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REGULAR ARTICLE

The relationship between hypertension and health-related quality of life: adjusted by chronic pain, chronic diseases, and life habits in the general middle-aged population in Japan

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Abstract
Objectives The aim of this study was to examine the relationship between hypertension and health-related quality of life (HRQoL) adjusted by chronic pain, other chronic diseases, and life habits in the general middle-aged population in Japan.
Methods This study is a population-based cross-sectional study. In this study, 1117 participants aged 40–65 years and living in Shika Town completed a self-administered questionnaire including Short Form-36 (SF-36). The scores of SF-36 among hypertensives were compared with those of normotensives. The independent association of hypertension with each SF-36 subscale was analyzed using a multiple linear regression model adjusted by age, BMI, chronic pain, chronic diseases, sleep, exercise, and occupational status. We analyzed two groups; Group 1 which contained 846 participants completed the questionnaire without coronary heart disease and cerebral vascular disease, Group 2 which contained 686 participants without coronary heart disease, cerebral vascular disease, or diseases accompanied by chronic pain (gastroduodenal ulcer, fracture, osteoarthritis, osteoporosis, rheumatoid arthritis, and disc herniation).
Results In Group 2, hypertensive women had a lower general health perception than normotensive women [unstandardized coefficients; $B = -8.84$, 95 % confidence interval (95 % CI) $= -13.3$ to -4.34, standardized coefficients; $\beta = -0.200$, $p < 0.001$], whereas hypertensive men had higher social functioning than normotensive men ($B = 5.66$, 95 % CI $= 1.30$–10.0, $\beta = 0.149$, $p < 0.05$) after adjusting by chronic pain and life habits.
Conclusions These results may be due to the sex difference in the light of the perception for health.

Keywords Health-related quality of life · Hypertension · Chronic pain · Sex difference

Introduction

Hypertension is one of the most common chronic diseases and is a major risk factor for multiple conditions. For example, the development of coronary heart disease (CHD) and cerebral vascular disease (CVD) is a major problem worldwide because around 54 % of strokes and 47 % of CHD cases are attributable to high blood pressure [1]. Hypertension, especially in mild to moderate stages, is usually considered as an asymptomatic condition. Despite the association between hypertension and health-related quality of life (HRQoL) having been focused on for the last several decades and numerous studies having addressed the impact of hypertension, this association is a still controversial issue. The influences of high blood pressure and the awareness of having hypertension require further investigation [2]. Previous studies showed a lower quality of life among subjects with hypertension [3]. By contrast, it has been pointed out that impaired HRQoL in hypertensives may be secondary to the awareness of hypertension and comorbidities not due to hypertension per se [4–9]. The inconsistent results on the association between hypertension and HRQoL might be due to differences in several factors, such as participants, study design, measures of

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HRQoL, and other confounders, but it seems unlikely that there is a simple explanation for it.

Chronic pain is also a common and highly prevalent factor that lowers HRQoL [10–12], however, this is the first study to adjust for chronic pain while studying the relationship between hypertension and HRQoL in the general population.

Many previous studies demonstrated the relationships of CHD [13, 14], CVD [15, 16], asthma or chronic obstructive pulmonary disease [17, 18], several cancers [19, 20], collagen disease [21], and allergic diseases [22, 23] with HRQoL. In addition, there is strong evidence showing that the onset of hypertension is related to bad habits, namely, physical inactivity, bad dietary habits, smoking, and obesity [24, 25]. Bad habits such as in terms of sleep [26, 27], physical activity [28, 29], smoking [30], alcohol consumption [31], and obesity [32–34] also cause lower HRQoL.

To clarify the relationship between hypertension and HRQoL, it is important to analyze subjects without any complications that lower HRQoL apparently and are mostly symptomatic, for example, CVD, CHD, and diseases accompanied by chronic pain. Therefore, we performed a complete survey on the general population in a region in Japan using multidimensional analysis adjusted by chronic pain, other chronic diseases [3, 35, 36] that lower HRQoL, and life habits after excluding subjects with some complications.

Materials and methods

Study design and participants

The study's design was cross-sectional. It was performed in Shika Town, Ishikawa Prefecture, a rural part of Japan, in October to December 2012. The total population of Shika Town is about 23,000 people, and the rate of the population aged over 65 years is 34.5 % (2011), which is higher than that for the whole of Japan (23.3 %, 2011). On September 1, 2005, Togi Town was merged into this town. Therefore, we selected two model districts, Horimatsu District [$n = 2293$ (2011)] and Higashimasuho District [$n = 1411$ (2011)]. These districts almost correspond to the neighborhood association districts of the former Shika Town and the former Togi Town, respectively. Neighborhood associations are voluntary groups whose membership is drawn from a small, geographically delimited, and exclusive residential area (a neighborhood) and whose activities are multiple (for example, waste management, and cultural, sport, and funeral activities) and are centered on that same area [37]. Moreover, the population demographics of these two model districts are similar to that of the whole of Shika Town. A questionnaire was given to all inhabitants aged 40–65 years ($n = 1291$) who lived in these two model districts, by trained interviewers.

Assessment instruments and definitions

We used a self-administered questionnaire that interviewers who were trained in the use of standardized procedures handed to the participants when visiting them; they explained this study and how to complete the questionnaire. A few days later, they visited them again to collect the completed forms, which were put in a sealed envelope.

Demographics

We collected data on general demographic characteristics, including age, sex, family members, occupational status, type of health insurance, housing type, education, height, and weight. Body mass index (BMI) was calculated from the height and weight and categorized as follows: underweight as BMI <18.5 kg/m^2, normal weight as BMI 18.5–24.9 kg/m^2, and overweight or obese as BMI ≥ 25 kg/m^2.

Medical history

We asked the participants to circle all diseases that they had suffered from until the present time by using the disease checklist, including no disease history, hypertension, diabetes mellitus, cerebral infarction, cerebral hemorrhage, angina pectoris, cardiac infarction, cancer, gastroduodenal ulcer, pollenosis, bronchial asthma, atopic dermatitis, depression, insomnia, osteoporosis, rheumatoid arthritis, and disc herniation. In addition, we asked about the conditions of any treatment that they had received [physician-diagnosed and taking medication 1, physician-diagnosed and recovering 2, physician-diagnosed or pointed out in a medical check and observation (including diet and exercise therapy) 3, physician-diagnosed and cessation of treatment 4].

Chronic pain, personal lifestyle, and behavior

Chronic pain was defined as pain that was experienced continuously for more than 3 months, or was experienced more than twice a week and had occurred within the last 1 month. We asked, "Do you have pain that has lasted more than 3 months?", and if participants answered yes, we determined that they had chronic pain. In addition, we asked about the site where they experienced chronic pain (head, neck, shoulder, elbow, hand, back, lower back, hip joint, knee, foot, chest, and abdomen). With regard to exercise, we asked two questions: "How many times do

you exercise a week?" and "How many times do you walk for more than 30 min a day per week?" Participants chose 1 option from 5 (every day, 5–6 times a week, 3–4 times a week, 1–2 times a week, and never). The participants also answered questions about their sleep (sleeping soundly, difficulty falling asleep, nocturnal awakening, and sleeping poorly) in the present month and their smoking history.

Short Form-36

MOS Short Form Health Survey (SF-36) is one of the generic instruments for investigating HRQoL; it is a self-administered questionnaire used all over the world [38]. It was translated, adapted, and validated for use in Japan [39, 40]. The Japanese version of SF-36v2 is now available [41]. The SF-36 was divided into eight domains, measuring physical functioning (PF), role limitation due to physical problems (RP), bodily pain (BP), general health perceptions (GH), vitality (VT), social functioning (SF), role limitation due to emotional problems (RE), and mental health (MH). Each domain was scored on a scale of 0–100, where 0 represented the worst overall health status and 100 the best.

Statistical analysis

We used *t* test and one-way analysis of variance (ANOVA) for continuous variables, and Chi square analysis for categorical variables to analyze the difference between groups of independent variables. Furthermore, we used one-way analysis of covariance (ANCOVA), defining age as a covariate. Multiple linear regression analysis was used to estimate the independent impacts of each variable on the eight SF-36 dimensions stratified by sex. We used independent variables {age, BMI $\geq$ 25 kg/m^2 (no 1, yes 2), hypertension (no 1, yes 2), diabetes mellitus (no 1, yes 2), allergic diseases (no 1, yes 2), cancer (no 1, yes 2), insomnia and depression (no 1, yes 2), chronic pain (no 1, yes 2), occupational status (employed 1, unemployed 2), sleep condition [good (including sleeping soundly) 1, not good (others) 2], and frequency of exercise in a week (more than 1–2 times a week 1, never 2)}. All hypothesis tests were two-sided and $p < 0.05$ was considered significant. All analyses were performed using SPSS ver. 19.0.

Ethics statement

This study was approved by the ethics committee of Kanazawa University (examination number 1373). All participants provided written informed consent for the study.

Results

Participant characteristics

A flow chart of the participants in this study is shown in Fig. 1. A total of 1117 participants (response rate: 86.5 %) returned the questionnaire and agreed to participate, and 879 participants completed the questionnaire about diseases, BMI, SF-36, and chronic pain. We defined 846 participants as "Group 1" after excluding 33 participants with CVD or CHD. Then, we defined 686 participants as "Group 2" after excluding 160 participants with diseases accompanied by chronic pain (gastroduodenal ulcer, fracture, osteoarthritis, osteoporosis, rheumatoid arthritis, and disc herniation).

There were no significant differences in the general characteristics and prevalence of disease between Group 1 and Group 2 (Table 1). In Group 2, mean age was 54.2 years old and 54.2 % were women. In addition, 25.2 % of the men and 20.4 % of the women reported hypertension.

Relationship between participant characteristics, diseases, and HRQoL adjusted by age

Table 2 displays the relationships between participant characteristics and the scores of SF-36 in Group 2. Men and women aged 60–65 had higher VT and MH than those aged 40–49. After adjusting by age, men who were overweight or obese had significantly lower PF than those with normal BMI. Although men who were underweight were very few in number ($n = 6$), they had significantly lower RP, GH, VT, SF, RE, and MH than those who had a normal BMI or were overweight. Participants with chronic pain and those who slept poorly had significantly lower scores for almost all of SF-36. Men who had a habit of exercising more than 1–2 times a week scored higher on PF, VT, SF, and MH than those who did not exercise. Finally, the unemployed had significantly lower RP, SF, and RE in men, and lower PF, RP, and GH in women.

Participants with no disease showed significantly higher HRQoL, whereas those with a disease showed lower HRQoL in both Group 1 and Group 2 (Table 3). Hypertensive women in Group 1 showed lower GH and VT than normotensive women after adjusting by age. In addition, hypertensive women showed lower PF and BP in Group 2. An exception to this relationship was recognized in hypertensive men in Group 2. In Group 1, there was no difference in the scores of SF-36 subscales between hypertensive men and normotensive men after adjusting by age. In Group 2, however, hypertensive men were associated with higher SF.

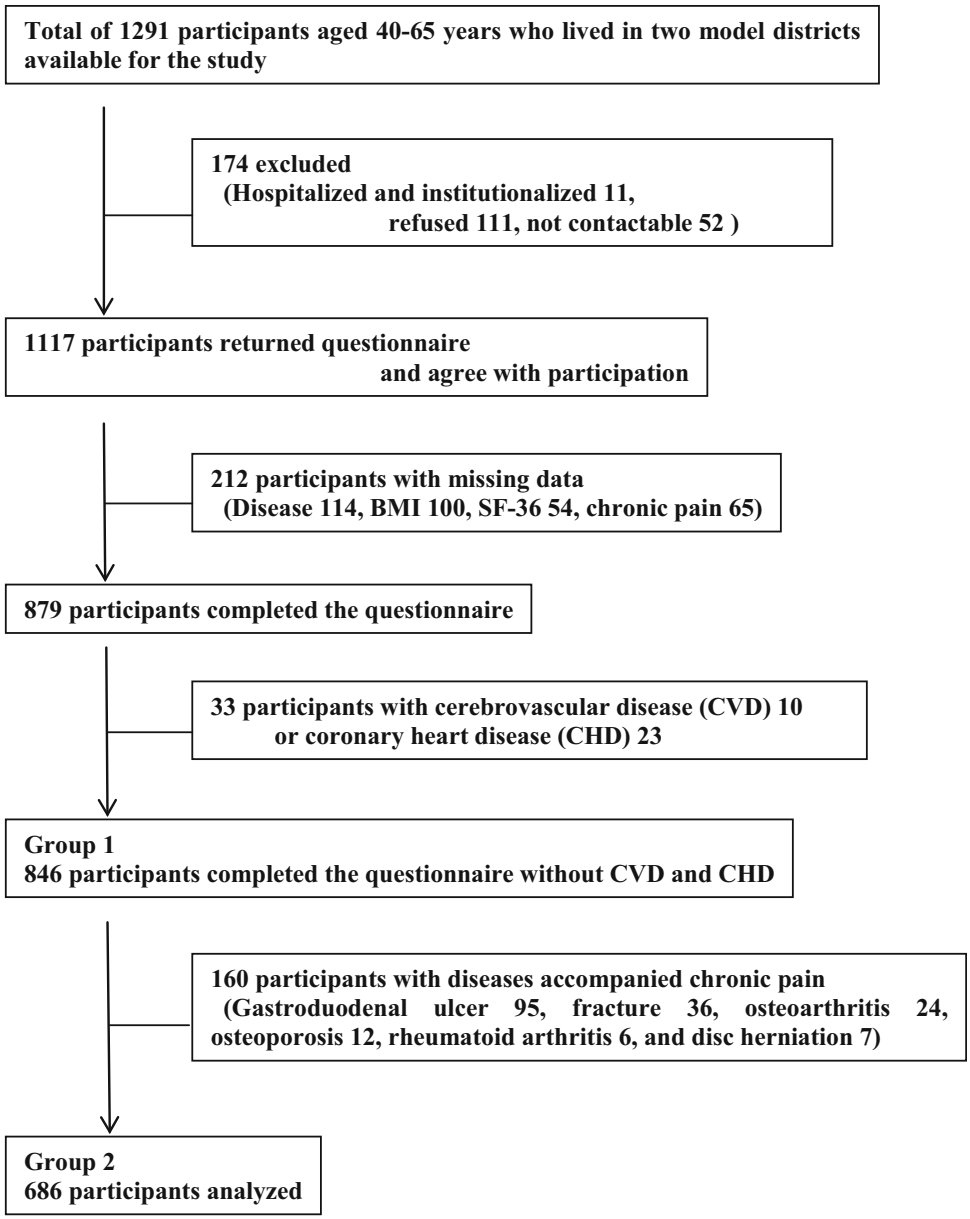


Fig. 1 Flow chart of participants of Shika study in 2012

Relationship between hypertension and HRQoL by multiple regression analysis

We performed multiple regression analysis in Group 2 adjusting by age, BMI, chronic diseases, chronic pain, occupational status, sleep condition, and exercise (Tables 4, 5, 6, 7). The SF of hypertensive men was significantly higher than that of normotensive men, whereas the GH of hypertensive women was significantly lower than that of normotensive women. Overweight was associated with lower PF, BP, SF, and RE only among men. There were strong relationships between chronic pain and lower HRQoL among men, while there were strong relationships between sleep condition and lower HRQoL among women. Poor sleep was associated with lower scores of all SF-36 subscales in women, whereas it was related to lower BP, GH, VT, and MH in men. In women with chronic pain, lower BP, GH, and VT were prevalent. On the other hand, men with chronic pain were associated with lower values for almost all SF-36 subscales (PF, RP, BP, GH, VT, and MH). Lower BP was more strongly related to chronic pain ($B = -0.148$, 95 % CI $= -25.0$ to -14.2, $\beta = -0.385$ in men, $B = -22.6$, 95 % CI $= -27.2$ to -18.1, $\beta = -0.469$ in women) than the other SF-36 subscales.

Table 1 General characteristics of participants in Shika study, 2012

	Group 1 ($n = 846$)				Group 2 ($n = 686$)			
	Men		Women		Men		Women	
	n	%	*n*	%	*n*	%	*n*	%
Total	401		445		314		372	
Age group								
40–49	118	29.4	131	29.4	93	29.6	117	31.5
50–59	136	33.9	166	37.3	106	33.8	139	37.4
60–65	147	36.7	148	33.3	115	36.6	116	31.2
BMI								
<18.5	11	2.7	40	9.0†††	6	1.9	33	8.9†††
18.5–24.9	270	67.3	321	72.1	209	66.6	273	73.4
25.0≤	120	29.9	84	18.9	99	31.5	66	17.7
Education								
Elementary and junior high school	85	21.4	80	18.4†††	69	22.2	69	19.0†††
High school	175	44.1	203	46.7	136	43.7	164	45.1
Junior college and vocational	57	14.4	124	28.5	43	13.8	106	29.1
University or higher	80	20.2	28	6.4	63	20.3	25	6.9
Occupational status								
Employed	336	85.1	327	74.1†††	263	84.6	277	75.1††
Unemployed	59	14.9	114	25.9	48	15.4	92	24.9
Smoking status								
Current smoker	175	44.0	46	10.3†††	131	41.9	43	11.6†††
Ex-smoker	163	41.0	54	12.1	131	41.9	44	11.8
Non-smoker	60	15.1	345	77.5	51	16.3	285	76.6
Chronic pain more than 3 months								
Not have	252	62.8	287	64.5	217	69.1	259	69.6
Have	149	37.2	158	35.5	97	30.9	113	30.4
Sleep condition								
Good	183	46.4	217	51.5	148	47.9	188	53.3
Not good	211	53.6	204	48.5	161	52.1	165	46.7
Frequency of exercise (How many times do you exercise a week?)								
Never	225	56.8	251	56.7	172	55.7	217	58.6
1–2 times a week	66	16.7	63	14.2	51	16.5	49	13.2
3–4 times a week	28	7.1	51	11.5	25	8.1	42	11.4
5–6 times a week	34	8.6	35	7.9	23	7.4	29	7.8
Every day	43	10.9	43	9.7	38	12.3	33	8.9
Prevalence of disease								
No disease	124	30.9	134	30.1	124	39.5	134	36.0
Hypertension	101	25.2	90	20.2	79	25.2	76	20.4
Diabetes mellitus	44	11.0	19	4.3†††	32	10.2	16	4.3††
Allergic diseases	48	12.0	67	15.1	30	9.6	48	12.9
Cancer	8	2.0	12	2.7	6	1.9	10	2.7
Insomnia and depression	11	2.7	17	3.8	7	2.2	10	2.7
Gastroduodenal ulcer	63	15.7	32	7.2†††				
Fracture	19	4.7	17	3.8				
Osteoarthritis	8	2.0	16	3.6				
Osteoporosis	1	0.2	11	2.5‡‡				
Rheumatoid arthritis	1	0.2	5	1.1				

Table 1 continued

	Group 1 ($n = 846$)				Group 2 ($n = 686$)			
	Men		Women		Men		Women	
	n	%	*n*	%	*n*	%	*n*	%
Disc herniation	5	1.2	2	0.4				

The value in participants with chronic pain was compared to that in participants without chronic pain stratified by sex. Chi-square test:† $p < 0.05$, †† $p < 0.01$, ††† $p < 0.001$; Fisher's exact test: ‡ $p < 0.05$, ‡‡ $p < 0.01$, ‡‡‡ $p < 0.001$

Allergic diseases mean bronchial asthma, pollinosis, and atopic dermatitis. Cancer includes gastric, breast, colon, prostate, and thyroid cancer

Discussion

Hypertension was found to be associated with lower general health perceptions in women, whereas it was associated with higher social functioning in men. This study seems to be the first to analyze the relationship between hypertension and HRQoL adjusted by chronic pain. Chronic pain was previously shown to be associated with worse HRQoL [10–12, 42]. Since about 30 % of the participants in this study had chronic pain, we could not ignore its influence on the relationship between hypertension and HRQoL, although hypertensives did not have a significantly higher prevalence of chronic pain than normotensives (data not shown). This study clarified the more precise relationship between hypertension and HRQoL.

Many previous studies have shown that hypertension is relevant not only to a worse general health perceptions but also to worse scores of other subscales of SF-36 [5, 43]. Inconsistency between studies might have resulted from differences in the study populations and the factors used to adjust their relationships. Our results coincide with the finding that women generally report worse health and HRQoL than men do [43]. In addition, hypertensive women perceive a lower health status than hypertensive men do [44, 45]. We assume that, for middle-aged women, hypertension is one of the first lifestyle-related diseases that they experience, which is subsequently suffered for a long time. These assumptions may account for our results showing that hypertensive women had lower general health perceptions than normotensive women.

This study indicated that hypertensive men showed better social functioning than normotensive men. The reason why hypertensive men showed better social functioning than normotensive men was unclear. In contrast to physical and mental health concepts that tend to "end at the skin" [46], the social functioning scale extends measurement beyond the individual to capture both the quantity and the quality of social activities with others [41]. Perhaps, personality is related to better social functioning. Some studies have shown the association between hypertension and Type A personality because such a personality is considered to be involved in aggressive and competitive interpersonal interactions and dominant behavior [47, 48]. Hozawa et al. reported that sociable and cheerful subjects have higher home systolic blood pressure [49]. This may explain our results showing that hypertensive men had better social functioning than normotensive men.

However, we had only subjective data about medical history: participants who indicated, "I have high blood pressure and am under medication" accounted for 83.7 % of all hypertensive participants in this study. If their hypertension control and adherence to hypertensive medication were good, the result that hypertension did not prevent their involvement in social activities was considered to be valid. As we did not ask about the extent of hypertension control and adherence to medication, we could not draw inferences on these relationships.

In this study, an overweight or obese status was related to worse physical functioning, bodily pain, social functioning, and role limitation due to emotional problems in men, but not in women. The results showed that physical health (physical functioning, bodily pain) and mental health (social functioning, role emotional) were affected. Overweight or obese subjects were correlated with impaired physical HRQoL but not with impaired mental HRQoL [32, 33, 50, 51]. However, mental HRQoL was most impaired at the extremes of BMI and this impairment was comparable to the impairment due to certain chronic conditions [52]. In this study, we decided to use BMI of 25 kg/m^2 as a threshold for two categories, although the WHO definition of obesity is BMI $\geq$30 kg/m^2 in Western countries. Since the extent of the influence of obesity on health differs among ethnic groups, the WHO has proposed alternative cut-offs for Asians (a BMI cut-off of 23 as overweight and 25 as obese), and the Japan Society for the Study of Obesity set BMI $\geq$25 as obesity in Japan. If the number of severely obese participants were to increase, the

Table 2 The relationships between characteristics of participants and the scores of SF-36 among participants stratified by sex

	N	Age (years) Mean (SD)	PF Mean (SD)	RP Mean (SD)	BP Mean (SD)	GH Mean (SD)	VT Mean (SD)	SF Mean (SD)	RE Mean (SD)	MH Mean (SD)
Men ($n = 314$)										
Age group										
40–49	93	44.7 (2.67)***	91.6 (13.9)	94.4 (13.5)	75.6 (24.0)	60.7 (15.6)†	61.6 (20.5)***	91.4 (15.1)	94.6 (13.3)	71.0 (16.4)**
50–59	106	54.6 (2.92)	90.3 (11.4)	91.8 (15.4)	76.2 (23.8)	57.3 (17.1)	62.4 (18.9)	90.6 (16.4)	91.4 (17.9)	72.0 (16.7)
60–65	115	62.3 (1.60)	89.2 (14.4)	92.1 (17.1)	76.2 (22.6)	61.6 (17.0)	71.8 (18.5)	90.8 (17.7)	93.3 (16.2)	77.4 (16.1)
BMI										
18.5–24.9	209	55.0 (7.56)	91.8 (12.1)*,†	94.0 (13.6)**,††	77.8 (22.6)	60.9 (15.8)*,†	66.4 (19.3)*,†	92.5 (14.1)***,†††	94.8 (13.1)***,†††	74.0 (16.6)**,††
<18.5	6	55.8 (8.47)	85.0 (19.7)	74.0 (29.2)	62.2 (34.3)	41.6 (28.0)	44.8 (16.0)	66.7 (33.2)	70.8 (24.6)	51.7 (21.1)
≥25.0	99	53.4 (7.48)	87.4 (14.8)	91.0 (17.4)	73.1 (23.9)	58.8 (17.3)	65.2 (20.3)	88.9 (18.5)	90.7 (19.5)	74.3 (15.6)
Education										
Elementary and junior high school	69	58.7 (6.59)***	88.8 (15.1)	93.8 (14.8)	75.7 (23.6)	61.5 (14.9)	68.3 (19.0)	91.3 (15.5)	93.7 (14.3)	74.4 (17.4)
High school	136	53.9 (7.36)	90.3 (13.6)	91.7 (15.7)	76.2 (23.0)	59.6 (17.1)	65.9 (18.2)	90.8 (17.0)	92.8 (15.4)	73.8 (16.8)
Junior college and vocational	43	51.6 (7.16)	91.0 (12.1)	95.2 (12.0)	79.8 (21.1)	57.0 (16.3)	64.1 (23.7)	89.0 (20.1)	92.8 (19.0)	72.9 (15.2)
University or higher	63	52.7 (7.48)	91.2 (11.5)	93.7 (13.7)	74.7 (24.0)	61.1 (18.2)	63.4 (20.9)	92.9 (11.4)	94.4 (12.8)	73.5 (16.3)
Occupational status										
Employed	263	53.4 (7.49)***	90.6 (13.2)	93.5 (13.9)†	76.3 (22.8)	60.0 (15.0)	65.2 (19.2)	91.6 (15.1)†	94.2 (13.7)*,††	73.7 (16.2)
Unemployed	48	60.0 (5.17)	88.9 (13.7)	87.6 (22.2)	75.3 (26.5)	59.3 (24.2)	68.5 (22.7)	86.7 (22.7)	86.5 (24.7)	74.4 (18.8)
Smoking status										
Non-smoker	51	52.3 (8.38)**	90.8 (13.4)	89.8 (22.1)	68.8 (29.1)	59.5 (18.6)	66.4 (18.4)	88.0 (20.8)	91.7 (19.4)	72.4 (18.4)
Ex-smoker	131	56.1 (7.43)	90.6 (13.0)	93.8 (13.9)	76.5 (22.7)	60.2 (18.0)	67.3 (21.4)	92.6 (14.6)	94.3 (13.4)	75.2 (17.0)
Current smoker	131	53.7 (7.08)	89.7 (13.6)	92.6 (13.9)	78.1 (21.0)	59.7 (14.7)	63.5 (18.6)	90.3 (16.4)	92.2 (17.1)	72.5 (15.3)
Chronic pain										
Not have	217	54.2 (7.59)	92.2 (11.3)**,†††	94.4 (13.2)**,††	82.6 (20.8)***,†††	62.4 (16.3)***,†††	69.2 (18.6)***,†††	91.6 (16.2)	94.4 (14.4)†	75.7 (16.2)**,†††
Have	97	55.2 (7.49)	85.9 (16.1)	88.7 (19.3)	61.2 (21.9)	54.2 (16.4)	57.6 (20.0)	89.3 (17.1)	90.1 (18.9)	69.1 (16.6)
Sleep condition										
Good	148	54.4 (7.72)	92.8 (11.7)**,††	94.8 (12.1)*,†	82.8 (20.6)***,†††	64.7 (16.2)***,†††	71.4 (17.7)***,†††	92.9 (14.7)*,†	94.9 (12.7)*,†	77.2 (14.9)**,†††
Not good	161	54.7 (7.46)	88.2 (14.2)	90.5 (18.1)	70.1 (23.9)	55.6 (15.7)	60.6 (20.0)	89.1 (17.9)	91.2 (18.6)	70.7 (17.5)
Frequency of exercise (How many times do you exercise a week?)										
Never	172	53.9 (7.42)	88.3 (14.3)**,††	91.6 (17.6)	74.2 (23.9)	59.2 (17.0)	61.4 (21.2)***,†††	89.0 (18.1)*,†	91.7 (18.3)	71.3 (17.7)**,†
More than 1–2 times a week	137	55.0 (7.76)	92.5 (11.7)	93.8 (12.7)	78.5 (22.7)	61.1 (16.5)	70.6 (16.6)	93.6 (13.8)	94.5 (12.7)	76.4 (14.8)
Women ($n = 372$)										
Age group										
40–49	117	44.3 (2.95)***	91.5 (12.2)	93.2 (15.1)	75.5 (21.2)	61.7 (16.3)	58.3 (18.8)***	87.1 (19.9)	90.4 (18.2)†	69.5 (19.1)**
50–59	139	54.9 (2.87)	89.8 (11.3)	91.8 (15.8)	75.6 (23.4)	61.1 (19.0)	62.3 (20.6)	89.8 (16.5)	90.5 (16.4)	73.0 (16.7)

Table 2 continued

	N	Age (years) Mean (SD)	PF Mean (SD)	RP Mean (SD)	BP Mean (SD)	GH Mean (SD)	VT Mean (SD)	SF Mean (SD)	RE Mean (SD)	MH Mean (SD)
60–65	116	62.5 (1.66)	89.9 (11.7)	90.9 (15.9)	78.3 (21.0)	63.1 (17.6)	71.0 (18.1)	89.9 (15.7)	91.2 (14.9)	77.3 (16.6)
BMI										
18.5–24.9	273	53.8 (7.83)*	90.7 (11.8)	92.7 (14.9)	76.8 (21.9)	62.6 (17.4)	63.5 (20.0)	88.5 (18.0)	90.9 (16.5)	73.5 (17.3)
<18.5	33	51.6 (7.15)	92.4 (9.1)	91.3 (15.1)	74.8 (27.3)	62.5 (17.6)	64.0 (18.6)	88.3 (16.8)	91.4 (13.4)	67.6 (20.5)
≥25.0	66	55.6 (7.18)	88.0 (12.2)	89.2 (18.4)	75.4 (19.5)	58.6 (19.1)	64.6 (20.5)	91.3 (14.9)	89.4 (18.1)	75.2 (17.4)
Education										
Elementary and junior high school	69	61.3 (3.91)***	90.2 (10.9)	90.0 (17.9)	79.0 (21.4)	61.6 (17.6)	72.2 (18.0)***,†	93.3 (13.1)	91.9 (16.0)	79.0 (14.7)*
High school	164	52.9 (7.28)	90.8 (11.5)	92.0 (15.2)	75.9 (23.3)	61.8 (19.0)	62.5 (21.1)	88.0 (18.3)	90.5 (16.3)	71.0 (18.8)
Junior college and vocational	106	50.8 (7.34)	89.1 (13.5)	93.2 (15.2)	75.8 (20.8)	63.1 (15.8)	63.1 (17.4)	88.7 (18.3)	90.3 (17.6)	73.4 (16.8)
University or higher	25	50.8 (6.68)	93.0 (6.9)	93.5 (9.6)	76.2 (20.4)	63.1 (17.1)	52.3 (19.3)	87.5 (15.7)	90.3 (15.5)	71.4 (18.2)
Occupational status										
Employed	277	52.6 (7.45)***	91.1 (10.1)†	93.3 (14.2)*,†	76.8 (21.8)	63.3 (16.9)*,††	62.9 (19.4)	89.2 (17.1)	91.5 (16.1)	72.8 (17.8)
Unemployed	92	57.9 (7.23)	88.0 (15.5)	88.5 (18.6)	75.1 (22.6)	57.8 (19.7)	66.2 (21.3)	89.5 (17.0)	89.1 (17.3)	74.5 (17.2)
Smoking status										
Non-smoker	285	54.8 (7.55)***	90.5 (11.1)	91.9 (16.2)	77.4 (21.8)	62.2 (18.0)	64.4 (19.9)	89.8 (16.9)	91.2 (16.3)	74.2 (17.2)
Ex-smoker	44	52.0 (7.27)	90.6 (11.1)	91.2 (14.3)	73.6 (17.9)	59.8 (16.3)	60.5 (18.9)	87.8 (16.7)	88.3 (17.3)	68.5 (18.9)
Current smoker	43	50.3 (7.97)	89.4 (16.0)	93.3 (13.2)	72.8 (26.2)	61.9 (17.3)	63.2 (21.4)	84.6 (20.7)	89.9 (17.6)	72.0 (19.2)
Chronic pain										
Not have	259	54.0 (7.87)	91.2 (11.9)*,†	93.0 (15.8)	83.4 (19.2)***,†††	64.5 (17.4)***,†††	67.5 (18.8)***,†††	90.3 (17.3)*,†	91.9 (16.4)*,†	74.8 (17.5)*,†
Have	113	53.7 (7.35)	88.5 (11.0)	89.6 (15.1)	60.4 (19.6)	56.0 (17.1)	55.3 (19.9)	85.8 (17.4)	87.9 (16.5)	69.7 (17.7)
Sleep condition										
Good	188	53.3 (7.53)*	92.2 (8.3)**,††	95.0 (12.7)***,†††	80.2 (20.8)**,††	67.0 (16.2)***,†††	68.8 (18.5)***,†††	92.6 (14.9)***,†††	95.2 (12.9)***,†††	78.8 (15.6)***,†††
Not good	165	54.9 (7.77)	88.5 (14.0)	88.5 (17.8)	73.0 (22.5)	57.3 (17.9)	59.0 (20.0)	85.7 (19.0)	86.0 (18.5)	68.2 (18.2)
Frequency of exercise (How many times do you exercise a week?)										
Never	217	53.5 (7.58)	89.2 (12.9)*,†	91.5 (16.0)	76.0 (23.2)	61.3 (17.6)	61.6 (21.0)*,†	88.9 (18.0)	90.8 (16.7)	72.5 (18.0)
More than 1–2 times a week	153	54.5 (7.83)	92.0 (9.7)	92.7 (15.2)	77.2 (20.2)	62.8 (18.0)	66.7 (18.0)	88.9 (16.6)	90.5 (16.4)	74.1 (17.2)

PF physical functioning, *RP* role physical, *BP* bodily pain, *GH* general health, *VT* vitality, *SF* social functioning, *RE* role emotional, *MH* mental health

We examined *t* test and one-way ANOVA (post hoc test: Dunnet *t*, first line of each item is reference group): * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ and age-adjusted one-way ANCOVA (post hoc test: LSD, first line of each item is reference group): † $p < 0.05$, †† $p < 0.01$, ††† $p < 0.001$

Table 3 The relationships between diseases and the scores of SF-36 among participants stratified by group and sex

	N	Age (years) Mean (SD)	PF Mean (SD)	RP Mean (SD)	BP Mean (SD)	GH Mean (SD)	VT Mean (SD)	SF Mean (SD)	RE Mean (SD)	MH Mean (SD)
Group 1 ($n = 846$)										
Men ($n = 401$)										
No disease										
+	124	52.9 (7.68)**	93.3 (11.9)***,††	93.8 (14.8)*	79.1 (22.4)**,††	65.1 (15.7)***,†††	65.4 (19.9)	90.1 (17.1)	93.8 (15.6)*	74.8 (16.4)†
−	277	55.3 (7.45)	87.8 (15.0)	90.2 (18.6)	71.6 (24.4)	56.1 (16.7)	63.0 (19.6)	88.9 (18.5)	90.2 (18.9)	71.3 (17.1)
Hypertension										
−	300	53.7 (7.71)***	89.9 (14.4)	91.4 (17.3)	73.9 (23.8)	59.6 (16.9)	62.7 (19.8)	88.5 (18.4)	90.7 (19.1)	71.7 (17.4)
+	101	57.3 (6.55)	88.3 (14.1)	91.0 (18.4)	73.9 (25.1)	56.7 (16.7)	66.7 (19.4)	91.5 (17.0)	93.1 (14.4)	74.5 (15.7)
Diabetes mellitus										
−	357	54.3 (7.70)**	89.7 (14.4)	91.4 (17.5)	73.8 (24.3)	59.9 (16.7)**,†††	63.8 (19.9)	89.2 (18.4)	91.5 (17.7)	72.5 (17.1)
+	44	57.2 (6.07)	88.4 (14.0)	90.6 (18.2)	74.8 (22.0)	50.6 (16.3)	63.5 (18.3)	89.8 (15.8)	89.2 (20.4)	71.0 (15.7)
Allergic diseases										
−	353	55.0 (7.47)**	89.3 (14.7)	91.2 (18.0)	74.0 (24.1)	59.0 (17.0)	64.0 (19.7)	89.3 (18.2)	91.7 (17.9)	72.9 (16.6)
+	48	51.8 (7.98)	90.9 (11.2)	92.1 (14.3)	73.4 (24.0)	58.0 (16.5)	61.6 (20.2)	88.8 (17.3)	88.2 (18.9)	68.5 (19.5)
Cancer										
−	393	54.4 (7.58)***	89.7 (14.3)	91.5 (17.4)	74.1 (24.1)	59.2 (16.7)**,††	64.0 (19.6)*,††	89.2 (18.1)	91.3 (18.0)	72.6 (17.0)*,†
+	8	62.0 (3.02)	82.5 (16.0)	82.0 (24.4)	67.0 (21.4)	42.6 (16.5)	48.4 (17.3)	92.2 (17.6)	89.6 (19.8)	60.6 (11.2)
Insomnia and depression										
−	390	54.7 (7.63)*	89.6 (14.3)	91.3 (17.5)	73.9 (24.2)	59.1 (16.6)	64.1 (19.4)*	89.7 (17.3)††	91.6 (17.7)†	72.7 (16.8)*,†
+	11	50.9 (4.72)	85.5 (13.9)	89.2 (19.4)	75.8 (18.1)	50.2 (25.0)	51.1 (27.4)	72.7 (32.5)	78.8 (25.1)	60.9 (19.1)
Gastroduodenal ulcer										
−	338	54.6 (7.59)	89.7 (14.4)	91.9 (17.1)	74.9 (23.8)	59.5 (17.2)	65.0 (19.9)**,††	90.2 (17.2)*,†	92.3 (16.9)*,††	73.3 (16.6)*,†
+	63	54.6 (7.66)	88.5 (14.3)	88.1 (19.9)	68.8 (25.1)	55.3 (14.7)	56.8 (17.2)	83.9 (21.6)	85.8 (22.4)	67.4 (18.4)
Fracture										
−	382	54.5 (7.60)	89.9 (13.7)†	91.7 (17.0)†	74.4 (23.9)	58.9 (16.6)	64.0 (19.6)	89.5 (17.9)	91.8 (17.4)†	72.5 (17.0)
+	19	55.2 (7.65)	82.7 (23.4)	82.6 (26.0)	64.2 (26.5)	58.5 (22.9)	58.9 (21.8)	84.2 (20.8)	82.0 (27.0)	69.9 (17.3)
Osteoarthritis										
−	393	54.5 (7.59)	89.7 (14.2)*,†	91.4 (17.4)	74.4 (23.8)**,††	59.1 (16.8)*,†	64.1 (19.6)**,††	89.2 (18.2)	91.5 (17.9)	72.6 (16.9)
+	8	57.0 (7.89)	78.2 (16.1)	82.8 (22.1)	48.1 (23.6)	46.0 (15.7)	45.3 (16.6)	92.2 (11.5)	81.3 (22.2)	62.5 (17.3)
Disc herniation										
−	396	54.6 (7.59)	89.7 (14.0)†	91.5 (17.0)†	74.3 (23.8)**,††	59.0 (17.0)	63.8 (19.8)	89.5 (17.7)††	91.3 (18.1)	72.4 (17.0)
+	5	56.0 (8.28)	73.0 (28.4)	72.5 (41.1)	41.4 (25.6)	52.8 (4.7)	58.8 (15.7)	67.5 (32.6)	93.3 (10.9)	74.0 (11.9)

Table 3 continued

	N	Age (years) Mean (SD)	PF Mean (SD)	RP Mean (SD)	BP Mean (SD)	GH Mean (SD)	VT Mean (SD)	SF Mean (SD)	RE Mean (SD)	MH Mean (SD)
Women ($n = 445$)										
No disease										
+	134	52.3 (7.58)***	92.5 (9.92)***,††	92.4 (15.9)	80.9 (20.0)***,†††	68.6 (16.8)***,†††	66.7 (22.0)*,††	90.2 (16.6)	91.4 (16.4)	74.5 (18.2)†
−	311	55.4 (7.56)	87.9 (13.6)	90.3 (17.1)	71.8 (23.4)	57.4 (16.6)	61.4 (18.5)	87.3 (18.7)	89.3 (18.0)	71.5 (17.6)
Hypertension										
−	355	53.5 (7.89)***	90.0 (12.0)*	91.1 (17.2)	75.5 (22.5)	62.5 (16.7)***,†††	63.6 (19.9)†	88.2 (18.3)	90.0 (17.7)	72.6 (17.9)
+	90	58.1 (5.55)	86.4 (15.2)	90.4 (14.7)	70.9 (23.8)	53.9 (18.7)	60.7 (19.2)	87.9 (17.3)	89.8 (17.3)	71.8 (17.8)
Diabetes mellitus										
−	426	54.2 (7.72)***	89.1 (13.0)**	90.8 (16.9)	74.4 (23.0)	61.1 (17.5)	62.6 (19.9)**	87.8 (18.4)***	89.8 (17.7)	72.2 (18.0)
+	19	59.4 (4.96)	93.6 (5.85)	94.7 (13.2)	79.2 (16.8)	53.3 (12.8)	72.0 (11.7)	96.7 (7.02)	93.0 (13.4)	76.3 (13.1)
Allergic diseases										
−	378	55.0 (7.54)***	89.3 (13.0)	90.9 (16.8)	74.6 (22.9)	61.2 (17.2)	63.7 (20.0)	88.6 (17.9)	90.3 (17.4)	72.8 (18.0)
+	67	51.1 (7.75)	89.1 (11.9)	91.3 (16.5)	74.3 (22.2)	58.0 (18.4)	59.4 (17.7)	85.6 (19.2)	88.2 (18.8)	70.1 (17.1)
Cancer										
−	433	54.3 (7.71)*	89.4 (12.5)	91.0 (16.6)	74.5 (22.9)	60.8 (17.5)	62.9 (19.7)	88.1 (18.3)	90.0 (17.6)	72.3 (17.9)
+	12	59.0 (5.66)	84.6 (21.3)	89.6 (19.8)	75.9 (17.6)	60.3 (15.3)	69.3 (19.3)	89.6 (12.9)	88.9 (18.2)	76.3 (15.4)
Insomnia and depression										
−	428	54.5 (7.67)	89.6 (12.4)††	91.6 (15.4)*,†††	74.9 (22.6)	61.2 (17.3)**,††	63.6 (19.3)**,††	88.6 (17.5)†	90.4 (16.6)††	72.9 (17.4)*,††
+	17	53.4 (8.30)	81.2 (18.5)	74.5 (33.1)	65.9 (25.7)	50.0 (18.3)	49.6 (26.0)	77.2 (29.1)	77.5 (32.2)	59.1 (24.3)
Gastroduodenal ulcer										
−	413	54.4 (7.72)	89.3 (12.9)	91.4 (15.9)	75.3 (22.4)*,†	61.2 (17.5)*,†	63.4 (19.8)	88.5 (17.7)	90.3 (16.6)	72.9 (17.7)*,†
+	32	54.8 (7.48)	88.5 (11.7)	85.7 (24.5)	65.4 (25.7)	54.8 (16.0)	58.2 (18.5)	83.6 (22.8)	85.2 (26.8)	65.9 (18.6)
Fracture										
−	428	54.3 (7.73)	89.4 (12.8)	91.1 (16.3)	74.7 (22.9)	61.0 (17.4)	63.2 (19.9)	88.6 (17.6)†	90.1 (17.2)	72.7 (17.8)†
+	17	56.8 (6.32)	85.6 (13.3)	86.4 (25.9)	70.1 (19.8)	53.3 (15.6)	59.6 (16.3)	78.7 (27.9)	84.8 (26.2)	64.1 (17.0)
Osteoarthritis										
−	429	54.2 (7.66)***	89.8 (12.1)*,†††	91.4 (16.5)**,††	75.2 (22.6)**,††	61.0 (17.4)	63.3 (19.7)†	88.4 (18.2)	90.1 (17.7)	72.5 (17.9)
+	16	61.9 (4.24)	74.6 (20.8)	78.5 (18.5)	57.4 (23.1)	53.0 (16.1)	54.7 (20.6)	82.0 (16.4)	85.4 (14.8)	69.7 (17.5)
Osteoporosis										
−	434	54.3 (7.72)***	89.6 (12.5)***,††	91.3 (16.5)*,†	74.9 (22.5)*,†	60.9 (17.4)	63.2 (19.6)	88.3 (18.0)	90.2 (17.4)	72.5 (17.8)
+	11	60.3 (3.23)	75.3 (18.5)	79.0 (21.9)	60.8 (30.5)	53.1 (16.7)	58.0 (23.2)	84.1 (23.1)	80.3 (22.4)	70.0 (22.0)
Rheumatoid arthritis										
−	440	54.4 (7.67)	89.4 (12.7)	91.1 (16.5)	74.7 (22.7)	60.9 (17.5)**	63.1 (19.7)	88.2 (18.1)	90.0 (17.5)	72.5 (17.9)
+	5	54.2 (10.6)	79.0 (16.4)	80.0 (29.1)	59.0 (27.5)	51.6 (4.28)	55.0 (21.4)	90.0 (22.4)	85.0 (22.4)	67.0 (18.9)

Table 3 continued

	N	Age (years) Mean (SD)	PF Mean (SD)	RP Mean (SD)	BP Mean (SD)	GH Mean (SD)	VT Mean (SD)	SF Mean (SD)	RE Mean (SD)	MH Mean (SD)
Group 2 ($n = 686$)										
Men ($n = 314$)										
No disease										
+	124	52.9 (7.68)**	93.3 (11.9)**††	93.8 (14.8)	79.1 (22.4)	65.1 (15.7)***†††	65.4 (19.9)	90.1 (17.1)	93.8 (15.6)	74.8 (16.4)
−	190	55.5 (7.32)	88.3 (13.8)	92.0 (16.0)	74.0 (23.8)	56.5 (16.5)	65.7 (19.7)	91.4 (16.1)	92.5 (16.3)	72.9 (16.7)
Hypertension										
−	235	53.6 (7.66)***	90.5 (13.4)	92.2 (16.1)	75.6 (23.5)	60.5 (17.0)	64.3 (20.3)*	89.7 (17.6)**†	92.3 (17.1)	72.6 (17.3)*
+	79	57.1 (6.67)	89.7 (13.0)	94.2 (13.6)	77.1 (23.1)	58.0 (15.7)	69.6 (17.7)	94.5 (12.1)	95.3 (12.1)	76.8 (13.8)
Diabetes mellitus										
−	282	54.1 (7.71)**	90.4 (13.1)	93.0 (15.0)	75.8 (23.4)	61.0 (16.3)**††	65.5 (19.9)	91.2 (16.4)	93.4 (15.2)	73.7 (16.7)
+	32	57.7 (5.21)	88.8 (14.5)	90.0 (19.3)	77.7 (23.1)	50.3 (17.0)	66.6 (18.8)	88.3 (17.4)	89.6 (22.0)	73.8 (16.0)
Allergic diseases										
−	284	54.9 (7.45)**	90.2 (13.3)	92.6 (15.7)	76.2 (23.2)	59.9 (16.9)	65.6 (19.8)	90.6 (16.9)	93.0 (16.2)	73.8 (16.4)
+	30	51.0 (7.88)	90.7 (13.2)	93.8 (13.5)	74.0 (24.9)	59.4 (15.5)	65.2 (19.9)	93.8 (11.7)	93.3 (14.1)	72.2 (18.2)
Cancer										
−	308	54.4 (7.55)**	90.5 (13.1)*†	93.0 (15.1)†	76.3 (23.3)	60.2 (16.5)**††	66.0 (19.6)*††	90.9 (16.4)	93.2 (15.9)	73.9 (16.6)†
+	6	62.2 (3.19)	78.3 (16.3)	76.0 (25.7)	60.7 (19.3)	41.2 (18.2)	46.9 (17.6)	89.6 (20.0)	86.1 (22.2)	62.5 (12.1)
Insomnia and depression										
−	307	54.5 (7.62)	90.5 (13.2)	92.8 (15.4)	76.0 (23.4)	60.2 (16.3)*†	65.8 (19.4)	91.2 (15.7)	93.2 (15.9)†	73.9 (16.5)
+	7	52.4 (3.78)	82.1 (16.5)	89.3 (19.7)	77.4 (20.5)	45.4 (26.9)	54.5 (31.8)	76.8 (36.4)	86.9 (20.3)	65.0 (20.4)
Women ($n = 372$)										
No disease										
+	134	52.3 (7.58)**	92.5 (9.92)**†	92.4 (15.9)	80.9 (20.0)**††	68.6 (16.8)***†††	66.7 (22.0)*††	90.2 (16.6)	91.4 (16.4)	74.5 (18.2)
−	238	54.9 (7.64)	89.1 (12.5)	91.7 (15.5)	73.9 (22.7)	58.1 (17.2)	62.1 (18.5)	88.3 (17.8)	90.3 (16.6)	72.5 (17.4)
Hypertension										
−	296	53.0 (7.88)***	91.2 (10.8)*††	92.2 (16.0)	77.4 (21.8)†	63.9 (16.8)***†††	64.4 (20.1)†	89.3 (17.3)	90.6 (17.1)	73.5 (17.9)
+	76	57.7 (5.65)	86.9 (14.4)	91.0 (14.2)	72.4 (22.4)	53.9 (19.1)	61.4 (19.0)	87.8 (17.7)	91.0 (14.3)	72.3 (17.1)
Diabetes mellitus										
−	356	53.7 (7.73)***	90.2 (11.9)	91.9 (15.7)	76.3 (22.2)	62.3 (17.8)†	63.4 (20.1)*	88.6 (17.7)***	90.7 (16.6)	73.1 (17.9)
+	16	59.5 (4.75)	93.0 (6.14)	93.8 (14.3)	79.3 (16.0)	53.7 (13.5)	71.5 (12.5)	97.7 (5.04)	91.7 (14.3)	76.6 (12.3)
Allergic diseases										
−	324	54.4 (7.53)**	90.4 (11.8)	91.7 (16.1)	76.3 (22.3)	62.1 (17.9)	64.1 (20.4)	89.2 (17.7)	90.8 (16.6)	73.3 (18.0)
+	48	50.5 (8.13)	90.2 (11.1)	93.9 (12.0)	77.2 (20.1)	60.5 (16.8)	61.3 (16.4)	87.8 (15.6)	90.3 (16.3)	72.6 (15.8)

Table 3 continued

	N	Age (years) Mean (SD)	PF Mean (SD)	RP Mean (SD)	BP Mean (SD)	GH Mean (SD)	VT Mean (SD)	SF Mean (SD)	RE Mean (SD)	MH Mean (SD)
Cancer										
−	362	53.8 (7.72)***	90.6 (11.2)†	92.1 (15.5)	76.5 (22.1)	62.0 (17.8)	63.7 (19.9)	88.9 (17.5)	90.8 (16.5)	73.2 (17.8)
+	10	60.3 (3.43)	82.5 (22.8)	87.5 (21.2)	74.3 (19.0)	59.4 (16.7)	68.1 (20.3)	91.3 (13.2)	88.3 (19.7)	76.0 (16.0)
Insomnia and depression										
−	362	53.9 (7.67)	90.8 (11.1)*†††	92.5 (14.6)†††	76.7 (21.7)	62.3 (17.6)*†	64.3 (19.5)**††	89.2 (17.0)	91.1 (15.9)†	73.8 (17.2)**††
+	10	53.4 (9.52)	75.0 (20.4)	72.3 (33.4)	66.5 (31.6)	47.8 (17.5)	45.6 (27.8)	82.5 (27.8)	77.5 (30.7)	54.5 (24.7)

Diseases which had less than 5 participants were not written

PF physical functioning, *RP* role physical, *BP* bodily pain, *GH* general health, *VT* vitality, *SF* social functioning, *RE* role emotional, *MH* mental health

We examined *t* test and one-way ANOVA (post hoc test: Dunnett, first line of each item is reference group): * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ and age-adjusted one-way ANCOVA (post hoc test: LSD, first line of each item is reference group): † $p < 0.05$, †† $p < 0.01$, ††† $p < 0.001$

result may become similar to those in previous studies on obesity and HRQoL.

Chronic pain and poor sleep were associated with worse physical and mental HRQoL. In particular, chronic pain seemed to have a strong influence on HRQoL in men, whereas sleep condition was associated with lower HRQoL in women.

Other studies indicated that poor sleepers complained of worse QoL than good sleepers [26, 27, 53]. These results are consistent with this study. With regard to sex differences in sleep, women had better sleep quality than men, whereas women had more sleep-related complaints than men, and menstrual cycles, pregnancy, and menopause were considered to alter the sleep architecture [54]. Since this study was based on subjective data and women were found to be more sensitive to poor sleep, our results suggest stronger associations between HRQoL and sleep condition among women than among men.

In recent years, sex differences in pain have been a topic attracting increased interest. Women were found to be at increased risk of chronic pain and they seemed to experience more severe clinical pain. Multiple biopsychosocial mechanisms contribute to these sex differences in pain, including sex hormones, endogenous opioid function, genetic factors, pain coping and catastrophizing, as well as gender roles [55]. On the basis of these considerations, we suppose that our results reflect that men reported their pain less than women and the influence of pain on their HRQoL seemed to be greater than for women when men reported their pain.

A main strength of our study is that we obtained a high response rate in this survey from a community-based sample in the Japanese population. In addition, we conducted the study in the entirety of the survey areas, depending on address. Therefore, we could minimize selection bias, along with CVD, CHD, and diseases accompanied by chronic pain being excluded, followed by sex stratification. This seems to be the first study to analyze the relationship between hypertension and HRQoL adjusted by chronic pain as an important confounder.

However, our study had some limitations. Since it had a cross-sectional design, we cannot directly infer causal relationships. Second, our data were based only on self-reports, not objective data like medical records and blood tests. Third, we summarized the presence of chronic pain as a yes/no variable, and did not consider the intensity of the chronic pain or its location. To demonstrate causal relationships, we have to perform longitudinal research with data based on objective diagnoses.

Table 4 Results of multiple linear regression analysis of the SF-36 scores: physical functioning (PF), role physical (RP), bodily pain (BP), and general health (GH), among men of Group 2

Explanatory variables	PF			RP			BP			GH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Constant	106.9	(95.4, 118.4)***		105.4	(91.6, 119.2)***		85.1	(66.2, 104.0)***		57.6	(43.7, 71.6)***	
Age	−0.189	(−0.401, 0.022)	**−0.108**	−0.041	(−0.295, 0.213)	**−0.020**	0.071	(−0.277, 0.418)	**0.023**	0.151	(−0.106, 0.407)	0.069
Obesity												
BMI < 25.0[a]												
BMI ≥ 25.0	−4.89	(−8.13, −1.65)	**−0.170****	−3.60	(−7.49, 0.286)	**−0.106**	−5.85	(−11.2, −0.526)	**−0.116***	0.283	(−3.65, 4.21)	**0.008**
Hypertension												
No[a]												
Yes	0.424	(−3.02, 3.87)	**0.014**	2.87	(−1.27, 7.00)	0.079	3.03	(−2.63, 8.70)	0.056	−2.71	(−6.89, 1.47)	**−0.071**
Diabetes mellitus												
No[a]												
Yes	−0.429	(−5.47, 4.61)	**−0.009**	−1.85	(−7.90, 4.20)	**−0.035**	5.53	(−2.76, 13.8)	0.070	−10.5	(−16.6, −4.35)	**−0.186****
Allergic disease												
No[a]												
Yes	1.88	(−3.08, 6.84)	**0.043**	1.60	(−4.36, 7.56)	**0.031**	2.60	(−5.56, 10.8)	**0.033**	0.864	(−5.16, 6.89)	**0.016**
Cancer												
No[a]												
Yes	−6.94	(−18.6, 4.72)	**−0.066**	−17.9	(−31.9, −3.89)	**−0.145***	−8.30	(−27.5, 10.9)	**−0.045**	−17.6	(−31.8, −3.46)	**−0.135***
Insomnia and depression												
No[a]												
Yes	−7.39	(−17.2, 2.40)	**−0.083**	−1.22	(−13.0, 10.5)	**−0.012**	1.31	(−14.8, 17.4)	**0.008**	−17.8	(−29.7, −5.92)	**−0.162****
Chronic pain												
No[a]												
Yes	−5.45	(−8.73, −2.16)	**−0.187****	−5.08>	(−9.02, −1.13)	**−0.148***	−19.6	(−25.0, −14.2)	**−0.385*****	−6.51	(−10.5, −2.52)	**−0.180****

Table 4 continued

Explanatory variables	PF			RP			BP			GH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Occupational status												
Employed[a]												
Unemployed	0.136	(−4.12, 4.39)	**0.004**	−5.46	(−10.6, −0.353)	**−0.126***	−1.06	(−8.06, 5.94)	**−0.016**	1.06	(−4.11, 6.23)	**0.023**
Sleep condition												
Good sleep[a]												
Poor sleep	−2.63	(−5.66, 0.398)	**−0.099**	−2.52	(−6.16, 1.11)	**−0.080**	−8.89	(−13.9, −3.91)	**−0.190****	−6.55	(−10.2, −2.87)	**−0.197****
Frequency of exercise												
More than 1–2 times a week[a]												
Never	−3.40	(−6.42, −0.378)	**−0.127***	−1.55	(−5.18, 2.07)	**−0.049**	−0.877	(−5.85, 4.09)	**−0.019**	1.13	(−2.54, 4.80)	**0.034**
Number of observations	302			302			302			302		
R^2	0.132			0.103			0.238			0.174		
Adjusted R^2	0.099			0.069			0.209			0.143		
F	4.011			3.014			8.216			5.568		
Significant *F*	0.000			0.001			0.000			0.000		

B unstandardized coefficients, *β* standardized coefficients

Bold values indicate $p < 0.05$

[a] Reference group, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5 Results of multiple linear regression analysis of the SF-36 scores: vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH) among men of Group 2

Explanatory variables	VT			SF			RE			MH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Constant	43.6	(27.5, 59.7)***		99.9	(85.4, 114.5)***		107.5	(93.1, 121.9)***		59.3	(44.8, 73.7)***	
Age	0.578	(0.282, 0.874)	**0.222*** **	0.029	(−0.238, 0.297)	**0.013**	−0.022	(−0.286, 0.242)	**−0.010**	0.381	(0.115, 0.647)	**0.174****
Obesity												
BMI < 25.0[a]												
BMI ≥ 25.0	−0.809	(−5.34, 3.72)	**−0.019**	−4.37	(−8.47, −0.277)	**−0.123***	−4.35	(−8.39, −0.315)	**−0.124***	0.768	(−3.30, 4.84)	**0.021**
Hypertension												
No[a]												
Yes	4.19	(−0.627, 9.01)	0.092	5.66	(1.30, 10.0)	**0.149***	4.09	(−0.207, 8.39)	**0.109**	3.11	(−1.22, 7.44)	0.081
Diabetes mellitus												
No[a]												
Yes	−0.463	(−7.51, 6.59)	**−0.007**	0.238	(−6.14, 6.61)	**0.004**	−2.46	(−8.75, 3.83)	**−0.045**	−1.39	(−7.73, 4.95)	**−0.025**
Allergic disease												
No[a]												
Yes	3.10	(−3.84, 10.0)	**0.047**	4.85	(−1.43, 11.1)	0.089	0.977	(−5.22, 7.17)	**0.018**	0.754	(−5.49, 7.00)	**0.014**
Cancer												
No[a]												
Yes	−15.8	(−32.1, 0.494)	**−0.102**	0.641	(−14.1, 15.4)	**0.005**	−6.12	(−20.7, 8.42)	**−0.048**	−5.93	(−20.6, 8.73)	**−0.046**
Insomnia and depression												
No[a]												
Yes	−9.66	(−23.4, 4.04)	**−0.074**	−10.0	(−22.4, 2.35)	**−0.092**	−2.32	(−14.5, 9.90)	**−0.022**	−7.83	(−20.1, 4.49)	**−0.071**
Chronic pain												
No[a]												
Yes	−9.93	(−14.5, −5.34)	**−0.231*** **	−1.22	(−5.38, 2.94)	**−0.034**	−3.70	(−7.80, 0.40)	**−0.104**	−5.53	(−9.66, −1.40)	**−0.153****

Table 5 continued

Explanatory variables	VT			SF			RE			MH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Occupational status												
Employed[a]												
Unemployed	0.025	(−5.93, 5.98)	**0.000**	−5.63	(−11.0, −0.244)	**−0.124***	−7.79	(−13.1, −2.48)	**−0.174****	−1.01	(−6.36, 4.35)	**−0.022**
Sleep condition												
Good sleep[a]												
Poor sleep	−7.72	(−12.0, −3.48)	**−0.195*****	−3.26	(−7.10, 0.568)	**−0.099**	−2.36	(−6.14, 1.42)	**−0.072**	−4.87	(−8.68, −1.06)	**−0.146***
Frequency of exercise												
More than 1-2 times a week[a]												
Never	−5.33	(−9.55, −1.10)	**−0.134***	−4.14	(−7.96, −0.313	**−0.125***	−2.74	(−6.51, 1.04)	**−0.084**	−2.81	(−6.62, 0.988)	**−0.084**
Number of observations	302			302			302			302		
R^2	0.227			0.094			0.092			0.117		
Adjusted R^2	0.198			0.060			0.058			0.083		
F	7.748			2.741			2.674			3.486		
Significant *F*	0.000			0.002			0.003			0.000		

B unstandardized coefficients, *β* standardized coefficients

Bold values indicate $p < 0.05$

[a] Reference group, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 Results of multiple linear regression analysis of the SF-36 scores: physical functioning (PF), role physical (RP), bodily pain (BP), and general health (GH), among women of Group 2

Explanatory variables	PF			RP			BP			GH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Constant	96.5	(87.4, 105.5)***		96.5	(84.2, 108.8)***		77.1	(61.4, 92.7)***		62.3	(49.1, 75.6)***	
Age	0.040	(−0.129, 0.208)	**0.026**	0.099	(−0.129, 0.327)	**0.049**	0.224	(−0.066, 0.513)	0.079	0.295	(0.049, 0.541)	**0.128***
Obesity												
BMI < 25.0[a]												
BMI ≥ 25.0	−1.14	(−4.27, 1.99)	**−0.038**	−3.23	(−7.46, 1.01)	**−0.080**	1.73	(−3.66, 7.12)	**0.030**	−1.54	(−6.11, 3.04)	**−0.033**
Hypertension												
No[a]												
Yes	−2.57	(−5.65, 0.505)	**−0.090**	1.81	(−2.36, 5.97)	**0.047**	−3.77	(−9.07, 1.52)	**−0.069**	−8.84	(−13.3, −4.34)	**−0.200*****
Diabetes mellitus												
No[a]												
Yes	3.87	(−1.89, 9.63)	0.070	1.39	(−6.40, 9.19)	**0.019**	1.51	(−8.40, 11.4)	**0.014**	−8.12	(−16.5, 0.312)	**−0.096**
Allergic disease												
No[a]												
Yes	−0.991	(−4.13, 2.15)	**−0.033**	0.665	(−3.58, 4.91)	**0.016**	0.624	(−4.77, 6.02)	**0.011**	−0.615	(−5.20, 3.97)	**−0.013**
Cancer												
No[a]												
Yes	−8.72	(−15.9, −1.57)	**−0.127***	−5.12	(−14.8, 4.55)	**−0.055**	−3.32	(−15.6, 8.99)	**−0.025**	−1.24	(−11.7, 9.22)	**−0.012**
Insomnia and depression												
No[a]												
Yes	−11.1	(−19.1, −3.22)	**−0.145****	−14.7	(−25.4, −4.00)	**−0.142****	−9.97	(−23.6, 3.65)	**−0.068**	−14.6	(−26.2, −3.04)	**−0.124***
Chronic pain												
No[a]												
Yes	−1.48	(−4.12, 1.16)	**−0.058**	−2.07	(−5.63, 1.50)	**−0.060**	−22.6	(−27.2, −18.1)	**−0.469*****	−5.72	(−9.58, −1.86)	**−0.146****
Occupational status												
Employed[a]												
Unemployed	−2.91	(−0.054)	**−0.109***	−4.19	(−8.06, −0.323)	**−0.117***	−2.14	(−7.06, 2.78)	**−0.042**	−5.28	(−9.46, −1.10)	**−0.129***

Table 6 continued

Explanatory variables	PF			RP			BP			GH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Sleep condition												
Good sleep[a]												
Poor sleep	−3.13	(−5.53, −0.732)	**−0.136***	−6.32	(−9.56, −3.07)	**−0.203*****	−4.41	(−8.53, −0.280)	**−0.101***	−8.77	(−12.3, −5.26)	**−0.247*****
Frequency of exercise												
More than 1–2 times a week[a]												
Never	−2.36	(−4.77, 0.061)	**−0.101**	−0.520	(−3.79, 2.75)	**−0.017**	−0.626	(−4.78, 3.53)	**−0.014**	−0.970	(−4.50, 2.57)	**−0.027**
Number of observations	348			348			348			348		
R^2	0.100			0.094			0.261			0.189		
Adjusted R^2	0.071			0.065			0.236			0.162		
F	3.411			3.180			10.76			7.102		
Significant *F*	0.000			0.000			0.000			0.000		

B unstandardized coefficients, *β* standardized coefficients

Bold values indicate $p < 0.05$

[a] Reference group, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7 Results of multiple linear regression analysis of the SF-36 scores: vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH) among women of Group 2

Explanatory variables	VT			SF			RE			MH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Constant	35.1	(20.6, 49.6)***		78.8	(65.3, 92.4)***		85.4	(72.7, 98.1)***		51.2	(37.9, 64.5)***	
Age	0.718	(0.450, 0.987)	**0.279*** **	0.275	(0.023, 0.526)	**0.124***	0.269	(0.034, 0.504)	**0.126***	0.532	(0.286, 0.778)	**0.231****
Obesity												
BMI < 25.0[a]												
BMI ≥ 25.0	2.81	(−2.19, 7.81)	0.054	1.99	(−2.69, 6.66)	**0.045**	−3.03	(−7.39, 1.34)	**−0.071**	3.31	(−1.26, 7.89)	0.072
Hypertension												
No[a]												
Yes	−4.69	(−9.61, 0.226)	**−0.095**	−1.96	(−6.56, 2.63)	**−0.046**	1.46	(−2.83, 5.75)	**0.036**	−2.77	(−7.27,1.73)	**−0.063**
Diabetes mellitus												
No[a]												
Yes	3.37	(−5.83, 12.6)	**0.036**	7.04	(−1.57, 15.6)	0.087	−0.798	(−8.84, 7.24)	**−0.010**	−0.440	(−8.86, 7.98)	**−0.005**
Allergic disease												
No[a]												
Yes	−1.15	(−6.16, 3.86)	**−0.022**	−0.580	(−5.26, 4.10)	**−0.013**	0.181	(−4.19, 4.56)	**0.004**	1.83	(−2.75, 6.42)	**0.039**
Cancer												
No[a]												
Yes	−1.11	(−12.5, 10.3)	**−0.009**	−0.546	(−11.2, 10.1)	**−0.005**	−3.63	(−13.6, 6.35)	**−0.037**	−0.808	(−11.3, 9.64)	**−0.008**
Insomnia and depression												
No[a]												
Yes	−14.0	(−26.6, −1.32)	**−0.106***	−4.91	(−16.7, 6.91)	**−0.043**	−15.9	(−27.0, −4.89)	**−0.146****	−17.8	(−29.4, −6.26)	**−0.152****
Chronic pain												
No[a]												
Yes	−10.0	(−14.2, −5.81)	**−0.229*** **	−2.95	(−6.88, 0.991)	**−0.079**	−2.69	(−6.37, 0.985)	**−0.075**	−2.32	(−6.17, 1.53)	**−0.060**
Occupational status												
Employed[a]												
Unemployed	0.115	(−4.45, 4.68)	**0.003**	−0.875	(−5.15, 3.40)	**−0.022**	−3.02	(−7.01, 0.973)	**−0.080**	0.274	(−3.91, 4.45)	**0.007**

Table 7 continued

Explanatory variables	VT			SF			RE			MH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Sleep condition												
Good sleep[a]												
Poor sleep	−9.46	(−13.3, −5.63)	**−0.239*****	−6.55	(−10.1, −2.97)	**−0.193*****	−9.18	(−12.5, −5.83)	**−0.280*****	−11.3	(−14.9, −7.84)	**−0.321*****
Frequency of exercise												
More than 1–2 times a week[a]												
Never	−3.21	(−7.07, 0.654)	**−0.080**	1.47	(−2.14, 5.08)	**0.043**	1.06	(−2.31, 4.43)	**0.032**	−0.639	(−4.17, 2.89)	**−0.018**
Number of observations	348			348			348			348		
R^2	0.222			0.074			0.130			0.180		
Adjusted R^2	0.197			0.043			0.102			0.153		
F	8.736			2.429			4.569			6.702		
Significant *F*	0.000			0.006			0.000			0.000		

B unstandardized coefficients, *β* standardized coefficients

Bold values indicate $p < 0.05$

[a] Reference group, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Conclusion

After adjusting by chronic pain and life habits, hypertension itself was associated with lower HRQoL, especially general health perceptions, in women, whereas hypertension was associated with higher social functioning in men. These results may be due to the sex difference in the light of the perception for health.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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ERRATUM

Erratum to: The relationship between hypertension and health-related quality of life: adjusted by chronic pain, chronic diseases, and life habits in the general middle-aged population in Japan

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Unfortunately, the bold values of Tables 4, 5, 6 and 7 were published incorrectly in the original publication of the article and are corrected with this erratum.

The standardized coefficients "β" values which contain asterisks (*, ** and ***) should be in bold.

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Table 4 Results of multiple linear regression analysis of the SF-36 scores: physical functioning (PF), role physical (RP), bodily pain (BP), and general health (GH), among men of Group 2

Explanatory variables	PF			RP			BP			GH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Constant	106.9	(95.4, 118.4)***		105.4	(91.6, 119.2)***		85.1	(66.2, 104.0)***		57.6	(43.7, 71.6)***	
Age	−0.189	(−0.401, 0.022)	−0.108	−0.041	(−0.295, 0.213)	−0.020	0.071	(−0.277, 0.418)	0.023	0.151	(−0.106, 0.407)	0.069
Obesity												
BMI <25.0[a]												
BMI ≥25.0	−4.89	(−8.13, −1.65)	**−0.170****	−3.60	(−7.49, 0.286)	−0.106	−5.85	(−11.2, −0.526)	**−0.116***	0.283	(−3.65, 4.21)	0.008
Hypertension												
No[a]												
Yes	0.424	(−3.02, 3.87)	0.014	2.87	(−1.27, 7.00)	0.079	3.03	(−2.63, 8.70)	0.056	−2.71	(−6.89, 1.47)	−0.071
Diabetes mellitus												
No[a]												
Yes	−0.429	(−5.47, 4.61)	−0.009	−1.85	(−7.90, 4.20)	−0.035	5.53	(−2.76, 13.8)	0.070	−10.5	(−16.6, −4.35)	**−0.186****
Allergic disease												
No[a]												
Yes	1.88	(−3.08, 6.84)	0.043	1.60	(−4.36, 7.56)	0.031	2.60	(−5.56, 10.8)	0.033	0.864	(−5.16, 6.89)	0.016
Cancer												
No[a]												
Yes	−6.94	(−18.6, 4.72)	−0.066	−17.9	(−31.9, −3.89)	**−0.145***	−8.30	(−27.5, 10.9)	−0.045	−17.6	(−31.8, −3.46)	**−0.135***
Insomnia and depression												
No[a]												
Yes	−7.39	(−17.2, 2.40)	−0.083	−1.22	(−13.0, 10.5)	−0.012	1.31	(−14.8, 17.4)	0.008	−17.8	(−29.7, −5.92)	**−0.162****
Chronic pain												
No[a]												
Yes	−5.45	(−8.73, −2.16)	**−0.187****	−5.08	(−9.02, −1.13)	**−0.148***	−19.6	(−25.0, −14.2)	**−0.385*****	−6.51	(−10.5, −2.52)	**−0.180****
Occupational status												
Employed[a]												
Unemployed	0.136	(−4.12, 4.39)	0.004	−5.46	(−10.6, −0.353)	**−0.126***	−1.06	(−8.06, 5.94)	−0.016	1.06	(−4.11, 6.23)	0.023
Sleep condition												
Good sleep[a]												
Poor sleep	−2.63	(−5.66, 0.398)	−0.099	−2.52	(−6.16, 1.11)	−0.080	−8.89	(−13.9, −3.91)	**−0.190****	−6.55	(−10.2, −2.87)	**−0.197****
Frequency of exercise												
More than 1−2 times a week[a]												
Never	−3.40	(−6.42, −0.378)	**−0.127***	−1.55	(−5.18, 2.07)	−0.049	−0.877	(−5.85, 4.09)	−0.019	1.13	(−2.54, 4.80)	0.034

Table 4 continued

Explanatory variables	PF			RP			BP			GH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Number of observations	302			302			302			302		
R^2	0.132			0.103			0.238			0.174		
Adjusted R^2	0.099			0.069			0.209			0.143		
F	4.011			3.014			8.216			5.568		
Significant *F*	0.000			0.001			0.000			0.000		

B unstandardized coefficients, *β* standardized coefficients

Bold values indicate $p < 0.05$

[a] Reference group, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5 Results of multiple linear regression analysis of the SF-36 scores: vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH) among men of Group 2

Explanatory variables	VT			SF			RE			MH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Constant	43.6	(27.5, 59.7)***		99.9	(85.4, 114.5)***		107.5	(93.1, 121.9)***		59.3	(44.8, 73.7)***	
Age	0.578	(0.282, 0.874)	**0.222****	0.029	(−0.238, 0.297)	0.013	−0.022	(−0.286, 0.242)	−0.010	0.381	(0.115, 0.647)	**0.174****
Obesity												
BMI <25.0[a]												
BMI ≥25.0	−0.809	(−5.34, 3.72)	−0.019	−4.37	(−8.47, −0.277)	**−0.123***	−4.35	(−8.39, −0.315)	**−0.124***	0.768	(−3.30, 4.84)	0.021
Hypertension												
No[a]												
Yes	4.19	(−0.627, 9.01)	0.092	5.66	(1.30, 10.0)	**0.149***	4.09	(−0.207, 8.39)	0.109	3.11	(−1.22, 7.44)	0.081
Diabetes mellitus												
No[a]												
Yes	−0.463	(−7.51, 6.59)	−0.007	0.238	(−6.14, 6.61)	0.004	−2.46	(−8.75, 3.83)	−0.045	−1.39	(−7.73, 4.95)	−0.025
Allergic disease												
No[a]												
Yes	3.10	(−3.84, 10.0)	0.047	4.85	(−1.43, 11.1)	0.089	0.977	(−5.22, 7.17)	0.018	0.754	(−5.49, 7.00)	0.014
Cancer												
No[a]												
Yes	−15.8	(−32.1, 0.494)	−0.102	0.641	(−14.1, 15.4)	0.005	−6.12	(−20.7, 8.42)	−0.048	−5.93	(−20.6, 8.73)	−0.046
Insomnia and depression												
No[a]												
Yes	−9.66	(−23.4, 4.04)	−0.074	−10.0	(−22.4, 2.35)	−0.092	−2.32	(−14.5, 9.90)	−0.022	−7.83	(−20.1, 4.49)	−0.071
Chronic pain												
No[a]												
Yes	−9.93	(−14.5, −5.34)	**−0.231*****	−1.22	(−5.38, 2.94)	−0.034	−3.70	(−7.80, 0.40)	−0.104	−5.53	(−9.66, −1.40)	**−0.153****
Occupational status												
Employed[a]												
Unemployed	0.025	(−5.93, 5.98)	0.000	−5.63	(−11.0, −0.244)	**−0.124***	−7.79	(−13.1, −2.48)	**−0.174****	−1.01	(−6.36, 4.35)	−0.022
Sleep condition												
Good sleep[a]												
Poor sleep	−7.72	(−12.0, −3.48)	**−0.195*****	−3.26	(−7.10, 0.568)	−0.099	−2.36	(−6.14, 1.42)	−0.072	−4.87	(−8.68, −1.06)	**−0.146***
Frequency of exercise												
More than 1−2 times a week[a]												
Never	−5.33	(−9.55, −1.10)	**−0.134***	−4.14	(−7.96, −0.313)	**−0.125***	−2.74	(−6.51, 1.04)	−0.084	−2.81	(−6.62, 0.988)	−0.084

Table 5 continued

Explanatory variables	VT			SF			RE			MH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Number of observations	302			302			302			302		
R^2	0.227			0.094			0.092			0.117		
Adjusted R^2	0.198			0.060			0.058			0.083		
F	7.748			2.741			2.674			3.486		
Significant *F*	0.000			0.002			0.003			0.000		

B unstandardized coefficients, *β* standardized coefficients

Bold values indicate $p < 0.05$

[a] Reference group, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 Results of multiple linear regression analysis of the SF-36 scores: physical functioning (PF), role physical (RP), bodily pain (BP), and general health (GH), among women of Group 2

Explanatory variables	PF			RP			BP			GH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Constant	96.5	(87.4, 105.5)***		96.5	(84.2, 108.8)***		77.1	(61.4, 92.7)***		62.3	(49.1, 75.6)***	
Age	0.040	(−0.129, 0.208)	0.026	0.099	(−0.129, 0.327)	0.049	0.224	(−0.066, 0.513)	0.079	0.295	(0.049, 0.541)	**0.128***
Obesity												
BMI <25.0[a]												
BMI ≥25.0	−1.14	(−4.27, 1.99)	−0.038	−3.23	(−7.46, 1.01)	−0.080	1.73	(−3.66, 7.12)	0.030	−1.54	(−6.11, 3.04)	−0.033
Hypertension												
No[a]												
Yes	−2.57	(−5.65, 0.505)	−0.090	1.81	(−2.36, 5.97)	0.047	−3.77	(−9.07, 1.52)	−0.069	−8.84	(−13.3, −4.34)	**−0.200*****
Diabetes mellitus												
No[a]												
Yes	3.87	(−1.89, 9.63)	0.070	1.39	(−6.40, 9.19)	0.019	1.51	(−8.40, 11.4)	0.014	−8.12	(−16.5, 0.312)	−0.096
Allergic disease												
No[a]												
Yes	−0.991	(−4.13, 2.15)	−0.033	0.665	(−3.58, 4.91)	0.016	0.624	(−4.77, 6.02)	0.011	−0.615	(−5.20, 3.97)	−0.013
Cancer												
No[a]												
Yes	−8.72	(−15.9, −1.57)	**−0.127***	−5.12	(−14.8, 4.55)	−0.055	−3.32	(−15.6, 8.99)	−0.025	−1.24	(−11.7, 9.22)	−0.012
Insomnia and depression												
No[a]												
Yes	−11.1	(−19.1, −3.22)	**−0.145****	−14.7	(−25.4, −4.00)	**−0.142****	−9.97	(−23.6, 3.65)	−0.068	−14.6	(−26.2, −3.04)	**−0.124***
Chronic pain												
No[a]												
Yes	−1.48	(−4.12, 1.16)	−0.058	−2.07	(−5.63, 1.50)	−0.060	−22.6	(−27.2, −18.1)	**−0.469*****	−5.72	(−9.58, −1.86)	**−0.146****
Occupational status												
Employed[a]												
Unemployed	−2.91	(−5.77, −0.054)	**−0.109***	−4.19	(−8.06, −0.323)	**−0.117***	−2.14	(−7.06, 2.78)	−0.042	−5.28	(−9.46, −1.10)	**−0.129***
Sleep condition												
Good sleep[a]												
Poor sleep	−3.13	(−5.53, −0.732)	**−0.136***	−6.32	(−9.56, −3.07)	**−0.203*****	−4.41	(−8.53, −0.280)	**−0.101***	−8.77	(−12.3, −5.26)	**−0.247*****
Frequency of exercise												
More than 1−2 times a week[a]												
Never	−2.36	(−4.77, 0.061)	−0.101	−0.520	(−3.79, 2.75)	−0.017	−0.626	(−4.78, 3.53)	−0.014	−0.970	(−4.50, 2.57)	−0.027

Table 6 continued

Explanatory variables	PF			RP			BP			GH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Number of observations	348			348			348			348		
R^2	0.100			0.094			0.261			0.189		
Adjusted R^2	0.071			0.065			0.236			0.162		
F	3.411			3.180			10.76			7.102		
Significant *F*	0.000			0.000			0.000			0.000		

B unstandardized coefficients, *β* standardized coefficients

Bold values indicate $p < 0.05$

[a] Reference group, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7 Results of multiple linear regression analysis of the SF-36 scores: vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH) among women of Group 2

Explanatory variables	VT			SF			RE			MH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Constant	35.1	(20.6, 49.6)***		78.8	(65.3, 92.4)***		85.4	(72.7, 98.1)***		51.2	(37.9, 64.5)***	
Age	0.718	(0.450, 0.987)	**0.279****	0.275	(0.023, 0.526)	**0.124***	0.269	(0.034, 0.504)	**0.126***	0.532	(0.286, 0.778)	**0.231****
Obesity												
BMI <25.0[a]												
BMI ≥25.0	2.81	(−2.19, 7.81)	0.054	1.99	(−2.69, 6.66)	0.045	−3.03	(−7.39, 1.34)	−0.071	3.31	(−1.26, 7.89)	0.072
Hypertension												
No[a]												
Yes	−4.69	(−9.61, 0.226)	−0.095	−1.96	(−6.56, 2.63)	−0.046	1.46	(−2.83, 5.75)	0.036	−2.77	(−7.27, 1.73)	−0.063
Diabetes mellitus												
No[a]												
Yes	3.37	(−5.83, 12.6)	0.036	7.04	(−1.57, 15.6)	0.087	−0.798	(−8.84, 7.24)	−0.010	−0.440	(−8.86, 7.98)	−0.005
Allergic disease												
No[a]												
Yes	−1.15	(−6.16, 3.86)	−0.022	−0.580	(−5.26, 4.10)	−0.013	0.181	(−4.19, 4.56)	0.004	1.83	(−2.75, 6.42)	0.039
Cancer												
No[a]												
Yes	−1.11	(−12.5, 10.3)	−0.009	−0.546	(−11.2, 10.1)	−0.005	−3.63	(−13.6, 6.35)	−0.037	−0.808	(−11.3, 9.64)	−0.008
Insomnia and depression												
No[a]												
Yes	−14.0	(−26.6, −1.32)	**−0.106***	−4.91	(−16.7, 6.91)	−0.043	−15.9	(−27.0, −4.89)	**−0.146****	−17.8	(−29.4, −6.26)	**−0.152****
Chronic pain												
No[a]												
Yes	−10.0	(−14.2, −5.81)	**−0.229*****	−2.95	(−6.88, 0.991)	−0.079	−2.69	(−6.37, 0.985)	−0.075	−2.32	(−6.17, 1.53)	−0.060
Occupational status												
Employed[a]												
Unemployed	0.115	(−4.45, 4.68)	0.003	−0.875	(−5.15, 3.40)	−0.022	−3.02	(−7.01, 0.973)	−0.080	0.274	(−3.91, 4.45)	0.007
Sleep condition												
Good sleep[a]												
Poor sleep	−9.46	(−13.3, −5.63)	**−0.239*****	−6.55	(−10.1, −2.97)	**−0.193*****	−9.18	(−12.5, −5.83)	**−0.280*****	−11.3	(−14.9, −7.84)	**−0.321*****
Frequency of exercise												
More than 1−2 times a week[a]												
Never	−3.21	(−7.07, 0.654)	−0.080	1.47	(−2.14, 5.08)	0.043	1.06	(−2.31, 4.43)	0.032	−0.639	(−4.17, 2.89)	−0.018

Table 7 continued

Explanatory variables	VT			SF			RE			MH		
	B	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*	*B*	(95 % CI)	*β*
Number of observations	348			348			348			348		
R^2	0.222			0.074			0.130			0.180		
Adjusted R^2	0.197			0.043			0.102			0.153		
F	8.736			2.429			4.569			6.702		
Significant *F*	0.000			0.006			0.000			0.000		

B unstandardized coefficients, *β* standardized coefficients

Bold values indicate $p < 0.05$

[a] Reference group, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$