**Gafarova A.V.[1,2], Gromova E.A.[1,2], Panov D.O.[1,2], Gagulin I.V.[1,2], Krymov E.A.[1,2], Gafarov V.V.[1,2]**
*[1]Research Institute of Internal and Preventive Medicine, Branch, Federal Research Center Institute of Cytology and Genetics, Siberian Branch, Russian Academy of Sciences, Novosibirsk, Russia; [2]Collaborative Laboratory for Epidemiology of Cardiovascular Diseases, Novosibirsk, Russia*
*[1,2]175/1, B. Bogatkov St., Novosibirsk 630089*

# Social support and stroke risk: an epidemiological study of a population aged 25–64 years in Russia/Siberia (the WHO MONICA-psychosocial program)

***Objective**: to determine the impact of social support on the risk of stroke in an open population aged 25–64 years in Russia/Siberia.*
***Patients and methods**. A random representative sample of a Novosibirsk population aged 25–64 years (657 men; mean age, 44.3±0.4 years; response rate, 82.1%; 689 women; mean age, 45.4±0.4 years; response rate, 72.5%) was examined within Screening III of the WHO MONICA-psychological program. The screening program included: registration of sociodemographic data and determination of social support (the index of close contacts (ICC) and the social network index (SNI). The prospective follow-up study period was 16 years. The study identified the following end-point: new-onset stroke cases.*
***Results and discussion**. The open population aged 25–64 years showed a low ICC in 62% of men and in 56.8% of women ($\chi^2$=22.603; df=2; p=0.0001) and a low SNI in 43.5% of men and in 33.9% of women ($\chi^2$=21.546; df=2; p=0.0001). During a 16-year follow-up, the risk of stroke in the people with a low ICC was 3.5 times higher for men (95% confidence interval (CI), 1.42–7.69; p<0.05), and that was 3.6 times higher for women (95% CI, 1.5–8.7; p<0.01). Over the same follow-up period, the risk of stroke in the patients having a low SNI was 3.4-fold higher for men (95% CI 1.28–5.46, p<0.001) and 2.3-fold higher for women (95% CI 1.18–4.49, p<0.05). Application of a multivariate model revealed an increase in the risk of stroke in people with a low level of social support: in men with an unfavorable family status, manual labor and in women with a low level of education.*
***Conclusion**. Social support is a protective risk factor for stroke in both men and women.*

***Keywords**: population; men; women; social support; stroke; stroke risk.*
***Contact**: Valery Vasilyevich Gafarov; **valery.gafarov@gmail.com***
***For reference:** Gafarova AV, Gromova EA, Panov DO et al. Social support and stroke risk: an epidemiological study of a population aged 25–64 years in Russia/Siberia (the WHO MONICA-psychosocial program). Nevrologiya, neiropsikhiatriya, psikhosomatika = Neurology, Neuropsychiatry, Psychosomatics. 2019;11(1):12–20.*
***DOI**: 10.14412/2074-2711-2019-1-12-20*

Stroke is the fourth leading cause of death in the world and often leads to serious long-term disability as well as deterioration in the quality of life of both patients and their families. Therefore, stroke prevention is a public health priority [1]. It is believed that social environment has a huge impact on the physical and psychological health and human well-being [2]. Social support demonstrates the structure of people's relationships in terms of quality and quantity [3], i.e., social support can be viewed in the structure of both family (relationships with loved ones, emotional care, instrumental help, information support) and social relationships (relationships in society) [3]. It is important to study the level of support between relatives and inside the families and integration into society because there are differences in the type, frequency, intensity and degree of support [4].

Previous epidemiological studies have shown that insufficient social network and lack of social support are associated with an increase in the incidence of coronary heart disease [5] and heart failure [6] but only a few studies have estimated the association of these factors with the risk of stroke [7].

The mechanisms underlying these associations are not fully elucidated but probably include behavioral (non-compliance with diet, smoking, alcohol consumption and low physical activity) [8] and physiological (presence of hypertension, diabetes, obesity and increased levels of C-reactive protein [CRP]) [9] components. Perhaps, a certain role is played by psychological stress (depression, feeling of loneliness or life exhaustion) [10]. At the same time, there is evidence that low levels of social network (close contact) and lack of social support are associated with a greater risk of stroke regardless of behavioral factors and other major stroke risk factors [11].

**The aim** was to study the influence of the level of social support (index of close contacts [ICC], social networks index [SNI]) on the risk of stroke in the open population of 25–64 years old in Novosibirsk.

**Patients and methods.** Under the III screening of the WHO MONICA-psychosocial program (Monitoring morbidity and mortality trends from cardiovascular diseases and their determinants) [12] a random representative sample of an open population aged of 25–64 years in the Oktyabrsky district of Novosibirsk was surveyed in 1994 (657 men, mean age – 44.3 ± 0.4 years, response – 82.1%; 689 women, mean age – 45.4 ± 0.4 years, response – 72.5%). This sample was compiled in accordance with the requirements of the WHO MONICA – psychosocial protocol [12].

The screening program included the following items:

1. *Registration of socio-demographic data, according to the standard epidemiological protocol of the WHO MONICA-psychosocial WHO program*: identification number, place of residence, full name, date of birth, date of registration. Gender: 1 – male, 2 – female. The distribution by age group is presented in Table 1.

Marital status (Table 2), educational level (Table 3), and occupation (Table 4) were evaluated.

2. *Testing by psychosocial methods to assess the level of social support (Social Support, Berkman-Syme test)* [13]. ICC (consisting of 17 points and rated as low, medium, high) and SNI (comprising 9 points and rated as low, medium-1, medium-2, high) were determined. The subjects were asked to independently answer the questions of the scale according to the instructions. The analyzed level of risk factor was assumed to be its value in the initial study, and the contribution of time dynamics was not taken into consideration.

The techniques were strictly standardized and complied with the requirements of the WHO MONICA-psychosocial protocol. [12].

The processing of the material under the WHO MONICA-psychosocial program was carried out at the MONICA Information Collection Center (Helsinki, Finland). Quality control was carried out at MONICA Quality Control Centers: Dundee (Scotland), Prague (Czech Republic), Budapest (Hungary). The results were judged to be satisfactory. [12].

Women and men with identified cardiovascular pathology (coronary heart disease, cerebrovascular diseases, arterial hypertension, myocardial infarction), diabetes developed before or during the screening were excluded from the study. The analysis included 384 women and 190 men at the baseline age of 25–64 years. The period of prospective observation of the participants was 16 years.

**Table 1. Distribution by age group of population aged 25–64 years (III screening, 1994)**

| Gender | Age group, years | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | 25–34 | | 35–44 | | 45–54 | | 55–64 | | |
| | n | % | n | % | n | % | n | % | |
| Males | 169 | 50.8 | 136 | 45.9 | 177 | 47.7 | 175 | 50.6 | 657 |
| Females | 164 | 49.2 | 160 | 54.1 | 194 | 52.3 | 171 | 49.4 | 689 |
| Total | 333 | 100 | 296 | 100 | 371 | 100 | 346 | 100 | 1346 |
| $\chi^2$=2.087, df=3, p=0.555 | | | | | | | | | |

**Table 2. Marital status in the population of 25–64 years old (III screening, 1994)**

| Gender | Marital status | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | never married | | married | | divorced | | widowed | | |
| | n | % | n | % | n | % | n | % | |
| Males | 45 | 51.1 | 559 | 51.7 | 40 | 35.7 | 13 | 20 | 657 |
| Females | 43 | 48.9 | 522 | 48.3 | 72 | 64.3 | 52 | 80 | 689 |
| Total | 88 | 100 | 1081 | 100 | 112 | 100 | 65 | 100 | 1346 |
| $\chi^2$=33.113, df=3, p=0.0001 | | | | | | | | | |

**Таблица 3. Educational level in the population 25–64 years old (III screening, 1994 )**

| | Educational level | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gender | university | | uncompleted university course/ college | | secondary | | uncompleted secondary/ primary | | Total |
| | n | % | n | % | n | % | n | % | |
| Males | 186 | 49.2 | 178 | 44.3 | 150 | 49.2 | 143 | 55.6 | 657 |
| Females | 192 | 50.8 | 224 | 55.7 | 155 | 50.8 | 114 | 44.4 | 685 |
| Total | 378 | 100 | 402 | 100 | 305 | 100 | 257 | 100 | 1342 |
| $\chi^2$=8.133, df=3, p=0.043 | | | | | | | | | |

The end point of the study was the first occurrence of stroke. Sources used to identify cases of stroke included: annual surveys of people in the population cohort, medical histories, hospital discharge reports, district clinics, death certificates, interviews with relatives, pathoanatomical and forensic medical reports. 35 cases of new-onset stroke in women and 22 in men were revealed during the follow-up period in this cohort. The authors proved that psychosocial factors are independent risk factors for stroke [12].

Statistical analysis was performed using the SPSS version 11.5 software package [14]. To test the statistical significance of differences between the groups, the Pearson _2 test was used [15]. For assessing the risk of incidence hazard ratio (HR) or its 95% confidence interval (CI, minimum – maximum) depending on different control times, univariate and multivariate Cox-regression proportional hazards model was used [16]. In all types of analysis differences were considered significant if p-value was $\leqslant 0.05$ ($p \leqslant 0.05$).

**Results.** In the open population of 25–64 years old, a low ICC was detected in 62% of men and 56.8% of women ($\chi^2$ = 22.603, df = 2, p = 0.0001). When distributed by age groups, the

**Table 4. Professional level in the population of 25–64 years old (III screening, 1994)**

| Gender | Occupational status | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TE | | MM | | FLM | | engineers | | WHPL | | WMPL | | WEPL | | students | | retired | | Total |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | |
| Males | 28 | 84,8 | 55 | 55,6 | 65 | 50,8 | 84 | 42 | 144 | 88,9 | 167 | 63,3 | 21 | 17,1 | 9 | 81,8 | 84 | 34,7 | 657 |
| Females | 5 | 15,2 | 44 | 44,4 | 63 | 49,2 | 116 | 58 | 18 | 11,1 | 97 | 36,7 | 102 | 82,9 | 2 | 18,2 | 158 | 65,3 | 605 |
| Total | 33 | 100 | 99 | 100 | 128 | 100 | 200 | 100 | 162 | 100 | 264 | 100 | 123 | 100 | 11 | 100 | 242 | 100 | 1262 |
| $\chi^2$=238,16, df=8, p=0,001 | | | | | | | | | | | | | | | | | | | |

Note. Abbreviations here and in Tables 10, 11, 14, 15: TE – top executives; MM – middle managers; FLM- first-line managers; WHPL – workers of hard physical labor; WMPL – workers of moderate physical labor; WEPL –workers of easy physical labor.

**Table 5. The level of social support in the population of 25–64 years old (III screening, 1994)**

Age groups, years

| Index | 25–34 | | | | 35–44 | | | | 45–54 | | | | 55–64 | | | | 25–64 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | male | | female | | male | | female | | male | | female | | male | | female | | male | | female | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| ICC: | | | | | | | | | | | | | | | | | | | | |
| low | 102 | 63.8 | 82 | 57.7 | 85 | 55.9 | 86 | 60.6 | 79 | 64.2 | 72 | 54.1 | 102 | 64.6 | 71 | 54.2 | 368 | 62 | 311 | 56.8 |
| medium | 39 | 24.4 | 50 | 35.2 | 44 | 28.9 | 45 | 31.7 | 33 | 26.8 | 52 | 39.1 | 37 | 23.4 | 55 | 42 | 153 | 25.9 | 202 | 36.9 |
| high | 19 | 11.9 | 10 | 7 | 23 | 15.1 | 11 | 7.7 | 11 | 8.9 | 9 | 6.8 | 19 | 12 | 5 | 3.8 | 72 | 12.1 | 35 | 6.4 |
| Total | 160 | 100 | 142 | 100 | 152 | 100 | 142 | 100 | 123 | 100 | 133 | 100 | 158 | 100 | 131 | 100 | 593 | 100 | 548 | 100 |
| | $\chi^2$=5.27, υ= 2, p=0.072 | | | | $\chi^2$=3.917, υ=2, p=0.141 | | | | $\chi^2$=4.388, υ=2, p=0.111 | | | | $\chi^2$=14.85, υ=2, p=0.0001 | | | | $\chi^2$=2.603, υ=2, p=0.0001 | | | |
| SNI: | | | | | | | | | | | | | | | | | | | | |
| low | 80 | 50 | 47 | 33.1 | 55 | 36.2 | 56 | 39.4 | 50 | 38.8 | 47 | 35.3 | 75 | 47.8 | 36 | 27.5 | 260 | 43.5 | 186 | 33.9 |
| medium-1 | 42 | 26.3 | 64 | 45.1 | 58 | 38.2 | 54 | 38 | 44 | 34.1 | 57 | 42.9 | 53 | 33.8 | 62 | 47.3 | 197 | 32.9 | 237 | 43.2 |
| medium-2 | 28 | 17.5 | 28 | 19.7 | 33 | 21.7 | 29 | 20.4 | 26 | 20.2 | 23 | 17.3 | 21 | 13.4 | 31 | 23.7 | 108 | 18.1 | 111 | 20.3 |
| high | 10 | 6.3 | 3 | 2.1 | 6 | 3.9 | 3 | 2.1 | 9 | 7 | 6 | 4.5 | 8 | 5.1 | 2 | 1.5 | 33 | 5.5 | 14 | 2.6 |
| Total | 160 | 100 | 142 | 100 | 152 | 100 | 142 | 100 | 129 | 100 | 133 | 100 | 157 | 100 | 131 | 100 | 598 | 100 | 548 | 100 |
| | $\chi^2$=15.894, υ=3, p=0.001 | | | | $\chi^2$=1.071, υ=3, p=1 | | | | $\chi^2$=2.489, υ=3, p=0.651 | | | | $\chi^2$=17.727, υ=3, p=0.0001 | | | | $\chi^2$=21.546, υ=2, p=0.0001 | | | |

lowest ICC was observed in men 55–64 years old: 64.6% ($\chi^2$ = 14.85, df = 2, p = 0.0001) and in women 35–44 years old: 60.6% ( $\chi^2$ = 3.917, df = 2, p = 0.141; Table. 5).

43.5% of males and 33.9% of females in the investigated population had a low SNI ($\chi^2$ = 21.546, df = 2, p = 0.0001). The lowest SNI was detected in young men 25–34 years old: 50% ($\chi^2$ = 15.894, df = 3, p = 0.001) and women 35–44 years old: 39.4% ($\chi^2$ = 1.071, df = 3, p = 1; see Table 5).

Table 6 shows distribution by ICC level and marital status. ICC was the lowest in unmarried men – 85% ($\chi^2$ = 9.681, df = 2, p = 0.008) and divorced women – 60.3% ($\chi^2$ = 8.687, df = 2; p = 0.013).

Similarly, a low SNI was observed more often in men who never married – 63.2% ($\chi^2$ = 25.374, df = 3, p = 0.0001), and in

**Table 6. ICC and marital status in the population of 25–64 years old (III screening, 1994)**

| ICC | Marital status | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | never married | | | | married | | | | divorced | | | | widowed | | | |
| | male | | female | | male | | female | | male | | female | | male | | female | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| low | 34 | 85. | 17 | 51.5 | 271 | 59.7 | 238 | 57.3 | 26 | 78.8 | 35 | 60.3 | 9 | 81.8 | 21 | 50 |
| medium | 5 | 12.5 | 14 | 42.4 | 121 | 26.7 | 146 | 35.2 | 5 | 15.2 | 23 | 39.7 | 1 | 9.1 | 19 | 4.2 |
| high | 1 | 2.5 | 2 | 6.1 | 62 | 13.7 | 31 | 7.5 | 2 | 6.1 | 0 | 0 | 1 | 9.1 | 2 | 4.8 |
| Total | 40 | 100 | 33 | 100 | 454 | 100 | 415 | 100 | 33 | 100 | 58 | 100 | 11 | 100 | 42 | 100 |
| | $\chi^2$=9.681, df=2, p=0.008 | | | | $\chi^2$=13.09, df=2, p=0.001 | | | | $\chi^2$=8.687, df=2, p=0.013 | | | | $\chi^2$=4.866, df=2; p=0.088 | | | |

**Table 7. SNI and marital status in the population of 25–64 years old (III screening, 1994)**

| SNI | Marital status | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | never married | | | | married | | | | divorced | | | | widowed | | | |
| | male | | female | | male | | female | | male | | female | | male | | female | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| low | 24 | 63.2 | 5 | 15.2 | 182 | 41.1 | 143 | 34.6 | 22 | 61.1 | 27 | 46.6 | 8 | 66.7 | 11 | 27.5 |
| medium-1 | 6 | 15.8 | 21 | 63.6 | 150 | 33.9 | 172 | 41.6 | 5 | 13.9 | 23 | 39.7 | 4 | 33.3 | 18 | 45 |
| medium-2 | 4 | 10.5 | 7 | 21.2 | 85 | 19.2 | 86 | 20.8 | 8 | 22.2 | 8 | 13.8 | 0 | 0 | 9 | 22.5 |
| high | 4 | 10.5 | 0 | 0 | 26 | 5.9 | 12 | 2.9 | 1 | 2.8 | 0 | 0 | 0 | 0 | 2 | 5 |
| Total | 38 | 100 | 33 | 100 | 443 | 100 | 413 | 100 | 36 | 100 | 58 | 100 | 12 | 100 | 40 | 100 |
| | $\chi^2$=25.374, df=3, p=0.0001 | | | | $\chi^2$=10.308, df=3, p=0.021 | | | | $\chi^2$=8.392, df=3; p=0.05 | | | | $\chi^2$=7.472, df= 2, p=0.076 | | | |

**Table 8. ICC and educational level in the population of 25–64 years old (III screening, 1994)**

| ICC | Educational level | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | university | | | | uncompleted university course/ college | | | | secondary | | | | uncompleted secondary/ primary | | | |
| | male | | female | | male | | female | | male | | female | | male | | female | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| low | 105 | 64.8 | 94 | 59.1 | 88 | 59.9 | 93 | 53.1 | 84 | 66.1 | 72 | 58.1 | 63 | 61.8 | 49 | 57.0 |
| medium | 43 | 26.5 | 55 | 34.6 | 39 | 26.5 | 68 | 38.9 | 24 | 18.9 | 48 | 38.7 | 26 | 25.5 | 30 | 34.9 |
| high | 14 | 8.6 | 10 | 6.3 | 20 | 13.6 | 14 | 8 | 19 | 15 | 4 | 3.2 | 13 | 12.7 | 7 | 8.1 |
| Total | 162 | 100 | 159 | 100 | 147 | 100 | 175 | 100 | 127 | 100 | 124 | 100 | 102 | 100 | 86 | 100 |
| | $\chi^2$=2.716, df=2, p=0.257 | | | | $\chi^2$=6.672, df=2, p=0.036 | | | | $\chi^2$=18.672, df=2, p=0.0001 | | | | $\chi^2$=2.492, df=2, p=0.288 | | | |

**Table 9. SNI and educational level in the population of 25–64 years old (III screening, 1994)**

| SNI | Educational level | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | university | | | | uncompleted university course/ college | | | | secondary | | | | uncompleted secondary/ primary | | | |
| | male | | female | | male | | female | | male | | female | | male | | female | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| low | 64 | 42.1 | 55 | 34.6 | 72 | 49.7 | 55 | 31.4 | 61 | 48.8 | 50 | 40.3 | 39 | 36.4 | 23 | 26.7 |
| medium-1 | 52 | 34.2 | 70 | 44 | 43 | 29.7 | 81 | 46.3 | 33 | 26.4 | 46 | 37.1 | 37 | 34.6 | 40 | 46.5 |
| medium-2 | 28 | 18.4 | 27 | 17 | 23 | 15.9 | 35 | 20 | 23 | 18.4 | 27 | 21.8 | 23 | 21.5 | 21 | 24.4 |
| high | 8 | 5.3 | 7 | 4.4 | 7 | 4.8 | 4 | 2.3 | 8 | 6.4 | 1 | 0.8 | 8 | 7.5 | 2 | 2.3 |
| Total | 152 | 100 | 159 | 100 | 145 | 100 | 175 | 100 | 125 | 100 | 124 | 100 | 107 | 100 | 86 | 100 |
| | $\chi^2$=3.265, df=3, p=0.477 | | | | $\chi^2$=14.537, df=3, p=0.003 | | | | $\chi^2$=8.99, df=3, p=0.038 | | | | $\chi^2$=5.72, df=3, p=0.167 | | | |

divorced women – 46.6% ($\chi^2$ = 25.374, df = 3, p = 0.0001; Table 7).

The lowest ICC was found in men (66.1%) and women (58.1%) with a medium level of education ($\chi^2$ = 18.672, df = 2, p = 0.0001; Table 8).

Table 9 shows correlation between SNI and educational level of the study participants. A low SNI was more common in men with uncompleted university course or college education – 49.7% ($\chi^2$ = 18.672, df = 2, p = 0.0001) and in women with high school education – 40.3% ($\chi^2$ = 8.99 , df = 3, p = 0.038).

Low ICC rates were significantly more often found in those males who were engineers (63.9%) than in females of the same group (49.4%; $\chi^2$ = 8.99, df = 3, p = 0.038; Table 10).

A low SNI was also significantly more frequently observed in men (50.7%) than in women (28.1%) who were engineers ($\chi^2$=10,705, df=3, p=0,017; Table 11).

During the follow-up period the risk of stroke in persons with a low ICC was 3.5-fold increased in men (95% CI 1.42–7.69; p <0.05) and 3.6-fold increased in women (95% CI 1.5–8.7; p <0.01) (Table 12).

The risk of stroke in men with a low SNI over 16 years was 3.4 times higher (95% CI 1.28-5.46; p<0.001), and in women – 2.3 times higher (95% CI 1.18-4.49; p<0.05; Table 13).

In the Cox multivariate proportional hazards model which included social gradient and age, the risk of stroke was 2 times higher in men with a low ICC (95% CI 1.27–3.61; p <0.01) and 4.13 times higher in women (95% CI 1.67–10.16; p<0.01). The combination of a low ICC and primary education increased the risk in both men (HR 2.2; 95% CI 1–4.5; p <0.05) and women (HR 6.26; 95% CI 1, 2–32.7; p <0.05) compared to persons with a university degree and higher ICC values. Also, the risk of stroke was higher only in women who had low and medium levels of ICC (HR 5.66; 95% CI 1.12–28.46; p <0.05) and uncompleted university education or college education (HR 5.17; 95% CI 1.2-22.29; p <0.05). The risk of stroke was 5.9 times higher in men engaged in manual labor with a low ICC (95% CI 2.1–16; p <0.001) compared to those who were in executive positions with a higher ICC. This indicator was also higher in divorced (HR 6.9; 95% CI 3.6–13; p <0.001) and widowed (HR 6.4; 95% CI 2.6–16; p <0.001) men with a low ICC versus married men with medium and above levels of ICC. At the age group of 55–64 years old with a low ICC the risk of stroke was 2.7 times higher in men (95% CI 1.4-5.2; p <0.01) and 5.19 times higher in women (95 % CI 1.11-24.23; p <0.05) compared to those aged 25–54 years with medium and above levels of ICC (Table 14).

After adjustment for social gradient and age in the multivariate analysis, the risk of stroke increased in those with a low SNI in both men (HR 2.2; 95% CI 1.3-3.8; p <0.01) and women (HR 2.23; 95% CI 1.1-4.49; p <0.05). The risk was higher in men (HR 2.8; 95% CI 1.4-5.7; p <0.01) and women (HR 5.74; 95% CI 1.19-27.62; p < 0.05) with primary education and low SNI values. It was also higher in women with uncompleted university education/ college education (HR 4.46; 95% CI 1.14-17.52; p <0.05) and secondary education (HR 4.91; 95% CI 1.07-22.4; p <0.05) with a low SNI, compared to women with a university degree and a higher SNI. Men engaged in moderate manual labor and having low SNI levels had a higher risk of stroke (HR 4,8; 95% CI 1,7-13; p<0,01) compared to managers. Divorced (HR 6,6; 95% CI 3-12,6; p<0,0001) and widowed men (HR 6,9; 95% CI 2,8-17; p<0,0001) with a low SNI had a higher risk of stroke compared to married men with medium and above levels of SNI. The risk of stroke was 2.3-fold increased in men aged 55–64 with a low SNI (95% CI 1,2-4,5; p<0,01) compared to those aged 25–54 with higher levels of SNI (Table 15).

**Discussion.** In this survey we explored social interactions and social support represented by two indices – ICC and SNI – in an open working-age population aged 25–64 years. Our estimates showed that a large number of men (62%) and women (56.8%) had a low level of ICC. Low ICC levels were detected in 60.6% of middle-aged women and 64.6% of older men who had a

## Table 11. SNI and occupational status in the population of 25–64 years old (III screening, 1994)

| SNI | Occupational status | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TE | | | | MM | | | | FLM | | | | engineers | | | | WHPL | | | | WMPL | | | | WEPL | | | |
| | male | | female | | male | | female | | male | | female | | male | | female | | male | | female | | male | | female | | male | | female | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| low | 11 | 44, | 1 | 20 | 17 | 43.6 | 14 | 35.9 | 21 | 39.6 | 19 | 40.4 | 37 | 50.7 | 25 | 28.1 | 51 | 44 | 4 | 33.3 | 55 | 41.7 | 29 | 37.2 | 7 | 43.8 | 38 | 41.8 |
| medium-1 | 8 | 32 | 2 | 40 | 10 | 25.6 | 20 | 51.3 | 21 | 39.6 | 20 | 42.6 | 26 | 35.6 | 39 | 43.8 | 32 | 27.6 | 7 | 58.3 | 44 | 33.3 | 31 | 39.7 | 7 | 43.8 | 29 | 31.9 |
| medium-2 | 5 | 20 | 1 | 20 | 10 | 25.6 | 5 | 12.8 | 9 | 17 | 6 | 12.8 | 8 | 11 | 23 | 25.8 | 27 | 23.3 | 1 | 8.3 | 22 | 16.7 | 14 | 17.9 | 1 | 6.2 | 23 | 25.3 |
| high | 1 | 4 | 1 | 20 | 2 | 5.1 | 0 | 0 | 2 | 3.8 | 2 | 4.3 | 2 | 2.7 | 2 | 2.2 | 6 | 5.2 | 0 | 0 | 11 | 8.3 | 4 | 5.1 | 1 | 6.2 | 1 | 1.1 |
| Total | 25 | 100 | 5 | 100 | 39 | 100 | 39 | 100 | 53 | 100 | 47 | 100 | 73 | 100 | 89 | 100 | 116 | 100 | 12 | 100 | 132 | 100 | 78 | 100 | 16 | 100 | 91 | 100 |
| | $\chi^2$=2.28, df=3, p=0.705 | | | | $\chi^2$=7.29, df=3, p= 0.082 | | | | $\chi^2$=0.366, df=3, p=1,000 | | | | $\chi^2$=10.705, df=3, p=0.017 | | | | $\chi^2$=5.391, df=3, p= 0.193 | | | | $\chi^2$=1.563, df=3, p= 0.914 | | | | $\chi^2$=4.711, df=3, p= 0.259 | | | |

## Table 11. SNI and occupational status in the population of 25–64 years old (III screening, 1994)

| SNI | Occupational status | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TE | | | | MM | | | | FLM | | | | engineers | | | | WHPL | | | | WMPL | | | | WEPL | | | |
| | male | | female | | male | | female | | male | | female | | male | | female | | male | | female | | male | | female | | male | | female | |
| | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % |
| low | 11 | 44, | 1 | 20 | 17 | 43.6 | 14 | 35.9 | 21 | 39.6 | 19 | 40.4 | 37 | 50.7 | 25 | 28.1 | 51 | 44 | 4 | 33.3 | 55 | 41.7 | 29 | 37.2 | 7 | 43.8 | 38 | 41.8 |
| medium-1 | 8 | 32 | 2 | 40 | 10 | 25.6 | 20 | 51.3 | 21 | 39.6 | 20 | 42.6 | 26 | 35.6 | 39 | 43.8 | 32 | 27.6 | 7 | 58.3 | 44 | 33.3 | 31 | 39.7 | 7 | 43.8 | 29 | 31.9 |
| medium-2 | 5 | 20 | 1 | 20 | 10 | 25.6 | 5 | 12.8 | 9 | 17 | 6 | 12.8 | 8 | 11 | 23 | 25.8 | 27 | 23.3 | 1 | 8.3 | 22 | 16.7 | 14 | 17.9 | 1 | 6.2 | 23 | 25.3 |
| high | 1 | 4 | 1 | 20 | 2 | 5.1 | 0 | 0 | 2 | 3.8 | 2 | 4.3 | 2 | 2.7 | 2 | 2.2 | 6 | 5.2 | 0 | 0 | 11 | 8.3 | 4 | 5.1 | 1 | 6.2 | 1 | 1.1 |
| Total | 25 | 100 | 5 | 100 | 39 | 100 | 39 | 100 | 53 | 100 | 47 | 100 | 73 | 100 | 89 | 100 | 116 | 100 | 12 | 100 | 132 | 100 | 78 | 100 | 16 | 100 | 91 | 100 |
| | $\chi^2$=2.28, df=3, p=0.705 | | | | $\chi^2$=7.29, df=3, p= 0.082 | | | | $\chi^2$=0.366, df=3, p=1,000 | | | | $\chi^2$=10.705, df=3, p=0.017 | | | | $\chi^2$=5.391, df=3, p= 0.193 | | | | $\chi^2$=1.563, df=3, p= 0.914 | | | | $\chi^2$=4.711, df=3, p= 0.259 | | | |

**Table 12. ICC and stroke risk in the population of 25–64 years old (Cox proportional hazards univariate model)**

| Follow-up, years | Age groups, years | male | | | | female | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | p | HR | 95% CI | | p | HR | 95% CI | |
| | | | | min | max | | | min | max |
| 16 | 25–64 | 0.02 | 3.5 | 1.428 | 7. 93 | 0.004 | 3.639 | 1.511 | 8.766 |

**Таблица 13. SNI and stroke risk in the population of 25–64 years old (Cox proportional hazards univariate model)**

| Follow-up, years | Age groups, years | male | | | | female | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | p | HR | 95% CI | | p | HR | 95% CI | |
| | | | | min | max | | | min | max |
| 16 | 25–64 | 0.001 | 3.4 | 1.285 | 5.462 | 0.014 | 2.309 | 1.188 | 4.491 |

**Table 14. ICC and stroke risk in the population of 25–64 years old (Cox proportional hazards multivariate model)**

| **Reference group** | **Controls** | **male** | | | | **female** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | p | HR | 95% CI | | p | HR | 95% CI | |
| ICC: high and medium | low | 0.008 | 2 | 1.27 | 3.61 | 0.002 | 4.13 | 1.67 | 10.16 |
| Education: university | uncompleted university course/ college | 0.3 | 1.45 | 0.62 | 3.29 | 0.027 | 5.17 | 1.2 | 22.29 |
| | secondary | 0.7 | 0.8 | 0.3 | 2.3 | 0.035 | 5.66 | 1.12 | 28.46 |
| | uncompleted secondary/ primary | 0.027 | 2.2 | 1 | 4.5 | 0.029 | 6.26 | 1.2 | 32.7 |
| Occupational status: managers | WHPL | 0.4 | 1.5 | 0.4 | 5.6 | 0.99 | 1.11 | 0.002 | 4.88 |
| | WMPL | 0.001 | 5.9 | 2.1 | 16 | 0.99 | 1.740 | 0.066 | 5.209 |
| | WEPL | 0.1 | 2.4 | 0.5 | 7.1 | 0.91 | 5.77 | 0.95 | 4.24 |
| Marital status: married | never married | 0.9 | 0.9 | 0.2 | 4 | 0.322 | 1.884 | 0.538 | 6.603 |
| | divorced | 0.001 | 6.9 | 3.6 | 13 | 0.542 | 0.736 | 0.275 | 1.970 |
| | widowed | 0.001 | 6.4 | 2.6 | 16 | 0.273 | 0.320 | 0.042 | 2.456 |
| Age, years: 25–54 | 55–64 | 0.003 | 2.7 | 1.4 | 5.2 | 0.036 | 5.19 | 1.11 | 24.23 |

**Table 15. SNI and stroke risk in the population of 25–64 years old (Cox proportional hazards multivariate model)**

| Reference group | Controls | male | | | | female | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | p | HR | 95% CI | | p | HR | 95% CI | |
| SNI: high and medium | low | 0.002 | 2.2 | 1.3 | 3.8 | 0.025 | 2.23 | 1.1 | 4.49 |
| Education: university | uncompleted university course/ college | 0.5 | 1.2 | 0.5 | 2.8 | 0.032 | 4.46 | 1.14 | 17.52 |
| | secondary | 0.3 | 0.5 | 0.2 | 1.6 | 0.04 | 4.91 | 1.07 | 22.4 |
| | uncompleted secondary/ primary | 0.003 | 2.8 | 1.4 | 5.7 | 0.029 | 5.74 | 1.19 | 27.62 |
| Occupational status: managers | WHPL | 0,8 | 1.1 | 0.3 | 4 | 0.526 | 1.363 | 0.523 | 3.550 |
| | WMPL | 0.002 | 4.8 | 1.7 | 13 | 0.352 | 0.388 | 0.053 | 2.857 |
| | WEPL | 0.2 | 1.7 | 0.6 | 5 | 0.930 | 1.786 | 0.654 | 3.897 |
| Marital status: married | never married | 0.9 | 0.9 | 0.2 | 4 | 0.340 | 1.801 | 0.538 | 6.026 |
| | divorced | 0.0001 | 6.6 | 3 | 12.6 | 0.804 | 1.130 | 0.432 | 2.954 |
| | widowed | 0.0001 | 6.9 | 2.8 | 17 | 0.376 | 0.406 | 0.055 | 2.993 |
| Age, years: 25–54 | 55–64 | 0.01 | 2.3 | 1.2 | 4.5 | 0.048 | 4.706 | 1.014 | 21.849 |

3-fold increased risk of stroke. SNI demonstrates the level of integration into society, and we found that it was low in almost one third of men and women. The prevalence of a low SNI was the highest in young men (50%) and middle-aged women (39.4%). The results are consistent with the data from other researchers who have found that from 40% to 70% of the world population either have a low level of social support or are socially isolated [17].

In our study the risk of stroke in both men (HR 3.5) and women (HR 3.6) was about the same within 16 years of follow-up in the population with low ICC levels. After adjustment for social variables (marital status, level of education, occupation and age) the risk of stroke in men decreased and was 2 times higher, but in women it increased and was 4 times higher compared to other participants. The subsequent detailed assessment of risk groups showed that family associated life events were more significant for males than females: the risk of stroke was the highest in divorced (HR 6.9) and widowed (HR 6.4) men with a low ICC. No such patterns were found in women, although the lowest ICC level was noted in divorced women. The combination of a low ICC with primary education increased the risk of stroke both in men (HR 2.2) and women (HR 6.26). Higher education and medium and above ICC proved to be protective factors in terms of stroke risk in women. But the risk of stroke was 5 times higher in women with a low ICC and uncompleted higher or secondary education. Occupational status was of great importance for men. The risk of stroke in those engaged in manual labor was 6 times higher compared to managers. A low SNI increased the risk of stroke both in men (HR 3.4) and women (HR 2.3) over the 16 year period of follow-up. The risk of stroke adjusted for social status and age, did not significantly influence the general picture neither in men (HR 2.2), nor in women (HR 2.23). A more detailed analysis showed that a combination of primary education and a low SNI was an adverse prognostic factor of stroke both in men (HR 2.8) and in women (HR 5.7). The risk of stroke was higher in women with a low SNI associated with uncompleted higher (HR 5.17) or secondary education (HR 5.66). Occupational status was essential for men: the risk of stroke was 6 times higher in those with moderate physical labor and a low SNI, compared to managers.

Additionally, we explored the risk of stroke depending on marital status together with SNI levels. The risk of stroke was higher in divorced (HR 6.9) and widowed (HR 6.4) men with a low SNI, compared to married ones. The risk was also higher in the age group of 55–64 years old, both in men and women, compared to other age groups with SNI of medium and high levels.

The results of this study were consistent with a systematic review of nine independent studies (total sample – 2577 cases) [17] which included our earlier study [18]. According to this review, the mean risk of stroke was 1.32 (95% CI 1.04-1.68; $p<0.05$). It should be noted, that socially isolated people are at a greater risk of stroke due to lack of family support, low level of education and socio-economic status, poor awareness of a healthy lifestyle and prevention of cardiovascular diseases. [19, 20]. All of this becomes an obstacle to raising awareness about risk factors of cardiovascular diseases and reduces the opportunity of their timely prevention. [18, 20].

The study showed that solving the problem of a low level of social integration can play an important role in preventing stroke as one of the main causes of morbidity in Russia.

**Conclusion.** Low ICC levels were observed in 62% of men and 56.8% of women, and low SNI levels – in 43.5% and 33.9%, respectively, in the open general population aged 25–64 years. We found an increased risk of stroke in persons with a low ICC (in men it was 3.5 times higher and in women – 3.6 times higher) and in persons with a low SNI ( in men – 3.4 times higher, in women – 2.3 times higher) over 16 years of follow-up, using univariate analysis. Multivariate model after adjustment for social factors and age revealed an increased risk of stroke in persons with low levels of social support. Men with a disadvantageous marital status, moderate physical labor, and women with a low level of education were at risk.

## REFERENCES


1. Go AS, Mozaffarian D, Roger VL, et al. Heart disease and stroke statistics-2014 update: a report from the American Heart Association. *Circulation*. 2014 Jan 21;129(3):e28-e292. doi: 10.1161/01.cir.0000441139.02102.80. Epub 2013 Dec 18.
2. Everson-Rose SA, Lewis TT. Psychosocial factors and cardiovascular diseases. *Annu Rev Public Health*. 2005;26:469-500. doi: 10.1146/annurev.publhealth.26.021304.144542
3. Arthur HM. Depression, isolation, social support, and cardiovascular disease in older adults. *J Cardiovasc Nurs*. 2006 Sep-Oct;21 (5 Suppl 1):S2-7; quiz S8-9.
4. Berkman LF, Glass T, Brissette I, Seeman TE. From social integration to health: Durkheim in the new millennium. *Soc Sci Med*. 2000 Sep; 51(6):843-57.
5. AndrO-Petersson L, Hedblad B, Janzon L, Estergren PO. Social support and behavior in a stressful situation in relation to myocardial infarction and mortality: who is at risk? Results from prospective cohort study «Men born in 1914,» Malmö, Sweden. *Int J Behav Med*. 2006; 13(4):340-7. doi: 10.1207/s15327558ijbm 1304_9
6. Cene CW, Loehr L, Lin FC, et al. Social isolation, vital exhaustion, and incident heart failure: findings from the Atherosclerosis Risk in Communities Study. *Eur J Heart Fail*. 2012 Jul;14(7):748-53. doi: 10.1093/eurjhf/hfs064. Epub 2012 May 14.
7. Rutledge T, Linke SE, Olson MB, et al. Social networks and incident stroke among women with suspected myocardial ischemia. *Psychosom Med*. 2008 Apr;70(3):282-7. doi: 10.1097/PSY.0b013e3181656e09. Epub 2008 Mar 31.
8. Ikeda A, Iso H, Kawachi I, et al. Social support and stroke and coronary heart disease: the JPHC study cohorts II. *Stroke*. 2008 Mar;39(3): 768-75. doi: 10.1161/STROKEAHA.107.496695. Epub 2008 Jan 31.
9. Loucks EB, Sullivan LM, D'Agostino RB, et al. Social networks and inflammatory markers in the Framingham Heart Study. *J Biosoc Sci*. 2006 Nov;38(6):835-42. Epub 2006 Jan 27.
10. Stuller KA, Jarrett B, DeVries AC. Stress and social isolation increase vulnerability to stroke. *Exp Neurol*. 2012 Jan;233(1):33-9. doi: 10.1016/j.expneurol.2011.01.016. Epub 2011 Jan 28.
11. Nagayoshi M, Everson-Rose SA, Iso H, et al. Social Network, Social Support, and Risk of Incident Stroke: The Atherosclerosis Risk in Communities Study. *Stroke*. 2014 Oct;45(10): 2868-73. doi: 10.1161/STROKEAHA.114. 005815. Epub 2014 Aug 19.
12. MONICA Monograph and Multimedia Sourcebook. Helsinki; 2003.
13. Stringhini S, Berkman L, Dugravot A, et al. Socioeconomic status, structural and functional measures of social support, and mortality: The British Whitehall II Cohort Study, 1985-2009. *Am J Epidemiol*. 2012 Jun 15;175(12):1275-83. doi: 10.1093/aje/kwr461. Epub 2012 Apr 24.
14. Бююль А, Цёфель П. SPSS: искусство обработки информации. Анализ статистических данных и восстановление скрытых закономерностей. Санкт-Петербург: DiaSoftЮП; 2015. [Byuyul' A, Tsefel' P. *SPSS: iskusstvo obrabotki informatsii. Analiz statisticheskikh dannykh i vosstanovlenie skrytykh zakonomernostei* [SPSS: the art of information processing. Analysis of statistical data and the restoration of hidden patterns]. Saint-Petersburg: DiaSoftYuP; 2015.]
15. Гланц К. Биомедицинская статистика. Москва: Практика; 1998. 459 с. [Glants K. *Biomeditsinskaya statistika* [Biomedical statistics]. Moscow: Praktika; 1998. 459 p.
16. Cox DR. Regression Models and Life Tables. *Journal of the Royal Statistical Society Series B*. 1972;34:187-220.
17. Valtorta NK, Kanaan M, Gilbody S, et al. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. *Heart*. 2016 Jul 1;102(13): 1009-16. doi: 10.1136/heartjnl-2015-308790. Epub 2016 Apr 18.
18. Gafarov V, Panov D, Gromova E, et al. Low social support as predictor of long-term risk of stroke in female population in Russia: MONICA-psychosocial epidemiological study. *Eur J Intern Med*. 2013;24(1):e47.
19. Soulsby LK, Bennett KM. Marriage and Psychological Wellbeing: The Role of Social Support Department of Psychological Sciences. *Psychology*. 2015;6(11):1349-59. doi: 10.4236/psych.2015.611132
20. Olomu AB, Grzybowski M, Ramanath VS, et al. Evidence of disparity in the application of quality improvement efforts for the treatment of acute myocardial infarction: the American College of Cardiology's Guidelines Applied in Practice Initiative in Michigan. *Am Heart J*. 2010 Mar;159(3):377-84. doi: 10.1016/j.ahj.2009.12.014.


Article received 16.08.2018