

Sleep disturbances and physical activity as risk factors for cardiovascular diseases in an open population of Novosibirsk aged 45–64 years (WHO MONICA-MOPSY program)

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Abstract

Objective. This study aimed to assess the association between sleep disturbances and physical activity as the risk factors for cardiovascular diseases in an open population aged 45–64 years of Novosibirsk.

Materials and methods. The IVth screening of random representative sample of the population aged 45–64 years was carried out between 2003–2005 years and included 1650 participants (men (n=576), mean age 54.23 ± 0.2 years, response rate 61%; women (n= 1074), mean age — 54.27 ± 0.2 years, response — 72%). Physical activity was assessed using the scale “Knowledge and attitude towards one’s own health” of WHO “MONICA-Psychosocial” program. The Jenkins Sleep Evaluation Questionnaire was used to study sleep disorders.

Results. In an open population aged 45–64 years, 74.2% of participants experienced sleep disturbances; 65.8% of men (satisfactory sleep — 53.6%, poor sleep — 12.2%) and 78.6% of women (satisfactory sleep — 58.9% and poor sleep — 19.7%) ($\chi^2 = 38.553$ df= 2; $p < 0.001$). Among men who described their sleep as “poor”, 35.7% believed that they “should exercises, but they don’t” and 28.6% “tried, but unsuccessfully” ($\chi^2 = 27.850$ df= 8; $p < 0.001$). Among women who believed that their sleep was “poor”, 47.2% answered “I should exercise, but I don’t” ($\chi^2 = 26.453$ df= 8; $p < 0.001$). Men who spend their leisure time “physically passive” more often characterized their sleep as “poor” (24.3%) than “good” (21.8%) ($\chi^2 = 92.019$ df= 6; $p < 0,0001$). To the question: “Has your physical activity changed over the past 12 months?” 30.4% of men and 35.3% of women of working age answered that they be-

came “less mobile”, among them 40% of men ($\chi^2 = 22.929$ df= 4; $p < 0.0001$) and 34.9% of women ($\chi^2 = 58.992$ df= 4; $p < 0.0001$), believed that they had “poor” sleep. Among participants who answered to the question “How do you rate your physical activity compared to other people your age?” that they were “somewhat more passive”, 7.1% of men ($\chi^2 = 28.520$ df= 8; $p < 0.0001$), and 11.3% of women ($\chi^2 = 90.554$ df= 8; $p < 0.0001$) had “poor” sleep.

Conclusion. The association between sleep disturbances and physical activity among men and women aged 45–64 years of Novosibirsk population was established. Considering close relationship between sleep disturbances and low physical activity, further prospects open up to investigate the combined effect of the above factors on cardiovascular health.

Keywords: sleep disturbance, physical activity, population, risk, cardiovascular disease.

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Introduction

Sleep disturbances, including chronic insomnia, are major public health issues [1]. The prevalence of sleep disorders ranges from 25% to 48% worldwide that indicates that these disorders are relatively common [2]. Sleep disturbances are mainly associated with chronic fatigue, impaired sustained attention and working memory, as well as reduced quality of life [3]. It is also noteworthy that numerous studies

have demonstrated the association between sleep impairment and cardiovascular diseases as the leading causes of death [4].

Physical activity is one of the major factors for health maintenance [5]. Regular physical activity reduces the prevalence of cardiovascular [6], metabolic [7] and neurodegenerative disorders [8], and decreases all-cause mortality [5].

Both insufficient sleep and low physical activity are associated with poor health outcomes, and those who are more physically active tend to have better sleep [9]. Therefore, physical activity may improve sleep quality, and vice versa sleep may lead to greater physical activity, however the direction of these relationship has not been clearly established yet [10].

Nevertheless, there is little evidence to establish optimal type or minimum level of daily physical activity that can positively affect sleep quality and provide clear guidance for public health or clinical interventions for insomnia. Given research data to date, the activity level that was recommended by the World Health Organization (WHO) in 2010 and have been included into the guidelines for promoting cardiovascular health worldwide seems to be the best candidate: 150 minutes of moderate-intensity physical activity per week that is usually mistaken for walking [11].

Therefore, this study aimed to assess the relationship between sleep disturbances and physical activity as cardiovascular risk factors in an open population aged 45–64 years in Novosibirsk.

The study has been approved by the Ethics Committee of the National Research Center for Therapy and Preventive Medicine—a branch of the Institute of Cytology and Genetics of the Russian Academy of Sciences, protocol № 1 from 14th of March, 2002, and protocol № 12 from 8th of December, 2020.

Materials and methods

The IVth population screening have been performed between 2003–2005 years and included 1650 people from Oktyabrsky district of Novosibirsk who formed random representative sample aged 45–64 years (men $n = 576$, mean age — 54.23 ± 0.2 years, response — 61%; women — $n = 1074$, mean age — 54.27 ± 0.2 years, response — 72%) [12]. response — 72%). Daily physical activity was assessed using the scale “Knowledge and attitude towards one’s own health”. The Jenkins Sleep Evaluation Questionnaire was used to study sleep disorders and sleep duration. The scale has been validated in the course of large-scale epidemiological study carried out in the framework of the WHO MONICA program (Multinational Monitoring of Trends and Determinants of Cardiovascular Disease) and the MONICA-Psychosocial Optional Study (MOPSY) subprogram between 1988–1994 [13]. The questionnaires were filled out by the participants themselves.

Statistical analysis has been performed using the SPSS 19 software [12]. The Pearson’s chi-square X^2 test has been used to assess the significance of differences between groups. The significance level was set as $p < 0.05$.

Results

In the open population aged 45–64 years, 74.2% of participants experienced sleep disturbances: 65.8% of men (satisfactory sleep — 53.6%, poor sleep — 12.2%) and 78.6% of women (satisfactory sleep — 58.9% and poor sleep — 19.7%) ($\chi^2 = 38.553$; $df = 2$ $p < 0.001$) (Table 1).

Table 1. Self-reported sleep quality in an open population aged 45–64 years old

Sleep quality	men		women		total	
	n	%	n	%	n	%
Good sleep	197	34,2	229	21,3	426	25,8
Satisfactory sleep	309	53,6	633	58,9	942	57,1
Poor sleep	70	12,2	212	19,7	282	17,1
Total	576	100	1074	100	1650	100

Note. $\chi^2 = 38,553$ $df = 2$; $p < 0,001$

Among study participants aged 45–64 years, only 14% of men and 10.3% of women regularly exercised, and “good” sleep prevailed both among men (17.3%) and women (15, 7%) from this group. The most popular answer among both women (34.4%) and men (40.8%) was: “I should exercise, but I don’t”. Men who assessed their sleep as “poor” more often believed that they “should exercise, but they don’t” — 35.7%, and 28.6% “tried, but unsuccessfully” ($\chi^2 = 27.850$ $df = 8$; $p < 0.001$). Among women who characterized that their sleep as “poor”, the answer “I should exercise, but I don’t” was more common: 47.2% ($\chi^2 = 26.453$ $df = 8$; $p < 0.001$) (Table 2).

All responders were asked the question: “How do you spend your leisure time?”. The majority of men (45.1%) and women (37.1%) answered “anything happens” and, in this category, 47.1% of men ($\chi^2 = 29.683$ $df = 6$; $p < 0.0001$) and 44.3% of women ($\chi^2 = 92.019$ $df = 6$; $p < 0.0001$) rated their sleep as “poor”. 20.5% of men and 17.4% of women did not perform any physical activity during their leisure time (lying, sitting, watching TV, reading, writing, making something by hand, etc.). Men who spent their leisure time without physical activity more often had poor sleep (24.3%) than good sleep (21.8%) (Table 3).

To the question: “Has your physical activity changed over the past 12 months?” among people of working

Table 2. Sleep disturbances and physical activity in an open population aged 45–64 years of Novosibirsk

	Do you exercise (excluding daily professional activity)?	Good sleep		Satisfactory sleep		Poor sleep		Total	
		n	%	n	%	n	%	n	%
Men*	I don't need it	56	28,4	54	17,5	11	15,7	121	21,0
	I should exercise, but I don't	66	33,5	107	34,6	25	35,7	198	34,4
	I tried, but unsuccessfully	41	20,8	108	35,0	20	28,6	169	29,3
	I exercise regularly	34	17,3	37	12,0	11	15,7	82	14,2
	Physical exercises are contraindicated for me	0	0	3	1,0	3	4,3	6	1,0
	Total	197	100	309	100	70	100	576	100
Women**	I don't need it	23	10,0	51	8,1	26	12,3	100	9,3
	I should exercise, but I don't	93	40,6	245	38,7	100	47,2	438	40,8
	I tried, but unsuccessfully	71	31,0	271	42,8	62	29,2	404	37,6
	I exercise regularly	36	15,7	56	8,8	19	9,0	111	10,3
	Physical exercises are contraindicated for me	6	2,6	10	1,6	5	2,4	21	2,0
	Total	229	100	633	100	212	100	1074	100

Note. * $\chi^2 = 27,850$ df = 8; p < 0,001, ** $\chi^2 = 26,453$ df = 8; p < 0,001

Table 3. Sleep disturbances and leisure time in an open population aged 45–64 years of Novosibirsk

	How do you spend your leisure time?	Good sleep		Satisfactory sleep		Poor sleep		Total	
		n	%	n	%	n	%	n	%
Men*	Physically active (working in the garden, playing sports, walking, cycling, running, etc.)	50	25,4	61	19,7	19	27,1	130	22,6
	Anything happens	94	47,7	133	43,0	33	47,1	260	45,1
	Physically passive (lying, sitting, watching TV, reading, writing, making something by hand, etc.)	43	21,8	58	18,8	17	24,3	118	20,5
	I don't have leisure time	10	5,1	57	18,4	1	1,4	68	11,8
	Total	197	100	309	100	70	100	576	100
Women**	Physically active (working in the garden, playing sports, walking, cycling, running, etc.)	75	32,8	165	26,1	70	33,0	310	28,9
	Anything happens	92	40,2	212	33,5	94	44,3	398	37,1
	Physically passive (lying, sitting, watching TV, reading, writing, making something by hand, etc.)	55	24,0	94	14,8	38	17,9	187	17,4
	I don't have leisure time	7	3,1	162	25,6	10	4,7	179	16,7
	Total	229	100	633	100	212	100	1074	100

Note. * $\chi^2 = 29,683$ df = 6; p < 0,0001, ** $\chi^2 = 92,019$ df = 6; p < 0,0001

Table 4. Sleep disturbances and physical activity in an open population aged 45–64 years of Novosibirsk

	Has your physical activity changed (total mobility, sports, etc.) over the last 12 months?	Good sleep		Satisfactory sleep		Poor sleep		Total	
		%	n	%	n	%	n	%	n
Men*	Yes, I have become more active	20	10,2	25	8,1	5	7,1	50	8,7
	It hasn't change	142	72,1	172	55,7	37	52,9	351	60,9
	I've become less active	35	17,8	112	36,2	28	40,0	175	30,4
	Total	197	100,0	309	100,0	70	100,0	576	100,0
Women**	Yes, I have become more active	38	16,6	34	5,4	7	3,3	79	7,4
	It hasn't changed	145	63,3	340	53,7	131	61,8	616	57,4
	I've become less active	46	20,1	259	40,9	74	34,9	379	35,3
	Total	229	100,0	633	100,0	212	100,0	1074	100,0

Note. * $\chi^2 = 22,929$ df = 4; p < 0,0001, ** $\chi^2 = 58,992$ df = 4; p < 0,0001

age, 30.4% of men and 35.3% of women answered that they have become “less mobile”. Among those who answered that they have become “less mobile”, 40% of men ($\chi^2 = 22.929$ df = 4; p < 0.0001) and 34.9% of women ($\chi^2 = 58.992$ df = 4; p < 0.0001), believed that their sleep was “poor”. Only 8.7% of men and 7.4% of women answered that they became “more physical-

ly active”, among them 10.2% of men and 16.6% of women had “good” sleep (Table 4).

To the question: “How do you rate your physical activity compared to other people your age?” the majority of respondents answered “the same as others” – 60.2% of men and 53.7% of women. Among those who believed that they were “significantly more

Table 5. Sleep disturbances and physical activity in an open population aged 45–64 years of Novosibirsk

	How do you rate your physical activity compared to other people your age?	Good sleep		Satisfactory sleep		Poor sleep		Total	
		n	%	n	%	n	%	n	%
Men*	Significantly more active	31	15,7	32	10,4	2	2,9	65	11,3
	Somewhat more active	49	24,9	59	19,1	18	25,7	126	21,9
	Same as others	108	54,8	199	64,4	40	57,1	347	60,2
	Somewhat more passive	9	4,6	14	4,5	5	7,1	28	4,9
	Significantly more passive	0	0	5	1,6	5	7,1	10	1,7
	Total	197	100	309	100	70	100	576	100
Women**	Significantly more active	56	24,5	44	7,0	24	11,3	124	11,5
	Somewhat more active	74	32,3	137	21,6	47	22,2	258	24,0
	Same as others	83	36,2	391	61,8	103	48,6	577	53,7
	Somewhat more passive	13	5,7	43	6,8	24	11,3	80	7,4
	Significantly more passive	3	1,3	18	2,8	14	6,6	35	3,3
	Total	229	100	633	100	212	100	1074	100

Note. * $\chi^2=28,520$ df=8; $p < 0,0001$, ** $\chi^2=90,554$ df=8; $p < 0,0001$

active” than others, 15.7% of men and 24.5% of women had good sleep. On the contrary, among men and women who answered that they were “somewhat more passive” than others, “bad” sleep prevailed both among men — 7.1% and women — 11.3% (men $\chi^2=28.520$ df=8; $p < 0.0001$ and women $\chi^2=90.554$ df=8; $p < 0.0001$) (Table 5).

Discussion

One of the promising and modern issues for epidemiological and experimental research is: does regular physical activity improve the quality of sleep? The expectation that exercise will improve sleep can be explained by traditional hypotheses that sleep is considered as energy conservation strategy and is essential for body repair or thermoregulatory functions that underpins much of the research in this area. Regular exercise can be beneficial for overall well-being, but can also cause stress [15].

Considering mentioned above background, we analyzed self-reported sleep quality and physical activity among working population aged 45–64 years old. According to our data, 1/3 of population experienced sleep disturbances. Sleep and physical activity affect each other through complex reciprocal relationship that involve various physiological and psychological mechanisms. Physical activity is usually considered beneficial for sleep; however, this association depends on several factors such as gender, age, fitness level, sleep quality and exercise characteristics (intensity, duration, time of the day, environment) [16]. In our study all the participants answered the question “Do you exercise (excluding daily professional activity)?” It turned out that only 14% of men and 10.3% of women regularly exercised, and they more often had

“good” sleep. Men who answered “I should exercise, but I don’t” or “I tried, but unsuccessfully” were more likely to rate their sleep quality as “poor”. Women who rated sleep as “poor” more often believed that “they should exercise, but they don’t.”

WHO in 2010 followed by international healthcare systems recommended to achieve at least minimum level of 150 minutes of moderate-intensity physical activity per 5 days a week [11]. It is also significant not only to do physical exercises, but also to spend leisure time actively in order to achieve result. To the question: “How do you spend your leisure time?” — 2/3 of men and 1/3 of women answered that “anything happens”, and in this category of participants “poor” sleep prevailed. Similarly, among men who spend their leisure time physically passively, “poor” sleep was the most common answer.

It is noteworthy that the change in physical activity affected the quality of sleep just in one year. About 1/3 of the men and women responded that they have become “less active” and the quality of sleep in this category decreased. On the other hand, men and women who answered that they have become “more active” also improved their sleep. In addition, men and women who felt that they have become “significantly more active” than others were more likely to rate their sleep as “good”. Among those who believed that they were “somewhat less active” than people around them “poor” sleep prevailed. Thus, this study confirms that the increase of the level of physical activity improves the quality of sleep and, conversely, the decrease of physical activity leads to sleep impairment [11].

To sum up our findings, exercise can positively affect sleep. The clinical significance of this study is that exercise may represent an alternative or ad-

ditional tool to existing treatment for sleep disturbances. Moreover, physical activity can be used as preventive strategy in clinical practice to manage the first symptoms insomnia before the onset of severe chronic insomnia [17].

Conclusion

The association between sleep disturbances and physical activity in the population of Novosibirsk aged 45–64 years was established.

For the first time in the population of Novosibirsk, it has been shown that men who assessed their sleep

as “poor” more often believed that “they should do exercises, but they don’t,” or “tried, but failed.” Men with sleep disturbances more often spent their leisure time “physically passive”. Among women who believe that their sleep is “poor,” the most common answer was: “I should exercise, but I don’t”. On the other hand, those who were “significantly more active” than others, more often positively assessed their sleep.

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