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Psychosocial Factors and the Risk of Type 2 Diabetes Mellitus in Women Population based Epidemiological Study

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ARTICLE INFO

Article history

Received: 21 August 2020

Accepted: 30 August 2020

Published Online: 30 September 2020

Keywords:

Depression

Social support

Diabetes

Female population

Risk

ABSTRACT

Our aim was to study the effect of depression and social support on the risk of type 2 diabetes in female population aged 25-64 in Russia / Siberia. Under the screening surveys random representative samples of women aged 25-64 years were examined in 1994 and 2005. Depression assessment was performed using the MONICA- MOPSY test. Social support was measured using the Berkman-Sim test. From 1994 to 2018 in a cohort of women new-onset cases of diabetes mellitus were detected. The risk of T2DM in persons with depression was 1.844 ($p < 0.01$). After adjusting for socio-demographic variables, the risk decreased by 6% but remained significantly significant ($p < 0.05$). The impact of a low level of social relations showed a significant effect on the risk of diabetes mellitus, including the multivariate model adjusted for the social gradient (HR=1.833, $p < 0.05$). The presence of psychosocial factors decreases the protective effect of education in diabetes incidence. The incidence of T2D was higher in the group of manual labor and in executives. Depression and low social support increase the risk of T2DM by 80%. The frequencies of T2DM are determined by the social gradient and are associated with the role conflict "family-work".

1. Introduction

The prevalence of type 2 diabetes mellitus (T2DM) is increasing annually in Russia. According to the 'State Register of Diabetes', it is estimated 3,000 per 100,000 of the population in the Siberian Federal District^[1]. The WHO statement, that 9.6% of women aged 25 years and older with diagnosed diabetes T2DM in the European region, illustrates the global concern and the lack

of effectiveness in risk management. The identification of new risk factors for T2DM and the search for ways to manage these factors is another challenge to the scientific community.

In a number of studies the growing interest in depression (D), as a new risk factor for T2DM, demonstrates the prognostic impact of depression in developing type 2 diabetes. It was detected that T2DM is often combined with D in a number of studies. They are mainly carried out in

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groups of patients, and the cross-sectional design may also make it difficult to establish, 'Which came first: diabetes mellitus or depression?' However, the first epidemiological studies on the impact of D on the risk for T2DM were limited to a male sample^[2] or based on diabetes reported by the respondents that was not confirmed by any other methods^[3]. The importance of social support (SP) in the control / management of T2DM is widely recognized^[4]. But the effect on glycemic control remains unclear. SP is a multidimensional quantity associated with individual perceptions and receiving support from their family, friends, etc., traditionally identified by two indicators: level of close contacts and social networking development^[5]. In this case, the positive impacts or lack of support leading to social isolation have a direct or indirect effect on health, for example, through health-related behavior.

In general, women with a low level of social support are characterized by a more unfavorable lifestyle than people with a high level of SP. Such women smoke more, pay less attention to physical activity, and less often measure blood pressure^[6]. It is worth noting that such a negative component of SP as loneliness leads to high rates of depressive symptoms in women^[7]. At the same time, social support can reduce the influence of negative psychosocial characteristics, for instance, hostility or D symptoms on aggressive behavior towards health (smoking, alcohol, nutrition)^[8,9].

The frontiers of research on impact of psychosocial factors (PSF) on the risk for T2DM are restricted by the classical epidemiological approaches, which are significant moderators of heterogeneity of results. Therefore, our objective was to study the prevalence and evaluate the impact of depression and social support on the risk of developing type 2 diabetes in the open population among women.

2. Materials and Methods

2.1. Study Design

The results of our study were obtained from the survey of the female population living in one of the districts in Novosibirsk. The screening examinations were performed at the Research Institute of Therapy and Preventive Medicine - a branch of the ICG SB RAS 1994-95 and 2003-2005 (scientific topic # AAAA-A17-117112850280-2). Samples were generated independently for each of the epidemiological programs, according to the requirements of protocol. Screening among female population in 1994-95 and 2003-2005 was conducted under the WHO MONICA-MOPSY program (Multinational Monitoring of Trends and Determinants of Cardiovascular Disease - Op-

tional Psychosocial Substudy). Quality assurance was carried out at the MONICA quality control centers: Dundee (Scotland), Prague (Czech Republic), Budapest (Hungary). The presented results were found satisfactory^[10].

2.2 Participants

As part of the screening in 1994-95, 870 women aged 25-64 years were examined, the average age was 45.4 + 0.4 years^[10]. The sample was generated using the electoral lists and a table of random numbers of 300 people in each age group (total - 1,200 people). The mechanical random sampling procedure was used. The response screening is 72.5%. In 2003-2005 the people aged 45-69 years were examined in the same district of the city (women - n = 1294, average age - 54.27 + 0.2 years, response - 72%). Subsequently, women over 64 were excluded from the analysis.

Of all people examined, a cohort study was designed in 1994-5 and 2003-5. 1619 women aged 25-64 years with completed questionnaires for depression and SP were included in the analysis after excluding from the study all women with T2DM that occurred prior to screening or identified by screening. The follow-up period, on average, was 15 years.

2.3 Outcome Measures

The substantive outcomes reported in this study were incidence of type 2 diabetes mellitus. All incidence of diabetes were recorded based on cohort study (screening, medical records, autopsy protocols), as well as using the WHO epidemiological program 'Register of acute myocardial infarction'. 134 incident cases of type 2 diabetes mellitus were diagnosed according to the ICD-10 classification from 1994 to 2018. Other types of diabetes were not considered and were not included in the analysis. Taking hypoglycemic drugs was not taken into account, either.

2.4. Psychosocial Factors Measures

The WHO MONICA-MOPSY (Multinational Monitoring of Trends and Determinants of Cardiovascular Disease - Optional Psychosocial Substudy) program was used to measure psychosocial factors^[10]. To evaluate depression, we used the form of the depression scale - the MOPSY test (Depression Scale), consisting of 15 questions. For each question there are 2 answers given: 'agree', 'disagree'. The severity of depression was assessed as no depression (No D), moderate (Mod. D), major (Major D). Social support was measured using the Berkman-Sim test^[5]; The Close Contact Index (ICC) and Social Relations Index (SNI) were taken into account. ICC

levels were rated as high, medium, low; SNI - high, mid-1, mid-2, low.

2.5. Other Social Factor Measurements

Social and demographic indicators were registered. Marital status: single, married, divorced, widowed. The level of education was evaluated as: higher, incomplete higher - secondary special, secondary, incomplete secondary - primary. The attitude to the professional group was evaluated as: (1) Executives. (2) Middle managers. (3) First-line managers. (4) Engineers, specialists. (5) Hard manual workers. (6) Moderate physical labor workers. (7) Easy manual workers. (8) Students. (9) Retired people. (10) Military personnel.

2.6. Statistical Analyzes

Statistical analysis was carried out with the SPSS (Statistical Package for the Social Science) software package, version 11.5. To test the statistical significance of differ-

ences between groups, the chi-square test (χ^2) was used. A p-values ≤ 0.05 were considered statistically significant. Cox-proportional regression model (Cox-regression) was used to assess the relative risk of developing diabetes.

2.7. Ethical Expertise

This study has been approved by the Local Biomedical Ethics Committee (protocol No. 4 of 10/15/2009).

3. Results

The prevalence of D in the open population among women aged 25-64 years was found 54.6% (Major D - 11.8%) in 1994; in the age group 45-64 years, the frequency of D was 58.9% (Major D - 11.5%). At a screening in 2003-2005, among women aged 45-64 years, the frequency of D was 36.4% (Major D - 4.7%). In the studied cohort among people with T2DM, the frequency of D was higher and estimated 51.3%.

Table 1. The prevalence of depression in the open population among women aged 25-64 years

	Screening 1994-1995 yy								Screening 2003-2005 yy							
	25-34 yy		35-44 yy		45-54 yy		55-64 yy		25-64 yy		45-54 yy		55-64 yy		45-64 yy	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Major D¹	10	9,7	18	13,6	1	2,9	8	18,6	37	11,8	28	5,1	22	4,2	50	4,7
Mod. D²	44	42,7	53	40,2	17	48,6	20	46,5	134	42,8	179	32,3	161	31	340	31,7
No D³	49	47,6	61	46,2	17	48,6	15	34,9	142	45,4	347	62,6	337	64,8	684	63,7
Total	103	100	132	100	35	100	43	100	313	100	554	100	520	100	1074	100
p for all <0.05																

Notes:

¹ Major D - major depression; ² Mod. D - moderate depression; ³ No D - no depression

The prevalence of social support was as follows. The proportion of low and average ICC in the open population among women aged 25-64 was 56.8% and 36.9%, respectively, in 1994; in the age group of 45-64, low ICC was found in 54.2% of women. The screening results in

2003-2005 among women aged 45-64 show that the incidence of low and average ICC was 51.1% and 43.9%, respectively. In a cohort of women with advanced type 2 diabetes, the frequency of low ICC was even higher and estimated 55.8%.

Table 2. The prevalence of levels of close contact in the open population among women aged 25-64 years

	Screening 1994-1995 yy								Screening 2003-2005 yy							
	25-34 yy		35-44 yy		25-34 yy		35-44 yy		25-34 yy		35-44 yy		25-34 yy		35-44 yy	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Low ICC¹	82	57,7	86	60,6	72	54,1	71	54,2	311	56,8	298	53,8	251	48,3	549	51,1
Average ICC²	50	35,2	45	31,7	52	39,1	55	42	202	36,9	231	41,7	240	46,2	471	43,9
High ICC³	10	7	11	7,7	9	6,8	5	3,8	35	6,4	25	4,5	29	5,6	54	5
Total	142	100	142	100	133	100	131	100	548	100	554	100	520	100	1074	100
n.s.								p<0.001		p<0.05		n.s.				

Note:

¹ Low ICC - low index of close contacts; ² Average ICC - average index of close contacts; ³ High ICC - high index of close contacts

The share of low SNI (combined low and average-1) in the open population among women aged 25-64 was 77.1%, average-2 SNI - 20.3%, respectively, in 1994; in the age group 45-64 years, low ICC was found in 76.5% of women. The screen-

ing results in 2003-2005 among women aged 45-64 show that the incidence of low and average SNI was 80.1% and 17.4%, respectively. Among women with advanced type 2 diabetes, the incidence of low SNI was even higher and estimated 87%.

Table 3. The prevalence of levels of social network in the open population among women aged 25-64 years

	Screening 1994-1995 yy								Screening 2003-2005 yy							
	25-34 yy		35-44 yy		25-34 yy		35-44 yy		25-34 yy		35-44 yy		25-34 yy		35-44 yy	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
low SNI ¹	47	33,1	56	39,4	47	35,3	36	27,5	186	33,9	143	25,8	133	25,6	276	25,7
Average - 1 SNI ²	64	45,1	54	38	57	42,9	62	47,3	237	43,2	301	54,3	283	54,4	584	54,4
Average - 2 SNI ³	28	19,7	29	20,4	23	17,3	31	23,7	111	20,3	97	17,5	90	17,3	187	17,4
High SNI ⁴	3	2,1	3	2,1	6	4,5	2	1,5	14	2,6	13	2,3	14	2,7	27	2,5
Total	142	100	142	100	133	100	131	100	548	100	554	100	520	100	1074	100
	p<0.01		n.s.		n.s.		p for all <0.001				n.s.					

Notes:

¹ Low SNI - low social network index; ² Average - 1 SNI - average-1 social network index; ³ Average - 2 SNI - average-2 social network index; ⁴ High SNI - high social network index

The relationship between PSF and the social characteristics of women and the development of T2DM was studied.

The structure of marital status in a cohort of women with developed T2DM and D was as follows: single – 4%; married – 72%; divorced and widowed –12% ($\chi^2 = 14.610$ df = 3 p <0.001). In the presence of D, the proportion of individuals with T2DM was statistically significantly higher among married women ($\chi^2 = 11.362$ df = 1 p <0.001), divorced ($\chi^2 = 6.417$ df = 1 p <0.05) and widowed ($\chi^2 = 5.324$ df = 1 p <0.05) compared with single women, where the incidence of T2DM was higher among individuals without D (4% and 34%, respectively).

The structure of educational level among people with T2DM and D was: higher education - 38%; incomplete higher education / college - 24%; high school - 26% and primary education - 12% (p > 0.05). The trends (p > 0.05) in the increased frequency of T2DM among people with D and higher and primary education are detected; the frequency of T2DM in women with specialized secondary education and high school is higher among the people without D.

Professional status in groups of women with T2DM and D indicated the followings: 6% - executives; 12% - middle manager; 14% - first-line managers; 16% - engineers, specialists; 10% - hard manual workers; 8% - moderate physical labor workers; 14% - easy manual workers; 18% - retired people; 2% - military personnel and persons assimilated thereto (p > 0.05). A significant increase was found in the proportion of hard manual workers among people with D and T2DM compared with a group of women without diabetes (10% and 0.9%, respectively; $\chi^2 = 4.375$ df = 1 p <0.05). Developed T2DM is associated with a reduction in the cumulative share of managers at

all levels in the presence of depression from 51.1% (No D) to 32% (with D), and an increase in the share of manual workers from 14.9% (No D) to 32% (with D) ($\chi^2 = 3.993$ df = 1 p <0.05).

The structure of marital status in a cohort of women with advanced T2DM and low ICC was as follows: single - 23.5%; married - 42.6%; divorced - 19.1% and widowed - 14.7% ($\chi^2 = 29.936$ df = 3 p <0.001). As in the group without diabetes, the proportion of married women with T2DM with a decrease in the index of close contacts was significantly reduced. However, people with advanced diabetes this decrease is less pronounced - from 88.9% (average and higher ICC) to 26% (low ICC) for people without diabetes, and up to 42.6% (low ICC) for people with type 2 diabetes ($\chi^2 = 6.504$ df = 1 p <0.05). The incidence of T2DM in the presence of low ICC is higher among single ($\chi^2 = 13.371$ df = 1 p <0.001), divorced ($\chi^2 = 14.951$ df = 1 p <0.001) and widowed ($\chi^2 = 4.223$ df = 1 p <0.05) than at a higher ICC compared to married ones.

The structure of educational level among people with T2DM and low ICC was: higher education - 38.2%; incomplete higher education / college - 17.6%; high school - 29.4% and primary education - 14.7% (p > 0.05). The trends (p > 0.05) in the increased frequency of T2DM among people with a low ICC compared with a higher ICC for all categories of education are detected, except for the people with specialized secondary education, where the trend reverses.

Professional status in groups of women with T2DM and low ICC indicated the followings: 3.1% - executives; 15.6% - middle managers; 18.8% - first-line managers; 7.8% - engineers, specialists; 4.7% - hard manual workers; 6.3% - moderate physical labor workers; 10.9% - easy

manual workers; 31.3% - retired people; 1.6% - military personnel and assimilated thereto ($p > 0.05$). The proportion of retired people with low ICC and T2DM was higher than in other professional categories, but only in comparison with engineers and specialists reached statistical significance ($\chi^2 = 3.944$ $df = 1$ $p < 0.05$).

The structure of marital status in a cohort of women with advanced T2DM and low SNI was as follows: single - 16%; married - 59.4%; divorced and widowed - 12.3% ($p > 0.05$). As in the group without diabetes, the proportion of married women with T2DM significantly reduced with a decrease in the index of social connectedness ($\chi^2 = 4.329$ $df = 1$ $p < 0.05$), in other categories of marital status, on the contrary, it increased.

The structure of educational level among people with T2DM and low SNI was: higher education - 35.8%; incomplete higher education / college - 23.6%; high school - 27.4% and primary education - 13.2% ($p > 0.05$). The trends ($p > 0.05$) in increased frequency of T2DM among people with low SNI compared with a higher SNI for high school education.

Professional status in groups of women with T2DM

and low SNI indicated the followings : 4.9% - executives; 15.7% - middle managers; 16.7% - first-line managers; 10.8% - engineers, specialists; 5.9% - hard manual workers; 8.8% - moderate physical labor workers; 8.8% - easy manual workers; 26.5% - retired people; 2.0% - military personnel and persons assimilated thereto ($p > 0.05$). The presence of T2DM is associated with an increase in the proportion of managers at all levels among people with low SNI to 37.3% (with a favorable SNI of 18.8%), while in the absence of diabetes, the trend reverses ($\chi^2 = 4.413$ $df = 1$ $p < 0.05$)

The risk of T2DM in individuals with depression was determined to be 1.844 (95% CI 1.238-2.746, $p < 0.01$). After standardization by age, the risk decreased by 21%, but still remained significant and estimated 1.633 (95% CI 1.083-2.461, $p < 0.05$). The inclusion of social characteristics in a multivariate model, such as marital status (reference category 'married'), educational level (reference category 'higher'), and professional status (reference category 'executive') increased the risk of T2DM by 1.781 times in people with D (tab. 4), compared with those ones who did not have D (95% CI 1.173-2.706, $p < 0.01$).

Table 4. The risk of type 2 diabetes mellitus depending on the level of depression, age and social characteristics in the female population aged 25-64 years

	B 1	SE 2	Wald 3	df 4	Sig.5	Exp(B) 6	95,0% CI 7 for Exp(B)	
							Lower	Upper
Depression	,577	,213	7,330	1	,007	1,781	1,173	2,706
25-34 years 8			23,394	2	,000			
45-54 years	-2,351	,511	21,201	1	,000	,095	,035	,259
55-64 years	-2,487	,518	23,031	1	,000	,083	,030	,230
Married 9			1,184	3	,757			
Single	,283	,273	1,071	1	,301	1,327	,777	2,266
Divorced	,277	,411	,454	1	,500	1,319	,589	2,953
Widowed	,123	,402	,094	1	,760	1,131	,515	2,484
University 10			3,566	3	,312			
College	-,260	,282	,845	1	,358	,771	,444	1,341
High School	,236	,302	,609	1	,435	1,266	,700	2,290
Elementary	,376	,490	,589	1	,443	1,457	,557	3,810
Executives 11			11,946	9	,216			
MidManagers12	,298	,513	,336	1	,562	1,347	,493	3,683
Managers 13	,174	,517	,114	1	,736	1,190	,432	3,278
Engineers	-,286	,546	,275	1	,600	,751	,257	2,192
Easy Manual	,782	,683	1,310	1	,252	2,186	,573	8,336
Mod. Manual 14	-,129	,631	,042	1	,838	,879	,255	3,031
Hard Manual	-,604	,615	,965	1	,326	,547	,164	1,824
Students	-9,800	214,802	,002	1	,964	,000	,000	3,836
Retired	,333	,535	,388	1	,533	1,395	,489	3,978
Military	-,886	1,109	,638	1	,425	,412	,047	3,626

Notes:

¹ B - regression coefficient; ² SE - standard error; ³ Wald - Wald criterion; ⁴ df - number of degrees of freedom; ⁵ Sig. - statistical significance; ⁶ Exp(B) - B exponent; ⁷ CI - confidence interval; ⁸ Age groups; ⁹ Marital status; ¹⁰ Educational level; ¹¹ Occupation; ¹² MidManagers - Middle managers; ¹³ Managers - First-line managers; ¹⁴ Mod. Manual - Moderate physical labor workers

The impact of social support has displayed an array of results. So, in the one factor model, the low close contact index - ICC indicated only the risk trend for T2DM (HR = 1.208 95% CI 0.845-1.727, p> 0.05) compared with people with a higher (good + average) level of close contacts. The correction for social variables in the multivariate model increased the risk of T2DM with a low ICC by 29%, but the significance of the results was higher than the confidence threshold (p> 0.05). Standardization by age indicated a lack of significant results.

But the influence of a low level of social connectedness (SNI, where low and average-1 is combined into the “low” category) indicated a significant effect on the risk of T2DM (HR = 1.713 95% CI 1.012-2.897, p <0.05). In a multifactor model with an indicator of social connectedness, the addition of social characteristics explained a 12% increase in the risk of T2DM in people with an undeveloped social network compared to a good SNI index (Table 5), while the results remained significant (HR = 1.833 95% CI 1.064-3.158, p <0.05).

Table 5. The risk of type 2 diabetes mellitus depending on the level of social connectedness and social characteristics in the female population aged 25-64 years

	B ¹	SE ²	Wald ³	df ⁴	Sig. ⁵	Exp(B) ⁶	95,0% CI ⁷ for Exp(B)	
							Lower	Upper
Low SNI ⁸	,606	,277	4,773	1	,029	1,833	1,064	3,158
Married ⁹			4,799	3	,187			
Single	-,585	,267	4,787	1	,029	,557	,330	,941
Divorced	-,121	,310	,152	1	,697	,886	,483	1,626
Widowed	-,096	,298	,104	1	,748	,909	,507	1,629
University ¹⁰			22,573	3	,000			
College	-,331	,267	1,537	1	,215	,718	,426	1,212
High School	,183	,282	,421	1	,517	1,201	,691	2,088
Elementary)	1,296	,355	13,354	1	,000	3,654	1,824	7,320
Executives ¹¹			9,968	9	,353			
MidManagers ¹²	,344	,509	,457	1	,499	1,411	,520	3,826
Managers ¹³	,291	,513	,322	1	,570	1,338	,489	3,662
Engineers	,049	,529	,008	1	,927	1,050	,372	2,960
Easy Manual	1,240	,643	3,718	1	,054	3,454	,980	12,179
Mod. Manual ¹⁴	,452	,578	,613	1	,434	1,572	,507	4,874
Hard Manual	-,097	,569	,029	1	,864	,907	,298	2,765
Students	-9,246	210,023	,002	1	,965	,000	,000	5,710
Retired	,518	,511	1,028	1	,311	1,678	,617	4,565
Military	-,090	,849	,011	1	,915	,914	,173	4,820

Notes:

¹ B - regression coefficient; ² SE - standard error; ³ Wald - Wald criterion; ⁴ df - number of degrees of freedom; ⁵ Sig. - statistical significance; ⁶ Exp(B) - B exponent; ⁷ CI - confidence interval; ⁸ Low SNI - low social network index; ⁹ Marital status; ¹⁰ Educational level; ¹¹ Occupation; ¹² MidManagers - Middle managers; ¹³ Managers - First-line managers; ¹⁴ Mod. Manual - Moderate physical labor workers

The addition of an age correction to the multivariate model reduced the reliability of the results, but the ten-

dency for risk of T2DM in individuals with low SNI still remained (HR = 1.674 95% CI 0.967-2.895, p = 0.066)

(Figure 1).

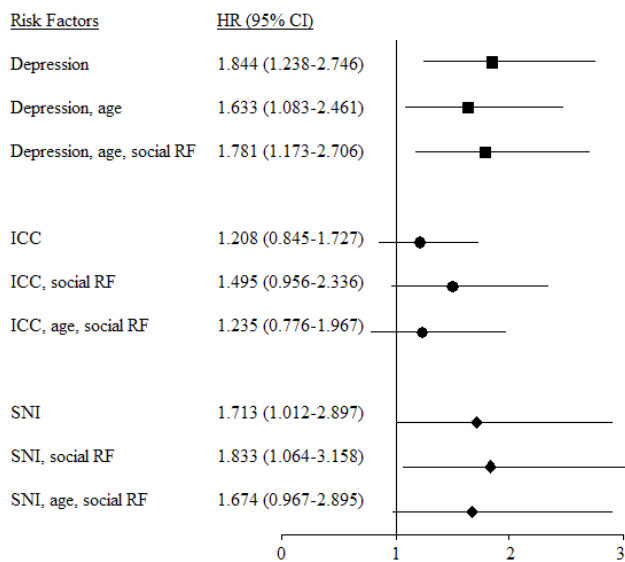


Figure 1. Psychosocial factors and risk of T2DM in female population of 25-64 years: D - depression; ICC - index of close contacts; SNI - social network index; Social RF - social risk factors

4. Discussion

This study showed a high prevalence of D and low SP among the female population. From the example of the female part of the urban population in Russia, the impact of depression and low SP on the risk of T2DM was first detected using classical epidemiological approaches.

The prevalence of D in the open population among women aged 25-64 years was 54.6% in 1994, the frequency of Major D was 11.8%; in 2005 - 36.4% (Major D - 4.7%). The decrease in the frequency of D in the age groups 45-64 years by 2005 does not contradict the global trend in increasing D, where this growth is provided by the youngest (18-25 years old) and older (> 65 years old) age groups^[11]. It should be noted that the prevalence of Major D in Russia / Siberia is lower than in high-income countries such as France - 20%, the Netherlands - 17.9% or the USA - 19.2%, and is comparable to countries with lower middle income, where the frequency of Major D is, on average, 11.1%^[12].

Considering the concept of health as a set of biological, psychological, social, cultural, economic and spiritual factors, it should be recognized that the sphere of mental health is not a simple biological or psychological aspect of it, which has a social dimension and nature. SP is such a value, which plays an important part in the creation, maintenance and health promotion, as well as in the incidence of chronic non-communicable diseases^[5].

No significant dynamics was found in the prevalence of SP from 1994 to 2005: low levels of close contacts, on average, was 53%, and social connectedness - 79%. Thus, more than half of the female population in Russia had an unfavorable level of social support. This part of the female population facing with stressful events is deprived of physical and psychological benefits which provides tangible support, and unable to cope with the consequences of psychological distress^[13].

The high correlation of PSF with socio-demographic variables, both according to our previous studies and other researchers, is related to the need to include in the model an adjustment for such variables as marital status, education, professional status^[5].

The family environment changes the level of close contacts in people with and without diabetes. Our results indicate that married women are more likely to have higher ICC levels both among people with and without diabetes. This is due to the lack of significant results in the risk of developing T2DM in people with low ICC, in a multivariate model adjusted for social variables, where, among others, marital status was taken into account. At the same time, married women show a higher incidence of depression: among people with D and developing T2DM, the proportion of married women was 72%. These indicators are associated with family stress and the personal work-family conflict, which lead to adverse consequences for somatic health^[14,15].

The results showed that the presence of D among women with higher and primary education increased the incidence of type 2 diabetes. A similar trend was indicated with a low level of ICC, which eliminates the protective effect of education at risk of developing diabetes. This reflects the independent impact of negative affective states on the risk of T2DM, confirmed in other cohort studies^[3,16].

With regard to professional status, it was indicated that the incidence of T2DM was higher in the manual labor group in combination with D. With regard to social connections, on the contrary, diabetes was more common among women leaders and a low social network. Recent studies have shown an adverse impact of manual labor on the risk of developing T2DM among men, but not women^[17,18]. And this connection can be weakened by traditional factors, such as obesity^[18]. Our results fill this gap by representing management at high risk for diabetes. The higher prevalence of T2DM in the group of managers with low social integration, as well as physical labor in women with D, shows the vulnerability of these occupational categories to the risk of developing diabetes. The low-skilled labor in our recent studies, as well as the work-family conflict that characterizes managers, are the

factors of higher psychosocial stress and, combined with PSF, are associated with the risk of serious cardiovascular catastrophes^[5,15].

The increase in the risk of type 2 diabetes by 1.8 times among the female population with D underlines the importance of studying this psychological factor. The correction for socio-demographic indicators slightly reduced this risk, which demonstrates the independent effect of the presence of depression in the development of T2DM. Recent foreign studies confirm such conclusions [16, 19]. Possible mechanisms include the effect of D on behavioral aspects such as physical activity, diet, and adherence to prevention methods^[20]. Biological mechanisms of influence include activation of the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system^[21].

The influence of a low level of social connectedness showed a significant effect on the risk of developing T2DM, including in a multi-factor model adjusted for a social gradient. The information about the effect of SP on the risk of T2DM is limited in the available literature. Similar studies were performed in groups of patients with T2DM or had a cross-sectional design, or surrogate endpoints, such as glycated hemoglobin, were estimated^[22-25]. One prospective design study published in 2019 had a similar design. For 14 years, American colleagues studied the effect of SP on the risk of T2DM in 139,924 women aged 50-79 years and obtained the similar results. They indicated that the risk of T2DM among women with high levels of SP is reduced, regardless of demographic and behavioral factors. The authors specify that indicators of social connectedness / interactions have a direct effect on the risk of T2DM, although they do not exclude an indirect effect through lifestyle and symptoms of depression^[26].

Identifying the strengths and weaknesses of our study, we note that this study provided a single measurement of PSF in 1994 and 2005, followed by assessment of the effect such as risk factors. However, this is not a limitation, since American researchers (Carnethon M. et al.) proved the sustained effect of both the once recorded signs of D and the persistent form of D on the risk of T2DM, regardless of traditional factors: BMI, physical activity, smoking, etc.^[27]. Our results fill a gap in epidemiological studies on the effect of PSF on the risk of T2DM. It makes it necessary to the assessment of nonconventional - psychosocial factors in addition to traditional risk factors of diabetes.

5. Conclusions

(1) It was estimated that the prevalence of depression in the open population among women aged 25-64 years in

1994 was 54.6% (Major depression - 11.8%); 45-64 years old- 58.9% (Major depression - 11.5%); in 2003-2005 aged 45-64 - 36.4% (Major depression - 4.7%). Among people with type 2 diabetes, the frequency of depression was higher and amounted to 51.3%.

(2) It was established that the proportion of the low index of close contacts in the open population among women aged 25-64 years was 56.8%; aged 45-64 - 54.2%. Among women with advanced type 2 diabetes mellitus, the frequency of low close contact index was 55.8%. The share of the low index of social connectedness was 77.1%; aged 45-64 - 80.1%. among women with type 2 diabetes mellitus, the incidence of a low index of social connectedness was 87%.

(3) The results show that the risk of type 2 diabetes mellitus in individuals with depression was significantly higher than without depression and amounted to 1.844 (95% CI 1.238-2.746, $p < 0.01$). After adjusting for socio-demographic variables, the risk decreased by 6%, but still remained significant ($p < 0.05$).

(4) It was indicated that a low level of social connectedness significantly affects the risk of developing type 2 diabetes mellitus, including in a multivariate model adjusted for social factors (HR = 1.833 95% CI 1.064-3.158, $p < 0.05$).

(5) We got proof that there is relationship between the social gradient and depression and type 2 diabetes mellitus among women: 1. the proportion of married women was 72%; 2. the presence of psychosocial factors mitigates the protective effect of education in the development of type 2 diabetes; 3. the frequency of type 2 diabetes was higher in the manual labor group in combination with D; 4. diabetes was more common among women leaders with a low social network.

Supplementary Materials: No.

Author Contributions: Conceptualization, Gafarov V.; methodology, Gafarov V.; software, Gagulin I.; formal analysis, Gagulin I. and Gromova E.; investigation, Gafarov V., Gagulin I., Gafarova A., Panov D.; data curation and processing, Gafarov V., Gagulin I., Gafarova A., Panov D and Gromova E.; writing-original draft preparation, Panov D.; writing-review and editing, Gafarov V. All authors have read and agreed to the published version of the manuscript.

Funding: “This research received no external funding”

Conflicts of Interest: “The authors declare no conflict of interest.”

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