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ORIGINAL ARTICLE

The societal burden of chronic pain in Japan: an internet survey

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Abstract
Objectives Chronic pain affects between 10–20 % of the population of Japan and several specific types of chronic pain have been found to be associated with worse health outcomes. The aim of the current study was to investigate the economic burden of chronic pain as well as the health status among Japanese patients.
Methods Data from the Japan National Health and Wellness Survey (NHWS), a cross-sectional health survey of adults, were used ($N = 30{,}000$). Respondents with chronic pain ($N = 785$) were compared with respondents without chronic pain ($N = 29{,}215$) with respect to health status (using the SF-12v2), work productivity and activity impairment (WPAI questionnaire), and healthcare resource use using regression modeling, controlling for demographic and health history covariates. Indirect costs were calculated using wage rates and the human capital method.
Results Back pain (72.10 %) and shoulder pain/stiffness (54.90 %) were the most prevalent pain types. Adjusting for demographic and health history differences, respondents with chronic pain reported lower health status [mental component summary (MCS): 44.26 vs. 51.14; physical component summary (PCS): 44.23 vs. 47.48; both $p < 0.05$], greater absenteeism (4.74 vs. 2.74 %), presenteeism (30.19 vs. 15.19 %), overall work impairment (31.70 vs. 16.82 %), indirect costs (¥1488,385 vs. ¥804,634), activity impairment (33.45 vs. 17.25 %), physician visits (9.31 vs. 4.08), emergency room (ER) visits (0.19 vs. 0.08), and hospitalizations (0.71 vs. 0.34) (all $p < 0.05$). Nearly 60 % of respondents with chronic pain were untreated. The mean level of pain severity in the last week was 5.26 (using a 0–11 scale); being female, being elderly, having low income, and having multiple pain types were significantly associated with greater pain severity (all $p < 0.05$). Regular exercise was associated with lower pain severity ($p < 0.05$).
Conclusions The results suggest that chronic pain has a significant association in an individual's health status, work productivity, daily activity impairment, healthcare resource use, and economic burden in Japan. Along with low treatment rates, a multidisciplinary approach may lead to an improved quality of life and reduce the economic burden among patients with chronic pain in Japan.

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Introduction

The prevalence of chronic pain, defined as pain lasting at least three months [1], varies between 11.5 and 55.2 % among Western nations [2]. The rates in Japan have been found to be similar. A recent (2011) study of 20,000 adults aged 20–69 years reported that 26.4 % met the criteria for chronic pain [3]. According to the Institute of Medicine, rates of chronic pain are expected to increase due to increases in other chronic conditions which co-occur with pain (e.g., cancer), increases in obesity, improved

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management of catastrophic injuries (which will reduce mortality but increase the number of survivors with chronic pain), and greater awareness on the part of the patient about chronic pain and treatment options [4].

Evidence from the Western literature suggests significant effects of chronic pain on quality of life, activities of daily living, productivity, suicide risk, and indirect and direct costs [4–6]. Using a nationwide mailed survey in Japan, Nakamura et al. [7] found that respondents who reported experiencing musculoskeletal pain also reported more work-related effects, more impairment in daily activities, and lower health status as assessed by the Short Form-36 (SF-36). Another study using a home visit survey of the elderly in Takasaki City, found that the presence of chronic knee pain was associated with significantly increased impairments in activities of daily living [8]. Recently, DiBonaventura et al. [9] compared respondents with neuropathic pain with controls, adjusting for comorbidities and other variables using the Japan National Health and Wellness Survey, and found that chronic neuropathic pain was associated with lower health status and greater work-related impairment and healthcare resource use. Aside from physical limitations, other studies have documented the relationship between pain and psychological illness [10].

However, much of the chronic pain research in Japan has been limited by a focus on specific types of pain (e.g., neuropathic, musculoskeletal, knee, etc.), and the evidence of the economic burden of chronic pain among Japanese patients is quite limited. Therefore, the aim of the current work was to more broadly examine the types of chronic pain experienced and its collective burden in Japan by assessing both humanistic and economic effects. Specifically, the present study explored the association between chronic pain and health status, work productivity loss, healthcare resource utilization, and indirect costs in a nationwide sample. A secondary aim was to understand what factors were most strongly associated with greater pain severity among those with chronic pain.

Methods

Data source and procedures

Data from the 2011 Japan National Health and Wellness Survey (NHWS) were used in the analyses. The NHWS is an Internet survey administered to adults in Japan from November to December, 2011. The NHWS is a purely patient-reported survey which includes information on sociodemographics, general health history, medical comorbidities, medication usage, and health outcomes, among other variables. NHWS respondents are members of the Lightspeed Research (LSR) panel or its partners, which are opt-in survey panels with a total of over 4 million members worldwide. Members of LSR and its partners were recruited through an opt-in email, co-registration with LSR partners, an e-newsletter campaigns, and online banner placements. All potential panel members must register with a unique email address and password and complete an in-depth demographic registration profile.

Panel members were not recruited from a purely convenience-of-sampling standpoint; some attempts were made to equate the panel membership with basic census information. For example, in Japan 52 % of the population is female and 32 % of the population reports an annual income of <¥4 million; 49 % and 31 % of the panel are female and have an annual income of <¥4 million, respectively [11]. Nevertheless, the characteristics of the panel do not entirely match that of the population and skew toward being a younger population.

The NHWS recruits from this panel in stratified random sample (by sex and age) was implemented to mitigate some of these biases by ensuring the final NHWS sample is demographically consistent with the Japanese adult population based on governmental statistics [12]. Specifically, by using the international database of the U.S. Census, the distribution of age and sex in Japan was identified and mimicked such that the final NHWS sample ($N = 30{,}000$; response rate = 15.33 %) matches these distributions. Although not included in the sampling frame, distributions of household income and region are also consistent between the NHWS data and the governmental statistics of Japan [12]. All respondents provided informed consent and the study protocol was reviewed and approved by an institutional review board. Respondents received modest compensation in exchange for their participation.

Sample

The total sample in the 2011 Japan NHWS is 30,000 respondents. All respondents were included in the analyses.

Measures

Chronic pain

All respondents in the NHWS were asked whether they experienced pain in the past 12 months. For those who answered affirmatively, they were then asked if they experienced pain in the past month. For those who answered affirmatively, they were presented with a list of types of pain and asked which they had experienced and whether those types of pain were diagnosed. If they were diagnosed, respondents were asked how long they experienced each type of pain. From all this information, a dichotomous group variable (having chronic pain vs. not having chronic pain) was used as the primary predictor of study outcomes. Chronic pain was defined as experiencing one of the following types of pain for three months or more: arthritis, back problems, cancer, fibromyalgia, joint, neck, neuropathic (including diabetic peripheral neuropathy), post-herpetic neuralgia, shoulder, sprain/strain, surgery/medical procedure, or phantom limb pain. Those that did not meet the definition for chronic pain were considered to not have chronic pain. Patients with chronic pain were asked to evaluate their level of severity for each type of pain ("mild", "moderate", or "severe") and also asked to provide an overall assessment of their pain severity in the last week using an 11-point numeric rating scale (NRS-11; with 0 representing no pain, to 10 representing the worst pain imaginable). Patients were also asked whether they were currently taking a prescription medication at the time of the survey (yes vs. no).

Sociodemographics

The sex, age, marital status (married/living with partner vs. not-married), education (university educated vs. less than university educated), annual household income (<¥3,000,000, ¥3,000,000 to <¥5,000,000, ¥5,000,000 to <¥8,000,000, ≥¥8,000,000, or decline to answer), and employment status (currently employed or not currently employed) were assessed and considered as covariates. Household composition (living alone, living with adults only, living with children and adults, or living with children only) was also included as an additional variable in lieu of marital status in certain analyses.

Health history

Smoking status (currently smoke vs. do not currently smoke), alcohol use (currently drink vs. do not currently drink), and exercise behavior (currently exercise vs. do not currently exercise) were assessed and used as covariates in regression analyses. Height and weight were converted to body mass index (BMI) with the following categories: <18.5 kg/m^2 (i.e., underweight), 18.5 to <25.0 kg/m^2 (i.e., normal BMI), ≥25.0 kg/m^2 (i.e., obese), or decline to provide weight. The Charlson comorbidity index (CCI) was also included and calculated by weighting the presence of a variety of chronic conditions and summing the result with greater total index scores indicating a greater comorbid burden on the respondent [13].

Health status

The Medical Outcomes Study 12-Item Short Form Survey Instrument (SF-12v2) is a multipurpose, generic health status instrument [14]. The items from the SF-12v2 are used to calculate two normed summary scores: physical component summary (PCS) and mental component summary (MCS). The SF-12v2 items can also be used to generate health state utilities, which represents the preference for a particular health state and varies conceptually from 0 (a state equivalent to death) to 1 (a state equivalent to perfect health). This conversion is achieved through application of the SF-6D classification [15]. For all SF-12v2-derived measures, higher scores indicate better health status.

Work productivity and activity impairment

Work productivity was assessed using the general health version of the Work Productivity and Activity Impairment (WPAI-GH) questionnaire, a 6-item validated instrument, which consists of four metrics: absenteeism (the percentage of work time missed because of one's health in the past seven days), presenteeism (the percentage of impairment experienced while at work in the past seven days because of one's health), overall work productivity loss (an overall impairment estimate that is a combination of absenteeism and presenteeism), and activity impairment (the percentage of impairment in daily activities because of one's health in the past seven days) [16]. Absenteeism, presenteeism, and overall work productivity loss were only calculated for respondents who were employed.

Healthcare resource use

Healthcare utilization was defined by the number of traditional healthcare provider visits, the number of emergency room (ER) visits ("How many times have you been to the ER for your own medical condition in the past six months?"), and the number of times hospitalized ("How many times have you been hospitalized for your own medical condition in the past six months?") for all medical conditions experienced in the past six months.

Statistical analyses

Differences between those with and without chronic pain were examined with respect to demographics and health characteristics using Chi square tests (categorical outcomes) and analysis of variance (ANOVA) tests (continuous outcomes). Differences between those with and without chronic pain were then examined with respect to health outcomes (i.e., health status, work productivity and activity impairment, and healthcare resource use) using regression modeling, controlling for age, gender, household income, BMI, smoking status, exercise behavior, and the CCI. These covariates were chosen because they differed between those with chronic pain and those without chronic pain and have known associations with health outcomes in Japan [12].

General linear models were used for health status variables due to the normality of the distribution. Aside from reporting the unstandardized regression estimate (*b*) for the effect of pain (which indicate the difference in the dependent variable between those with and without chronic pain, holding all covariates constant), adjusted means were also reported from these models using a least squares algorithm, setting each covariate to the mean of the analytical sample. Generalized linear models were used for work productivity and healthcare resource use variables due to their pronounced skew. A negative binomial distribution provided the best fit for the work productivity, activity impairment, and healthcare resource use variables due to the skewed distributions and a multiplicative dispersion parameter being added to adjust the standard errors because of a slight model underdispersion. Unstandardized regression estimates (*b*) as well as the anti-log of b (i.e., e^b or rate ratios) were presented for the effect of pain. Rate ratios represent the multiplicative factor for which the mean of the pain group is greater than that of the control group (e.g., a rate ratio of 1.30 indicates the mean for the pain group is 1.30 times that of the control group). In addition, adjusted means were also reported from these models using a maximum likelihood algorithm, setting each covariate to the mean of the analytical sample.

Annual costs due to absenteeism and presenteeism were calculated by integrating information from the WPAI and hourly wage rates from the Japan Basic Survey on Wage Structure [17] using the human capital method. For each employed respondent, his or her hours lost due to either absenteeism or presenteeism (measured using the WPAI instrument) were then multiplied by their estimated wage (based on age and sex) to estimate total weekly indirect costs. These figures were then annualized. The presence of chronic pain was then used to predict these total indirect costs using a generalized linear model (again, with a negative binomial distribution and a log-link function to best capture the skewness of the data) controlling for age, sex, household income, BMI, smoking status, exercise behavior, and the CCI. Adjusted means were reported from these models using a maximum likelihood algorithm, setting each covariate to the mean of the analytical sample.

To further illustrate the burden of chronic pain, an additional analysis was performed comparing those with chronic pain to those with non-chronic pain (i.e., those without any pain from the control group in the main analysis were excluded from the control group in this supplemental analysis). This approach would isolate the effect of chronic pain on health outcomes above and beyond any effect of general non-chronic pain. Aside from excluding respondents without pain from the control group, this supplemental analysis replicated the exact approach in the main analysis described above. The same outcomes were examined and the same modeling procedure was used.

To examine the secondary objective, overall pain severity in the last week was predicted using the available sociodemographic and health history variables in a general linear model. In this model, the same covariates were coded and used as described above with the following exceptions: age was categorized in ten-year increments as opposed to entered continuously (to best understand the age groups with the highest pain severity), household composition was used in lieu of marital status, and the number of pain types (1, 2, 3, or 4+) was used as an additional predictor.

All analyses were conducted using SAS version 9.3 (Cary, NC).

Results

A total of 785 respondents met our criteria for chronic pain (2.62 %). Demographic and health characteristics for respondents with and without chronic pain are shown in Table 1. Respondents with chronic pain were significantly more likely to be older, be female, be unemployed, exercise regularly, and have a greater BMI and comorbidity burden compared with those without chronic pain (all $p < 0.05$).

Among respondents who reported chronic pain, the types of pain experienced in the past month and types of pain diagnosed are shown in Table 2. Both back pain (72.10 %) and shoulder pain/stiffness (54.90 %) were the most prevalent pain types and were experienced by more than half of respondents with chronic pain. A total of 41.02 % respondents reported they were currently using a prescription medication for their pain. However, there was considerable variability in treatment rates across pain types, as shown in Table 2. Despite the small sample size (which creates additional uncertainty around these estimates), broken bones (71.43 %), cancer pain (66.67 %), and phantom limb pain (66.67 %) were the most likely pain types to be treated. Conversely, menstrual cycle pain (38.60 %), back pain (40.81 %), and post-herpetic neuralgia (40.91 %) were the pain types least likely to be treated.

Analyses were then conducted to compare the health outcomes of those with and without chronic pain using regression analysis. Respondents with chronic pain reported significantly lower levels of MCS [*b* (unstandardized regression estimate) $= -3.24$, $p < 0.05$] and PCS ($b = -6.88$, $p < 0.05$) relative to respondents without chronic pain (both $p < 0.05$). Figure 1 shows the adjusted means for MCS (44.26 vs. 51.14 for chronic pain and controls, respectively) and PCS scores (44.23 vs. 47.48 for chronic pain and controls, respectively). Additionally, those with chronic pain reported significantly lower levels of health utilities ($b = -0.09$, $p < 0.05$; Adjusted means = 0.68 vs. 0.77 for those with and without chronic pain, respectively).

Table 1 Demographic and health characteristics in those with and without chronic pain

	Total ($N = 30{,}000$)	Chronic pain ($N = 785$)	No chronic pain ($N = 29{,}215$)	p
Age (years)				
Mean ± SD	47.38 ± 15.63	53.97 ± 13.78	47.20 ± 15.64	<0.001
Gender				
Female (%)	14,958 (49.9 %)	428 (54.5 %)	14,530 (49.7 %)	0.008
Male (%)	15,042 (50.1 %)	357 (45.5 %)	14,685 (50.3 %)	
Education level				
Less than university education (%)	15,912 (53.0 %)	422 (53.8 %)	15,490 (53.0 %)	0.683
University education or higher (%)	14,088 (47.0 %)	363 (46.2 %)	13,725 (47.0 %)	
Household composition				
Live alone (%)	4466 (14.9 %)	111 (14.1 %)	4355 (14.9 %)	0.047
Live with children only (%)	375 (1.3 %)	15 (1.9 %)	360 (1.2 %)	
Live with adults only (%)	17,538 (58.5 %)	485 (61.8 %)	17,053 (58.4 %)	
Live with adults and children (%)	7621 (25.4 %)	174 (22.2 %)	7477 (25.5 %)	
Annual household income				
<¥3 million (%)	5143 (17.1 %)	152 (19.4 %)	4991 (17.1 %)	<0.001
¥3 million to <¥5 million (%)	7571 (25.2 %)	204 (26.0 %)	7367 (25.2 %)	
¥5 million to <¥8 million (%)	7664 (25.5 %)	179 (22.8 %)	7485 (25.6 %)	
¥8 million or more (%)	6586 (22.0 %)	201 (25.6 %)	6385 (21.9 %)	
Decline to answer (%)	3036 (10.1 %)	49 (6.2 %)	2987 (10.2 %)	
Employment status				
Not currently employed (%)	12,180 (40.6 %)	365 (46.5 %)	11,815 (40.4 %)	<0.001
Employed (%)	17,820 (59.4 %)	420 (53.5 %)	17,400 (59.6 %)	
Body mass index (BMI) category				
Underweight (%)	3131 (10.4 %)	65 (8.3 %)	3066 (10.5 %)	<0.001
Acceptable risk (%)	15,197 (50.7 %)	350 (44.6 %)	14,847 (50.8 %)	
Increased risk (%)	8309 (27.7 %)	259 (33.0 %)	8050 (27.6 %)	
High risk (%)	2147 (7.2 %)	98 (12.5 %)	2049 (7.0 %)	
Decline to provide weight (%)	1216 (4.1 %)	13 (1.7 %)	1203 (4.1 %)	
Alcohol use				
Do not drink (%)	8485 (28.3 %)	217 (27.6 %)	8268 (28.3 %)	0.687
Drink alcohol (%)	21515 (71.7 %)	568 (72.4 %)	20947 (71.7 %)	
Smoking behavior				
Never smoked (%)	16780 (55.9 %)	375 (47.8 %)	16405 (56.2 %)	<0.001
Former smoker (%)	7057 (23.5 %)	241 (30.7 %)	6816 (23.3 %)	
Current smoker (%)	6163 (20.5 %)	169 (21.5 %)	5994 (20.5 %)	
Exercise behavior				
Do not exercise (%)	16443 (54.8 %)	372 (47.4 %)	16071 (55.0 %)	<0.001
Regularly exercise (%)	13557 (45.2 %)	413 (52.6 %)	13144 (45.0 %)	
Charlson comorbidity index				
Mean ± SD	0.15 ± 0.58	0.49 ± 1.82	0.14 ± 0.50	<0.001

Those with chronic pain also reported significantly higher levels of absenteeism ($b = 0.55$, rate ratio = 1.73, $p < 0.05$), presenteeism ($b = 0.69$, rate ratio = 1.99, $p < 0.05$), overall work impairment ($b = 0.63$, rate ratio = 1.89, $p < 0.05$), and activity impairment ($b = 0.66$, rate ratio = 1.94, $p < 0.05$). Figure 2 shows the associated adjusted means for these outcomes (absenteeism: 4.74 vs. 2.74 %; presenteeism: 30.19 vs. 15.19 %; overall work impairment: 31.70 vs. 16.82 %; and activity impairment: 33.45 vs. 17.25 %) for those with and without chronic pain, respectively (all $p < 0.05$).

Differences in absenteeism and presenteeism were then converted to annual costs in Fig. 3. Adjusting for confounding variables, employed patients with chronic

Table 2 Types of pain experienced, diagnosed, and treated, and levels of pain severity among those with chronic pain ($N = 785$)

Pain type	Experienced in the past month (among all patients, $N = 785$)		Using a prescription medication (among patients with that particular type of pain)		Diagnosed (among all patients, $N = 785$)		Severity of pain experienced in the past month					
							Mild		Moderate		Severe	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Back problems	566	72.10	231	40.81	477	60.76	241	42.58	253	44.70	72	12.72
Shoulder pain/stiffness	431	54.90	179	41.53	233	29.68	185	42.92	185	42.92	61	14.15
Joint pain	252	32.10	108	42.86	180	22.93	128	50.79	100	39.68	24	9.52
Neck	208	26.50	98	47.12	112	14.27	90	43.27	90	43.27	28	13.46
Arthritis	191	24.33	80	41.88	154	19.62	111	58.12	63	32.98	17	8.90
Headache	164	20.89	77	46.95	53	6.75	91	55.49	64	39.02	9	5.49
Migraine	115	14.65	56	48.70	46	5.86	51	44.35	53	46.09	11	9.57
Dental problems	57	13.32	22	38.60	16	3.74	45	73.77	13	21.31	3	4.92
Menstrual cycle	61	7.77	25	40.98	45	5.73	29	50.88	17	29.82	11	19.30
Sprains/strains	50	6.37	23	46.00	31	3.95	39	78.00	8	16.00	3	6.00
Neuropathic pain (including DPN)	26	3.31	13	50.00	29	3.69	12	37.50	16	50.00	4	12.50
Post-herpetic neuralgia	22	2.80	9	40.91	18	2.29	14	63.64	5	22.73	3	13.64
Surgery/medical procedure	22	2.80	15	68.18	21	2.68	9	40.91	6	27.27	7	31.82
Fibromyalgia	18	2.29	8	44.44	22	2.80	9	45.00	8	40.00	3	15.00
Broken bones	14	1.78	10	71.43	12	1.53	7	50.00	7	50.00	0	0.00
Cancer	6	0.76	4	66.67	6	0.76	4	66.67	2	33.33	0	0.00
Phantom limb pain	6	0.76	4	66.67	3	0.38	2	33.33	3	50.00	1	16.67

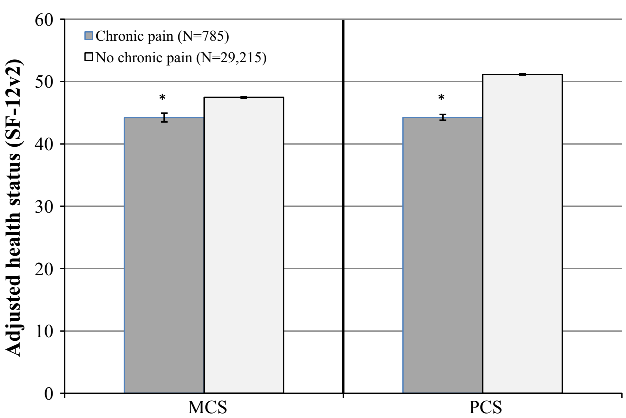

Fig. 1 Adjusted means of physical and mental health component summary scores among those with and without chronic pain. *$p < 0.05$ relative to the no chronic pain group (based on a *t* test of the chronic pain parameter estimate in the general linear model); *error bars* represents 95 % confidence intervals. *PCS* physical component summary and *MCS* mental component summary of the SF-12v2. All models controlled for age, sex, household income, body mass index, smoking status, alcohol use, exercise behavior, and the Charlson comorbidity index

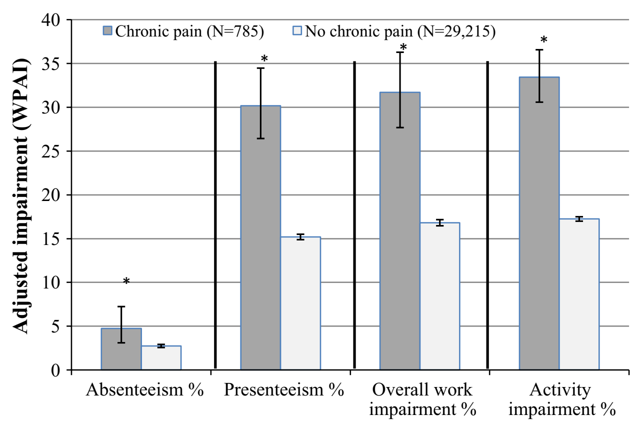

Fig. 2 Adjusted means of work productivity and activity impairment among those with and without chronic pain. *$p < 0.05$ relative to the no chronic pain group (based on a *z* test of the chronic pain parameter estimate in the generalized linear model); *error bars* represents 95 % confidence intervals. Only those employed full or part-time ($n = 17{,}820$) provided data for absenteeism, presenteeism, and overall work impairment. All models controlled for age, sex, household income, body mass index, smoking status, alcohol use, exercise behavior, and the Charlson comorbidity index

pain had ¥232,815 in lost wages due to absenteeism per-patient per-year compared with ¥139,330 for employed respondents without chronic pain ($p < 0.05$). Similarly, employed patients with chronic pain had ¥1,255,570 in lost wages due to presenteeism per-patient per-year compared with ¥665,304 for employed respondents without chronic pain ($p < 0.05$). The total indirect costs for employed patients with chronic pain were significantly higher than

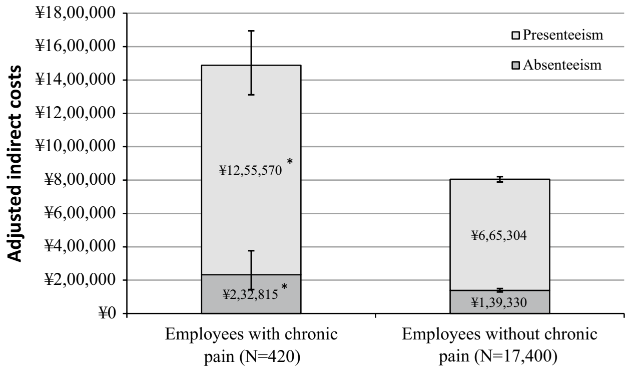

Fig. 3 Adjusted means of indirect costs among those with and without chronic pain. *$p < 0.05$ relative to the no chronic pain group (based on a z test of the chronic pain parameter estimate in the generalized linear model); *error bars* represents 95 % confidence intervals. All models controlled for age, sex, household income, body mass index, smoking status, alcohol use, exercise behavior, and the Charlson comorbidity index

employed respondents without chronic pain (¥1,488,385 vs. ¥804,634, $p < 0.05$).

Similar relationships were observed when predicting healthcare resource use. Chronic pain was associated with an increased number of physician visits ($b = 0.83$, rate ratio = 2.29, $p < 0.05$), ER visits ($b = 0.86$, rate ratio = 2.37, $p < 0.05$), and hospitalizations ($b = 0.74$, rate ratio = 2.10, $p < 0.05$). The adjusted means of these models are shown in Fig. 4. In all cases, the adjusted means were more than twice as high for respondents with chronic pain: physician visits = 9.31 vs. 4.08, ER visits = 0.19 vs. 0.08, and hospitalizations = 0.71 vs. 0.34 (all $p < 0.05$).

Severity of pain experienced in the past month for each specific pain type was examined among those with chronic pain, as shown in Table 2. For most types of pain, between 40–60 % of respondents reported their pain as moderate-to-severe. The highest proportion of severe pain was experienced in relation to surgery/medical procedure pain (31.82 %). A majority of respondents experiencing chronic pain reported not being treated for their pain ($n = 463$, 58.98 %).

As discussed in the statistical analysis section above, a supplemental analysis was performed to compare health outcomes between respondents with chronic pain ($N = 785$) and respondents with non-chronic pain ($N = 3219$). Adjusting for the same set of covariates as noted in the main analysis, a similar pattern of results was observed (see Table 3). Although adjusted MCS scores were not significantly different between groups (44.04 vs. 44.41 for chronic pain and non-chronic pain, respectively; $p = 0.38$), PCS scores and health utilities were significantly lower among those with chronic pain (both $p < 0.05$). Similarly, all forms of work impairment, activity impairment, and healthcare resource use were significantly higher among those with chronic pain compared with those with non-chronic pain (all $p < 0.05$). Levels of impairment and healthcare resource use were generally 50 % higher among those with chronic pain.

Further, employed patients with chronic pain had ¥218,424 in lost wages due to absenteeism per-patient per-year compared with ¥121,339 for employed respondents with non-chronic pain ($p < 0.05$). Similarly, employed patients with chronic pain had ¥1,300,077 in lost wages

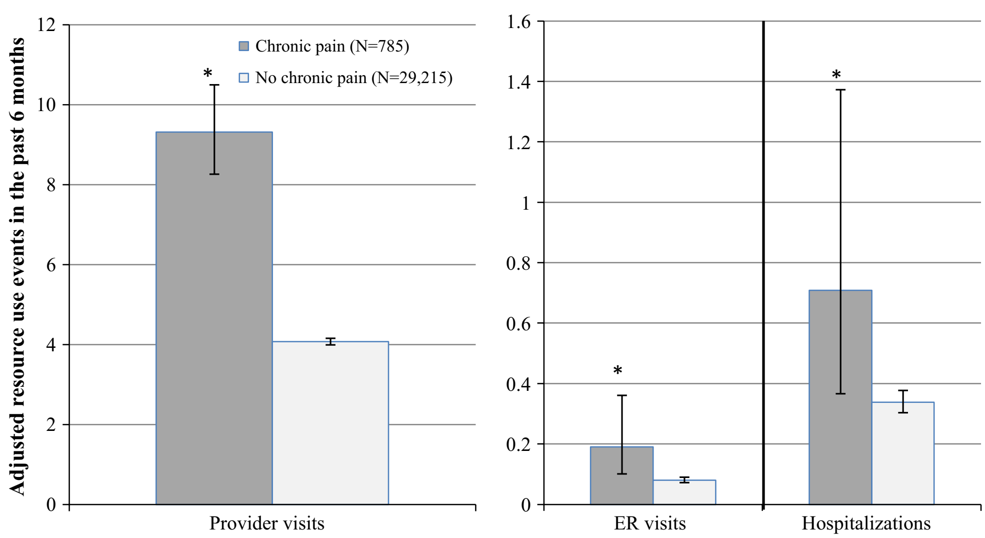

Fig. 4 Adjusted means of healthcare resource use among those with and without chronic pain. *$p < 0.05$ relative to the no chronic pain group (based on a z test of the chronic pain parameter estimate in the generalized linear model); *error bars* represents 95 % confidence intervals. All models controlled for age, sex, household income, body mass index, smoking status, alcohol use, exercise behavior, and the Charlson comorbidity index

Table 3 Adjusted means of health outcomes between those with chronic pain and those with non-chronic pain

Dependent variable	Pain group	Adjusted mean	SE	95 % LCL	95 % UCL	*p* value
SF-12: mental component summary	Chronic pain	44.04	0.38	43.29	44.79	0.3848
SF-12: mental component summary	Non-chronic pain	44.41	0.19	44.05	44.78	–
SF-12: physical component summary	Chronic pain	43.93	0.28	43.38	44.48	<0.0001
SF-12: physical component summary	Non-chronic pain	47.73	0.14	47.46	48.00	–
Health state utility score	Chronic pain	0.67	0.00	0.66	0.68	<0.0001
Health state utility score	Non-chronic pain	0.71	0.00	0.70	0.71	–
Absenteeism %	Chronic pain	4.70	0.98	3.12	7.08	0.0111
Absenteeism %	Non-chronic pain	2.60	0.25	2.15	3.14	–
Presenteeism %	Chronic pain	30.33	1.62	27.32	33.67	<0.0001
Presenteeism %	Non-chronic pain	20.38	0.51	19.41	21.41	–
Overall work impairment %	Chronic pain	32.02	1.77	28.74	35.68	<0.0001
Overall work impairment %	Non-chronic pain	21.96	0.57	20.87	23.10	–
Activity impairment %	Chronic pain	34.79	1.17	32.56	37.17	<0.0001
Activity impairment %	Non-chronic pain	26.07	0.43	25.25	26.93	–
Healthcare provider visits in past 6 months	Chronic pain	10.91	0.56	9.86	12.06	<0.0001
Healthcare provider visits in past 6 months	Non-chronic pain	6.34	0.16	6.03	6.67	–
ER visits in the past 6 months	Chronic pain	0.20	0.05	0.12	0.33	0.0127
ER visits in the past 6 months	Non-chronic pain	0.10	0.01	0.08	0.13	–
Hospitalizations in the past 6 months	Chronic pain	0.78	0.22	0.45	1.35	0.0356
Hospitalizations in the past 6 months	Non-chronic pain	0.41	0.05	0.31	0.53	–

SE standard error, *LCL* lower confidence limit, *UCL* upper confidence limit

due to presenteeism per-patient per-year compared with ¥894,642 for employed respondents with non-chronic pain ($p < 0.05$). The total indirect costs for employed patients with chronic pain were significantly higher than employed respondents with non-chronic pain (¥1,513,879 vs. ¥1,000,650, $p < 0.05$).

The overall rating of pain was 5.26 (SD = 2.47) on the eleven-point NRS. We sought to examine which factors were associated with a higher assessment of severity (see Table 4). Pain severity was highest among respondents with chronic pain between 30 and 80 years (bs = 1.36–1.77) and lowest among respondents less than 30 years (all $p < 0.05$). Females reported higher levels of pain ($b = 0.41$) as did respondents with lower household income ($b = 0.58$; both $p < 0.05$). Regular exercise was associated with lower pain severity ($b = -0.43$). Although comorbidities were unrelated to pain severity, an increasing number of pain types was associated with increased severity (2 pain types: $b = 0.49$; 3 pain types: $b = 1.19$; 4+ pain types: $b = 1.37$; all $p < 0.05$).

Discussion

Although a few studies have examined the effect of specific chronic pain conditions on the health outcomes of patients in Japan, the literature has lacked a broad assessment of the effect of chronic pain. The aim of the current study was to address this gap by examining the effect of chronic pain across health status, work productivity, healthcare resource use, and economic outcomes as well as determining which factors were most strongly associated with greater pain severity

A large percentage of chronic pain was experienced in the back, joints, neck, and shoulders, which replicates previous prevalence studies in Japan [7, 8]. Nearly 60 % of patients with chronic pain were not currently treated, highlighting the unmet needs of these patients. A previous study in Japan found a similar percentage of chronic pain patients had sought treatment (42 %), however this included both treatment through a medical institution and folk remedies and only in patients experiencing chronic musculoskeletal pain [7]. The current finding suggests an inadequacy with current treatment options which has been previously reported in prior studies in Europe [8, 18].

Very few studies have assessed the burden of chronic pain in Japan; the ones that have done so were limited by only including a specific type of pain [7–9]. Comparisons between those with and without chronic pain suggested, even after adjusting for demographic and health history differences, that patients with chronic pain report worse health status. Chronic pain affects physical functioning, and it is, therefore, not surprising that group differences were greater for physical health than on mental health. Nevertheless, for

Table 4 Predictors of pain severity among those with chronic pain ($N = 785$)

Parameter	*b*	95 % LCL	95 % UCL	*t*	*p*
Intercept	2.97	1.93	4.00	5.63	<0.0001
Age group: <30 years	–	–	–	–	–
Age group: 30 to <40 years	1.36	0.44	2.27	2.91	0.0037
Age group: 40 to <50 years	1.55	0.69	2.40	3.55	0.0004
Age group: 50 to <60 years	1.77	0.92	2.61	4.10	<0.0001
Age group: 60 to <70 years	1.50	0.66	2.34	3.49	0.0005
Age group: 70 to <80 years	1.68	0.78	2.59	3.64	0.0003
Age group: 80 years or more	0.43	−1.30	2.17	0.49	0.6221
Male	−0.41	−0.79	−0.02	−2.08	0.0377
Income: < ¥3 million	0.58	0.07	1.10	2.21	0.0273
Income: ¥3 million to <¥5 million	–	–	–	–	–
Income: ¥5 million to <¥8 million	0.06	−0.42	0.54	0.24	0.8099
Income: ¥8 million or more	−0.53	−1.01	−0.05	−2.19	0.029
Income: decline to answer	−0.07	−0.81	0.68	−0.18	0.8589
BMI: underweight	0.24	−0.40	0.88	0.74	0.458
BMI: acceptable risk	–	–	–	–	–
BMI: increased risk	0.17	−0.22	0.56	0.85	0.3976
BMI: high risk	0.40	−0.15	0.94	1.43	0.1544
BMI: decline to provide weight	0.24	−1.08	1.56	0.36	0.7202
Former smoker	0.25	−0.15	0.66	1.24	0.2157
Current smoker	0.15	−0.32	0.61	0.62	0.5357
Alcohol use	−0.03	−0.43	0.36	−0.16	0.872
Regular exercise	−0.43	−0.77	−0.08	−2.45	0.0147
CCI	0.06	−0.04	0.15	1.22	0.2235
Household composition: live alone	–	–	–	–	–
Household composition: live with adults only	0.33	−0.20	0.86	1.23	0.2182
Household composition: live with children and adults	0.18	−0.44	0.79	0.56	0.5751
Household composition: live with children only	0.59	−0.71	1.90	0.89	0.3726
Number of pain types: 1 pain type	–	–	–	–	–
Number of pain types: 2 pain types	0.49	0.03	0.96	2.07	0.0387
Number of pain types: 3 pain types	1.19	0.70	1.69	4.72	<0.0001
Number of pain types: 4+ pain types	1.37	0.91	1.83	5.88	<0.0001

b unstandardized regression estimate, *95 % LCL* 95 % lower confidence limit of the unstandardized regression estimate, *95 % UCL* 95 % upper confidence limit of the unstandardized regression estimate, *t* *t*-value

both physical and mental components, differences between those with and without chronic pain exceeded established clinically-relevant cutoffs, emphasizing the dramatic effect of chronic pain on the patient health experience.

By using the WPAI-GH questionnaire, one of the few ways to understand from the patient perspective how their health is affecting their job duties, this study also provides an estimate of the economic burden of chronic pain. Compared with those without chronic pain, respondents with chronic pain were characterized by significantly greater work and activity impairment relative to those without chronic pain, which is consistent with past research in Japan that focused on work effects and impairment in activities of daily living [7–9]. Respondents with chronic pain reported between 73–99 % more work and activity impairment compared to those without chronic pain; this equated to approximately one-third more of work time that was missed or rendered ineffective due to health problems. The data additionally showed that respondents with chronic pain reported more resource use than those without chronic pain. Chronic pain patients reported over twice the number of physician visits, ER visits and hospitalizations.

To further reinforce the effect of chronic pain on health outcomes, we also performed a supplemental analysis which compared patients with chronic pain to patients with non-chronic pain. Although, as would be expected, the differences between groups was less than in the main analysis, significant effects were observed in health status, work impairment, and healthcare resource use. Indeed, respondents with chronic pain reported significantly lower levels of PCS and health utilities to a clinically relevant degree and reported approximately 50 % more work impairment and healthcare resource use visits compared with respondents with non-chronic pain. These results further reinforce the burden of chronic pain, even above and beyond that of more general, non-chronic pain.

The severity results suggest that most patients experience moderate-to-severe levels of pain. Holding other variables constant, income <¥3 million was associated with higher pain severity. Johannes et al. [19] identified an association of low household income and chronic pain, which support our current findings. The current study also demonstrated the negative correlation of regular exercise and pain severity. These results suggest that encouragement of regular exercise by healthcare professionals may help to alleviate the severity of a patient's pain.

In conclusion, the results suggest that chronic pain has a significant role in an individual's health status, work productivity, daily activity impairment, healthcare resource use, and economic burden in Japan. Given this burden, and low treatment rates, the current study suggests that a multidisciplinary approach to patients with chronic pain in Japan is warranted.

Limitations

Because chronic pain could only be calculated for those who were diagnosed with their type of pain (since duration of pain was not known among those without a diagnosis of their pain), the prevalence estimate of chronic pain (2.62 %) is dramatically underestimated. However, if we assume the distribution of pain duration for those diagnosed is similar to all of patients who reported pain in the past month, then the prevalence of chronic pain in the NHWS sample could be estimated at 12 % (90 % of patients diagnosed had their pain for 3 months or more $\times$13.31 % of all NHWS respondents who reported pain in the past month = 12 %). This figure of 12 % is more consistent with the literature in Japan [20].

Other limitations of the current study include a reliance on patient-reported data, the cross-sectional design, statistical methods, and the sampling method. Although patient-reported data is necessary to assess the subjective nature of pain, measurement data may have been introduced due to the inability to verify patient reports of certain variables such as treatment use or healthcare resource use. Additionally, the cross-sectional nature of the data does not allow the ability to make causal inferences between the presence of chronic pain and various outcomes or between health history and pain severity. We attempted to control for a variety of key important variables (e.g., age, comorbidities, etc.). However, it is possible there are other third variables not included in the analysis that would explain part, or all, of the association between chronic pain and health outcomes. There was also a large imbalance in sample size between the pain and control groups. Although this does not bias our estimates of the burden of pain, different adjusted means might be generated if alternative techniques are used (e.g., matching, instrumental variable approach). Lastly, it is unclear the extent to which our chronic pain sample generalizes to the chronic pain population; certain subpopulations (i.e., patients in very poor health) may be underrepresented.

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