WHO PROGRAMS: "REGISTER ACUTE MYOCARDIAL INFARCTION", "MONICA" — DYNAMICS ACUTE CARDIOVASCULAR ACCIDENT AT YEARS 1977-2009 IN GENERAL POPULATION AGED 25-64 YEARS IN RUSSIA

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Aim. To study 33-year (1977–2009) dynamics acute cardiovascular accident in general population aged 25-64 years in Russia

Material and methods. Data of WHO studies ("Acute Myocardial Infarction Register" and "MONICA") were analyzed in three districts of Novosibirsk.

Results. Myocardial Infarction (MI) morbidity in 25–64-year-old population in Russia was found one of the highest worldwide. MI morbidity rates remained steady for the entire period of study except for 1988, 1994, 1998 (increase), 2002–2004, and 2006 (decrease). Mortality and lethality resembled morbidity except for 1977–1978 (decrease) and 2002–2005 (increase). Prehospital mortality and lethality significantly exceeded in-hospital deaths. Lethal outcomes after MI exceeded deaths from alcohol abuse by 2-3 times. Mortality and lethality decrease during period of unchanged morbidity suggested improved management of cardiac care; increase in mortality and lethality at a time of decreased morbidity indicated deterioration of medical assistance for cardiac patients. No changes in behavioral and somatic risk factors were found during 1977–2009. Significant increase in levels of psychosocial risk factors was documented.

Conclusion. MI morbidity, mortality, and lethality rates are the markers of increasing social stress in population. Deaths from MI have been the main component of the increase in mortality in Russia.

Russ J Cardiol 2016, 4 (132), Engl.: 129–134
http://dx.doi.org/10.15829/1560-4071-2016-4-eng-129-134

Key words: cardiology, dynamics acute cardiovascular accident, epidemiology, risk factors.

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BP — blood pressure, CVD — cardiovascular diseases, f — female, ICC — index of close contacts, IHD — ischemic heart disease, HCE — hypercholesterolemia, m — male, MI — myocardial infarction, MONICA — Multinational Monitoring of Trends and Determinants in Cardiovascular Disease, RR — relative risk, SNI — social network index, WHO — World Health Organization.

Received February 17, 2016.
Revision received February 18, 2016.
Accepted February 25, 2016.

ПРОГРАММЫ ВОЗ: "РЕГИСТР ОСТРОГО ИНФАРКТА МИОКАРДА", "МОНИКА" — ДИНАМИКА ОСТРЫХ СЕРДЕЧНО-СОСУДИСТЫХ КАТАСТРОФ В 1977-2009ГГ В ОБЩЕЙ ПОПУЛЯЦИИ В ВОЗРАСТЕ 25-64 ЛЕТ В РОССИИ

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Цель. Изучить динамику острых сердечно-сосудистых катастроф в общей популяции в возрасте 25-64 лет в России в течение 33 лет (1977-2009).

Материал и методы. Программы Всемирной Организации Здравоохранения "Регистр острого инфаркта миокарда", "Моника", проводимые в трех районах г.Новосибирска

Результаты. Заболеваемость инфарктом миокарда (ИМ) оставалась стабильной за весь период изучения, за исключением 1988, 1994, 1998 (увеличение), 2002-2004 и 2006 (уменьшение). Такие же показатели у смертности, за исключением 1977-1978 (уменьшение) и 2002-2005 (увеличение). Уровни смертности и летальности до больницы в 2-3 раза превышают смертность и летальность в больнице. Количество летальных исходов от ИМ превышает смертность от потребления алкоголя в 2-3 раза. Снижение смертности, летальности на фен стабильной заболеваемости ИМ свидетельствует о улучшении организации оказания медицинской помощи заболевшим; увеличение смертности и летальности на фоне снижения заболеваемости ИМ — об ее ухудшении. Не получено динамики поведенческих и соматических факторов риска в течение 1977-2009гг. В то же время отмечено значительное увеличение уровней психосоциальных факторов риска.

Заключение. Показатели заболеваемости, смертности и летальности являются маркерами повышения социального стресса в популяции. Смертность от ИМ была главным компонентом увеличения смертности в России.

Российский кардиологический журнал 2016, 4 (132), Англ.: 129–134
http://dx.doi.org/10.15829/1560-4071-2016-4-eng-129-134

Ключевые слова: кардиология, динамика острой сердечно-сосудистой катастрофы, эпидемиология, факторы риска.

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Russia entered the XXI century with an array of problems affecting both human wellbeing and national security. One of the most severe challenges was the unfavorable demographic situation developed in the 1990s. During those years, the so-called "supermortality" had reached five million people while the life expectancy at birth dropped to extremely low 59 years. It is worthy of note that the medical components of the problem were significant and the cardiovascular diseases (CVD) remained the number one cause of the increased mortality contributing to 55.4% of all deaths. Among 2,200,000 people deceased in Russia in 2000, 1,200,000 died from CVD. The most alarming observation was the fact that morbidity and mortality rates escalated among the people in their most productive years alongside with the increased CVD detection [1-3]. Keeping this in mind, accurate and

comparable data elucidating the long-term CVD trends should be obtained based on the standard, strictly unified programs, which have been in a great demand providing a background for fighting CVD. Such studies enable us to elucidate nature of the undergoing population changes, to outline the ways, and to evaluate potential effect of the preventive measures [4, 5]. Upon reviewing the available literature, we have not found the reports focusing on such studies in Russia.

The goal of the present study was to analyze the 33-year (1977–2009) long-term trends and determinants in morbidity, mortality, and lethality from myocardial infarction (MI) in a high-risk population of the West Siberia metropolis (the city of Novosibirsk) using the unified World Health Organization (WHO) studies: "Register Acute Myocardial Infarction", "Multinational Monitoring of Trends and Determinants in Cardiovascular Disease" (MONICA), and MONICA-psychosocial [6-8].

Material and methods

The WHO "Register Acute Myocardial Infarction"-based study has covered the population aged 25 to 64 years living in three districts of the city of Novosibirsk including the Oktyabrsky district (starting on January 1, 1977) following with the Leninsky and Kirovsky districts (starting on January 1, 1981) [5, 6]. The total population of the three districts included 600,000 people. The WHO MONICA project continued in the same districts since 1983 [7]. No significant differences between data of two programs were found regarding the registered MI events (9). Quality assessment of the diagnostic IM categories was performed by the WHO Quality Control Centre for Event Registration in Dundee (Scotland), and the results were found acceptable [10-14]. 24,835 cases of MI including 8,122 lethal outcomes had been registered in the districts during the long-term monitoring covering the period from January 1, 1977 to December 31, 2009.

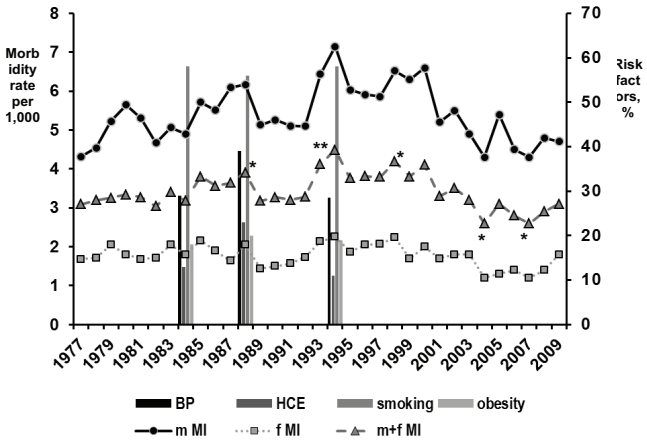

Figure 1. Annual acute myocardial infarction (MI) morbidity rates (per 1,000 population) among 25-64-year-old residents of Novosibirsk and common CVD risk factors (m — male, f — female).
Annotation: * — p<0,05, ** — p<0,01.

Standardization was performed using the standard world population. Representative random samples (a total of 2981 males aged 25 to 64 years) were examined in the Oktyabrsky district accordingly to three standard screening epidemiology programs: the WHO "MONICA", "MONICA-psychosocial", (1984, 1988, and 1994) [7], and the "HEPIEE" (2000). The pilot project was supported by the Welcome Trust grant. The response rates were 71,2%, 71,3%, and 82,1% for the first, second, and third screenings, respectively.

The anxiety was evaluated using the Spielberger's test (anxiety level, subscale of anxiety as personality characteristic) [15]; social support was estimated with the method developed by Berkman & Syme based on calculation of a social network index (SNI) and an index of close contacts (ICC). Encoding of the test consisted in the plotting of the index components and calculating the scores according to the proposed algorithm [16]. All new cases of MI in the cohort were registered among the people who did not have CVD at the moment of examination according to the WHO "Register Acute Myocardial Infarction" data for a period of 20 years (1984–2004). A total of 280 newly diagnosed MI cases were detected.

Statistical analysis of data was performed using the SPSS 11.5 Software. The stratified Cox proportional regression model was used for determination of the Hazard retio (HR); X2 test was used as the most important member of the nonparametric family of statistical tests.

Results

Our results suggested that the MI morbidity in a high-risk population (the city of Novosibirsk) in Russia was one of the highest in the world. Table 1 shows 33-year trends in the MI incidence rates. Dynamics in the MI morbidity was fairly steady except for the years of 1988, 1994, and 1998 that revealed significant morbidity increase (χ^2=5,482, n=1, p<0,05; χ^2=16,31, n=1, p<0,01; χ^2=4,876, n=1, p<0,05, respectively). Statistically proven decrease in the MI incidence rates was found during a period from 2000 to 2004 and in 2006 (χ^2=4,573, χ^2=3,529, n=1, p<0,05, respectively) while, in 2007–2009, we observed an upward trend of the rates. For the entire period of study, a significant age-dependent increase in the MI morbidity was found in both gender groups. The MI incidence rates in males prevailed over those of females by 2–7 times in all age groups (χ^2=12,976, p<0,01; χ^2=19,367, n=1, p<0,001, respectively) (Figure 1). The highest increase in MI morbidity was observed among males (3–5-fold, χ^2=18,826, n=1, p<0,001) and females (5–10-fold, χ^2=21,464, n=1, p<0,001) in the 45–54-year-old age groups in comparison with the preceding age groups. Analysis of the dynamic changes in the MI morbidity in different age groups showed that increase in the MI incidence rates in 1988 was mostly associated with the group of 45–64-year-old males while the increases in 1994 and 1998 were due to MI events among 55–64-year-old

Table 1

Acute myocardial infarction (MI) morbidity, mortality, and lethality in 1977–2009 in Novosibirsk according to the WHO "Acute Myocardial Infarction Register" and "MONICA" Programs.

Years	MI incidence rate per 1,000			MI death rate per 100,000						Lethality, %		
				m			f					
	m	f	m+f	iH	oH	iH+oH	iH	oH	iH+oH	m	f	m+f
1977	4,3	1,6	3,1	70,1	125,4	195,5	32,1	43,7	75,8	45,3	35,6	41,6
1978	4,5	1,7	3,2	25,8	118,0	143,9	20,4	40,8	61,2	31,7	28,8	30,6
1979	5,2	2,0	3,3	32,2	114,5	146,7	13,9	44,4	58,3	28,1	33,9	29,8
1980	5,6	1,7	3,3	23,4	131,8	158,2	14,1	45,2	59,3	28,4	36,8	30,7
1981	5,3	1,6	3,3	39,3	119,6	158,9	3,9	27,6	31,5	29,9	18,9	26,8
1982	4,6	1,7	3,0	37,6	109,5	147,1	13,1	26,5	39,6	27,5	24,8	26,7
1983	5,0	2,0	3,4	26,4	106,3	132,7	5,9	43,7	49,6	26,2	24,2	26,6
1984	4,9	1,7	3,2	36,9	133,6	170,5	15,8	35,5	51,3	32,9	28,0	31,4
1985	5,7	2,1	3,8	48,1	124,5	172,6	21,1	43,9	65,0	31,5	31,8	31,8
1986	5,5	1,8	3,6	39,1	122,7	161,8	7,0	49,7	56,7	30,7	31,2	30,8
1987	6,0	1,6	3,6	59,8	116,7	176,5	5,6	42,9	48,5	29,0	31,5	29,6
1988	6,1	2,0	3,9	80,3	185,6	265,9	13,8	49,8	63,6	43,1	40,7	42,5
1989	5,1	1,4	3,2	23,3	148,8	172,1	7,9	54,9	62,8	34,3	37,1	35,1
1990	5,2	1,5	3,3	39,1	139,3	178,4	16	27,7	43,7	36,6	36,3	36,5
1991	5,1	1,5	3,2	31,5	132,7	166,3	11,8	33,9	45,7	32,8	34,5	33,2
1992	5,0	1,7	3,3	34,2	147,2	181,3	20,3	33,3	53,6	35,6	31,1	34,3
1993	6,4	2,0	4,1	36,1	170,2	206,4	11,3	47,4	58,7	32,1	27,5	30,8
1994	7,1	2,2	4,5	47,3	217	264,2	15,2	66,1	81,3	38,6	36,7	38,0
1995	6,0	1,8	3,7	27,0	147,2	174,1	9,6	43,5	53,1	30,3	28,8	29,9
1996	5,9	2,0	3,8	21,1	148	169,1	7,7	46,3	54,0	29,3	25,7	28,3
1997	5,8	2,0	3,8	26,1	165,4	191,5	11,0	32,0	43,0	33,0	19,8	29,1
1998	6,5	2,2	4,2	42,3	166,6	208,9	14,3	39,7	54,0	32,4	23,1	29,7
1999	6,3	1,7	3,8	29,8	165,0	194,7	6,2	40,6	46,8	30,9	26,8	29,9
2000	6,6	2,0	4,1	19,8	167,5	167,5	12,5	43,7	56,2	25,5	28,6	26,3
2001	5,2	1,7	3,3	29,8	172,7	202,6	11,4	38,4	49,8	38,8	28,6	35,9
2002	5,5	1,8	3,5	29,8	190,2	220,0	12,4	48,8	61,2	40,7	33,5	38,6
2003	4,9	1,8	3,2	16,2	177,7	193,9	11,4	49,8	61,2	39,5	34,3	37,9
2004	4,3	1,2	2,6	35,9	162,7	198,6	15,8	33,6	49,4	46,1	40,3	44,6
2005	5,4	1,3	3,1	27,3	218,8	247,1	9,8	38,2	48,0	32,4	45,2	44,4
2006	4,5	1,4	2,8	26,1	120,0	146,1	2,9	29,4	32,3	32,4	24,1	30,1
2007	4,3	1,2	2,6	19,7	126,5	146,2	7,6	27,7	35,3	33,9	28,5	32,5
2008	4,8	1,4	2,9	14,5	125,0	139,5	10,2	19,4	29,6	29,1	21,2	27,1
2009	4,7	1,8	3,1	15,6	138,4	154,0	6,5	24,9	31,4	32,8	17,4	27,9

Abbreviations: m — male, f — female, m+f — male and female, iH — in-hospital, oH — out-hospital, iH+oH — in-hospital and out-hospital.

males and in the groups of 35–44, 45–54, and 55–64-year-old females. Decrease in the MI incidence rates in 2002–2004 and 2006 was found mostly in males while the upward trend of mortality in 2007–2009 was caused by the MI events in both gender groups with female predominance.

Mortality during the entire 33-year period of study remained fairly steady except the decline in death rates in 1977–1978 (χ^2=9,063, n=1, p<0,05) and in 2006 (χ^2=5,142, n=1, p<0,05) and increased mortality in 1988 (χ^2=11,589, n=1, p<0,001), 1994 (χ^2=13,573, n=1, p<0,001), 1998 (χ^2=8,489, n=1, p<0,05), 2002, and 2005 (χ^2=4,649, χ^2=3,837, n=1, p<0,05, respectively) (Figure 2). Reduction in mortality in 1977–1978 and increase in death rates in 1994 and 1998 were found in both gender groups. On the other hand, the MI mortality significantly increased in 1988, 2002, 2005 and decreased in 2006 only in males.

Dynamics of age-dependent mortality resembled that of morbidity. The MI mortality was increasing from the younger age groups toward the older ones for both sexes through the entire period of study. The mortality rates in males were 2–3 times higher than in females (χ^2=15,841, n=1, p<0,001). The lethality changes resembled dynamics of mortality. During the first two years of study (1977-1978), significant decrease in the lethality was found in both gender groups (χ^2=4.080 n=1 p<0,05). Increase in the lethality of

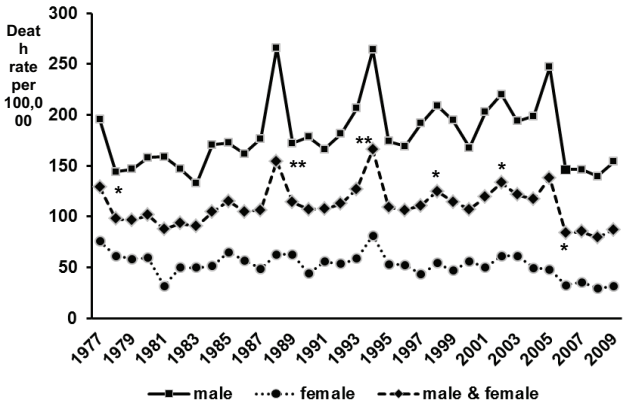

Figure 2. Annual myocardial infarction mortality rates among 25–64-year-old residents of Novosibirsk (deaths per 100,000 population).
Annotation: * — p<0,05, ** — p<0,01.

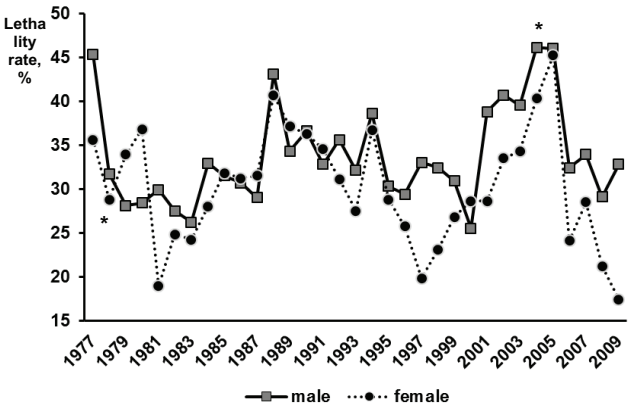

Figure 3. Myocardial infarction (MI) lethality (%) among 25–64-year-old residents of Novosibirsk.
Annotation: *– p<0,05.

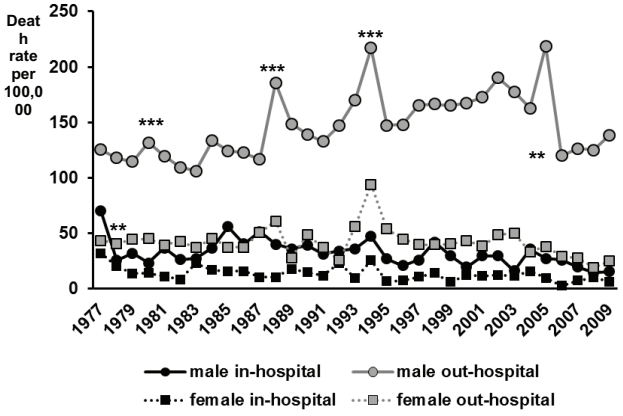

Figure 4. Annual myocardial infarction (MI) mortality rates among 25-64 year-old residents of Novosibirsk in regard to site of death (deaths per 100,000 population).
Annotation: ** — p<0,01, *** — p<0,001.

MI was observed in 1988 (χ^2=5,802, n=1, p<0,05), 1994 (χ^2=6,103, n=1, p<0,05), and in 2001–2005 (χ^2=4,649, χ^2=3,837, n=1, p<0,05) in both sexes and in 1998 (χ^2=5,844, n=1, p<0,05) only in males (Figure 3). During the entire period of the population-based study, the highest rates of lethality in males and females were recorded in the youngest age groups. Unlike the mortality, dynamic changes in lethality during the entire period of study were caused by the MI deaths in both males and females.

In both gender groups, the prehospital mortality and lethality prevailed during all years of study (Figure 4). We found that decline in the mortality and lethality in 1977-1978 was caused by the drop in the in-hospital deaths. At the same time, the decline in mortality in 2006 was caused by a lower number of the prehospital MI events. Increase in the MI mortality and lethality through the entire period of study was associated with the higher rates of the prehospital MI deaths. It should be noted that downward trend in female lethality in 2008-2009 was caused by in-hospital events.

The 18-year study (1977–1998) showed that the MI incidence rates were 2–3-fold higher compared to the death rates caused by alcohol abuse with the exception of the period of the profound social reorganization in 1994 when those rates were equal (χ^2=8,4, n=1, p<0,01; χ^2=14,59, n=1, p<0,002) (Figure 5).

Dynamic changes in the levels of both psychosocial risk factors of ischemic heart disease (IHD) and somatic and behavioral risk factors such as arterial hypertension, smoking, hypercholesterolemia, and obesity were determined based on the results of four screening studies focused on representative random samples of 25-64-year-old population of both sexes in the districts of Novosibirsk in 1994, 1988, and 1994. No significant changes in the levels of the somatic and behavioral risk factors were found (Figure 1).

Significant dynamic changes in the prevalence of anxiety (by Spielberger's test) were observed in the population according to the three screening studies of 1984, 1988, and 1994. Anxiety level increased from 35% to 52%; at the same time; SNI significantly decreased in the period from 1984 to 1994 (χ^2=35,952, n=6, p<0,001) (Figure 5). No statistically proven dynamic changes in the levels of anxiety, ICC, and SNI were found in the fourth screening study.

Males with the high anxiety levels had a significantly higher Hazard retio (HR) of MI development compared to individuals who had the medium levels. During 20-year period from 1984 to 2004, HR was initially increasing from HR =2,5 for five years (95% CI=1,63–4,62, p<0,001) to HR =3,1 for ten years (95% CI=1,48–5.61, p<0,001, respectively), eventually decreasing toward the end of the 20-year period to HR =2,7 (95% CI=1,27–5,71, p<0,05).

Discussion

Our results have demonstrated that the MI morbidity in a high-risk population of the city of Novosibirsk in Russia was among the highest in the world [17-19]. 33-year-long study of the dynamic changes in the MI rates showed steady state stabilization of the MI incidence except for the years of 1988, 1994, and 1998 (significant

increase) and 2002, 2003, 2004 and 2006 (significant decrease). We would like to make a point that the MI events in males of the older age groups contributed to the significant increase in the MI morbidity in 1988. Unlike this, the MI incidence rates in 1994 and 1998 increased mostly due to the higher morbidity among females of almost all age groups (except 25-34-year-olds). Only one group of males (55-64-year-olds) showed the significantly increased MI incidence rates in 1994 and 1998. The MI mortality and lethality rates remained steady during the entire 33-year period of study except for 1977-1978 when they decreased and except for 1988, 1994, 1998, and 2002–2005 when we found an increase in death rates. The age-dependent dynamic changes in mortality resembled those of morbidity. MI death rates in males exceeded mortality of females by 2-3 times. At the same time, MI deaths among both males and females contributed to the dynamic changes in lethality during the entire period of study.

Analysis of mortality and lethality trends in terms of a site of death showed that the prehospital mortality and lethality prevailed during all years of the study. Significant decline in mortality and lethality in males as well as similar tendency in females were found to be associated with an early hospital admission of the MI patients resulting, in turn, in the lower rates of complications and recurrent MI events [20]. It was found that the increase in the MI mortality and lethality in males and females in 1988, 1994, 1998, and 2002-2005 was associated with the higher number of sudden prehospital deaths. An increase in prehospital mortality was found in males in 1988 and 2002-2005 and in both males and females in 1994 and 1998; trend in 2009 was caused by the MI events both in males and females.

Paradoxical absence of the expected reduction in the MI morbidity at a time of the decreased MI mortality and lethality in 1977-1978 as well as a decrease in the morbidity rates at a time of the mortality and lethality increase in 2002-2004 may be explained by improved management of medical assistance for patients in the first instance and some downtrend in cardiac care in the second example.

We could not find associations between the changes in the MI rates and the levels of the main IHD risk factors because their values did not significantly change over time. This was likely due to the fact that the risk factor prevalence in the population was very high anyway. No association between the MI rates and ecological factors was found as well [21]. Strong associations between the MI rates and the psychosocial factors (increase in anxiety level) was determined based on the results of the three screening studies. Amplitude of this parameter reflected the level of social stress in the population. Therefore, the rates of MI morbidity, mortality, and lethality were the markers of growing social and economic instability in the society. This conclusion was confirmed by the observation of the decline in the MI morbidity and mortality in 2006. We cannot rule

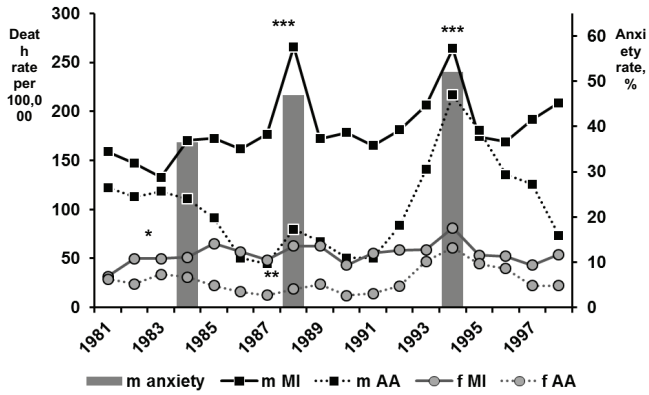

Figure 5. Annual myocardial infarction (MI) and alcohol abuse (AA) mortality (per 100,000 population) rates among 25-64 year-old residents of Novosibirsk and psychosocial factors (anxiety) in male.
Annotation: * — p<0,05, ** — p<0,01, *** — p<0,001.

out that this happened due to alleviation of social tension in the society i.e. decrease in the levels of psychosocial risk factors and augmentation of social support at that time. The period of 2006-2007 and the first half of 2008 were the most favorable years for Russia. During those years, the business revenues significantly grew leading to the higher budget revenues; human wellbeing improved; the government began to support (I) national projects stimulating demographic growth, physical culture and sports, medicine, education, and home mortgage programs; (II) economy development i.e. new job creation; (III) establishment of the stabilization funds. Upon these measures, people started to feel more stable; confidence in the future improved; social tension was alleviated. However, all these implicit indicators were indirectly associated with each other. Direct confirmation of the idea that the MI morbidity, mortality, and lethality can be considered the markers of growing social and economic instability was the fact that high anxiety level was associated with the significantly higher HR for MI development according to the results of 20-year-long study of the CVD-free cohort.

Our study has shown that the MI mortality rates exceeded the death rates caused by alcohol abuse by 2-3 times except the period of profound social reorganization in Russia in 1994 when those rates were equal.

Conclusion

1. We found that the MI morbidity in a 25–64-year-old high-risk population (the city of Novosibirsk) in Russia was among the highest in the world.

2. The MI incidence rates remained fairly steady over the entire period of the 33-year-long population-based study except for the years of 1988, 1994, 1998 (increase) and 2002-2004, 2006 (decrease). Mortality and lethality changes resembled the dynamics of morbidity except for the years of 1977–1978 (decrease) and 2002-2005 (increase). Prehospital mortality and lethality rates significantly exceeded the rates of in-hospital death events. It has been

shown that increase in mortality and lethality in 1988, 1994, 1998, and 2002-2005 was caused by higher number of prehospital deaths while their decrease in 1977-1978 was related mainly to in-hospital mortality and lethality.

3. The mortality and lethality decrease during a period of the steady MI morbidity suggested improved management of cardiac care; increase in the mortality and lethality at a time of the decreased MI morbidity indicated deterioration of medical assistance for cardiac patients.

4. Analysis of the behavioral and somatic IHD risk factors in the population of the city of Novosibirsk during the 33-year period did not reveal significant dynamic changes in these parameters. At the same time, the significant increase in the levels of psychosocial risk factors was detected over the same period.

5. Indirect evidence suggested that the MI morbidity, mortality, and lethality rates were the markers of the growing social stress in the society. Direct confirmation of this thesis was a significant increase of the RR for MI development in the individuals with the high anxiety levels according to the 20-year-long study of the CVD-free cohort.

6. The MI mortality exceeded incidence of deaths caused by alcohol abuse by 2-3 times and was the main determinant of the increase in mortality of urban population in Russia.

Acknowledgments. Support for this project was provided by the Russian Academy of Medical Sciences and the Wellcome Trust (grant # 056268).

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