference, not only to the lower rates in the more southern regions of the Barents countries, but also between the sexes, with women earning almost a third more university degrees than men in the region. Recent research has suggested this may help to improve readiness of the territory, as communities with more educated women are more able to cope with climate change.

It is not straightforward to conclude on the degree of population aging at this time of the changing methodology: standard and new "prospective" indices for aging result in considerably different conclusions with regard to the aging rates. Nevertheless, the North of Norway, Sweden (the oldest by far), and Finland (the fastest dynamics of population getting aged) now have population structures that are almost twice as old as the Russian part of the Barents region. Given that the older residents of the Barents region are among the most vulnerable at-risk groups because of climate change, it is vital to address their needs in terms of living environments, housing conditions, food insecurity, and exposure to new diseases as a result of climate change.

Overall, this analysis suggests no convergence in the studied parameters, but rather a growing variation across the Barents region. At the same time, there are regions showing sometimes the opposite trends in population dynamics. For example, Russia's northern territories as well as the Finnish Kainuu and North Ostrobothnia have experienced a rise in fertility, while in the rest of the Barents region the indicator of TFR has fallen. Mortality rates have increased in Russia, Kainuu, Oulu, and Norrbotten, while in other areas rates have fallen. In the case of population aging, most of the Barents territories are moving towards an older age structure, albeit at different paces. During 2000−2010, only minor changes to this trend – so-called 'rejuvenation' patterns – can be seen by using prospective indicators such as prospective old-age dependency ratio, prospective median age, and Prop RLE 15- (more on de-aging in Emelyanova 2015). Within the Barents region, Russian areas have been aging slower, and there is no similarity in dynamics with the Nordic counterparts.

The evidence presented in this review may inform decision-makers to plan in response to stresses to society, health, and the environment in the Barents region. The discussed patterns can help individual and group strategies in health, well-being, and lifestyle; the degree to which Barents residents can contribute to environmental burdens and climate change adaptation; and the capabilities and resources for the territorial development. Of equal importance is appropriate policy support for health, education and schooling, a healthy environment, and other variables related to future sustainability and human well-being in the Barents region.

References

AMAP, 2015 (2015). *AMAP assessment 2015: Human health in the Arctic*. Arctic Monitoring and Assessment Programme (AMAP). 165 p. Oslo, Norway.

Arctic Resilience Interim Report 2013 (2013). Arctic Council, Stockholm Environment Institute and Stockholm Resilience Centre, Stockholm.

Autti, O. & E. K. Hyry-Beihammer (2014). School closures in rural Finnish communities. *Journal of Research in Rural Education* 29: 1, 1−17.

Begum, S. (2012). Climate change and vulnerability of the Arctic elderly: An assessment from human rights point of view. *CES Working Papers* 4: 3a, 459−479.

Climate change impact on public health in the Russian Arctic (2008). United Nations in the Russian Federation. 16. 5. 2016. <*http://www.ecfor.ru/pdf.php?id=books/revich01/oon*>. (in Russian).

Danielsson, S., Odsjö, T., Bignert, A. & M. Remberger (2008). *Organic contaminants in moose (Alces alces) and reindeer (Rangifer tarandus) in Sweden from the part twenty years*. Report 7: 43 p. Swedish Natural History.

Dudarev, A. A., Alloyarov, P. R., Chupakhin, V. S., Dushkina, E. V., Sladkova, Y. N., Dorofeyev, V. M., Kolesnikova, T. A., Fridman, K. B., Nilsson, L. M. & B. Evengård (2013a). Food and water security issues in Russia I: Food security in the general population of the Russian Arctic, Siberia and the Far East, 2000−2011. *International Journal of Circumpolar Health* 72: 21848.

Dudarev, A. A., Dushkina, E. V., Sladkova, Y. N., Alloyarov, P. R., Chupakhin, V. S., Dorofeyev, V. M., Kolesnikova, T. A., Fridman, K. B., Evengard, B. & L. M. Nilsson (2013b). Food and water security issues in Russia II: food and waterborne diseases in the Russian Arctic, Siberia and the Far East, 2000−2011. *International Journal of Circumpolar Health* 72: 21646.

Dudarev, A. A., Dorofeyev, V. M., Dushkina, E. V., Alloyarov, P. R., Chupakhin, V. S., Sladkova, Y. N., Kolesnikova, T. A., Fridman, K. B., Nilsson, L. M. & B. Evengard (2013c). Food and water security issues in Russia III: food and waterborne diseases in the Russian Arctic, Siberia and the Far East, 2000−2011. *International Journal of Circumpolar Health* 72: 21856.

Dudarev, A. A., Dushkina, E. V., Sladkova, Y.N. et al. (2015). Evaluating health risk caused by exposure to metals in local foods and drinkable water in Pechenga district of Murmansk region. *Meditsina truda i promyshlennaia ekologiia* 11: 25−33. (in Russian).

Filiberto, D., Wethington, E., Pillemer, K., Wells, N. M., Wysocki, M. & J. T. Parise (2011). Older people and climate change: vulnerability and health effects. *Generations: Journal of the American Society on Aging.* 16.10.2016. <*http://www.asaging.org/blog/older-people-and-climate-change-vulnerability-and-health-effects*>.

Egeland, G. M., Pacey, A., Cao, Z. & I. Sobol (2010). Food insecurity among Inuit preschoolers: Nunavut Inuit Child Health Survey, 2007−2008. *CMAJ* 182: 3.

Emelyanova, A. (2015). *Cross-regional analysis of population aging in the Arctic.* Acta Univ Oul. D1326, Thesis University of Oulu 2015. 16.5.2016. <*http://jultika.oulu.fi/files/isbn9789526210049.pdf*>

Hassan, A. A., Rylander, C., Brustad, M. & T. M. Sandanger (2013). Persistent organic pollutants in meat, liver, tallow and bone marrow from semi-domesticated reindeer (Rangifer tarandus tarandus L.) in Northern Norway. *Acta Veterinaria Scandinavica* 13: 55−57.

Hamilton, L. C. (2010). Footprints: Demographic effects of outmigration. *In* Huskey L. & C. Southcott (eds.): *Migration in the Circumpolar North: Issues and Contexts,* 1−14. Canadian Circumpolar Institute Press, Edmonton, Alberta.

Henttonen, H. (2000). Long-term dynamics of the bank vole at Pallasjärvi, Northern Finnish taiga. – *In* Bujalska, G and Hansson, L. (eds.): Bank vole biology: Recent advances in the population biology of a model species. *Polish Journal of Ecology* 48 Suppl.: 87−96.

Holma-Suutari, A. (2014). Harmful agent (PCDD/Fs, PCBs, and PBDEs) in Finnish reindeer (Rangifer tarandus tarandus) and moose (Ales alces). Thesis University of Oulu 2014. *19.10.2016).* <http://www.onehealthinitiative.com/about.php>

ISCED. (2011). International standard classification of education. UNESCO Institute for Statistics, Montreal.

Larsen, J. N. & G. Fondahl (2014; eds.). *Arctic human development report-II: Regional processes and global linkages*. 500 p. Nordic Council of Ministers, Copenhagen.

McMahon, W. W. (1998). Conceptual framework for the analysis of the social benefits of lifelong learning. *Education Economics* 6: 3, 309–346.

Martin, S. (2009). The effects of female out-migration on Alaska villages. *Polar Geography* 32: 1−2, 61−67.

Messner, T., Lundberg, V. & B. Wikstrom (2002). A temperature rise is associated with an increase in the number of acute myocardial infarctions in the subarctic area. *International Journal of Circumpolar Health* 61: 3, 201−207.

Nilsson, L. M., Destonuni, G., Berner, J., Dudarev, A., Mulvad, G., Odland, J. O., Rautio, A., Tikhonov, C. & B. Evengård (2013). A call for urgent monitoring of food and water security based on relevant indicators for the Arctic. *AMBIO A Journal of the Human Environment* 42: 816−822.

One Health Initiative. (2016). 19.10.2016 <*http://www.onehealthinitiative.com/about.php*>

Parkinson, A. J. & J. C. Butler (2005). Potential impacts of climate change on infectious diseases in the Arctic. *International Journal of Circumpolar Health* 64: 478–486.

Revich, B., Tokarevich, N. & A. Parkinson. (2012). Climate change and zoonotic infections in the Russian Arctic. *International Journal of Circumpolar Health* 71: 18792.

Russian Federation Federal State Statistical Service. (2016). 10.5.2016 <*http://www.gks.ru/*> (in Russian).

Sanderson, W. & S. Scherbov (2013). The characteristics approach to the measurement of population aging. *Population and Development Review* 39: 4, 673−685.

Skirbekk, V. & S. K. C. (2012). Fertility-reducing dynamics of women's social status and educational attainment. *Asian Population Studies* 8: 251−264.

Soininen, L. (2015). The health of the Finnish Sami in light of mortality and cancer pattern. Thesis University of Helsinki 2015. 28.11.2016 <*https://helda.helsinki.fi/bitstream/handle/10138/154662/THEHEALTHO_korjattu.pdf?sequence=3*>

Statistics Finland. (2016). 11.5.2016 < *http://www.stat.fi/index_en.html/*>

Statistics Norway. (2016). 11.5.2016 <*https://www.ssb.no/en/*>

Statistics Sweden. (2016). 11.5.2016 <*http://www.scb.se/en/*>

Striessnig, E. & W. Lutz (2013). Can below-replacement fertility be desirable? *Empirica* 40: 409−425.

Sumarokov, Y., Brenn, T., Kudryavtsev, A. & O. Nillsen. (2014). Suicides in the indigenous and non-indigenous populations in the Nenets Autonomous Okrug, Northwestern Russia, and associated socio-demographic characteristics. *International Journal of Circumpolar Health* 73: 24308.

Woodhall, M. (2001). Human capital: educational aspects. *In* Smelser N. J. & P. B. Baltes (eds.): *International Encyclopedia of the Social and Behavioral Sciences* 10: 6951−6955. Elsevier, Oxford.