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ORIGINAL RESEARCH

Can Russia's high mortality return until 2030 to trajectory of the 1980-ies and reach the SDGs evenly across the country?

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Abstract

Aim: This study reviews the ability of the Russian Federation to reduce the high mortality until 2030 evenly across the country and in accordance with the Sustainable Development Goals (SDG). **Methods:** We adopted the method suggested by Haenszel for estimating Premature Years of Life Lost for the age group <70 years and applied a projected reduction of 33% by 2030 as proposed for SDG 3.4. To calculate the potential time gap we used the model of the United Nations Development Programme and standardized the rates by the OECD 1980 Standard Population employing the direct method.

Results: If Russia keeps the present level of effort the reduction by one third of the level of premature mortality as in 2013 will be in reach already in 2024 i.e. 5.9 years in advance of the SDG 3 target for 2030. This target is achieved quite evenly also throughout the 8 districts of the Russian Federation between 10.6 and 5.0 years in advance and in selected special districts/republics with the highest and lowest mortality rates.

Conclusion: After the steep decrease of life expectancy during the 1990ies the Russian Federation returned to the original trajectory.

Keywords: gap analysis, premature mortality, public health, Russian Federation, SDG.

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Introduction

The Russian Federation (RF) is with 17.1 million sqkm the largest country in the world with a population of 146 million, distributed over the territory quite unevenly. Life-expectancy is increasing like in most regions of the world after a steep downturn in the 1990ies (1): For Russia from 69.5 in 1988 to 64.5 years in 1994, to 65.5 in 2000 and to 72.4 in 2017, however with the highest gap worldwide between males and females (2), e.g. in 2017 67.1 vs. 77.4, a difference of 10.3 years, as compared to the European Union (3) with a life-expectancy of 80.9 and a much smaller gender gap (e.g. in 201778.3 vs. 83.5). According to Vlassov (4), Vladimir Putin - when re-elected as president in 2018 - declared a life expectancy at birth for both sexes of 76 years to be achieved in 2024 and of 80 in 2030.

For the calculation of premature mortality, in Russia mainly determined by Non-Communicable Diseases (NCDs), usually a borderline age of <70 years is considered as upper limit. The Sustainable Development Goals (5) ask for a reduction by one third of NCDs mortality up to 2030. For Russia as a whole this seems to be in reach as published earlier (6).

In this paper we analyse the eight Federal Districts of the Russian Federation with regard to their premature mortality as there are: North Caucasus, South, Privolzhskiy (Volga), Far East, Uralskiy, Siberian, Central, and North West Federal Districts. In addition, we determine whether each of the eight districts is on track to reach the SDG target by 2030. Furthermore we also try to analyse selected subunits e.g. oblasts as the Russian Federation consists in total of 85 subjects, including 22 Republics (for example Karelia, Altai, Tatarstan, Chechnia etc.), 9 Territories (e.g. Perm territory), 46 regions (e.g. Kaliningrad region), cities of federal significance (e.g. Moscow and Sankt Petersburg), 1 Autonomous oblast (Jewish Autonomous region) and 4 Autonomous districts (Chukotka, Yamalo-Nenets, Khanty-Mansijsk (Yugra), and Nenets). However, in this paper we do not consider a possible impact of the Corona pandemic in 2020 but plan to do that on the basis of reliable figures later.

Methods

We adopted the method suggested by Haenszel (7) for estimating Premature Years of Life Lost (PYLL) <70 years of age and applied a projected reduction of 33% by 2030 as proposed by the United Nations for SDG 3.4 targeting Non-Communicable Diseases (NCD) (5) which make up for 87% of the total mortality in Russia (8). We gave preference to the determination of PYLL instead of Life Expectancy (LE) to avoid the instability of the highest age-groups.

As for other components of total mortality: In Russia the levels of the Maternal Mortality Ratio (MMR, SDG 3.1) and Neonatal Mortality Rate (NMR, SDG 3.2), are already well below the UN targets (70 for MMR and 12 for NMR): MMR 17/100.000 live births; NMR 5.4/1.000 live births. SDG 3.3 refers to Communicable Diseases (5% of total mortality incl. MMR and NMR) and SDG 3.6 to Road Traffic Accidents (8% of total mortality) for which reductions between appr. 30% and 90% are defined. In conclusion we consider it justified to apply an overall reduction by 1/3 to the total mortality until 2030, with reference to the years 2013, 2015 (estimated), and 2018.

To calculate the time gap (G), i.e. the time needed to achieve an agreed target deadline related to the time remaining between the year of observation and the target year, we use the mathematical model of the United Nations Development Programme (9). The likelihood of achieving the SDG target 2030 will be determined by the indicators' time gap, i.e. the time remaining to achieve an agreed target, according to the following equations:

[1] $T_r = t_t - t_c$

and:

[2] $T_n = t_t - [t_b + (t_t - t_b)\ (x_c - x_b) / (x_t - x_b)]$

Then the resulting time-gap G is calculated as:

[3] $G = T_r - T_n$

T_r - remaining time

T_n - time needed to achieve the target (in linear progress)

x_b - baseline value of the indicator

x_t - target value of the indicator

x_c - observed value of the indicator

G - time gap (gain or delay)

t_t - target year

t_c- year of observation

t_b - baseline year

A positive time-gap G indicates that the respective country is "On Track" to achieve the target on time or even earlier; a negative value indicates that it may still be "Likely" or even "Unlikely" to achieve the target within the target timeframe i.e. in 2030. A country is still considered likely to achieve the target as long as a negative value for G does not make up for less than -25% of the remaining time T_r i.e. the relative Gap G_r is: $G_r = G / T_r >= -0.25$.

We standardized the rates by the OECD 1980 Standard Population (10) (**Annex 1**) employing the direct method (e.g. Armitage (11). For details of the calculation see also Chernyavskiy et al. (6).

The Federal Research Institute for Health Organization and Informatics of the Russian Ministry of Health provided the demographic data (**Annex 1 and 2**) which are used to calculate the time gap for SDG 3 of the entire Russian Federation and separately for the 8 districts. On the basis of these data we analyze the age groups 0-<70, 0-<30, and 30-<70 as well as both sexes together and separate.

For the determination of the gap in 2024 and 2030 and the analysis of the trajectory 1960-2030, based on life expectancy data, we made use of the database of the World Bank (1) and identified the peak data before and after the crisis during the 1990ies.

Results

If Russia keeps the present level of effort to improve the life of the Russian citizens a reduction of one third of the level of premature mortality as in 2013 will be in reach already in 2024 (**Table 1**) i.e. 6.1 years in advance of the SDG 3 target for 2030, here applied not only to NCD mortality in general but to the overall premature mortality before age 70.

Table 1. Projected reduction of Premature Years of Life Lost (PYLL) targeted 2013-2030

Russian Federation and Federal Districts	PYLL/ 100,000 2013*	PYLL/ 100,000 2018	PYLL/ 100,000 Target 2030 based on 2013	Years up to 2030 in 2018	Years needed as of 2018	Years in advance/delay of 2030	Gr to be >= -0.25
EU-27	*3,243*	*3,066*	*2,162*	*12*	*14.2*	*-2.2*	*-0.18*
(for comparison)							
RUSSIAN FEDERATION							
0-<70 years of age	10,313	8,060	6,875	12	5.9	6.1	0.51
0-<30 years of age	6,283	4,043	4,189	12	-1.2	13.2	1.10
30-<70 years of age	15,073	12,881	10,049	12	9.6	2.4	0.20
Males 0-<70	15,137	11,480	10,091	12	4.7	7.3	0.61
Females 0-<70	5,809	4,689	3,873	12	7.2	4.8	0.40
FEDERAL DISTRICTS:							
North Caucasus	7,153	4,970	4,769	12	1.4	10.6	0.88
South	8,351	6,032	5,567	12	2.8	9.2	0.76
Privolzhskiy (Volga)	10,010	7,295	6,667	12	3.2	8.8	0.73
Far East	12,529	9,203	8,352	12	3.5	8.5	0.71

Uralskiy	11,910	9,032	7,940	12	4.7	7.3	0.61
Siberian	11,829	9,133	7,885	12	5.4	6.6	0.55
Central	9,322	7,272	6,208	12	5.8	6.2	0.52
North West	9,726	7,824	6,483	12	7.0	5.0	0.41
SPECIAL TERRI-TORIES:							
Crimea 0-<70	9,730	8,388	6,480	12	11.6	0.4	0.03
Sevastopol 0-<70	10,085	7,252	6,723	12	9.6	2.4	0.80

* For Sevastopol 2015-2020

All districts reach the target in advance of 2030, the District of North Caucasus 10.6 years earlier and the North West District still 5 years in advance of 2030. For comparison, the progress of the EU-27 has been calculated which - at a considerably lower level - shows smaller rates of reduction and therefore a delay of -2.2 years in 2030.

Already in 2016 Russia achieved the corresponding target for the younger age group 0-<29 years of age and needs only 9.6 years to reach the target in the elder group 30-<70. For males the target will be achieved 7.3 years in advance i.e. in 2022 and for females 4.8 years in advance. The example of males and females 0-<70 is used in **Table 2** to demonstrate the level of uncertainty. The averaged trend we use is a conservative estimate between the straight continuation of the trend 2013-2018 and the target line for 2030.

Table 2. Projected reduction of Premature Years of Life Lost (PYLL) targeted 2013-2030 for both sexes separately with levels of uncertainty

Trend projections	Males 0-<70 PYLL/100,000	Females 0-<70 PYLL/100,000	
Targets based on 2013 reduced by 1/3	10,091	3,873	
Averaged estimate of trends	**8,957**	**3,721**	Corresponding to 7.3 years in advance of 2030 for males and 4.8 years for females (see Table 1)
Straight projection of the trend 2013-2018 to 2030	7,823	3,569	

As the SDGs have been accepted in 2015/16 (2) we applied the 1/3 reduction in addition to the baseline in 2013 also to the data estimated for 2015 as an average of 2013 and 2018, and to the data of 2018 which constitutes a more demanding i.e. lower target for 2030 (**Annex 4a and b**). However, the general impression is the same in that still all federal districts would achieve the target before 2030 whether the 1/3 reduction is based on 2015 or 2018. Furthermore we applied different baselines for the entire Russian Federation, namely also 2003 and 2009 (**Annex 4c**), which predict likewise an achievement of the targets before 2030. A look at the presidential targets, formulated as improvements in Life Expectancy (LE), demonstrates that targeted achievements in 2024 and 2030 are possible with only small delays of 0.9 and 1.3 years respectively (**Annex 4d**).

Finally we show data for smaller subunits i.e. the 4 oblasts with the highest mortality and 4 Republics/Autonomous Districts with the lowest mortality (**Annex 5**). The Uralskiy District contains the highest as well as one of the lowest ranking oblasts. Although the rates are already considerably lower in the Caucasian republics, they show similar reductions of mortality as indicated for the North Caucasus in table 1, in other words the positive developments seem to be similar across the entire Russian Federation.

Discussion

The Gap-analysis shows clearly that all districts of the Russian Federation are in line and will reach the targeted reduction of premature mortality several years before 2030. It is astonishing how the Russian Federation managed to continue the upward trend of the late 1980ies after the catastrophic down-turn in the mid-nineties (1), an observation which has been noted already very early in 2003 (12). An explanation may be a short-termed 'Glasgow-effect' (13), the observation that life expectancy is persistently much lower in

one district of Glasgow than in the rest of the United Kingdom, likely due to persisting social deprivation. The deprivation of the mid-nineties has obviously been overcome in the early 2000s contrary to the United Kingdom, taking the example of Glasgow. Nevertheless, Russia had and has higher levels of mortality than the EU average, a situation that persists until today (3). The decrease in PYLL began to slow down in the second half of the last decade. Whereas the trajectory 2003-2018-2030 results in a Gap Ratio of 0.71 allowing to reach the target already in 2021, for the trajectory 2013-2018-2030 (used in the main body of this paper) we get a Gap Ratio of 0.51 corresponding to 2023 or 6.1 years in advance of 2030. Accordingly Gr is further reduced if we base the target calculation on the observation year 2018, however, still the 2030 target will be reached at least 2.8 years in advance.

In the formula (9), as described above, the factor $(x_c - x_{b)} / (x_t - x_b)$ determines the proportion of the remaining time to achieve the targets. The higher the baseline value (compared to the observed value) the faster the targeted reduction is achieved, and the lower the baseline, the flatter is the projected line of reduction. This phenomenon follows the rule of "Diminishing Marginal Returns" as Varian (14) states: "…the marginal product of a factor will diminish as we get more and more of that factor". Depending where a combination of input/output is located on a production curve, i.e. in a steep or more flatten part of the curve, the effectivity of the input will be higher or lower. To maintain nevertheless the same size of the product it would require more and more resources or time. The latter applies to the situation wherein we find the EU27: The projection of its trajectory 2013-2018 to 3030 is flatter than required and leads to a delay of at least -2.2 years or more whereas the corresponding trajectory of the RF is much steeper and indicates an earlier achievement by at least +6.1 years.

There are other reasons to be skeptical about the future of the recent steep increase in Russian life expectancy. In adulthood - e.g. at age 30 to <70 years –the PYLL rate did not decrease to a degree comparable to the younger age group under 30 years of age according to the data presented in **Table 1**. This means that although Russia went through the epidemiological transition already in the mid-20th century, progress in the prevention and management of chronic conditions remained weak.

The initial question, posed in the headline of this paper, is whether the Russian Federation returned to the trajectory of 1988. Based on the LE data of the World Bank (1) the calculations presented in **Table 3** demonstrate that this question can be answered positively: After the nineties Russia returned to the earlier trajectory.

Table 3. Life Expectancy at birth according to the trajectory 1960-1988 for the Russian Federation targeting 2017 and 2030 along the same trajectory

Year	1960	1988	Improvement of LE 1988-1960 per 10 years	2017 LE target based on 1960-1988	2017 LE observed	2030 LE target based on 1960-1988	Gap- analysis 1960-1988-2030
Life Expectancy (LE)	66.1	69.5	+1.2	72.9	72.4	74.5	0.3 years in advance; Gr = +0.01

The objective of increasing the longevity of Russian people has been an important element of state policy for the past 18 years. The current Health and Demography national projects are aimed at improving the performance of health services and to raise the living standards of the Russian citizens in such a way that they not only live longer but lead active lives in decent conditions. Russia plans to spend 1.7 trillion rubles ($26.68 billion) on dramatically improving health care to accomplish the goal of raising life expectancy. These plans may be even accelerated given the devastating effects of the COVID-19 pandemic (15).

Conclusion

The Russian Federation is on track with regard to SDG 3 and very likely will have reduced its mortality rates calculated as PYLL by one third as of 2013. This is mainly due to a steep improvement in the age group 0-<30, a success which occurred after the deep decrease of life expectancy in the mid-nineties. The impressive improvement occurred quite evenly throughout the 8 administrative districts of the Russian Federation, between North Caucasus best and the North West district still in advance. Also the smaller subunits (oblasts or republics) obviously follow the same trajectories whether ranking highest or lowest regarding their mortality rates. In summary after the steep decrease of life expectancy during the 1990ies the Russian Federation returned to the original trajectory.

Key-points:

- During the 1990ies Russia experienced a steep decrease of Life Expectancy from 69.5 in 1988 to 64.5 years in 1994.
- Since the 2000nds Premature Years of Life Lost as well as Life Expectancy improved again so that Russia is likely to reach the SDG target of mortality reduction by 1/3 in 2030.
- The reduction of premature mortality is with some variation evenly distributed across all eight Federal Districts

of the Russian Federation and subunits with highest or lowest mortality rates.

- The positive trajectory of the 1980ies has been regained during the 2010s.

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ANNEXED DATA

The annexed data are attached to this PDF (left upper corner of the screen).