

Research article

SUICIDES DURING THE COVID-19 PANDEMIC: COMPARING FREQUENCIES IN THREE POPULATION GROUPS, 9.2 MILLION PEOPLE OVERALL

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There are observations that right after total quarantine measures were introduced, there was no growth in number of suicides, but a situation remains unclear when it comes down to new waves in the pandemic development.

Our research goal was to estimate risks of suicide in heterogeneous population groups in 2020, that is, from the pandemic start and up to the second wave rise.

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We analyzed data on completed suicides in Saint Petersburg, Udmurtia Republic (Russia), and Odessa region (Ukraine), 6375 cases overall among population groups with total number of people being equal to 9,216 thousand starting from January 01, 2016 to December 31, 2020. Confidence intervals for frequencies as per months (per 100,000 people) in 2020 were calculated as per Wilson and compared with average ones calculated for 2016–2019.

There was a decrease in frequency of completed suicides in all three population groups during a period when the strictest quarantine measures were valid; by the mid-summer the trend normalized or there was even a slight increase. When the second pandemic wave came, changes were multidirectional; in particular, in Saint Petersburg there was another decrease by the end of the year, the most apparent and statistically significant among men whereas there were short-term rises in Udmurtia and Odessa.

Our comparison performed for population groups with initially different levels of suicides confirms that right after a crisis starts, suicidal behavior becomes less frequent among people; however, as a response to the second pandemic wave, we can expect both falls and rises in number of suicides and it requires more intense preventive activities.

Key words: *suicides, suicidal behavior, pandemic, large population groups, males and females, frequency estimate, confidence intervals calculation, different stages in an epidemic process.*

On March 11, 2020 the WHO Director-General declared that an outbreak of a new coronavirus infection (caused by 2019-nCoV more widely known as COVID-19) was “an international emergency in public healthcare”, that is, a pandemic [1]; more than a year has passed since then. Over this period 128 million people have caught this infection worldwide and 2.79 million out of them have died (as per data on April 01, 2021) [2]. Over the same year, according to the WHO estimates, approximately 0.8 million people have committed suicide [3]. At the same time many suicidologists in different countries are of the same opinion that the figure is rather underestimated, by 30 percent or even more (here opinions are different); therefore, this number is likely to be close to one million [4–6]. In Russian experts in demography believe that in some regions even higher per cent of unaccounted suicides may be among death cases accounted as “self-mutilations with uncertain intentions” or among causes that are stated inaccurately [7, 8]. Moreover, according to the WHO estimates, approximately 10 times more people have tried to commit suicide over the last year and it means 10 or more million potential suicides worldwide [3]. All this indicates that suicide is a complicated issue that is wider and more significant than it is usually seen by public (and even by professionals) if we rely solely on mortality figures.

Issues related to suicides have acquired some new aspects during the pandemic that has aggravated multiple economic and political problems as well as problems in public

healthcare all over the world. This pandemic has certain peculiarities but the most outstanding ones are not ultrahigh mortality (approximately 2.81 % worldwide and it is much lower than in case of some other infections) and even not significantly high incidence but extremely intensive media and information campaigns that accompany the epidemic process and everything related to it including measures aimed at fighting the disease. Global nature of the disease, information about it being easily available and obtrusive, everyday reports on a number of people who have caught it or died from it, reports on insufficient capabilities of public healthcare systems, and extreme measures taken by governments, stories on TV showing patients in reanimations being in grave condition have become a part of our everyday life. All this combined with rather strict limitations introduced in most countries was justly considered to be a serious threat to mental health of wide population groups and also a potential danger that a number of suicides would grow [9–11].

Indeed, studies performed instantly in many countries (basically, they were online polls) indicated that stress, anxiety, and depression tended to be high among public at large as well as among medical personnel, students, and some other categories, in particular among people who already had mental issues directly during strict isolation [12–14]. There was no unified methodology developed for such studies, and prevalence figures differed significantly (from 10–15 % to 45–50 %) depending on a country, context, a methodology

for involving respondents, etc. even despite standardized questioning instruments were applied [12–14]. More objective longitude studies that allowed tracing dynamics prior to and during pandemic waves on the same continent revealed that actual depression levels changed only slightly whereas anxiety among population indeed grew by almost two times (from 13 % to 24 %) especially among women, young people, and people with low socioeconomic status [15].

At the same time, analysis of the existing situation in 21 counties revealed that a number of suicides either didn't grow during the strictest quarantine (April–May 2020) and the 1st wave (up to September 2020) or even went down in a significant number of cases [16]. Our observations also showed that there was a short-time decrease in suicidal behavior in urban population directly after an external global stressor as an existential threat was “introduced” [17]. It can be considered an effect of a society uniting in the face of danger and a subsequent activation of adaptive (vital) trends versus non-adaptive (anti-vital) ones [16, 17].

However, it is not the reason for complacency; moreover, as the pandemic has been developing in several waves, there are changes in lifestyle and stress levels people have to face, there is growth not only in anxiety or depression, but also aggression (it can be seen in countries where long-term and strict quarantine was introduced and it led to protests and demonstrations). Given that, concerns regarding growth in suicides are becoming more intense and more and more people are included into risk groups. On one hand, it is the overall population that faces problems and frustration due to changes in lifestyle, ruined plans, family complications, children's distant studies etc. On the other hand, there are people who have had the infection; this number is growing all the time, and this group causes the greatest alarm. Many recovered patients may still have chronic consequences such as neurologic, psychiatric, and psychological disorders in-

cluding PTSD, depression, sleeping disorders, lower working capacities, and psychosomatic symptoms caused by a stress they survived, or by biological factors, for example, chronic inflammation in nerve tissues [18, 19]. All these consequences may enhance suicidal risks. Patients who already have mental disorders are another additional risk group since this situation involves not only aggravating symptoms for them but also impossibility to get all the necessary help. Observations indicate that a number of applications for aid to psychiatric clinics dropped directly after the pandemic started; it may be due to people believing their mental issues “are no longer important now”, and it is also an alarming signal that a considerable number of patients are left alone with their issues and these issues are only accumulating and aggravating [20].

All this requires more attention to be paid to suicidal behavior among population, and it is necessary to assess risks basing on profound and wide-scale analysis of mortality, taking into account morbidity dynamics and limitations. These considerations gave grounds for the present research where we have tried to cover as wide heterogeneous population groups as it was only possible since it is easier to detect nonrandom trends when “big data” are analyzed; or, at least, it is possible to assess whether all concerns that are being discussed in expert society are real or not.

Data and methods. We were provided with data on a number of completed suicides for the following population groups: Saint Petersburg (the Russian Federation), overall population amounted to 5,368 thousand people on January 01, 2021; Udmurtia Republic (the Russian Federation), overall population amounted to 1,493 thousand people; and Odessa region (Ukraine) overall population mounted to 2,355 thousand people; the overall sampling was equal to 9,216 thousand people. Geographically these three regions are three vertexes of a equilateral triangle since Odessa and Saint Petersburg are located practically on the same meridian (30° east

longitude) but the latter lies much farther to the north, and Izhevsk, the center of Udmurtia, is located much farther to the east and lies somewhere in between Odessa and Saint Petersburg as per latitude. Population density in Saint Petersburg amounted to 3,730 people per 1 square km taking into account geographical boundaries of the city; Odessa region, 71 people per 1 square km; Udmurtia, 35 people per 1 square km. As for national structure, Russians prevailed overwhelmingly in Saint Petersburg (92.5 %), Ukrainians took the second place (1.5 %) some other nationalities accounted for shares not exceeding 1 %. In Udmurtia Russians accounted for 62.2 %; Udmurts, 28.0 %; Tatars, 6.7 %; the other nationalities, less than 1 %. According to the latest available data, Ukrainians prevailed in Odessa region (62.8 %), followed by Russians (20.7 %), Bulgarians (10.1 %), Moldavians, (5 %), Gagauz, (1.1 %), all the other nationalities accounted for less than 1 %. Climate was moderately continental in Saint Petersburg and partially moderately marine. In Odessa region climate was humid and moderately continental combined with warm marine; Udmurtia is located in a zone with intra-continental climate with typically hot summers and cold winters with a lot of snow.

Criminal data on suicides given as “a date of death, sex, age, and suicidal style” were provided by the Saint Petersburg City Office for Forensic Medical Examination and Odessa Regional Office for Forensic Medical Examination; data on Udmurtia Republic were provided by the administration of the Republican Clinical Psychiatric Hospital, Udmurtia Public Healthcare Ministry. Data on population number were taken from official sources (Rosstat, The Central Statistic Office in Odessa Region). Initial data on completed suicides as per years are given for a period 1995–2020 for Udmurtia; 2001–2020, for Odessa region; 2016–2020, for Saint Petersburg. Criminal data (as per months and with a date of death) were obtained for all three population groups for a period of time from January 01, 2016 to December 31, 2020.

Frequencies were calculated per 100,000 people a year or a month, depending on goals that were to be achieved via comparative analysis; Wilson score method was applied to calculate confidence intervals for relative frequencies [21]. Changes that occurred during the pandemic were analyzed with a simplified procedure called “excess mortality” that involves comparing frequency in the index year to average frequencies over 4 previous years [22]. Effects produced by the pandemic were given on graphs as a difference between monthly frequencies obtained via averaging data collected over 2016–2019 and monthly frequencies in 2020. Confidence intervals for differences in frequencies were also calculated as per Wilson score method. Significant differences were those for which a confidence interval for a difference in frequencies didn’t cross a reference line for 2016–2019. Over the examined period, 2,316 suicides were registered in databases in Udmurtia; 2,282 suicides, in Odessa region; 1,777 suicides, in Saint Petersburg; 6,375 suicides overall. Men/women ratio for three population groups over the examined period amounted to 5.00 in Udmurtia; 4.50, in Odessa region; 2.87, in Saint Petersburg. Data on dynamics of morbidity with COVID-19 were taken from the sources [23, 24].

Results and discussion. At a preliminary stage in our research we traced changes in relative frequencies of suicides a year over the last 10 years (from 2011 to 2020) in Udmurtia and Odessa region, as well as over the last 5 years (from 2016 to 2020) in Saint Petersburg (Figure 1). The graphs show that, in spite of apparent differences in absolute values, there was a descending trend in a number of suicides in all three examined population groups. In Udmurtia it went down from 47.1 in 2011 to 28.4 in 2020; in Odessa region, from 25.9 to 18.3 accordingly; in Saint Petersburg, from 7.2 to 6.1 over the last 5 years. And it is interesting to note that curves showing data on Udmurtia and Odessa region are very much alike, the correlation is equal to 0.963 at $p = 0.00001$ (Spearman’s rank

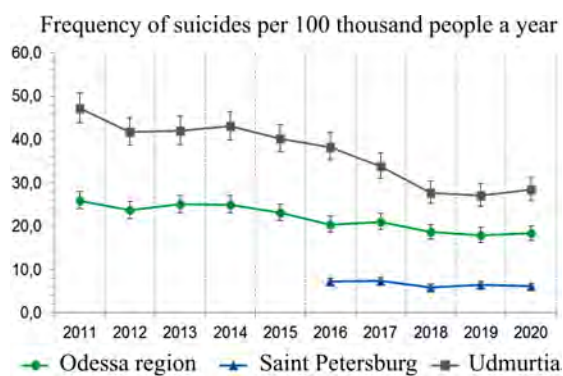


Figure 1. Average annual number of suicides in the examined population groups taken in dynamics over a period of time from 2011 to 2020

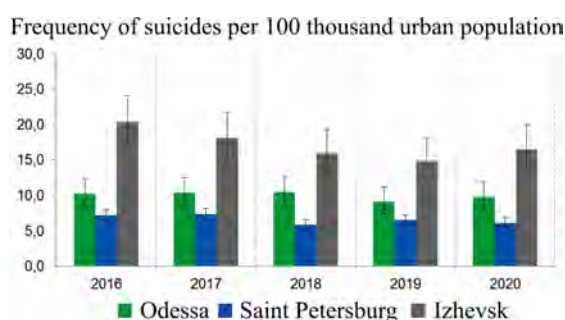


Figure 2. Average annual number of suicides among urban population in three examined cities from 2016 to 2020

correlation coefficient). At the same time, there was a small rise in the trend for these two groups in 2020 and there were no such changes in Saint Petersburg.

Since it seems advisable to make any comparison between urban population groups only, these parameters were calculated separately for Izhevsk, Odessa, and Saint Petersburg within comparable time periods (Figure 2). As we can see, from 2016 to 2020 frequencies were the lowest in Saint Petersburg (7.2–5.9 per 100,000 people a year); they were approximately 1.5 times higher in Odessa and 2.5 times higher in Udmurtia. Differences in frequencies between all three cities were statistically significant in each year.

Figures 3–5 show differences in relative monthly frequencies in 2020 and average monthly ones in 2016–2019 together with confidence intervals for these differences. In Saint Petersburg there was a decrease in frequency of suicides against its average value just after strict

quarantine was introduced (March – April); it was especially apparent in April (by 24.4 % from 0.6376, *CI* 95 % 0.5391–0.7542 to 0.4821, *CI* 95 % 0.3290–0.7064). Then there was a rise in June (by 13.5 %) and then in July – September frequencies remained lower than average (by 21.6 % in September). After a rise in October frequencies went on declining reaching their minimum in December (fall by 37.7 %, from 0.5954, *CI* 95 % 0.5005–0.7084 to 0.3708, *CI* 95 % 0.2401–0.5758).

Figure 3 shows that there was a fall in frequency of suicides in Saint Petersburg both among men and women after the pandemic had been declared; then there were slight rises in May (men) and in June (women). However, certain differences occurred in October–December: values fluctuated near the reference line for women but there was a significant drop in the trend for men after a rise in October, by 45.1 % in November and by 44.1 % in December, and in the latter case it can be considered to be significant (fall from 1.0260 to 0.5731, the difference is -0.4529 (*CI* 95 % $-0.7745-0.0230$)).

Suicidal activity among population in Udmurtia and Odessa region was quite similar to that in Saint Petersburg during the 1st pandemic wave but there were still certain differences (Figures 4 and 5). Thus, frequencies for the total population were lower than usual in the 1st half of the year; the greatest decrease was detected in Udmurtia in May, by 27.8 % (from 3.0432, *CI* 95 % 2.6341–3.5158 to 2.1968; *CI* 95 % 1.5656–3.0875) and in Odessa region also in May, by 22.2 %. There was a slight rise in Udmurtia in June and July (by 12.2 % maximum) whereas in Odessa region the trend just returned to average values detected in previous years. Then the trend went down again in autumn in Udmurtia (the greatest decrease was in September, by 19.9 %) and in Odessa region in August (by 19.2 %). In Udmurtia the second peak occurred in December (the trend rose by 29.1 %) and in Odessa it was in October (by 28.3 %). Therefore, at the end of the year the situation in Odessa region was similar to that in Saint

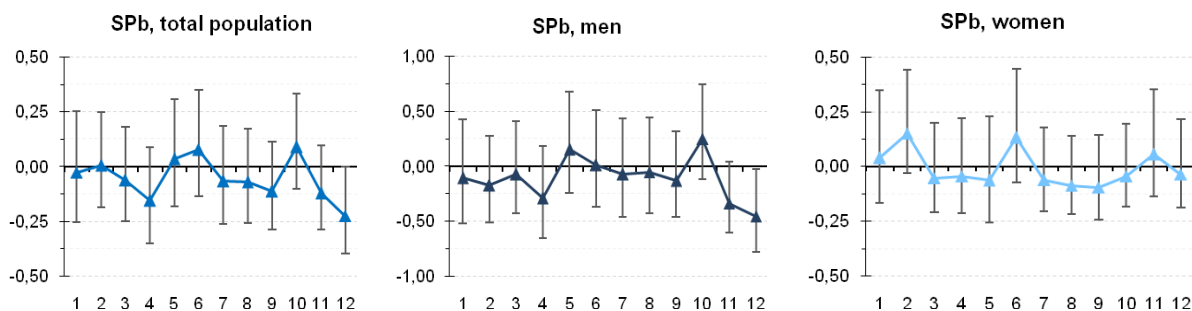


Figure 3. Deviations in frequencies of monthly suicides in Saint Petersburg (total population, men, women) in 2020 from average values over 2016–2019 and their confidence intervals

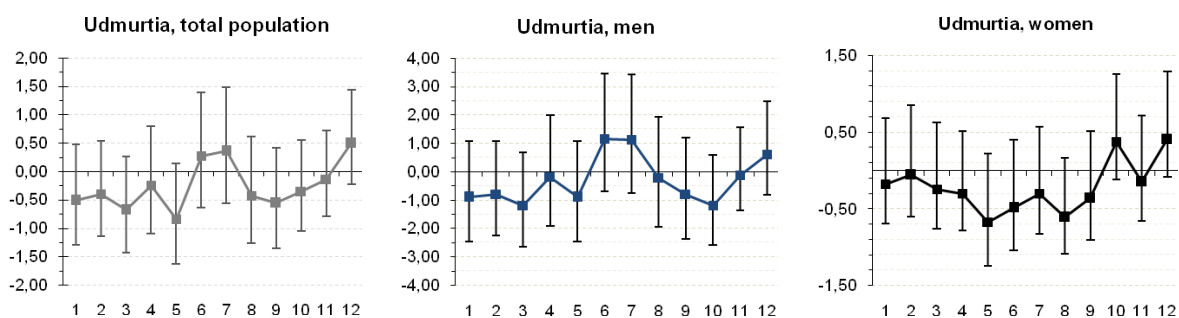


Figure 4. Deviations in frequencies of monthly suicides Udmurtia (total population, men, women) in 2020 from average values over 2016–2019 and their confidence intervals

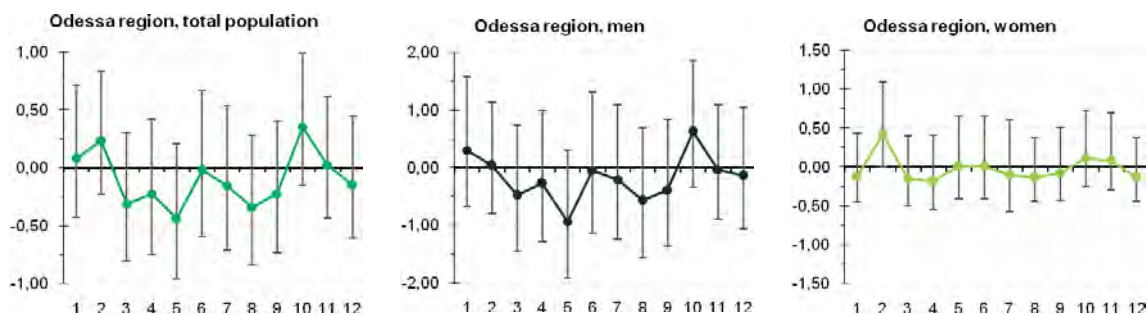


Figure 5. Deviations in frequencies of monthly suicides in Odessa region (total population, men, women) in 2020 from average values over 2016–2019 and their confidence intervals

Petersburg whereas it was rather different in Udmurtia since the peak was delayed and there was no decrease at the end of the year (Figures 4 and 5).

Curves that show changes in frequencies of suicides are similar to those showing these changes for men in all three population groups; it is due to suicides among men pre-

vailng significantly over suicides among women if we consider absolute values. In other words, any changes in the trends occur predominantly due to suicides among men and women make a much smaller quantitative contribution. And curves showing frequencies of suicides among women are rather peculiar and apparently tend to fluctuate less¹. However, if

¹ Graphs in Figures 3–5 are given with different axis scales for men and women to make them easier for perception.

Maximum fluctuation range for changes in frequencies of suicides among men and women in the examined population groups (in %)

Region	Men			Women		
	minimum	maximum	range	minimum	maximum	range
Saint Petersburg	-45.1	+35.6	80.7	-39.2	+79.7	118.9
Odessa region	-26.9	+28.4	55.3	-30.1	+111.5	141.6
Udmurtia	-27.4	+22.8	50.2	-62.2	+101.5	163.7

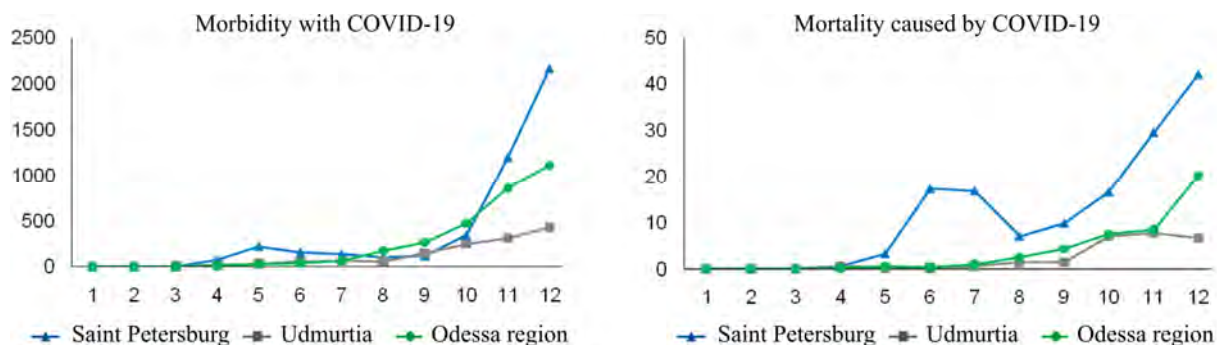


Figure 6. Morbidity and mortality caused by COVID-19 among the examined population groups per 100,000 people a month in 2020

we estimate maximum and minimum deviations in parameters in 2020 from averaged values in 2016–2019 in per cent, we can see that fluctuation range is more apparent for women (1.5–3 times). It occurs in all three population groups with certain differences between them; the higher is suicide-related mortality as a whole, the smaller is fluctuation range for men and the greater for women (Table 1). We should also note that rises in frequencies among women were much greater than falls whereas these changes in the trends were quite similar among men.

If we consider COVID-19-related incidence and mortality in all three regions (Figure 6), we can see that the curves had more apparent 1st wave in Saint Petersburg and parameters per 100,000 people as a whole were much higher there. The situation in Udmurtia could be considered the most favorable. Odessa region was somewhere in between in this respect.

Our basic research result is that frequency of suicides didn't grow in either of three examined groups during the first months after the pandemic had started, that is, when strict quarantine was introduced. Such a growth had been predicted quite often; instead, we detected that

there was a descending trend in the parameter. After that, in summer when incidence started to fall and the situation seemed to be stabilizing, there was a slight rise or return from the expected level. These changes were quite similar in all three groups. Then, at the end of 2020, that is, when the 2nd pandemic wave was developing and it was much more apparent than the 1st one, the trends fluctuated in different directions. Thus, in Saint Petersburg and Odessa region (where incidence was high) there was a decrease in December whereas in Udmurtia where incidence was lower, there was a rise. We should note that fluctuations in frequencies calculated for the whole population were within 30–40 % and didn't reach statistical validity.

The same drop in suicidal activity among population was detected during the 1st pandemic wave in some other countries and regions, in particular, in New South Wales (Australia); Alberta and British Columbia (Canada); Chile; Leipzig (Germany); Japan; New Zealand; South Korea; California, Massachusetts, Illinois, and Texas (the USA); and Ecuador. This drop varied from 6 to 50 % and it was not statistically confirmed for some spe-

cific territories, but still it was proven to be statistically authentic when pooled estimates were performed for all population groups and time series analysis was applied [16]. Falls in Norway, Peru, Austria (Tirol) and Japan were reported separately [25–28]. We should also note that as it was stated in the work [16] the fall occurred only in 12 out of 21 examined population groups, there were no marked changes in some countries and cities, and there was even a slight rise (by 10–20 %) in some European regions (Carinthia in Austria and Cologne administrative district in Germany), as well as in Brazil (Botucatu), New-Jersey, and Puerto-Rico [16].

We should point out that the research we have already cited and which is the most comprehensive one on the subject at the moment focuses on analyzing the situation only over a rather short period of time, starting from the moment when the first world lockdown was introduced, that is, March 2020, and to June 2020 [16]. We should also mention a short study in Russia that was based on data collected in 5 RF regions (Krasnodar region, Transbaikalia, Bashkortostan, Udmurtia, and Belgorod region); the authors compared a number of suicides in April 2019 and April 2020 and there was a drop in it everywhere [29]. At the same time, in Japan there was a fall by 14 % during the first 6 months in 2020; but the number grew by 16 % already in October during the 2nd pandemic wave, and this growth was higher among women (by 37 %) and teenagers (by 49 %) [30, 31]. Our observations cover a longer period of time since we took data for the whole 2020; they indicate that changes could take different directions during the 2nd pandemic wave. In particular, rises in the trend in Saint Petersburg and Odessa region occurred simultaneously with the beginning of the 2nd pandemic wave and then there was a fall; in Udmurtia a rise in number of suicides occurred later than a growth in incidence.

Therefore, our research revealed rather similar trends in three populations that were hardly interrelated. These trends are close to those revealed in wider-scale studies and it confirms their basic conclusions regarding a drop in a number of suicides during the 1st pandemic wave and simultaneously allows noticing how people responded to the 2nd pandemic wave. We should note that previously we described the situation in Odessa and the region in greater detail covering long periods of time and it turned out to be quite typical (more suicides among rural population than among urban one, and suicides among men were 4–5 times more frequent than among women) [32–34]. Suicides in Udmurtia were also considered; frequencies tended to be higher in this region than on average in Russia, especially in rural areas where native Udmurt people accounted for the greatest share of population, and also among women living in urban areas [35–37]. Suicides in Saint Petersburg have not been analyzed recently within any statistic studies when it comes to population as a whole; there was only a profound analysis regarding suicides among young people².

So, we have revealed similar trends, especially during the 1st month after the pandemic was officially declared, in a highly urbanized megacity in the north-western region in the country; in the southern region that was historically close to Saint Petersburg (Black Sea steppes were actively populated after Ismail fortress was taken, and Odessa as a city was founded as a part of imperial projects developed by Ekaterina II at the end of the 18th century); as well as in an eastern region that was historically more traditional with its history being closely connected with the Kazan Khanate and its developing having started as far back as in the 16th century. These revealed trends indicate that there are the same factors that influence heterogeneous population in case of a pandemic. These factors are

² Shamkova S.V. Social parameters of suicides among young people in Saint Petersburg: Abstract of the thesis ... for the Candidate of Social sciences degree. – Saint Petersburg, 2006. – 24 p.

most likely related to a sense of a danger and a crisis and they tend to produce unified effects despite all cultural, national and economic differences, different degree of urbanization, population density, geographic and climatic conditions. And there is a certain relation with pandemic waves since their occurrence results in changes in suicidal activity by population, basically, short-term drops in the beginning with subsequent return to expected values or a rise depending on a region. As for a degree of urbanization, a recent study performed in Japan has revealed that suicidal thoughts that occurred during the pandemic (August–September, 2020, an online poll) were to a greater extent associated with it as well as with low quality of living conditions than with incidence in a given region [38]. Our data contradict this conclusions and it may be due to different approaches to assessing quality of living conditions and Japan cultural peculiarities.

Some studies performed in other countries and regions also indicate there are similar trends in changes of population's suicidal behavior at early stages in the pandemic. Thus, in the USA in 2020 number of suicides fell by 5.6 % simultaneously with an overall rise in mortality by 17.7 % [39]. And there was a drop not only in a number of completed suicides but also suicide attempts and other self-mutilations. Thus, experts analyzed data on applications to emergency departments in 23 hospitals in 10 countries (Great Britain, Scotland, Ireland, Italy, Hungary, Serbia, Turkey, Oman, and the UAE) covering 31.2 million people and approximately 200 thousand application per year; the analysis revealed that there was a 33 % drop in a number of applications by children and teenagers caused by any self-mutilations and mental disorders during the strict lockdown (March–April 2020) [40]. However, an increase was detected in a number of grave self-mutilations (when a potentially lethal suicidal style was chosen or there were medical outcomes that required staying in a hospital for not less than 72 hours) [40].

It is interesting to compare intensity of fluctuations in suicidal behavior by men and women, especially taking into account degree of urbanization and national and cultural differences between population groups. In our research, we revealed a single statistically significant event and it was a 45 % drop in frequency of suicides among men in Saint Petersburg against the 2nd pandemic wave. At the same time, fluctuations were much more intense among women, both rising and falling ones, and reached 100 % but remained statistically insignificant. Many authors mention higher quantities of mental disorders among women during the pandemic [12–15], and also note that the greatest rise in frequency of suicides occurred exactly among women after a slight fall in it during the first months of it [17, 30]. Women are traditionally considered to be home-keepers, both in our culture and in many others, and it is a factor that prevents them from committing suicide [41]; nevertheless, more profound research is required if we want to clarify to what extent this factor preserves its influence under such uncommon circumstances as a pandemic.

This pandemic, being a true world crisis, has created a unique situation that allows assessing not only dynamics of incidence and efficiency of vaccination but also psychological state and suicidal behavior among broad masses of population given this global external threat. All these parameters as well as related risks should be assessed taking into account limitations, mortality caused by the infection, as well as activities aimed at compensating for a fall in economy and growth in unemployment. It seems vital to get a better insight into trends in suicidal behavior in different countries, among different population groups with variable ethnic structure, with geographic and other peculiarities, both for monitoring and for working out relevant guidelines on how to prevent suicides during such global crises. It is still too early to make any conclusions on a relation between suicidal behavior and pandemic ways basing solely on the results obtained via the present

study; more targeted research is required that involves using analysis of dynamic series and it also attracts our attention. Although there are no clear perceptions of these relations, we still believe that it is advisable to rely on available guidelines that have been published recently [42–44] and focus on how to adapt prevention activities during the pandemic. In our opinion, the most relevant ones are educational activities that are aimed at raising awareness about suicide-related issues among people and medical personnel responsible for rendering first aid to population as well as organizational activities that help improve communications within a system for medical aid provision; achieve more qualita-

tive accounting of completed suicides and non-fatal self-mutilations; and implement more efficient procedures for providing psychosocial help to people who have tried to commit suicide.

Limitations. The present study is based on an approach that doesn't allow assessing influence exerted by a prevailing trend or seasonal fluctuations; it was performed on only three population groups that were relatively weakly interrelated.

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References

1. Listings of WHO's response to COVID-19. *World health organization*, 2020. Available at: <https://www.who.int/ru/news/item/29-06-2020-covid-timeline> (28.03.2021).
2. Weekly Operational Update on COVID-19. *World health organization*, 2021. Available at: <https://www.who.int/publications/m/item/weekly-operational-update-on-covid-19---29-march-2021> (28.03.2021).
3. Health issues. Suicide. *World health organization*. Available at: <https://www.who.int/topics/suicide/eng/> (04.03.2021).
4. Sainsbury P., Jenkins J.S. The accuracy of officially reported suicide statistics for purposes of epidemiological research. *J. Epidemiol. Commun. Health*, 1982, vol. 36, no. 1, pp. 43–48. DOI: 10.1136/jech.36.1.43
5. Rockett I.R. Counting suicides and making suicide count as a public health problem. *Crisis*, 2010, vol. 31, no. 5, pp. 227–230. DOI: 10.1027/0227-5910/a000071
6. Katz C., Bolton J., Sareen J. The prevalence rates of suicide are likely underestimated worldwide: why it matters. *Soc. Psychiatry Psychiatr. Epidemiol*, 2016, vol. 51, pp. 125–127. DOI: 10.1007/s00127-015-1158-3
7. Ivanova A.E., Sabgaida T.P., Semenova V.G., Zaporozhchenko V.G., Zemlyanova E.V., Nikitina S.Yu. Factors distorting death causes structure in working population in Russia. *Sotsial'nye aspekty zdorov'ya naseleniya*, 2013, vol. 32, no. 4, pp. 1–2 (in Russian).
8. Semenova V.G., Ivanova A.E., Sabgaida T.P., Evdokushkina G.N. Smertnost' trudosposobnogo naseleniya Rossii ot suitsidov: ofitsial'nye i real'nye urovni [Mortality among employable population in Russia due to suicides: official data and actual figures]. *II Vserossiiskii demograficheskii forum s mezhdunarodnym uchastiem: materialy foruma*, Moscow, 2020, pp. 70–73 (in Russian).
9. Röhr S., Müller F., Jung F., Apfelbacher C., Seidler A., Riedel-Heller S.G. Psychosoziale Folgen von Quarantänemaßnahmen bei schwerwiegenden Coronavirus-Ausbrüchen: ein Rapid Review. *Psychiatr Prax*, 2020, vol. 47, no. 4, pp. 179–189. DOI: 10.1055/a-1159-5562
10. Brown S., Schuman D.L. Suicide in the time of COVID-19: A perfect storm. *J. Rural Health*, 2021, vol. 37, no. 1, pp. 211–214. DOI: 10.1111/jrh.12458
11. Wasserman D., Iosue M., Wuestefeld A., Carli V. Adaptation of evidence-based suicide prevention strategies during and after the COVID-19 pandemic. *World Psychiatry*, 2020, vol. 19, pp. 294–306. DOI: 10.1002/wps.20801
12. Xiong J., Lipsitz O., Nasric F., Lui L., Gill H., Phan L., Chen-Li D., Iacobucci M. [et al.]. Impact of COVID-19 pandemic on mental health in the general population: A systematic review. *J. Affect. Disord.*, 2020, vol. 277, pp. 55–64. DOI: 10.1016/j.jad.2020.08.001

13. Salari N., Hosseinian-Far A., Jalali R., Vaisi-Raygani A., Rasoulpoor S., Mohammadi M., Rasoulpoor S., Khaledi-Paveh B. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Globalization and Health*, 2020, vol. 16, pp. 57. DOI: 10.1186/s12992-020-00589-w
14. Vindegaard N., Benros M.T. COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain, Behavior, and Immunity*, 2020, vol. 89, pp. 531–542. DOI: 10.1016/j.bbi.2020.05.048
15. Kwong A., Pearson R., Adams M., Northstone K., Tilling K., Smith D., Timpson N. Mental health before and during the COVID-19 pandemic in two longitudinal UK population cohorts. *Br. J. Psychiatry*, 2020, pp. 1–10. DOI: 10.1192/bjp.2020.242
16. Pirkis J., John A., Shin S., Del Pozo-Banos M., Arya V., Analuisa-Aguilar P., Spittal M.J. Suicide trends in the early months of the COVID-19 pandemic: an interrupted time-series analysis of preliminary data from 21 countries. *Lancet Psychiatry*, 2021, vol. 8, no. 7, pp. 579–588. DOI: 10.1016/S2215-0366(21)00091-2
17. Rozanov V.A., Semenova N.V., Vuks A.Ya., Freize V.V., Isakov V.D., Yagmurov O.D., Neznanov N.G. Suicides in the COVID-19 pandemic – are we well informed regarding current risks and future prospects? *Consortium Psychiatricum*, 2021, vol. 2, no. 1, pp. 32–39. DOI: 10.17816/CP56
18. Cabrera M.A., Karamsetty L., Simpson S.A. Coronavirus and Its Implications for Psychiatry: A Rapid Review of the Early Literature. *Psychosomatics*, 2020, vol. 61, no. 6, pp. 607–615. DOI: 10.1016/j.psych.2020.05.018
19. Mazza M.G., De Lorenzo R., Conte C., Poletti S., Vai B., Bollettini I., Benedetti F. Anxiety and depression in COVID-19 survivors: Role of inflammatory and clinical predictors. *Brain Behav. Immun.*, 2020, vol. 89, pp. 594–600. DOI: 10.1016/j.bbi.2020.07.037
20. Neelam K., Duddu V., Anyim N., Neelam J., Lewis S. Pandemics and pre-existing mental illness: A systematic review and meta-analysis. *Brain Behav. Immun. Health*, 2021, vol. 10, pp.100177. DOI: 10.1016/j.bbih.2020.100177
21. Grzhibovskii A.M. Confidence intervals for proportions. *Ekologiya cheloveka*, 2008, no. 5, pp. 57–60 (in Russian).
22. Viglione G. The true tall of the pandemic. *Nature*, 2020, vol. 585, pp. 22–24.
23. Coronavirus: dashboard. *Yandex DataLens Public*. Available at: https://datalens.yandex/7o7islq6ikh23?tab=X1&utm_source=cbscenarios&state=70a061de11642 (04.03.2021).
24. Coronavirus in Odessa Region. *Minfin*. Available at: <https://index.minfin.com.ua/reference/coronavirus/ukraine/odesskaya/> (04.03.2021).
25. Qin P., Mehlum L. National observation of death by suicide in the first 3 months under COVID-19 pandemic. *Acta Psychiatr. Scand*, 2021, vol. 143, no. 1, pp. 92–93. DOI: 10.1111/acps.13246
26. Calderon-Anyosa R.J.C., Kaufman J.S. Impact of COVID-19 lockdown policy on homicide, suicide, and motor vehicle deaths in Peru. *Preventive Medicine*, 2021, vol. 143, pp. 106331. DOI: 10.1016/j.ypmed.2020.106331
27. Deisenhammer E.A., Kemmler G. Decreased suicide numbers during the first 6 months of the COVID-19 pandemic. *Psychiatry Research*, 2021, vol. 295, pp. 113623. DOI: 10.1016/j.psychres.2020.113623
28. Ueda M., Nordström R., Matsubayashi T. Suicide and mental health during the COVID-19 pandemic in Japan. *medRxiv*, 2020, pp. 21. DOI: 10.1101/2020.10.06.20207530
29. Kekelidze Z.I., Polozhii B.S., Boiko E.O., Vasil'ev V.V., Evtushenko E.M., Kamen-shchikov Yu.G., Ruzhenkov V.A., Ruzhenkova V.V. [et al.]. Suitsidy v period pandemicheskoi samoizolyatsii [Suicides during pandemic self-isolation]. *Rossiiskii psikiatricheskii zhurnal*, 2020, no. 3, pp. 4–13 (in Russian).
30. Tanaka T., Okamoto S. Increase in suicide following an initial decline during the COVID-19 pandemic in Japan. *Nat. Hum. Behav*, 2021, vol. 5, no. 2, pp. 229–238. DOI: 10.1038/s41562-020-01042-z
31. Sakamoto H., Ishikane M., Ghaznavi C., Ueda P. Assessment of Suicide in Japan During the COVID-19 Pandemic vs Previous Years. *JAMA Netw. Open*, 2021, vol. 4, no. 2, pp. e2037378. DOI: 10.1001/jamanetworkopen.2020.37378

32. Zakharov S.E., Rozanov V.A. Dinamika samoubiistv i suitsidal'nykh popytok v Odesse v 2001–2008 gg. – pervye priznaki vliyaniya mirovogo krizisa? [Dynamics of suicides and suicide attempts in Odessa in 2001–2008: the first impacts exerted by the world crisis?]. *Medichna psikhologiya*, 2009, vol. 4, no. 4 (16), pp. 38–47 (in Russian).

33. Rozanov V.A., Valiev V.V., Zakharov S.E., Zhuzhulenko P.N., Krivda G.F. Children and adolescents suicide attempts and completed suicides in Odessa in 2002–2010. *Zhurnal psikhatrii i meditsinskoi psikhologii*, 2012, vol. 28, no. 1, pp. 53–61 (in Russian).

34. Zakharov V.E., Rozanov V.A., Krivda G.F., Zhuzhulenko P.N. Suicide attempts and completed suicides monitoring in Odessa in 2001–2011. *Suitsidologiya*, 2012, no. 4, pp. 3–10 (in Russian).

35. Polozhii B.S., Lazebnik A.I. Osobennosti suitsidal'nogo povedeniya sel'skogo naseleniya Udmurtii [Peculiarities of suicidal behavior typical for rural population in Udmurtia]. *Rossiiskii psikhiatricheskii zhurnal*, 2006, no. 5, pp. 17–21 (in Russian).

36. Popov A.V. Mortality from the external reasons in rural population of the Udmurtian republic. *Sotsial'nye aspekty zdorov'ya naseleniya*, 2011, vol. 6, no. 22, pp. 7 (in Russian).

37. Polozhii B.S., Vasil'ev V.V. Epidemiology of female suicide (on the data of a large industrial city). *Psikhicheskoe zdorov'e*, 2009, vol. 7, no. 9 (40), pp. 28–32 (in Russian).

38. Okubo R., Yoshioka T., Nakaya T., Hanibuchi T., Okano H., Ikezawa S., Tabuchi T. Urbanization level and neighborhood deprivation, not COVID-19 case numbers by residence area, are associated with severe psychological distress and new-onset suicidal ideation during the COVID-19 pandemic. *J. Affect. Disord*, 2021, vol. 287, pp. 89–95. DOI: 10.1016/j.jad.2021.03.028

39. Ahmad F.B., Anderson R.N. The leading causes of death in the US for 2020. *JAMA*, 2021, vol. 11, no. 325 (18), pp. 1829–1830. DOI: 10.1001/jama.2021.5469

40. Ougrin D., Wong B., Vaezinejad M., Plener P.L., Mehdi T., Romaniuk L., Landau S. Pandemic-related emergency psychiatric presentations for self-harm of children and adolescents in 10 countries (PREP-kids): a retrospective international cohort study. *Eur. Child Adolesc. Psychiatry*, 2021, no. 7, pp. 1–13. DOI: 10.1007/s00787-021-01741-6

41. Watson P. Explaining rising mortality among men in Eastern Europe. *Social Science & Medicine*, 1995, vol. 41, no. 7, pp. 923–934. DOI: 10.1016/0277-9536(94)00405-i

42. Wasserman D., Iosue M., Wuestefeld A., Carli V. Adaptation of evidence-based suicide prevention strategies during and after the COVID-19 pandemic. *World Psychiatry*, 2020, vol. 19, no. 3, pp. 294–306. DOI: 10.1002/wps.20801

43. Rozanov V.A. Current tasks in the field of suicidal prevention in connection with the COVID-19 pandemic. *Suitsidologiya*, 2020, vol. 11, no. 1, pp. 39–52 (in Russian).

44. Protocol for Responding to Global and Cross-National Public Health Emergencies and Natural Disasters. *International Association for Suicide Prevention (IASP)*, 2020, pp. 18.

Rozanov V.A., Semenova N.V., Kamenshchikov Yu.G., Vuks A.Ya., Freize V.V., Malyshko L.V., Zakharov S.E., Kamenshchikov A.Yu., Isakov V.D., Krivda G.F., Yagmurov O.D., Neznanov N.G. Suicides during the COVID-19 pandemic: comparing frequencies in three population groups, 9.2 million people overall. *Health Risk Analysis*, 2021, no. 2, pp. 131–142. DOI: 10.21668/health.risk/2021.2.13.eng

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