

COMPARATIVE ASSESSMENT OF STILLBIRTH RATE IN BRYANSK REGION, EU AND CIS COUNTRIES (1995–2014)

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Stillbirth rate is one of the most important indicators allowing assessment of the population's living standards and forecasting its growth rate. This study aimed to compare the frequency of stillbirths in the Bryansk region, EU and CIS countries based on the official statistical data covering the period from 1995 to 2014. It was established that male stillbirth rate is greater than female stillbirth rate both in the Bryansk region and the Russian Federation (by 14.2% and 9%, respectively), which is consistent with the worldwide trend that has the male stillbirth risk 10% higher than that for girls. Provided the dynamics remain the same, 2016 to 2021 the share of stillbirths in the Bryansk region will continue to grow and reach 28.8% by 2021, which is greater than nationwide. The gender distribution will also grow to 32.6% (male stillbirths more common than female) by 2021.

Keywords: stillbirths, boys, girls, Bryansk region, Russian Federation, European Union, Commonwealth of Independent States, World Health Organization.

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СРАВНИТЕЛЬНАЯ ОЦЕНКА ЧАСТОТЫ МЕРТВороЖДАЕМОСТИ В БРЯНСКОЙ ОБЛАСТИ, СТРАНАХ ЕВРОПЕЙСКОГО СОЮЗА И СОДРУЖЕСТВА НЕЗАВИСИМЫХ ГОСУДАРСТВ (1995–2014 ГГ.)

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Одним из важнейших показателей, позволяющих оценить уровень жизни населения и спрогнозировать рост его численности, служит частота случаев мертворождения детей. Целью работы было на основании официальных статистических данных за 1995–2014 гг. провести сравнительную оценку частоты мертворождаемости мальчиков и девочек в Брянской области, странах ЕС и СНГ. Установлено превышение частоты мертворожденных мальчиков над девочками, как по Брянской области (на 14,2%), так и по Российской Федерации в целом (на 9%), что подтверждает общемировые тенденции, выявившие повышенный риск мертворождения плодов мужского пола примерно на 10%. При сохранении существующих тенденций динамики мертворождаемости в Брянской области коэффициент мертворождений будет увеличиваться относительно общероссийских значений в период 2016–2021 гг. и достигнет 28,8% к 2021 г., причем разрыв между мальчиками и девочками будет возрастать и составит 32,6% к 2021 г.

Ключевые слова: мертворождаемость, мальчики, девочки, Брянская область, Российская Федерация, Европейский союз, Содружество Независимых Государств, Всемирная организация здравоохранения

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According to the World Health Organization [1], there were about 2.6 million stillbirths registered worldwide in 2009. Every day, over 7,200 children are born dead; 98% of these stillbirths occur in countries with low and mid-level standards of living. The same WHO report [1] states that 1995 to 2009 the rate of stillbirths decreased by just 1.1%, from 3,000,000 cases in 1995 to 2,600,000 cases in 2009. Finland is the country with

the lowest number of stillbirths (2 dead-born in every 1,000 newborns), Nigeria and Pakistan are the nations where the rate of stillbirths is the highest (40 out of 1,000 births) [1]. In 2011, Nepal had the stillbirth rate of 22.4 per 1,000, with 80% of these deaths occurring during the pregnancy period [2]. The largest absolute number of stillbirths in the world was recorded in India — about 590,000 in 2015 [3].

It was also established that gender of the child matters. A group of researchers from the Exeter University (UK) has analyzed over 30,000,000 cases of stillbirth worldwide [4] and found that boys run an approximately 10% greater risk than girls, which translates into about 100,000 more stillborn males a year. The reasons for such a difference are yet unknown; it may be defined, for example, by the peculiarities of placenta development and functions, or the greater sensitivity of male fetuses to harmful environmental factors. China and India were the exceptions to the rule: there, the percentage of stillborn boys and girls did not differ. This may be due to the selective abortions, which are common in these countries: when the US scan shows the fetus is female, abortion is the option of choice in many cases. Overall, the rate of stillbirths in China and India was slightly higher than the global average [4].

There is a number of factors that up the risk of bearing a dead child, including complications during childbirth, maternal age over 35, preeclampsia, placental abruption, chronic infections in mother during pregnancy (brucellosis, toxoplasmosis, listeriosis, tuberculosis, syphilis, etc.), acute infections (angina, influenza, pneumonia etc.), high blood pressure, diabetes, diseases of the heart, lungs, kidneys and other internal organs, drug abuse [5–7], socioeconomic problems, poor educational status [8], as well as polluted environment, intrauterine growth retardation and congenital malformations (FCA) [9]. Refusal to visit antenatal clinics and/or lack of antenatal aid is a major factor affecting the risk of stillbirth; unlike many other factors, this one is can be influenced [10].

Almost half of all stillbirths (1,200,000 cases) occur during childbirth. These deaths are the result of mothers and children not having any help from qualified specialists in this critical

process. Two-thirds of the cases belong to rural areas, where obstetricians — midwives and doctors aiding childbirth — are not always available, same as assistance in emergency situations that require interventions like cesarean section [1]. In the countries where the standards of living (and level of income) are high, the share of stillbirths occurring during childbearing was decreased significantly through better obstetric care; in the contrary, the number of stillbirths did not go down significantly [11]. This fact proves that even in the richer countries, stillbirth prevention strategies based on the detection of high-risk pregnancies were unsuccessful.

Approximately in a quarter of cases the causes of stillbirth remain unclear; this is one of the priority problems for the modern medicine [4]. A very important step on the way to its solution is the discovery of a new factor reducing the risk of stillbirth, the detection of which requires gathering special statistical data [4]. Large FCA may be such a factor, those rendering living impossible and leading to both spontaneous abortions (miscarriages) [9] and abortions for medical reasons; such FCA are detected more often in pregnancies carried by women residing in areas contaminated by the Chernobyl meltdown [12].

Thus, the primary mission of healthcare professionals is timely arrest of pathological processes in pregnant women both during pregnancy (including early FCA diagnosing) and in the process of delivery.

It should be noted that in 2015, Bryansk region ranked 16 out of 18 regions belonging to the Central Federal District in terms of quality of life, while in the national rating its position was 52 (out of 85); as for the health of its population, the region is 67th nationwide [13].

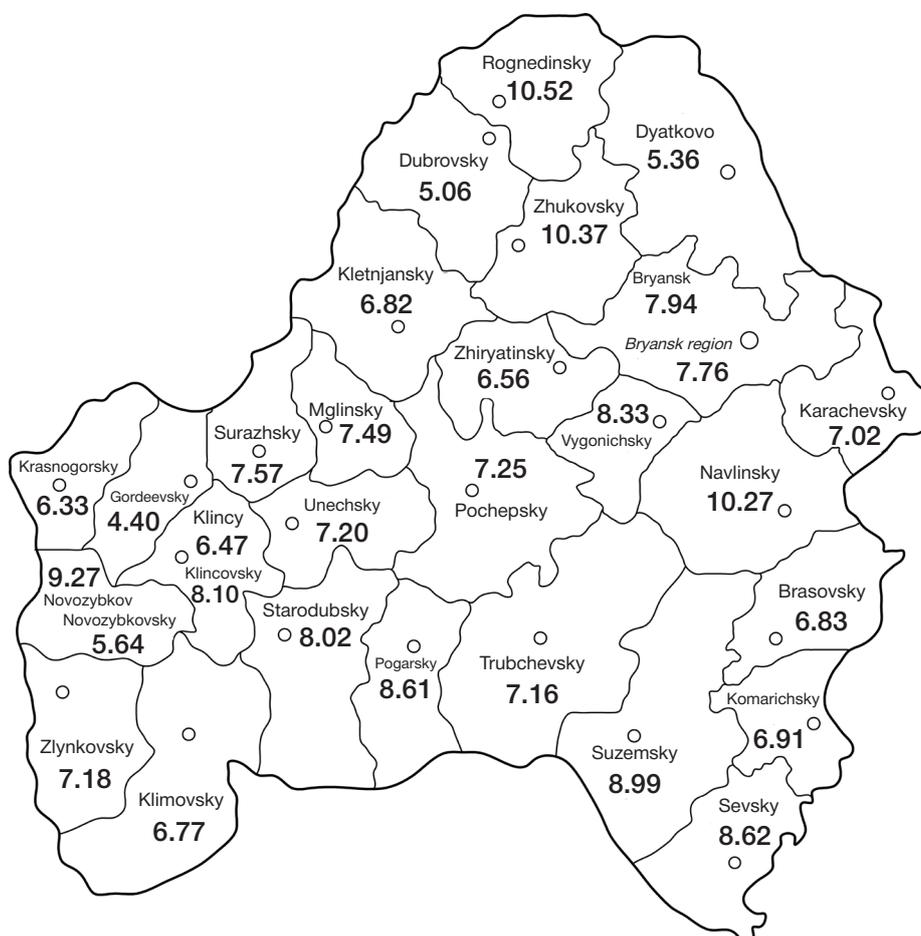


Fig. 1. Stillbirth rate in Bryansk Region, boys, 1995 to 2015 (per 1,000 births, ‰)

In this connection, a long-term observation and analysis of the dynamics of stillbirth rate (overall and by gender) in Bryansk region, EU and CIS countries is an extremely important and urgent task.

METHODS

Source of the statistical data covering the period from 1995 to 2015 and describing the rate of stillbirths (by gender) in Bryansk region and in Russia — official materials issued by Bryanskstat, territorial body of the Federal State Statistics Service in Bryansk region [14]. Source of the data describing stillbirth rate registered in the EU and CIS countries in 1995 to 2014 — reports published to the official website of WHO [15].

Stata SE 14 software was used to perform statistical analysis of the data obtained. Sample mean was taken as the average value. Student's *t*-test helped determine statistical significance of deviations.

Using the data available, we forecast the stillbirth rate for the Bryansk region and the Russian Federation, overall and by gender. To this effect, we applied the least squares method to find the $y = ax + b$ linear function that approximates the statistical data for each of these categories most accurately. Data analyzed covered the period from 2009 to 2015 for Bryansk region and from 2009 to 2014 for the Russian Federation (data covering 2015 are not yet available for the Russian Federation). Using the aforementioned linear function, we forecast the dynamics for the two three-year periods from 2016 to 2021.

RESULTS

Figures 1 through 3 depict the data describing stillbirth rate in the Bryansk region (years 1995 through 2015): boys, girls, overall and by districts.

Most often, boys are stillborn in Rognedinsky district (10.52 stillbirths per 1,000 births), followed by Zhukovsky (10.37), Navlinsky (10.27) and Suzemsky (8.99) districts (Figure 1); on the other side of the range are Gordeevsky (4.40), Dubrovsky (5.06), Dyatkovo (5.36) and Novozybkovsky (5.64) districts. The stillbirth rate in the region ranges from 4.40 to 10.52. In Rognedinsky district, the incidence is 2.4 times as frequent as in Gordeevsky district. Stillbirth rate registered in the city of Bryansk is 7.94.

As for the female stillbirths, they are most common in Zhiryatinsky district (12.80 girls born dead out of every 1,000 born), Pogarsky (9.57), Dubrovsky (8.77) and Klimovsky (8.59) districts; the lowest rates are in Zlynkovsky (3.80), Gordeevsky (4.02), Karachevsky (4.20) and Krasnogorsky districts (5.27). The highest rate in the region, which was registered in Zhiryatinsky district, is 3.4 times greater than the lowest rate, registered in Zlynkovsky district. In Bryansk, the average female stillbirth rate is 6.35, which is 20% less than male stillbirths (Fig. 2).

Overall, the districts with the most stillbirths (both boys and girls) registered within the period considered are Zhiryatinsky (9.68), Rognedinsky (9.09), Pogarsky (9.09) and Zhukovsky (8.53); those with the lowest stillbirth rate are Gordeyevsky (4.21), Novozybkovsky (5.36), Zlynkovsky (5.49) and Karachevsky (5.61) (Figure 3). The stillbirth rate in the region

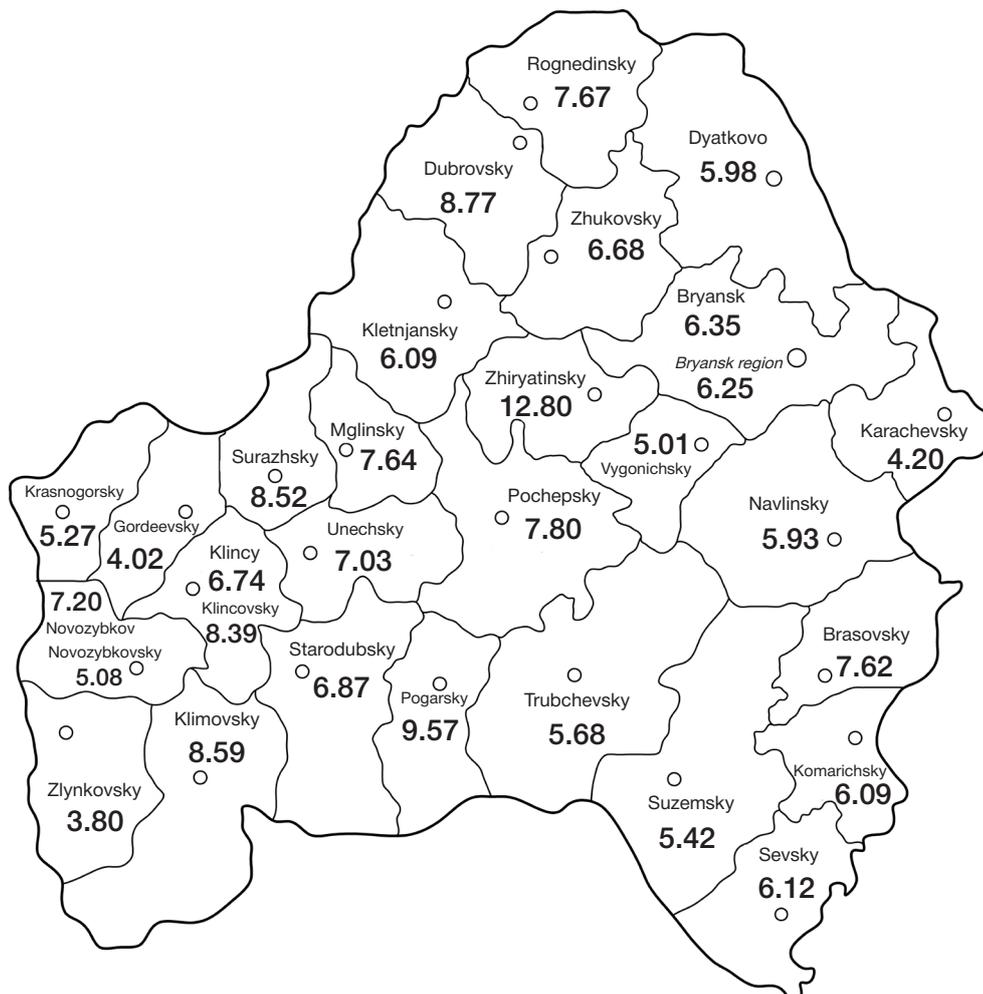


Fig. 2. Stillbirth rate in Bryansk Region, girls, 1995 to 2015 (per 1,000 births, ‰)

ranges from 4.21 to 9.09 deaths in a 1,000 born. The highest rate was registered in Zhiryatinsky district (2.2 greater than in Gordeyevsky district). The rate registered in the city of Bryansk is 7.15.

As shown in Table 1, the average percentage of stillborn boys in Bryansk region (years 1995 to 2014) is 16.5% greater than the national average: 7.49 against 6.43 ($p < 0.05$); as for girls, the rate is 11.2% greater than the national average, 6.56 against 5.90 ($p > 0.05$). The overall stillbirth rate registered in the Bryansk region is 13.8% ($p < 0.05$) greater than the national average: 7.02 (boys) and 6.17 (girls). Male stillbirths are 14.2% more common than female stillbirths in the Bryansk region (7.49 and 6.56 deaths per 1,000 births, respectively); compared to the national indicators, it is 9.0% greater (6.43 and 5.90, respectively) although the differences do not reach the level of significance ($p > 0.05$).

Table 2 shows that the average stillbirth rate in the years from 1995 to 2014 in the EU countries was less than in the CIS countries by 2.47 times ($p < 0.001$). The highest rates are recorded in Armenia (15.74), Ukraine (15.36), Georgia (14.30), Azerbaijan (11.67), Tajikistan (10.99) and in the CIS countries on the whole (12.17); the lowest rates are seen in the Czech Republic (2.98), Italy (3.10), Spain (3.43), Finland (3.47),

Sweden (3.55) and the EU countries on the whole (4.93). In the EU, the highest stillbirth rate is registered in France (8.00), Bulgaria (7.49), Latvia (6.91) and the Netherlands (5.96). In the CIS countries, the stillbirth rate ranges from 4.90 to 15.74, while in the EU countries the range is from 2.98 to 8.00. In the Russian Federation, the stillbirth rate is 6.17 ± 0.23 , which is 1.25 times higher than in the EU but 1.97 times lower than in the other CIS countries (differences being statistically significant, $p < 0.001$). It should be noted that only three EU countries — France, Bulgaria and Latvia, — have stillbirth rates higher than in the Russian Federation (8.0, 7.49 and 6.91, respectively). In the Republic of Belarus, the stillbirth rate is 1.26 times lower than in the Russian Federation and 2.48 times lower than in the CIS countries (4.90); it is almost the same as in the EU (4.93).

Dynamics of the stillbirth rate in Bryansk region, Russian Federation, EU countries and CIS countries in 1995–2014 (Fig. 4) confirm the data provided in Table 2 and show that in the CIS countries the stillbirth rate is the highest; it reached the maximum in 1997–1998 (17.1), then from 1999 it was gradually decreasing, reaching the minimum in 2011–2014 (8.9). Unlike CIS countries, EU has not seen sharp fluctuations of stillbirth rate over the considered 20-year period (1995–2014): the

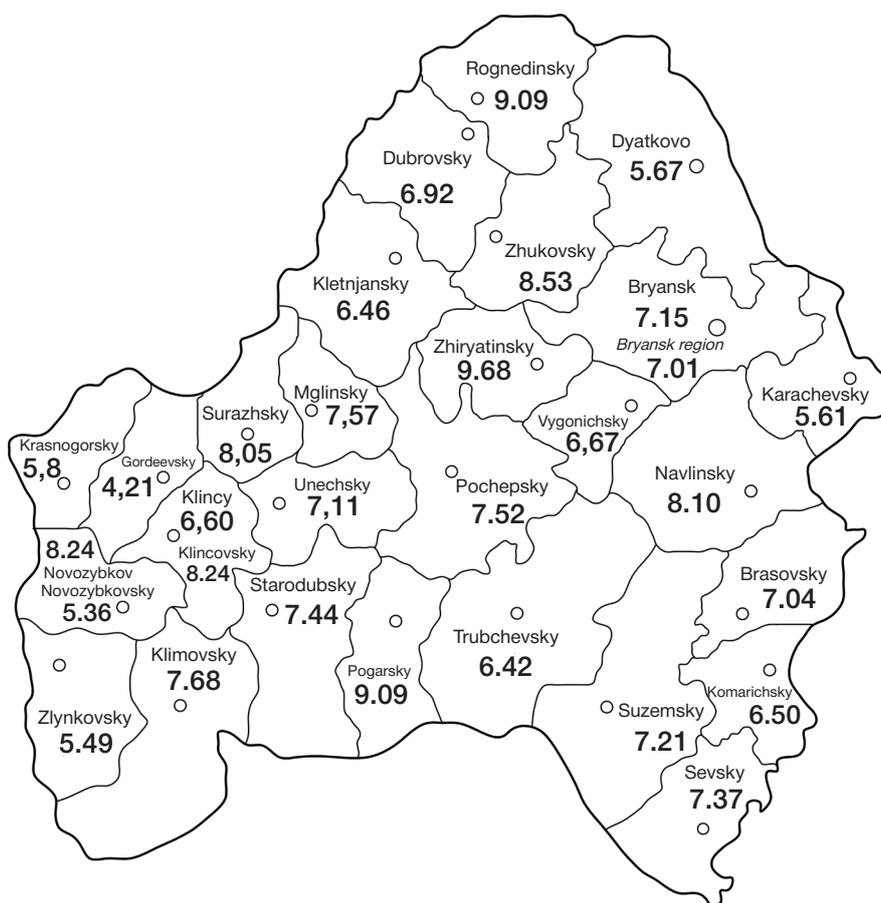


Fig. 3. Stillbirth rate in Bryansk Region, boys and girls, 1995 to 2015 (per 1,000 births, %)

Table 1. Stillbirth rate in Bryansk region and the Russian Federation, 1995–2014, boys and girls, per 1,000 births, $M \pm m$

Country, region	Stillbirth rate, boys, ‰	Stillbirth rate, girls, ‰	Stillbirth rate, boys and girls combined, ‰
Bryansk region	7.49 ± 0.41	6.56 ± 0.27	7.02 ± 0.32
Russian Federation	6.43 ± 0.25	5.90 ± 0.22	6.17 ± 0.23

Note: difference between male and female stillbirth rate in Bryansk region and in the Russian Federation, $p > 0.05$;
 difference between male stillbirth rate in Bryansk region and in the Russian Federation, $p < 0.05$;
 difference between female stillbirth rate in Bryansk region and in the Russian Federation, $p > 0.05$;
 difference between overall stillbirth rate (boys and girls combined) in Bryansk region and in the Russian Federation, $p < 0.05$.

Table 2. Stillbirth rate in the EU and CIS countries, 1995–2014, boys and girls combined, per 1,000 births, $M \pm m$

Country, region	Stillbirth rate (1995–2014), ‰	Significance of differences with the EU, p
<i>Commonwealth of Independent States</i>	<i>12.17 ± 0.69</i>	<i>$p < 0.001$</i>
<i>European Union</i>	<i>4.93 ± 0.03</i>	–
Armenia	15.74 ± 0.55	$p < 0.001$
Ukraine	15.36 ± 1.46	$p < 0.001$
Georgia	14.30 ± 0.78	$p < 0.001$
Azerbaijan	11.67 ± 0.30	$p < 0.001$
Tajikistan	10.99 ± 0.24	$p < 0.001$
Kyrgyzstan	9.94 ± 0.76	$p < 0.001$
Moldova	9.38 ± 0.51	$p < 0.001$
Turkmenistan	9.20 ± 1.01	$p < 0.001$
Kazakhstan	8.64 ± 0.30	$p < 0.001$
Uzbekistan	8.06 ± 0.82	$p < 0.001$
France	8.00 ± 0.55	$p < 0.001$
Bulgaria	7.49 ± 0.09	$p < 0.001$
Latvia	6.91 ± 0.34	$p < 0.001$
Russian Federation	6.17 ± 0.23	$p < 0.001$
Netherlands	5.96 ± 0.12	$p < 0.001$
Serbia	5.42 ± 0.12	$p < 0.001$
Lithuania	5.41 ± 0.18	$p < 0.05$
Ireland	5.34 ± 0.20	$p > 0.05$
Romania	5.25 ± 0.22	$p > 0.05$
UK	5.25 ± 0.07	$p < 0.001$
Estonia	5.21 ± 0.36	$p > 0.05$
Poland	5.08 ± 0.23	$p > 0.05$
Slovenia	5.00 ± 0.15	$p > 0.05$
Republic of Belarus	4.90 ± 0.42	$p > 0.05$
Hungary	4.82 ± 0.14	$p > 0.05$
Greece	4.74 ± 0.21	$p > 0.05$
Malta	4.63 ± 0.31	$p > 0.05$
Denmark	4.63 ± 0.13	$p < 0.05$
Luxembourg	4.59 ± 0.30	$p > 0.05$
Belgium	4.48 ± 0.08	$p < 0.001$
Portugal	4.43 ± 0.26	$p > 0.05$
Croatia	4.27 ± 0.12	$p < 0.001$
Switzerland	4.09 ± 0.08	$p < 0.001$
Austria	3.88 ± 0.08	$p < 0.001$
Germany	3.81 ± 0.07	$p < 0.001$
Slovakia	3.79 ± 0.11	$p < 0.001$
Sweden	3.55 ± 0.08	$p < 0.001$
Finland	3.47 ± 0.13	$p < 0.001$
Spain	3.43 ± 0.07	$p < 0.001$
Italy	3.10 ± 0.13	$p < 0.001$
Czech Republic	2.98 ± 0.08	$p < 0.001$

range was from 4.6 to 5.1. In Bryansk region, stillbirth rate ranged from 4.3 to 9.9, the curve depicting its dynamics featuring a number of humps: the rate was in line with the national average in 1995 and 1996 (7.4), increased in 1997 to 9.9, then decreased and stabilized in 1998–2005 (7.2–8.5). In 2006–2010, the rate went down to the country average level (4.3–5.2), and in 2011–2014 it grew up again (5.8–7.9). As for the Russian Federation in general, in 1995–1997 the stillbirth rate was almost unchanged (7.4–8.0), then, 1998 to 2011, it

decreased gradually and reached 4.5 in 2011, but within the last three years the rate has grown to 6.2.

In the Czech Republic, Finland and Germany, the stillbirth rate ranges from 2.3 to 4.8 and does not exceed the EU average (Fig. 5). Unlike the Czech Republic, Finland and Germany, France has had a stillbirth rate surge registered in 2002: it increased 1.7 times, from the stable EU average of 4.6–5. (seen 1995 through 2001) to 8.2. The rate peaked at 11.7 in 2009 and remained relatively high and stable in 2010–2014 (9.6–10.2).

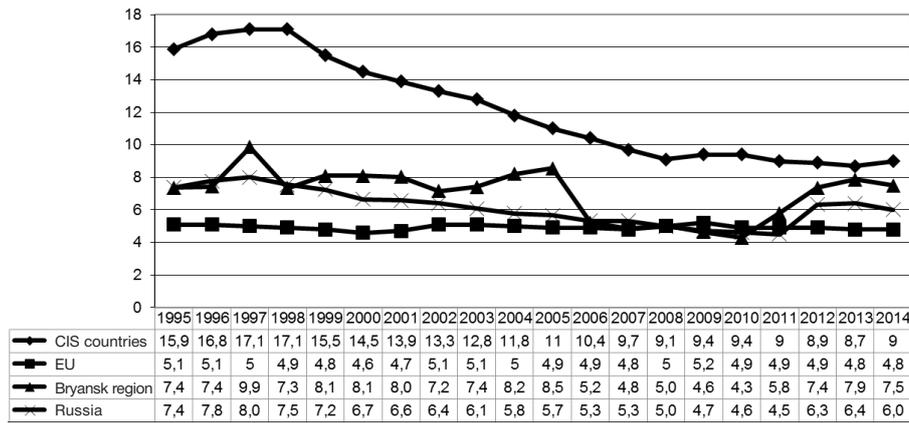


Fig. 4. Stillbirth rate, dynamics, boys and girls combined, Bryansk region, Russian Federation, EU and CIS countries, 1995 to 2015 (per 1,000 births, ‰)

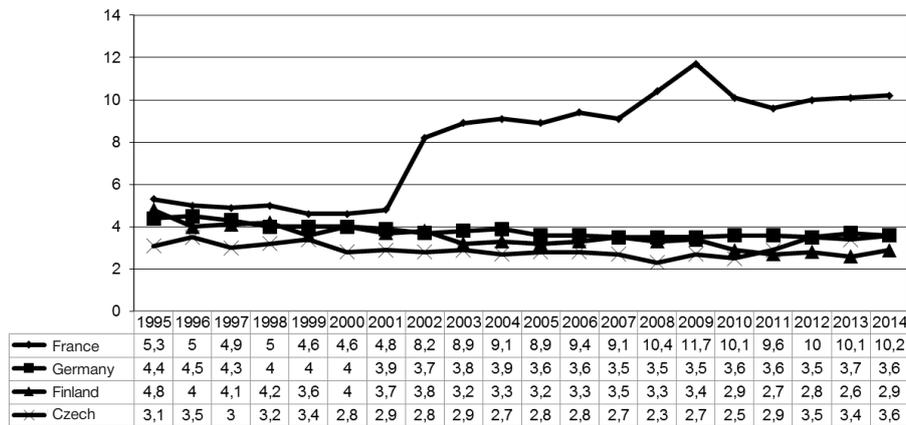


Fig. 5. Stillbirth rate in France, Germany, Finland and the Czech Republic, boys and girls combined, 1995 to 2014 (per 1,000 births, ‰)

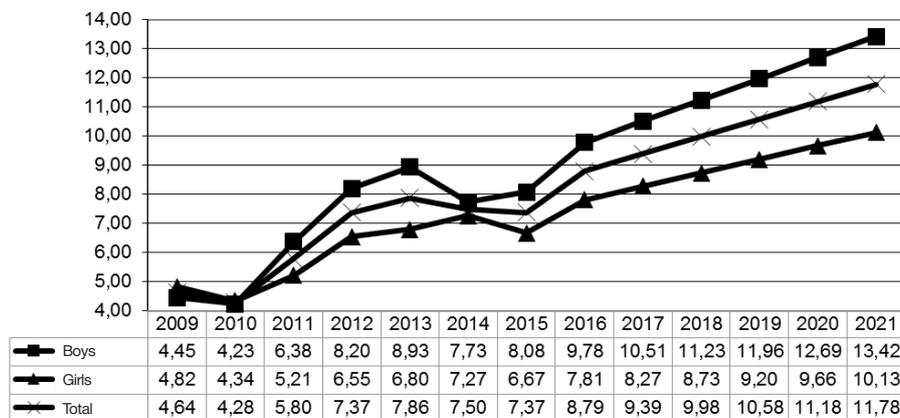


Fig. 6. Stillbirth rate, dynamics, boys and girls, Bryansk region, 2009–2015 and 2016–2021 linear forecast (per 1,000 births, ‰)

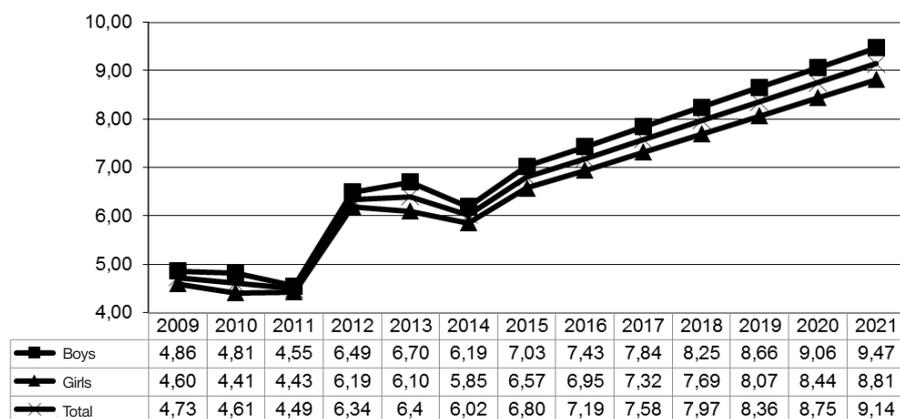


Fig. 7. Stillbirth rate, dynamics, boys and girls, Russian Federation, 2009–2014 and 2016–2021 linear forecast (per 1,000 births, ‰)

We applied the following method to forecast the stillbirth rate for 2017–2021: a) calculated the linear regression $y = ax + b$ based on the data covering 1986 to 2016, with y being the stillbirth rate, x — year (short format, e.g., 9 or 16); b) found y in this formula for $x = 17, \dots, 21$. The results filled the table and allowed plotting a graph.

Bryansk region, boys: $y = 0.730x - 1.901$.

Bryansk region, girls: $y = 0.464x + 0.379$.

Bryansk region, boys and girls combined: $y = 0.597x - 0.761$.

Russian Federation, boys: $y = 0.407x + 0.915$.

Russian Federation, girls: $y = 0.374x + 0.966$.

Russian Federation, boys and girls combined: $y = 0.391x + 0.940$.

According to our calculations, if the current trend persists the stillbirth rate in Bryansk region will continue to grow, and the gap between stillborn boys and girls will reach 32.6% by 2021 (Fig. 6 and 7).

The forecast has the gap between stillbirth rate in Bryansk region and the Russian Federation on the whole reaching 28.8% by 2021.

DISCUSSION

Evaluating the data above, it should first of all be noted that the male stillbirth rate calculated for the 20-year period (1995–2014) is greater than the female rate by 14.2% in Bryansk region and 9.0% in the Russian Federation. The results are consistent with the global trends, which have the risk for boys approximately 10% higher than for girls [4].

In 2015 Bryansk occupied the 16 position in the Central Federal District's living standards rating (18 regions all in all) and 52 in the same national rating (85 regions all in all), and its population's health puts the region on the 67 place in the appropriate rating of the Russian regions [13]; the data we received are consistent with the ratings: through the 20 years considered (1995–2014), Bryansk region has the stillbirth rates 16.5% (boys) and 11.2% (girls) greater than the national average.

The stillbirth rates calculated for the EU and CIS countries (1995–2014) align with the WHO report that puts 98% of stillbirths to countries with low-to-medium living standards (levels of income) [1], and the average stillbirth rate in the CIS countries is 2.5 times higher than that in the EU countries ($p < 0.001$).

Overall, EU countries have shown a stable stillbirth rate throughout the 20 years considered (1995–2014): it never exceeded 10.9% (4.6–5.1); in the CIS countries and, the rate was surging and dropping, fluctuations equaling 92.1% (8.9–17.1) and 122.0% (4.2–9.1).

In France, Latvia and Bulgaria, all of which are EU countries, stillbirth rate is higher than in the Russian Federation, although Russia ranks 58 in the worldwide living standards rating (out of

142 countries) while France, Latvia and Bulgaria rank 22, 40 and 51, which is closer to the top of the list [16].

Unexpectedly, France had a stillbirth rate surge in 2002, when it increased 1.7 times from 4.6–5.3 deaths per 1,000 births (average European values in 1995–2001) to 8.2 stillbirths, then peaked in 2009 at 11.7 and remained relatively high and stable in 2010–2014 (9.6–10.2). A number of factors, including migration, could have affected the data, which translates into the need for further research.

It should be noted that the Republic of Belarus has the lowest stillbirth rate among the CIS countries, 4.90; it is 25.9% lower than the Russian Federation's rate and almost the same as in the EU (4.93).

Since about a quarter of stillbirths remain unexplained [4], and one of the major factors contributing to the growth of the stillbirth rate is FCA, it would be interesting to compare stillbirth rates peculiar to Bryansk region and other regions of Russia, Ukraine and Belarus that suffered the consequences of the Chernobyl meltdown while taking into account the degree of radioactive contamination of the areas (long-lived radionuclides), as well as chemical pollution of the environment resulting from operation of factories, plants, vehicles.

Our 2016–2021 forecast, which projects the stillbirth rate for Bryansk region in particular and the Russian Federation in general, has revealed alarming trends and should not only be analyzed by the scientific community but taken as a decision-making factor by the healthcare authorities of the region: if the situation develops as it does, the stillbirth rate in Bryansk region will reach 28.8% by 2021, which is considerably greater than the national average, and the gap between male and female stillbirth rates will be 32.6%.

CONCLUSIONS

Over the 20-year period (1995–2014), male stillbirth rate in both Bryansk region and the Russian Federation exceeds female stillbirth rate by 14.2% (Bryansk) and 9.0% (Russia), which is consistent with the world statistics that have the stillbirth risk about 10% higher for boys. In Bryansk region, the rates for boys and girls are higher than the national average by 16.5% and 11.2%, respectively. CIS countries have the stillbirth rate 2.5 times higher than the EU countries; in Russia, the rate is 1.3 times higher than in the EU countries ($p < 0.001$).

The highest stillbirth rate among CIS countries is registered in Armenia (15.7), the lowest in Belarus (4.9); as for the EU, the highest stillbirth rate was registered in France (8.0), the lowest — in the Czech Republic (3.0).

Provided the dynamics remain the same, 2016 to 2021 the share of stillbirths in the Bryansk region will continue to grow and reach 28.8% by 2021, and the gender gap will grow to 32.6% (male stillbirths more common than female) by 2021.

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