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THE RISK MORTALITY OF THE POPULATION OF AZERBAIJAN FROM CIRCULATORY DISEASES, DEPENDING ON THE SEASON

A. J. Rzayeva, K. F. Agayeva, E. M. Hatamzada, A. K. Mammadbayli

Azerbaijan State Advanced Training Institute for doctors named after A. Aliyev, Baku

ABSTRACT

The Objective. To obtain evidence-based data about the role of seasons of the year in the formation of the population mortality risk from the circulatory system diseases (CSD) in Azerbaijan and its regions with specific climate.

Materials of the study. A case of mortality was a unit of statistical observation.

The fatalities from all reasons, including CSD have been distributed by the days of every month in the year. Daily average amount of fatalities by months and seasons (from 20 December to 19 March – winter; from 20 March to 19 June- spring; from 20 June to 16 September; from 20 September to 19 December - autumn) have been determined.

Results. In Azerbaijan the risk of general mortality and mortality from CSD is the highest in winter, it decreases in spring but nonuniformly (the general mortality rate is less than that from CSD). That is why the share of CSD increases among mortality reasons.

Conclusions. Seasonal change of mortality risks from CSD is multivariant. Winter-spring increase of risk predominates in Azerbaijan. In some regions of Azerbaijan the mortality risk from CSD increases only once either in spring or in summer or winter.

Key words: seasonal dynamics, risk of mortality, circulatory system diseases.

Background. The influence of seasonal factors on the human body has long attracted the attention of scientists worldwide. In recent years, attention to this problem has increased [1-8]. It is believed that knowledge of the laws of the seasonal dynamics of disease are important not only from the theoretical considerations, they are of great practical importance in terms of the organization of

medical prophylactic measures. Seasonality of morbidity and mortality is closely related to climatic and geographical conditions. Azerbaijan Republic has a great variety of climatic zones and cannot but attract attention. There are 9 of 11 climate zones, which are combined into 4 groups: semi-desert and dry lake climate, warm-temperate climate, cold climate and mountain tundra climate. Therefore, the study of seasonal dynamics of the risk of mortality in Azerbaijan as a whole and in its regions is an actual scientific and practical problem.

Objective: to obtain scientifically valid data on the role of the seasons in the formation of the risk of mortality from the circulatory system diseases (CSD) in Azerbaijan and its regions with specific climate.

Materials. The case of death testified by a medical doctor and registered in accordance with the legislation of Azerbaijan, which is in compliance with WHO requirements was a Unit of observation (UO). The materials has been collected by blanket coverage for 2011, 2012 and 2013, respectively, which amounts to 53762, 55017 and 54383 UO. CSD as a primary cause of death was recorded respectively in the 32835, 34832 and 34379 medical death certificates.

The data about areas of the Azerbaijani Republic, where forced migrants live (Zangilan, Lachin, Jabrail, Shusha, Agdam, Fizuli, Kelbedzher, Khojaly, Khojavand, Gubadli) have been excluded from these materials. As a result, the population size under study for three years equaled to 155244 deaths from all reasons, including 84862 from CSD.

Information about the average daily air temperature and humidity, sunshine duration was obtained from the database of the Hydrometeorological Service of the Azerbaijan Republic which has a permanent monitoring stations in 11 large and medium cities (Baku, Ganja, Mingachevir, Lankaran, Yevlakh, Beylagan, Guba, Sheki, Lankaran, Kyurdyamir, Chamakh).

Methodology of the study. Deaths from all causes, including from CSD were distributed by the days of each month and year. The average daily number of deaths by month and by season (from December, 20 to March, 19 - winter, from March, 20 to June, 19 - spring, from June, 20 to September, 19 - summer, from September, 20 to December, 19 - autumn) have been determined. Fatalities weight (separately for all causes and for CSD) for each standard month and season has been calculated. Standard month is equal to 30.4 days (365: 12). The number of deaths for each standard month was calculated by multiplying the average daily number of deaths in a calendar month by 30.4. The example of calculation of deaths weight in a standard month "January" = (average daily number of deaths in a calendar month "January" for 2011-2013 x 30.4) x 100 : annual deaths for 2011- 2013 (%). The standard error of this indicator was determined by the

standard formula)

$m = \sqrt{(P (100 - p) : n)}$ [9];

where P – is weight;

n – is mean annual cases of deaths for 2011-2013.

Statistical significance between the pair of months and seasons was evaluated by criterion Z [9]. Dynamics trend of the average daily deaths on standard months was defined by the equation of regression, which coefficients of determination (R^2) were used to assess the strength of association. Statistical processing was performed with the use of the package "Data Analysis" program Excel for PC.

All the calculations listed have been performed on a nationwide scale and for each administrative city and a district of republican subordination (areas within cities were not taken into account). In the cities with a constant monitoring of meteorological parameters (Baku, Ganja, Mingachevir, Lankaran, Yevlakh, Beylagan, Guba, Sheki, Zagatala, Kyurdyamir, Chamakh) the correlation between the average daily number of deaths and the average daily temperature, humidity and sunshine duration have been studied.

The descriptive statistics of meteorological parameters (mean, its error and standard deviation, variance, central distribution) has been obtained, too. Calendar day, the actual value of the average daily air temperature, corresponding to 0-10 and 90-100 percentile were selected for comparison. At the same time, the temperature below the 10th percentile was considered as "cold weather", and the temperature above the 90th percentile was considered as "warm weather". The descriptive statistics of mean daily deaths was obtained for cold and warm days and the significance of the difference between them was estimated by unpaired t-test with different variances. [9]

Results Obtained. Indicators of monthly and seasonal dynamics of deaths from all causes and from CSD are listed in Table 1.

Table 1

MONTHLY AND SEASONAL DYNAMICS OF THE AZERBAIJANIAN POPULATION MORTALITY

Months and seasons	Average daily deaths from all causes	Share of monthly deaths from all causes, %	Average daily death cases from CSD	Share of monthly deaths CSD, %	Share of CSD as leading cause of death, %
January	151.3	9.0±1.0	81.6	8.9±0.2	53.6±0.7
February	168.3	9.4±0.1	91.0	9.3±0.2	54.1±0.7
March	153.0	9.2±0.1	86.0	9.4±0.2	56.3±0.7
April	152.0	8.8±0.1	89.3	9.4±0.2	58.7±0.7
May	139.2	8.3±0.1	77.1	8.4±0.2	55.4±0.7
June	139.4	8.1±0.1	82.6	8.7±0.2	59.2±0.7
July	127.4	7.6±0.1	72.0	7.8±0.2	56.5±0.7
August	134.0	8.0±01	74.0	8.1±0.2	55.8±0.7
September	122.0	7.1±0.1	64.2	6.8±0.2	52.6±0.8
October	130.0	7.8±0.1	71.5	7.8±0.2	54.9±0.7
November	143.5	8.3±0.1	73.8	7.8±0.2	51.4±0.8

December	141.3	8.4±0.1	72.1	7.6±0.2	51.1±0.8
Winter	157.6	27.0±0.2	86.6	27.8±0.3	55.0±0.5
Spring	143.5	25.3±0.2	83.1	26.7±0.3	57.9±0.5
Summer	127.6	22.5±02	69.5	22.3±0.3	54.5±0.5
Autumn	138.4	24.4±0.2	72.8	23.6±0.3	52.6±0.5

Most (9,4 ± 0,1%) and the lowest (7,1 ± 0,1%) proportion of deaths occurred in February and September (P <0.01). The monthly proportion of deaths at the conditional admissibility of the lack seasonal dynamics should be 8,3 ± 0,12% (95% confidence interval 8,1-8,5%). Statistically significant proportion of deaths is observed in February, March, January and April and it is higher than this conditional level. In September, July, October proportion of deaths from all causes was significantly lower (P <0.05) than 8,3 ± 0,12%. In winter and spring the proportion of deaths from all causes are not significantly different (P <0.05) from each other and are statistically significant (P <0.01) higher than the proportion of deaths from all causes in summer (22,5 ± 0,2%) and autumn (24,4 ± 0,2%). The proportion of deaths from all causes in summer (22,5 ± 0,2%) is significantly lower than that in autumn (24,4 ± 0,2%). It is obvious that Azerbaijan has the lowest risk of death in summer, and autumn, spring and winter lie the subsequent places according to the degree of risk.

In general, Azerbaijan is characterized by winter-spring increased risk of mortality and its summer-autumn downturn.

The monthly proportion of deaths from CSD at the conditional admissibility of seasonal dynamics lack should be 8,3 ± 0,15% (95% confidence interval 8,0-8,6%). Statistically significant (P <0.05) higher this level was the proportion of deaths from CSD in March (9,4 ± 0,2%), April (9,4 ± 0,2%), February (9,3 ± 0.2%) and in January (8,9 ± 0,2%). Below the level marked were the indicators observed in September (6,8 ± 0,2%), December (7,6 ± 0,2%), July, October and November (by 7,8 ± 0,2%). Differences in the risk of mortality by calendar month of the year are significant.

Percentage of deaths was significantly higher in winter (22,8 ± 0,3%), while in summer it was minimal (22,3 ± 0,3%) and significantly lower than that in spring (26,8 ± 0,3%) and autumn (23,6 ± 0,3%). So, the seasonal dynamics of the risk of mortality from all causes, including CSD as a whole is similar and is characterized by winter-spring increase and summer-autumn decline.

Among all causes of death CSD's share is 54,7 ± 0,13% (95% confidential interval 54,5-55,0%). The largest share of CSD as causes of fatality was in June (59,2 ± 0,7%), and the lowest - in December (51,1 ± 0,8%). The proportion of CSD as a cause of death in winter (55,0 ± 0,5%) and in summer (59,5 ± 0,5%) were very close to each other and were significantly higher than that in autumn (52,6 ± 0,5%). The largest share of CSD as fatalities cause was in the spring (57,9 ± 0,5%), and it was significantly higher than in other seasons.

Thus, in Azerbaijan, the risk of total mortality and mortality from CSD is the greatest in winter, spring is characterized by not uniformly reduced risk (total mortality decreases more than CSD's mortality) therefore the proportion of CSD as a leading cause of death increases.

Trend of average daily deaths from all causes (E_0) by the months of the year (x - number of a month) is described in the following regression equation:

$E_0 = 0{,}002x^5 - 0{,}0989x^4 + 1{,}7955x^3 - 13{,}902x^2 + 38{,}838x + 126{,}63$ ($R^2 = 0{,}861$)

The regression equation describing the trend of average daily deaths from CSD (E_{CSD}):

$E_{CSD} = -0{,}0006x^5 + 0{,}0042x^4 + 0{,}2723x^3 - 4{,}1719x^2 + 16{,}392x + 69{,}93$ ($R^2 = 0{,}8187$)

It should be noted that the all - republican law of total mortality and mortality from CSD by seasons in a number of regions is not observed (Table 2).

TABLE 2.

SEASONAL DYNAMICS OF DAILY AVERAGE TEMPERATURE, THE RISK OF TOTAL MORTALITY AND MORTALITY FROM CIRCULATORY SYSTEM DISEASES IN SOME CITIES OF AZERBAIJAN

City	Daily average tє				Total deaths proportion, %				Share of deaths from CSD			
	W	Sp	S	A	W	Sp	S	A	W	Sp	S	A
Baku	3.6	14.3	26.6	16.7	28.3±0.2	24.9±0.2	22.2±0.2	24.6±0.2	27.7±0.3	27.3±0.3	22.2±0.3	22.8±0.3
Lankaran	4.3	14.2	25.6	18.1	27.9±0.7	29.7±0.7	23.8±0.6	18.6±0.6	34.2±1.0	29.1±1.0	20.5±0.9	16.2±0.8
Beilagan	3.2	15.4	26.0	17.9	24.3±1.1	23.0±1.1	20.9±1.0	31.8±1.1	24.1±1.3	34.1±1.5	16.5±1.2	25.3±1.3
Kyurdyamir	3.4	15.8	28.1	22.1	30.1±1.0	21.5±0.9	25.3±1.0	23.2±0.9	19.8±1.2	24.4±1.3	34.9±1.5	20.9±1.3
Mingecaur	4.0	16.1	27.7	18.8	28.1±1.1	22.2±1.0	16.6±0.9	33.0±1.1	29.1±1.4	28.2±1.4	17.3±1.2	25.5±1.3
Ganja	2.4	14.9	25.7	17.0	29.4±0.6	24.6±0.6	24.3±0.6	24.3±0.6	27.2±0.8	21.5±0.7	27.7±0.8	23.7±0.7
Sheki	2.0	13.8	24.3	15.4	30.1±0.8	17.7±0.6	24.2±0.7	24.2±0.7	31.9±1.1	27.5±1.1	14.0±0.8	26.5±1.0
Zakatala	1.9	14.5	25.2	16.3	26.0±0.9	18.9±0.8	28.4±0.9	28.4±0.9	24.5±1.2	33.3±1.3	19.1±1.1	23.0±1.2
Shamakha	-1.0	11.2	23.7	13.9	31.1±1.1	24.0±1.1	24.0±1.1	25.6±1.1	32.2±1.6	19.7±1.3	25.7±1.4	22.4±1.3
Guba	-1.0	11.6	23.2	13.8	28.7±0.8	24.1±0.7	24.1±0.7	20.5±0.7	22.4±1.1	32.1±1.3	24.5±1.2	21.0±1.1
Yevlakh	3.1	16.1	27.5	18.0	25.6±1.0	22.5±0.9	22.5±0.9	22.0±1.2	22.9±1.2	36.1±1.3	20.4±1.1	20.6±1.1

In the cities with permanent, stationary stations of meteorological monitoring, the average daily temperature in all seasons differ from each other. In Baku, Lankaran, Mingachevir and Sheki average winter temperature is (3.6; 4.3; 4.0 and 2.0є C) and summer (26; 25.6; 27.7 and 24,3єC) and are not dramatically different. In these cities, as the republic as a whole, the mortality from CSD is higher in winter and spring than in summer and autumn. In Beylagan, where the average daily temperature by seasons is similar to that marked in the cities mentioned above (3.2; 15.4; 26.0 and 17,9ºC), a sharp rise in the risk of mortality from CSD is observed in spring (34,1 ± 1,5%). In winter, and autumn risk of mortality is significantly (24.1 ± 1,3 and 25.3 ± 1,3%) higher more than in summer (16,5 ± 1,2%).

In this case, the winter-spring probability of death (58.2%) is higher than summer - autumn probability (41.8%).

In Kyurdyamire where the average daily air temperature in summer (28,1єC) is relatively low, the risk of mortality from CSD in autumn and winter is almost the same (19,8 ± 1,2 and 20,9 ± 1,3%). In spring (24.4 ± 1,3%) this index is statistically significant higher than in winter and autumn, and in summer there is the maximum mortality (34,9 ± 1,5%) rate.

In the city of Ganja, where the average seasonal daily air temperature is not significantly different from the above mentioned cities (2.4; 14.9; 25.7 and 17,єC) the probability of mortality in winter and summer is similar (27.2 ± 0.8 and 27.7 ± 0.8%) and significantly higher than in autumn and spring (23.7 ± 0.7 and 21.5 ± 0.7%).

In Zagatala, where the average daily air temperature is close (1.9; 14.5; 25.2 and 16.3) to that in Sheki (2.0; 13.8; 24.3 and 15,4єC) the risk of mortality from CSD (24.5 ± 1.2 and 23.0 ± 1.2%) is the same in winter and autumn but significantly ($P < 0.05$) higher than in summer (19.1 ± 1.1%), and the greatest probability of death from CSD (33.3 ± 1.3%) takes place in spring.

Chamakh and Guba have similar characteristics of annual mid-day and seasonal temperature. These cities are different from the rest by their cold winters (average temperature is -1.0єC) and cool spring (11.2-11.6єC), moderate summer (23.7-23.2єC) and autumn (13.9- 13.8єC). In Chamakh the minimal probability of death from CSD is in winter (19.7 ± 1.3єC) and in Guba – in autumn (21.0 ± 1.1%). The maximum probability of fatality from CSD in Chamakh is in winter (32.2 ± 1.6%), and in Guba – in spring (32,1 ± 1,3%). In both cities the death rate from CSD in winter-spring period (51.9% and 54.5%, accordingly) is higher than in summer-autumn period (48.1 and 45.5%).

Yevlakh by seasonal average daily air temperature (3.1; 16.1; 27.5 and 18.0єC) is close to Mingecaur, but has different seasonal dynamics of mortality from CSD. In Yevlakh, unlike Mingechaura, the probability of death from CSD in winter, summer and autumn is not significantly different (22.9 ± 1.2; 20.4 ± 1.1 and 20.6 ± 1.1%). In Yevlakh as well as in Mingechaur, the probability of death is high in spring of (36.1 ± 1.3%).

Discussion of the results obtained. Literature data about the influence of cold on the risk of mortality risk from CSD are rather rich [6,7,8]. There are valid evidences of morbidity and mortality increased rate in winter, obtained in Russia, China, Bangladesh, Check Republic, Iceland [1-7]. In the work presented we have synthesized data on Azerbaijan as a whole and the data on the city of Baku, Lankaran, Mingachevir and Sheki conform fully to the data of the authors mentioned [1-8].

At the same time, Azerbaijan has several cities where the greatest risk of death from CSD is observed in spring (Beylagan, Zagatala, Guba and Yevlakh), and even in summer (Kyurdyamir). Winter-spring increase of death risk can not be attributed only to the air temperature. The cold affects the risk of mortality at very low temperatures, which are rarely observed in Azerbaijan. Apparently,

seasonal variation in mortality risk has deeper mechanisms associated with the complex of natural and social factors. In the first instance it refers the readiness of health care services for emergency medical aid rendering in cold weather. Summer increase of mortality risk which is more pronounced in Kyurdyamire (average summer temperature here is the highest in the republic - 28єC) can be colligated with the influence of heat. Effect of heat on the daily mortality change was observed in Moscow [5]. Correlation between the average daily temperature and average daily deaths from CSD is -0.32 in Baku, 0.53 in Kyurdyamire and is less than 0.1 in other cities. It confirms that the seasonal dynamics of the risk of mortality from CSD is not due to the effect of air temperature, and is caused by exposure to complex environmental factors and biological rhythms of the body. In the regions of Azerbaijan seasonal dynamics of mortality risk differ from each other and it allowed us select a few options:

?- uniform winter-spring risk increase (Baku, Mingachevir);

-? winter - spring risk increase on the background of more promoted winter risk (Lankaran, Sheki);

?- Spring increased risk (Beylagan, Guba, Yevlakh, Zagatala);

?- Summer increased risk (Kyurdyamir);

?- summer - winter increased risk (Ganja);

? - winter increased risk (Chamakha).

CONCLUSIONS

1. Seasonal variation of risk mortality from CSD is multivariate in character, and winter and spring increased risk dominates in Azerbaijan.

2. In some regions of the country risk of mortality from CSD is in only one season (or in spring, summer and winter).

Competing interests.

Rzayeva A. J., Agayeva K. F., Hatamzada E. M, Mammadbayli A. K. declare that they have no competing interests.

Authors contributions

R.A conceived of the study, spent gathering information

A.K. articipated in the sequence alignment and drafted the manuscript.

H. E. and M.A. performed the statistical analysis

The final manuscript has been read and approved by all the authors.

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