SAHLGRENSKA ACADEMY

Associations between chronic pain and the work ability

Degree Project in Medicine

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Abstract

Objective

The aim of this study was to investigate if chronic pain is a predictor for future work ability and sleeping problems among young adults.

Introduction

Chronic pain is a major health problem with a prevalence of 15-30%, are shown to be associated with sleeping problems and are a common reason for long-term sick leave and thereby affect the work ability. However, few studies have examined the prevalence and how chronic pain affects the work ability in a younger population.

Methods

Data from 1603 young adults in the ages 20-24 participating in the longitudinal population-based cohort study (Ung vuxen). The data at baseline and the ten-year follow up were used. Regression models were applied to determine the predictive value of chronic pain on the ten-year outcome of work ability respectively sleep problems..

Results

Over the ten year period the prevalence of chronic pain increased by 10% (22% to 32%). Sleeping problems were more common among the chronic pain group with the increased odds of 60% (OR 1.6, 95%CI 1.33:1.92). There was a modest, but statistically significant difference of 8% in work ability between the group that both suffered from chronic pain and often had sleeping problems compared to the group that did not have chronic pain and seldom experienced sleeping problems.

Conclusions

The 8% difference in work ability may be a beginning of a downward trend and it is important that the health care system address the chronic pain condition in time, in first hand to reduce the patients suffering and increase the quality of life, hence also prevent the work ability to further decline.

Key words

work ability, chronic pain, sleeping problems, young adults, prospective cohort study.

Introduction

Prevalence of chronic pain

Chronic pain is a major global health problem. Approximately 20% percent of the global population suffers from chronic pain conditions (1-3). The high prevalence causes a substantial impact to, in first case the individuals due to reduced quality of life, but also their employers, the healthcare system and the society in general. (4) The Swedish agency for health technology assessment and assessment of social services estimated that the total estimated yearly costs for chronic pain in Sweden 2003 were 877 million euros. (5) The estimation included healthcare costs such as treatment and rehabilitation and indirect costs like left out tax income due to sick leave. Chronic pain conditions are the third most common reason for sick leave in Sweden. (6) Even among young adults chronic pain is common. According to Bergman et al the prevalence among young adults in Sweden are approximately 15% among men and 18 % for women. (7). Chronic pain conditions has shown associations to numerous co-morbidities, such as depression (8), sleep disorders (9), obesity (10, 11), and a declined work ability (12).

Definition of pain

Pain is an essential part of our normally functioning somatosensory nervous system and acts like a crucial alert signal to make our mind conscious about an ongoing peril or trauma. The general definition of pain according to International Association for the Study of Pain (IASP) is “An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (13) The experience of pain is thereby linked to both sensory aspects such as intensity and localisation, however also to emotional and psychological aspects. Pain is a individual experience, where psychological and emotional aspects interact with the ascending sensory inputs and modulates the perception of pain. The

Nociceptive pain is the most common experienced type of pain, it is the pain we feel when tissue damage or hypoxia occurs in cell. It arises from the nociceptors, the endings of the primary afferent sensory nerves. If a lesion occurs to sensory a nerve, due to injury or other disease, it can induce a defect action potential signaling and give rise to *neuropathic pain* (14). When we feel acute pain, it generally originates from a nociceptive stimuli that is in proportion to the potential tissue damage. In most cases the pain diminishes when the tissue are healed and we do not acquire any further complications. However, a persistent influx of nociceptive stimuli or lingering neuropathic lesions may give rise to a modified response by the pain-processing areas of the brain, referred to as *central sensitization.* This lead to a decreased downstream inhibition of the ascending afferent pain input. The neurons may also become over excitable and evoke nociceptive firing from normally innocuous sensations (15-17). The central sensitization leads to a lowered pain threshold and may extend the areas of pain sensitivity and this condition may persist even when the origin of the pain is dampened or have diminished completely (18-20). This type of malfunctioning pain condition are to be classified as *Nociplastic pain.* It is suggested to include diagnoses like Complex Regional Pain Syndrom 1(CRPS1), Fibromyalgia, and functional visceral pain (13, 21). Pain can in some cases be experienced without any known origin, in some cases there might be a psychological explanation, in other cases the origin remain unknown. This type of pain is referred to as *pain with unknown cause*. (14) When the pain becomes persistent it may become chronic. The International association of the study of pain, IASP defines chronic pain as pain that recurs or persists longer than three months (22).

Depression and pain

The experience of pain are closely associated to the emotion related circuitry of the brain. It has been shown that the mere anticipation of pain can lead to lowered pain-thresholds (23, 24) and there seem to be a reciprocal concept between pain and negative psychological conditions such as depression (25). Imaging studies have demonstrated possible large scale shifts in the activity of key parts of the emotion circuitry in the brain, such as the prefrontal cortex and amygdala (26). This altered activity may increase the central pain sensitization, but also aggravate the depression due to the negative impact of the quality of life (25). Aside from sickness, decreased physical function can hinder the physical ability to participate in normal daily activities, thereby miss out on social activities. It can generate feelings of unfairness and injustice of the situation, and failed attempts and efforts of becoming pain free can lead to feeling of failure. These indirect aspects of the pain further worsens the negative psychological impact (12, 27-30). A concept of the different dimensions of pain are illustrated by Loeser in figure 1 (31). The nociception, which represent the origin of the pain which leads to central sensitization, the suffering which can be seen as the experience of pain and the negative psychological response, this in turn alters the behaviour and give rise to the negative impacts of quality of life.(31, 32)

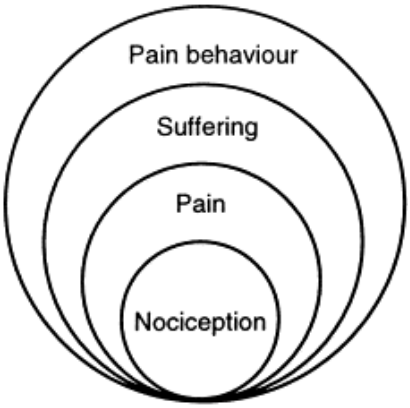

Figure 1 Loeser's multifaceted model of the components of pain (31).

Sleep disorders and pain

Sleep disorders are one aspect to the negative effect of the altered pain sensitization give rise to (9). The prevalence of sleeping disorders among patients with chronic pain conditions is estimated to be approximately 50% (9, 33), compared to 10-30% among the general

population. Among young adults the occurrence of sleeping disorders seem to be lower, around 16%. (34, 35). Sleep deprivation studies have demonstrated that lack of sleep lower the threshold of pain (36, 37). And its common among patients with chronic pain to have a low wake up threshold which often leads to frequent awakening's during the night and this may worsen the pain condition by reduced restorative effects of sleep and may contribute to an increased attention to pain during the day (38, 39). The poor sleep has also been seen to affect the work ability. One study concluded that that 80% percent among patients with fibromyalgia reported that tiredness where a limiting factor for their ability to work. (40) Other studies of patients with chronic pain conditions has, apart from pain, highlighted tiredness and disrupted sleep as significant components for managing a work role (40, 41).

Work ability

Work ability is a complex term and can be defined in several ways, though many definitions has in common that work ability is an interaction between the person , the task and the environment. One property of the term may aim to determine the professional competence, the actual work skills and the attitude and motivation to perform on the workplace (42). Other studies has estimated the work ability by extent of long-term sick leave (43). Individual factors such as illness, disease and physical ability, including high BMI (44), and contextual factors such as the organization of work and the social relations in private or working life affects ones work ability. When assessing the work ability these aspects should be considered (12, 28, 45). In figure 2 Ilmarinen has summarized the different aspects in a conceptual model

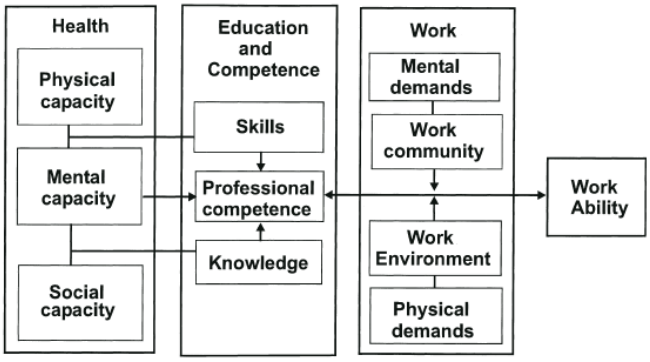

Figure 2 Ilmarinens conceptual model of determents of work ability (46).

(46). One instrument used in clinical practice as well in research is the Work Ability Index (WAI). It consists of several questions about work demand, mental health, sick leave, physical activity etc. The questions than merges into an index which gives a score to estimate work ability. (47) However, for a self-estimation of one's work ability, there has been shown that one specific single item from the WAI index may be accurate enough (48). The single item is phrased: "Let's assume that your utmost work ability is scored ten on a scale zero to ten, which point would you score your current work ability?" (48). Chronic pain conditions are the third most common reason for sick leave in Sweden (6) and are shown in many cross-sectional studies to be related to a lowered work ability (11, 12, 49, 50). One example of the negative impact of chronic pain on work ability is a pilot-study of women in the ages 18-39 who were newly diagnosed with fibromyalgia. The study investigated how the chronic pain condition symptoms affected the employment status. The percentage of women being employed decreased from 60% at time of the diagnosis to 41 % at the one year follow up (51). Another cross-sectional study found that 87% percent among patients with fibromyalgia reported that pain where a limiting factor for their ability to work (50). The work ability has also been seen to decrease along with age (40, 52). One study that investigated the work ability among health care personnel showed that the work ability began to decline as early as 35 years of age (53). In other studies it has been seen a reduction after 40 years of age (54). Hence the research on work ability has been showed to have strong associations with older age, thereby the research tend to be oriented to investigate the work ability of an older population (42, 55, 56). Studies that have investigated a younger population has been of cross-sectional design and thereby it is hard to determine the predictive value of chronic pain for the changes in work ability (12, 52, 57-59).

Strategies for treatment and rehabilitation

Due to the complex nature of the chronic pain condition non- pharmacological treatment and rehabilitation- strategies are of importance this may include lifestyle changes, exercise and in some cases weight reduction. The health care emphasis to address the chronic pain condition with a multimodal team that may include physical therapists, psychologists and medical personnel that together address the different aspects of the patients rehabilitation. The chronic pain condition are often difficult to sufficiently treat and many patients do not become pain free. One part of the rehabilitation may be cognitive behavioural therapy, the patients learn coping strategies and acceptance of the pain as well as education about pain and focus on the functions and sides to life that do function despite the pain. Non-pharmacological treatments such as TENS and warm baths are also to consider for some patient groups. The pharmacological treatment of the chronic pain depends on the type of pain the patient suffer from. Nociceptive pain may be sufficient treated with NSAIDs and paracetamol, while neuropathic pain requires medication that dampens the neurological activity. Antidepressants such as SSRI and TCA are also a common treatment that may have a dampening effect on the pain input as well as treatment of comorbid depression symptoms. Opioids are an efficient treatment to acute pain, however the analgesic effect subside over time and may stress for frequent increase of dosage which also put the patient in risk of substance dependence and abuse. For a sustainable treatment regimen the common practice among health care professional is to evaluate the available pharmacological and non-pharmacological treatment options in order to avoid long-term opioid use. (5, 60, 61).

Aim

The aim of this study was to investigate if chronic pain is a predictor for future work ability among young adults.

Specific research questions:

What does the change in prevalence of chronic pain look like in a group of young adults over a 10-year period?

Is chronic pain at baseline a predictor for work ability at the ten year follow up?

Does aspects of sleep, (sleeping problems, wake up refreshed) modify the predictive ability of chronic pain for work ability at the 10 year follow-up?

Is chronic pain at baseline a predictor for sleeping problems and not wake up refreshed at the ten year follow up?

Material and Methods

Study design

The material for this study is based on data from Ung Vuxen, a longitudinal population-based cohort study. More information about the study and the baseline questionnaire can be found in Occupational and Environmental Medicine Report nr. 118 (62). All data were self-reported using a questionnaire, including questions about mental and physical health, pain, work-ability, lifestyle and demographic factors. The participants were young adults aged 20-24 at baseline. Baseline-survey was conducted in 2007 and follow up 2008, 2012 and 2017. A random selection from Swedish tax agency selected 10 000 men and 10 000 females aged 20-24 which were got an invitation letter to participate in the study and participation was voluntary. At baseline there were 7125 participants, 61% women and 39% men. For this study only the participants which answered the questions in the questionnaire about pain at baseline, the five and ten-year follow up were included. As illustrated in figure 4 ,1603 participants where included.

A dropout analysis done in by Thomeè et al 2015 demonstrated that participants were more likely to be of female gender, students, have higher level of education compared to the dropout group (63).

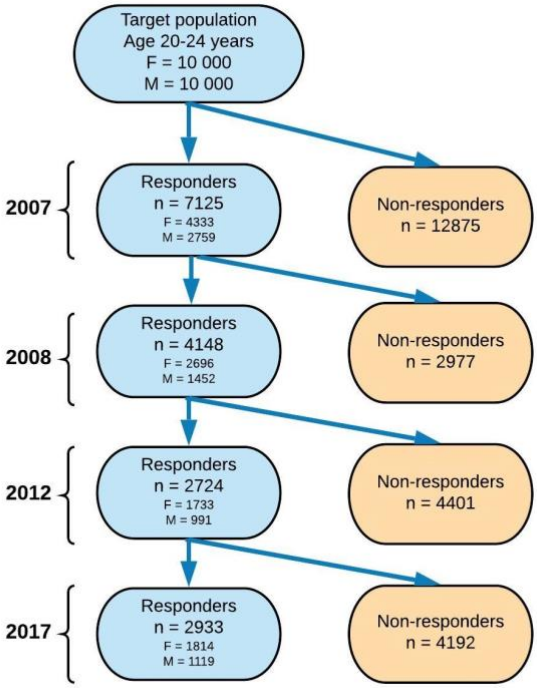

Figure 3 Flowchart WAYA cohort study baseline 2007 and follow up 2008, 2012 and 2017.

Statistical procedures and regression analyses

Data management were conducted using SPSS v.25 for Mac. Descriptive statistics were performed for the presentation of data. For the outcome work ability, linear regressions were made with the primary explanatory variable *Chronic pain.* In a second step, aspects of sleep (*sleeping problems* and *wake up refreshed*) were set as predictors and modifiers. The outcome was the *Work ability* 2017 and the explanatory and confounding variables were from baseline 2007. For the outcome aspects of sleep (*sleeping problems* and *wake up refreshed*) logistic regressions were made with the explanatory variable *Chronic pain*. Calculations of confidence intervals for comparing the prevalence of chronic pain among men and women, and when calculating the modifying effect of sleep problems formulas were used described by Zou and Donner in Statistics in Medicine 2008 (64) and by Altman in Statistics with confidence (65).

Variables generated from the questionnaire

The variables used in the regression analyses were created out of the answers from the 2007, 2012 and 2017 questionnaire. Details about the design of the questions can be found in Report from Occupational and Environmental Medicine No.118 (62). The variable coding for chronic pain followed the IASPs definition (22) and participants that answered that they have had pain for more than three months from at least on region of the upper body were classified as having chronic pain. Short-term pain was defined as pain for 1-3 months. Participants that answered that they had sleeping problems at some occasions per month to several times a week were categorized as having sleeping problems. In the same way, participants that answered that they never or at some occasions per month woke up refreshed were categorized as no waking up refreshed. Occasionally the term sleeping disorders is used, this term refer to the variables sleeping problems and wake up refreshed together. The variable symptoms of

depression was formulated by the prime MD standard of screening for depression, more information can be found in Report from Occupational and Environmental Medicine No.118 (62). The variable for Work ability was created from the 1-10 scale in the questionnaire. As presented in table 2 the 1-10 scale were categorized as poor (1-4), moderate (5-7) and good (8-10). The created variables for the regression analyses are summarized in table 1, additional variables describing the baseline population can be found in table 2.

Table 1. Created variables from the questionnaire

None, Short-term pain or Chronic pain
Sleeping problems
Wake up refreshed
Pain and Sleeping problems
Pain and Wake up refreshed
Symptoms of depression
Work ability

Analysis of possible confounders

Possible confounders, gender, depression and BMI where examined by using the criteria of a p-value < 0.2 and a percentage impact >10% on the parameter estimate for the explanatory variable, when added to the regression model. (66) The possible confounder BMI did not meet our criteria for a confounder, however the variables *symptoms of depression* and *gender* did. Due to the narrow age range of 20-24 years at baseline, age wasn't considered a possible confounder. All regressions were adjusted for the confounders symptoms of depression and gender except the regressions on the sub-set of only women, which were adjusted for symptoms of depressions.

Ethics

The participants were informed about the aim of the poll before they choose to participate. The study is approved at the ethical review board at University of Gothenburg. (Registry

number 191-05 and 876-11) and was carried out according to the Helsinki declaration - Ethical Principles for Medical Research Involving Human Subjects. The research material was anonymized and used after written informed consent from the participant

Results

Descriptive statistics

At baseline there were 6735 participants that answered the questions about pain. Of those 1133 women and 412 men had chronic pain. BMI and prevalence of obesity was roughly the same between the groups, 3 % (157/5205) of the none or short term pain group and 4% (60/1551) of the chronic pain group had a BMI over 40 and classified as obese (67). The self-estimated general health was lower in the chronic pain group and 8% estimated their health as bad or really bad, compared to 3% among those without pain. The prevalence of longer sick-leave (25-365 days) were also higher 8%, as to 2% of those without chronic pain. The MD50 screening questions for depression also shows a potential higher prevalence of depression among those with chronic pain. Of those with chronic pain,18% reported a poor work ability and 56% said that the pain had in some extent or a major impact on their work ability. The employment status was roughly the same between the groups hence with a slightly higher prevalence of long term sick leave, parental leave and unemployment among those with chronic pain. Occurrence of sleep disorders was also in some extent higher among those with chronic pain.

Table 2. Participants at baseline that answered the questions about pain.

	None or short-term pain	Chronic pain

Variables %(n) of the related category.		77(5205)	23(1551)
Age mean (SD)		22 (1.4)	22 (1.4)
Sex	women	42(2991)	73(1133)
	men	58(2199)	27(412)
BMI	Underweight	4(230)	6(91)
	Normal weight	67(3506)	68(986)
	Overweight	17(897)	20(288)
	Obesity	3(157)	4(60)
	Morbid obesity	1(60)	2(24)
General health	Good	79(4118)	60(934)
	Average	18(927)	31(484)
	Bad or really bad	3(148)	8(128)
Sick leave due to illness last 12 months	0-24 days	89(4617)	92(1280)
	25-365 days	2(122)	8(111)
Depression MD50	No signs of depression	43(2221)	31(474)
	Diminished interest or pleasure	43(2214)	57(872)
	Feeling ill at ease	41(2134)	56(859)
Psychological conditions validated by doctor	Yes	6(285)	11(170)
Sleeping problems	Often/every night	26(1339)	46(706)
Wake up refreshed	Seldom/Never	53(2774)	66(1016)
Work ability	Poor	11(520)	18(246)
	Moderate	33(1574)	43(586)
	Good	56(2623)	39(538)
Affected work ability due to pain	No impact	84(3956)	44(606)
	In some extent	13(629)	35(475)
	Major impact	3(124)	21(287)
Employment status	Working/Studying	89(4553)	86(1304)
	Long-term sick leave	1(58)	3(37)
	Parental leave/off duty	2(122)	3(42)
	Unemployed	7(366)	8(127)
Physical activity	Minimal/Sedentary	14(733)	16(237)
	Moderate/regular	76(3852)	76(1146)

	Elite level	10(514)	8(126)
Smoking	Daily	13(657)	19(291)

Changes in prevalence of chronic pain during the ten-year period

In Figure 4 and 5, only those participants answering the questions about pain at baseline, five-year and ten-year follow up were included. As follows 1603 participants were included. As shown in table 2, at baseline 73% reported no pain, 5% short-term pain (< 3 months) and 22% chronic pain.

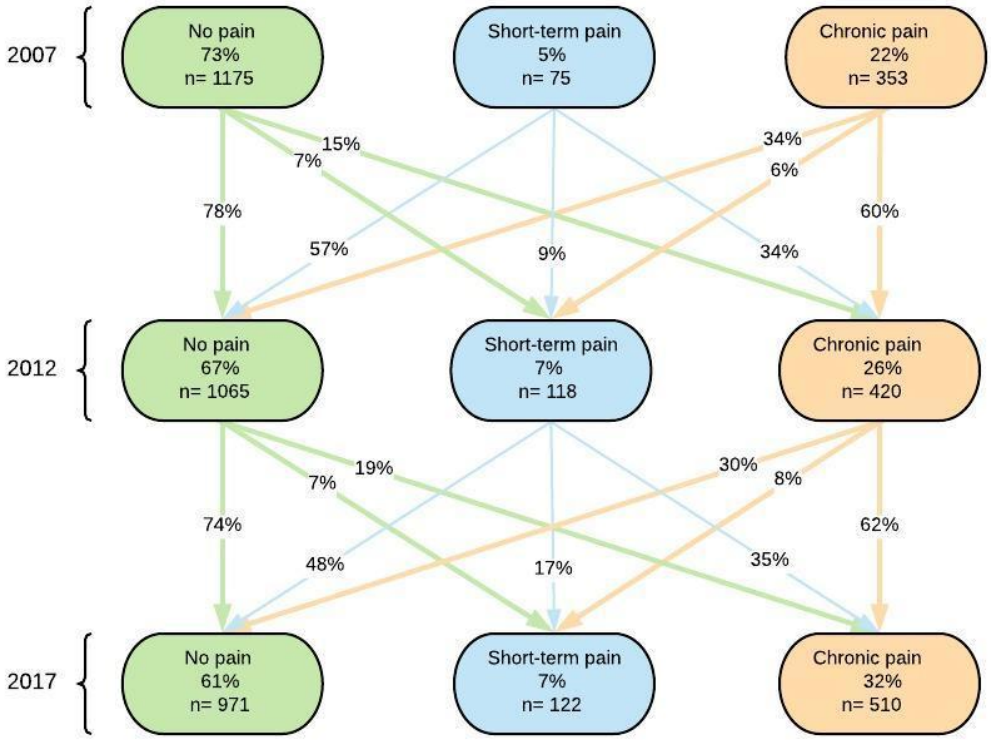

Figure 4 Migration between the no pain, short-term pain and chronic pain groups.

The majority of the participants reported to having no pain during the ten year period. Even though the no pain group decreased by 12% and on average 17% migrated to the chronic pain group and 7% to the short-term pain group, 59% remained pain free during the ten-year period. There was an extensive migration from the short-term pain group to the other groups and only 0,2% of the individuals reported short-term pain at all three measure points. Of those with short-term pain, 34% migrated to the chronic pain group at the five-year follow up and 17% remained in that group at the ten-year follow up. Subsequently 33% became pain free

and remained so at the ten-year follow up. Of those who reported chronic pain at baseline, 44% remained in the group pain at ten-year follow up.

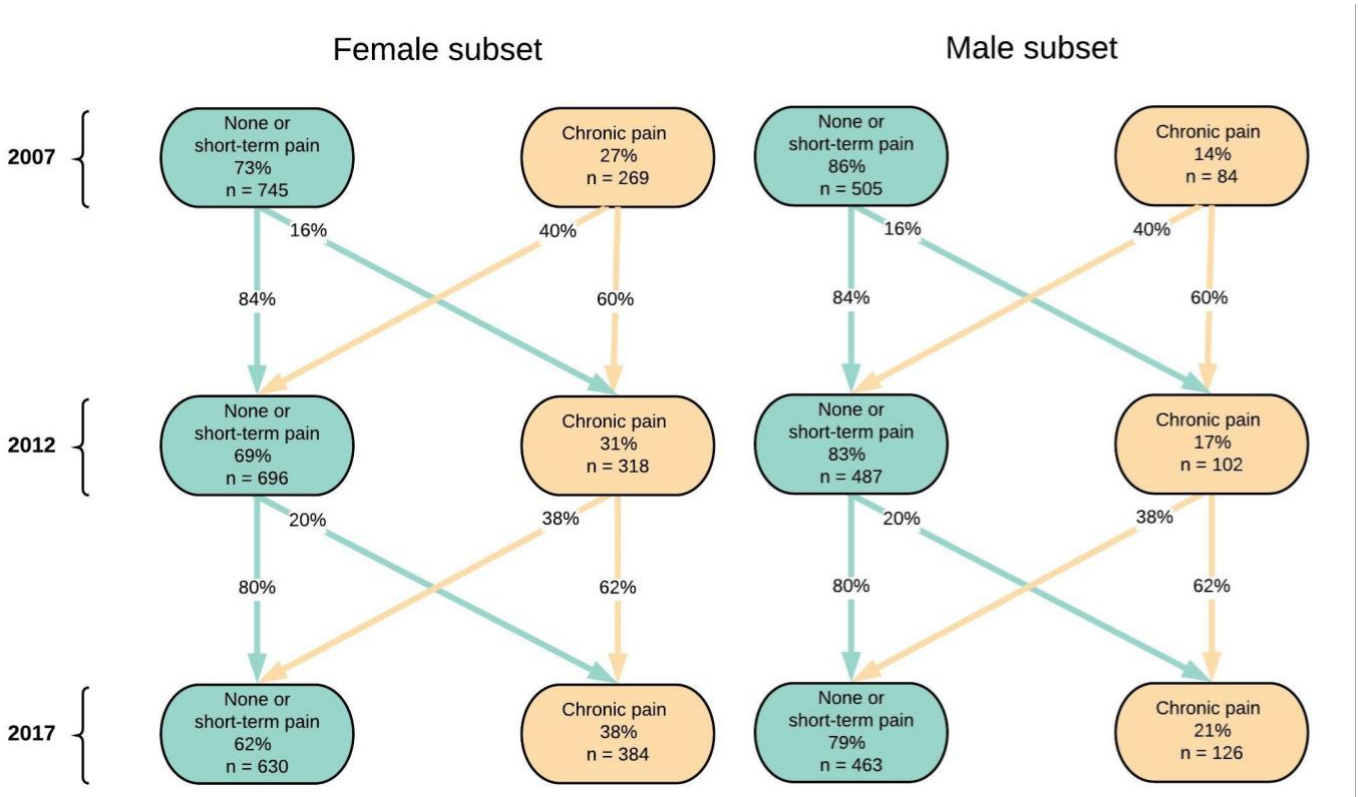

Figure 5 None or short-term pain divide by gender subsets.

The prevalence of chronic pain differed between the genders, as shown in Figure 5, at baseline 27% of the women reported chronic pain compared to 14% of the men. At the ten-year follow up 38% of the women reported chronic pain, 17% higher compared to the 21% of the men.

Predictive value of chronic pain and sleeping disorders for work ability 2017

The variables chronic pain, sleeping problems and wake up refreshed were set as predictors in multiple linear regression models with the outcome Work ability 2017, table 4 shows the summarized outcome. Chronic pain as predictor generated a mean work ability of 7.7

compared to 8.0 for the none or short-term pain category (p=0.001). And as the parameter values demonstrates, having chronic pain at baseline generates a -0.31 impact of the Work ability at the ten-year follow up. The impact is a 3% negative effect to outcome of work ability. In the same way, having sleeping problems affected the work ability with negative 4% (p<0.001) and seldom wake up refreshed roughly 2% (p= 0.012).

Table 4. Linear Regression. Dependent: Work ability 2017. Predictors: Chronic pain, Sleeping problems respectively Wake up refreshed.

Dependent Variable	Predictor	Model mean	95% CI	Parameter estimate	95% CI	P
Work ability 2017						
Unadjusted	Chronic pain	7.6	7.42 : 7.72	-.46	-.288 : -.635	<.001
	None or short-term pain	8.0	7.95 : 8.11	.	.	.
Adjusted*	Chronic pain	7.7	7.54 : 7.85	-.31	-.480 : -.132	.001
	None or short-term pain	8.0	7.92 : 8.08	.	.	.
Work ability 2017						
Unadjusted	Often sleeping problems	7.5	7.38 : 7.63	-.61	-.765 : -.548	<.001
	Seldom sleeping problems	8.1	8.03 : 8.19	.	.	-
Adjusted*	Often sleeping problems	7.6	7.52 : 7.78	-.42	-.578 : -.259	<.001
	Seldom sleeping problems	8.1	7.98 :8.15	.	.	.
Work ability 2017						
Unadjusted	Seldom wake up refreshed	7.8	7.71 : 7.89	-.30	-.444 : -.162	<.001
	Often wake up refreshed	8.1	8.00 : 8.21	.	.	.
Adjusted*	Seldom wake up refreshed	7.8	7.77 : 7.96	-.18	-.324 : -.040	0.012
	Often wake up refreshed	8.0	7.94 : 8.15	.	.	.

*Adjusted for the confounders *gender* and *symptoms of depression.*

Aspects of sleep as effect modifier

The adjusted model means displayed in table 5 show that participants that reported both chronic pain and sleeping disorders 2007 had an average work ability 2017 on 7.5 compared

to 8.1 among the participants that without chronic pain or sleep problems. The difference in the outcome of work ability between the group with no chronic pain or sleeping problems, and the group with chronic pain and still without sleeping problems was 0.31(0,089:0.539) (64). Adding sleeping problems gives a difference to 0.58 which gives a precentral difference of 8%. The modified effect of sleeping problems to chronic pain gives roughly a 3% decrease in work ability. In the same way the modifying effect of the variable wakeup refreshed to chronic pain generated a decrease of 0.14(-0.141:0.441) (64) or 1% to the outcome of work ability.

Table 5 Dependent: Work ability 2017 and chronic pain and sleeping problems, or chronic pain and wake up refreshed as predictor.

Dependent Variable	Predictor	Model mean	95% CI	Parameter estimate	95% CI	P
Work ability 2017						
Unadjusted	No pain, no sleeping problems	8.1	8.09 : 8.28	.85	.603 : 1.099	<.001
	No pain, sleeping problems	7.5	7.41 : 7.74	.25	-.035 : .527	<.001
	Chronic pain, no sleeping problems	7.7	7.56 : 7.96	.43	.123 : .737	<.001
	Chronic pain, sleeping problems	7.3	7.10 : 7.56	.	.	.
Work ability 2017						
Adjusted*	No chronic pain, no sleeping problems	8.1	8.03 : 8.22	.58	.326 : .840	<.001
	No chronic pain, sleeping problems	7.6	7.52 : 7.85	.14	-.136 : .424	<.001
	Chronic pain, no sleeping problems	7.8	7.61 : 8.01	.27	-.039 : -.576	<.001
	Chronic pain, sleeping problems	7.5	7.30 :7.77	.	.	.
Work ability 2017						
Unadjusted	No chronic pain, often wake up refreshed	8.2	8.04 : 8.28	.68	.464 : .902	<.001
	No chronic pain, seldom wake up refreshed	7.9	7.80 : 8.02	.44	.218 : .653	<.001
	Chronic pain, often wake up refreshed	7.8	7.48 : 8.02	.27	-.058 : .599	<.001
	Chronic pain, seldom wake up refreshed	7.5	7.29 : 7.66	.	.	.

Adjusted*	No chronic pain, often wake up refreshed	8.1	7.97 : 8.21	.44	.211 : .659	.001
	No chronic pain, seldom wake up refreshed	7.9	7.81 : 8.04	.27	.054 : .490	.001
	No chronic pain, often wake up refreshed	7.8	7.51 : 8.04	.12	-.204 : .448	.001
	Chronic pain, seldom wake up refreshed	7.7	7.46 : 7.85	.		.

*Adjusted for the confounders gender and symptoms of depression

Chronic pain as predictor for sleeping problems at year ten

Logistic regressions summarized in table 6 demonstrated that the risk of having sleeping problems were higher if you additionally suffered from chronic pain. The odds ratio for having sleeping problems at year ten were 1.6 (1.33:1.92) for the chronic pain group compared to the None or short-term pain group. Thereby the analysis state that there are 60% increased odds for having sleep problems if suffering from chronic pain at baseline, compared to if not having chronic pain at baseline. The odds ratio for waking up refreshed were 0.59 (0.505:0.712) for the chronic pain group compared to the None or short-term pain group. Thereby 41% decreased odds for waking up refreshed while suffering from chronic pain. The model means for having sleep problems among them who suffered from chronic pain was 0.35 (0.31:0.38) and 0.25 (0.23:0.27) for those without chronic pain. This demonstrates that there is 10% more common with sleeping problems while also suffering from chronic pain. In the same way, the model means for wake up refreshed for the chronic pain group was 0.35 (0.31:0.38), and 0.47 (0.45:0.49) for none or short term pain group. Thereby the is 12% less common to wake up refreshed among participants who also suffering from chronic pain in relation to the none or short-term pain group.

Table 6 Logistic Regression with chronic pain at baseline as predictor for sleeping disorders.

Dependent Variables	Predictor	Model means	95% CI	Odds ratio	95% CI	P
Sleeping problems						
Unadjusted	Chronic pain	.39	.36 : .42	1.9	.1.15 : 2.33	<.001
	None or short-term pain	.25	.23 : .27	1	.	.
Adjusted*	Chronic pain	.35	.31 : .38	1.6	1.33 : 1.92	<.001
	None or short-term pain	.25	.23 : 27	1	.	.
Wake up refreshed						
Unadjusted	Chronic pain	.35	.32 : .39	0.55	.467 : .657	<.001
	None or short-term pain	.50	.48 : .52	1	-	-
Adjusted*	Chronic pain	.35	.31 : .38	0.59	.505 : .712	<.001
	None or short-term pain	.47	.45 : .49	1	.	.

*Adjusted for the confounders gender and symptoms of depression

Regression analyses with female subset

Regressions selected by female subset in table 7 displayed similar results as regressions including the whole group. The odds ratio for having sleeping problems at the ten year follow up when having chronic pain at baseline was 1.6 (1.28:1.93) compared to those without chronic pain (p=<.001). The odds ratio for waking up refreshed was marginally higher for women compared to the whole group. The regressions with female subset generated an odds ratio of 0,64 (0.496:0.814) (p= <.001), which is 5% higher compared to odds ratio of the whole group 0.59 (0.505:0.712). The model means for having sleeping problems was 0,51 (0.47:0.56) among them with chronic pain compared to 0.40 (0.37:0.42) for those without chronic pain and in the same way the means for waking up refreshed was 0.24 (0.20:0.28) compared to 0.35 (0.31:0.38) for the whole group. It is thereby 11 % more common with

sleeping problems and not waking up refreshed for women with chronic pain compared to the whole group (p<.001).

Table 7 Female subset. Dependent: Sleeping problems, wake up refreshed. Predictor: Chronic pain 2007

Dependent Variables	Predictor	Model means	95% CI	Odds ratio	95% CI	P
Sleeping problems						
Unadjusted	Chronic pain	.52	.48 : .57	1.7	.1.39 : 2.14	<.001
	None or short-term pain	.39	.36 : .41	1	.	.
Adjusted*	Chronic pain	.51	.47 : .56	1.6	1.28 : 1.93	<.001
	None or short-term pain	.40	.37 : .42	1	.	.
Wake up refreshed						
Unadjusted	Chronic pain	.24	.20 : .28	.59	.468 : .760	<.001
	None or short-term pain	.34	.32 : .37	1	-	-
Adjusted*	Chronic pain	.24	.20 : .28	0.64	.496 : .814	<.001
	None or short-term pain	.33	.31 : .36	1	.	.

*Adjusted for the confounder symptoms of depression.

Discussion

Over the ten year period the prevalence of chronic pain increased by 10%. Sleeping problems were more common among the chronic pain group with the increased odds of 60%.

There was a minor difference in work ability (8%) between the those who suffered from chronic pain and had sleeping problems compared to those without chronic pain and sleeping problems. It seems that despite the chronic pain, this younger population did not find their work ability to be affected in a greater extent. However due to the relative young age of the study population this may be seen as a beginning of a trend and the work ability, as seen in prior studies, may continue to decline further on. Previous studies have found a decline in work ability at the ages 45-55. (42, 55, 56). A potential follow up study 20 years from baseline may disclose this declining trend in a greater extent.

So how does the development of chronic pain look like in a group of young adults? Over the ten year period there was a yearly increase by 1%. At the ten-year follow up nearly two out of five women and almost one of five men suffered from chronic pain from at least one region of the upper body. The prevalence is in the upper spectrum compared to prior studies and it goes in line with prior conclusions about the associations with female gender (7, 68). The underlying causes to this distinction is not yet fully understood, however a newly published study points to gender differences in the neuroimmune response signalling, and the fact that women have substantial higher rates of autoimmune diseases and endometriosis are aspects to consider (69-72). Pregnancy and delivery complications may also contribute to a higher prevalence among women (73, 74).

A secondary aim was to investigate if chronic pain was a predictor for sleeping disorders. As the findings showed the odds for having sleeping problems were higher (60%) for the chronic

pain group. This supports prior studies and demonstrates that sleeping problems are likewise common among younger people with chronic pain.

One aim was also to investigate if sleep disorders modify the predictive ability of chronic pain for work ability. As the findings demonstrated, the modified effect contributed in a minor way with a 3% decrease in work ability for the variable *sleeping problems* and 1% for the variable *wakeup refreshed*. This implies that sleeping disorders do not seem to have a substantial amplifying effect to the predictive value of chronic pain. However an noteworthy find was that to have sleep problems seem to have a negative impact to the work ability in the same extent as having chronic pain. Prior studies has shown a high prevalence of sleep disorders (27%) among young adults, and this is linked to a negative impact to academic achievements (75). The findings are in line with prior studies that's showed that insomnia and short sleep duration are associated with poor work ability. (76). The high prevalence and the adverse impact to the work ability are a matter of concern and the health care-system should increase their focus on prevention and appropriate treatment-strategies. Among the chronic pain patients to address the sleeping problems may also have a positive effect to the patients chronic pain condition. While more research addressing the underlying causes of the high prevalence of sleeping problems are needed, improving sleep habits seem to be beneficial for hindering a further decline of the work ability.

Strengths

A strength of the study is that the is the relative large population sample and the study design as a prospective cohort which enables for predictive risk estimations of chronic pain and sleeping problems and outcomes about work ability among young adults. It contributes to a

field of research that have been oriented to an older population and prior studies tend to be of cross sectional design.

Limitations

A limitation to the study may be that there is a five year interval between surveys. The regular intervals may reduce the recall bias however it is plausible that the participants pain condition may fluctuate and temporary improve between the surveys thus not suffering from chronic pain conditions continuously over the ten-year period. However IASPs definition of chronic pain entails that the pain does not have to be consistent yet can be recurrent and one can argue that even if the participants pain fluctuates between the surveys it is to be considered to be chronic due to it reoccurrence.

The high self-reported prevalence of chronic pain might seem notable, yet there are in line with prior studies (7, 77). One could ask if reporting bias could be a concern, i.e. that individuals who suffer from chronic pain are more prone to take part in a survey about pain. However, this survey did not have a primary focus to pain and included questions this various other subjects such as lifestyle, mobile phone and computer habits. Hence a this type of bias is not particularly likely.

The earlier carried out dropout analysis and this study showed a predominance of women with higher education, therefore the generalizability of the findings in this study may be considered limited to in first-hand females with a higher education.

Another limitation to the study was that the questionnaire only included questions about pain in the upper part of the body (thus including the lower back) and did not include pain from the hips and lower extremities. Therefore some cases of chronic pain from e.g. the knee joints may have been missed out. However prior studies has demonstrated that isolated pain in the

lower extremities are likely to be accompanied by pain in other regions of the body as well and chronic pain conditions are likely to generate more widespread pain over time. (7, 78-81) The prevalence for isolated chronic pain conditions in the lower extremities may be lower, for example Anderssen et al found that the prevalence for chronic isolated knee pain were 12% compared to 22% and 28% for isolated chronic lower back, neck and shoulder pain (79).

Implications

This study demonstrated that chronic pain predict sleep disorders and by extension could predict lowered work ability, even among young adults. As prior research showed, the chronic pain condition might lead to increased physical limitations, depression and withdrawal from social activities (12, 28). It is therefore important that the health care system address the chronic pain condition in time, in first hand to reduce the patients suffering and increase the quality of life, hence also prevent the work ability to further decline. It is therefore important that the medical professionals have sufficient education of treatment and rehabilitation-strategies for chronic pain-patients. Medical specialists that regularly treat patients with complicated pain conditions such as rheumatologists, neurologists, orthopaedists and pain and rehabilitations specialists need to communicate their knowledge to the primary care in purpose of a better understanding and treatment for the chronic pain patients. Needless to say this also becomes a financial matter thus multimodal teams and rehabilitations such as cognitive behavioural therapy, individual physical therapy and warm water treatment comes with higher costs. One could argue if these costs are not worth the investment when compared to the total yearly bill for chronic pain in Sweden of 877 million euros. (5) A major part of these costs are indirect costs like left out tax income due to sick leave, and with sufficient treatment in an early stage this these numbers may be reduced due to the improved treatment

and prevention of decline in work ability. Chronic pain conditions need to be addressed by the health care with a salutogenic perspective in mind. In addition to medical treatment and rehabilitation it is important to address sleeping problems, symptoms of depression, facilitate social activities and cognitive therapy for coping strategies. An important strategy are to shift focus from the limiting factors the chronic pain may give rise to, and instead focus on the aspects of personal life and employment that do work or are in range with proper rehabilitation.

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Populärvetenskaplig sammanfattning

Långvarig smärta, innebär ihållande eller upprepad smärta från minst en kroppsregion i tre månader eller mer. Som regel orsakas smärtan av en sjukdom eller skada och upphör sedan vid läkning. Men vid långvarig smärta kan det ske förändringar i hjärnan och nervsystemet som leder till att smärtan blir kvar och breder ut sig, den blir också då mer svårbehandlad. Långvariga smärtsyndrom är ett stort folkhälsoproblem där 20–30% befolkningen i världen är drabbade. Tidigare studier visar att de som lever med långvarig smärta ofta har en sänkt livskvalitet, det är också vanligt med sömnproblem och depression. Den långvariga smärtan och dess konsekvenser påverkar också i vilken utsträckning man kan arbeta, och tidigare forskning har visat att långvarig smärta är en vanlig orsak till långtidssjukskrivningar. I denna studie, som bygger på en större enkätstudie, följdes 1603 personer åldrarna 20–24 år under en tio-års period. Frågor om sömn, smärta och arbetsförmåga analyserades. Över tio-års perioden ökade andelen personer med långvarig smärta med 10%. Denna grupp hade också större risk att också lida av sömnproblem. Arbetsförmågan var i snitt 8% lägre jämfört med dem som inte hade långvarig smärta eller sömnproblem. Denna studie bekräftar tidigare studier om att sömnproblem är vanligare hos personer med långvarig smärta och att det blir vanligare med långvarig smärta och sämre arbetsförmåga ju äldre man blir. Det är viktigt att vidta vårdåtgärder och rehabilitering i ett tidigt skede för att förhindra att smärtan orsakar förändringar i nervsystemet och på sikt blir mer svårbehandlad.

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