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Occupation, Working Hours and Arthritis: Evidence from a Nationally Representative Sample of Older Age Adults

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Abstract

Driven by falling fertility rates and increase in life expectancy, aging populations is an evident phenomenon. In line with this demographic change, even though health deteriorates with age, many older workers is expected to continue working and participate in labor force. Accordingly, analyzing health effects of various working conditions are central to develop policies and interventions to ensure healthy aging workforce. Against this background, the article examines the probability of developing arthritis for older workers in relation to working hours and occupation categories in the United States. Using Health and Retirement Study, a nationally representative data set for the US, we found that increasing a person's working hours reduces their probability of developing arthritis. Moreover, we identified that considering probability of developing arthritis, higher and lower risk occupations differ by gender. Low-risk occupations for both sexes are professional specialty operation and technical support and clerical, administrative support. The only common high-risk occupation is health services.

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1. Introduction

Aging populations is a phenomenon experienced not only in the developed world, but also in the developing countries. While population of children under 15 years old are twice the population of individuals above 60 at present, the population of each end of the age spectrum is expected to equalize in 2050, reaching 2.1 billion [1]. This trend, as in all demographic changes, brings opportunities and challenges and necessitates adaptations in social and economic life. In this respect more than doubling of old age dependency ratios in 30 years globally and reaching as high as 46.3 per hundred for high-income countries [2], among many other institutional consequences, would require revisions of social security systems, notably pension systems [3, 4], with measures such as possible increases in retirement ages [5]. Be it for institutional reasons or individual motivations [6], more and more people will extend their working life and number of older workers will increase. Accordingly, understanding impact of various working conditions on older workers is crucial for businesses and policy makers to design necessary interventions.

As a contribution to this endeavor, this article investigates older age population's probability of developing arthritis in relation to working hours and occupations. In fact, arthritis is a highly prevalent chronic condition, leading to a decrease in life satisfaction [7]. This joint-related chronic condition, with more than 100 types [8], is a major source of disability [9]. Apart from immediate physical effects such as persistent inflammation, pain, swelling, tenderness and difficulties with body functions and in severe cases with mobility [10], it is associated with psychological and socio-economic consequences.

Arthritis, in general, restricts social participation of patients [11]. Some types, such as rheumatoid arthritis may lead to work disability, reduction in income as well as changes in leisure time activities [12]. Some patients feel fatigue and experience low mood [13] and depression [14]. Moreover, individuals with rheumatoid arthritis are faced with higher mortality rates as opposed to general population [15].

In the United States prevalence of arthritis is 22.7% among all adults and women are more likely to be affected. Prevalence increases as age groups get older. Among adults that are older than 64 years old, nearly one individual out of two is dealing with arthritis [16]. The prevalence is estimated to increase to 25.9% among all adults in 2040 and largest increase in prevalence is estimated to be experienced by the age group of adults that are 65 and older [17].

There are multiple causes of each type of arthritis, some of which are identified and might be related to tasks under taken at work, work environment or traits linked to occupations. For instance, individuals who are squatting, bending or kneeling, stair climbing or lifting heavy objects are more prone to developing osteoarthritis of the knee, most common type of arthritis [18, 19]. Another example can be given for rheumatoid arthritis, where exposure to silica, asbestos, organic solvents and mineral oil increases the likelihood for developing the condition [20]. Yet another illustration would be for gout, where consumption of meat, alcohol, seafood, sugar sweetened drinks brings elevated risk [21].

Despite high prevalence of arthritis among older age adults and present and projected increase of labor force participation of individuals that are over 50 [22], to our knowledge, there is no study focusing on the relationship between working hours and arthritis among older age population using nationally representative dataset. Furthermore, relation between developing arthritis among older population and occupational categories have not been analyzed.

This study bridges this gap in the literature by examining the probability of developing arthritis for older workers in relation to working hours and occupation categories in the United States. We applied Cox regression to panel data taken from the Health and Retirement Study (HRS) and found that increasing a person's working hours reduces their probability of developing arthritis. Moreover, we identified that considering probability of developing arthritis, higher and lower risk occupations differ by gender. Low-risk occupations for both sexes are (02.) professional specialty operation and technical support and (04.) clerical, administrative support. The only common high-risk occupation is (08.) health services.

This paper proceeds as follows. Section 2, describes the previous literature that examine the effects of occupational groups and working hours on health. The dataset is described and the methodology used in the study is presented in Section 3. Section 4, describes the main results, and Section 5, summarizes and discusses the findings.

2. Occupation, Working Hours Health

Occupation and working conditions play an important role in individual's health. In fact, based on an extensive literature review, Barnay [23] finds that working at a job with convenient conditions play a role in protecting one's physical and psychological health. On the other hand, poor working conditions have well-documented adverse health effects [24].

2.1 Occupations

Occupations dictate many of the working conditions. For instance, while some occupations necessitate dense physical activity, some are sedentary in nature. Likewise, exposure to hazardous substances might be more probable in some occupations, while some might involve serenity. Accordingly, occupations might have direct and indirect effects on health of individuals. Factors linked with direct effects include exposure to hazards and job strain, whereas circumstances linked with indirect effects include wealth and time constrains as well as peer pressure [25]. There is a wealth of literature regarding health indicators, medical conditions and health behaviors by occupation, some of which include smoking [26, 27], alcohol related hospitalization and mortality [28, 29], obesity [30, 31], suicide [32, 33] and prostate cancer [34, 35].

Studies analyzing relationships between different types of arthritis and occupation groups were also undertaken. Dillon, Petersen [36] examined the relation between

hand-wrist arthritis and occupation using U.S. National Health Interview Survey–Occupational Health Supplement (NHIS-OHS) data collected in 1998 and found that 'military occupation', technicians', 'machine operators, farmers, laborers and crafts and production workers' are at higher risk. Focusing on rheumatoid arthritis Olsson, Skogh [37] identified that men in Sweden working as 'conductors, freight and transport workers' as well as 'farmers and farm workers' are faced with elevated risk, while women in Sweden have higher risk if they are working as 'printmakers and process engravers'. In a similar recent study again for Sweden, Ilar, Alfredsson [20], detected higher risk for male 'bricklayers and concrete workers', 'material handling operators' and 'electrical and electronics workers', while for women 'assistant nurse and attendants' were at moderate risk.

2.2 Working hours

Working time, especially long working hours, and its impact on health has long been an object of scientific and political interest [38]. There is a vast literature pointing to association between long working hours and problems related to physical and psychological health. In this regard, systematic reviews and meta-analyses focusing on different aspects of this relation provide general outlook. One of the early reviews by Sparks, Cooper [39] detected a significant, but small relation between working hours and physiological and psychological health. Based on a review of epidemiological studies, Bannai and Tamakoshi [40] disclosed that depressive state, anxiety, sleep condition and coronary heart diseases are associated with working long hours. Virtanen, Heikkilä [41] and Kang, Park [42] identified relation between long working hours and coronary heart diseases. Kivimäki, Jokela [43] established higher risk for stroke and somewhat weaker relation with coronary heart diseases. Another weaker relation was put forth by Bonde, Jørgensen [44] for long working hours and miscarriage. Solovieva, Lallukka [45] found a small significant relation between long works hours and obesity. The relationship was stronger for men. As put forth by Wagstaff and Lie [46] long working hours increase accident risk, hence pose threat to health. Kwimaki, Virtanean et al. [47] disclosed a positive relation between long working hours and type-2 diabetes for only lower socioeconomic groups. Furthermore, Virtanen, Jokela [48] identified a positive association between long work hours and alcohol use at levels that carry health risk.

Nevertheless, Ganster, Rosen [49] diligently criticizing the methodologies of most of the recent systematic reviews and meta-analysis, argue that there is not a clear link between long work hours and well-being. Fujino, Horie [50] found inconsistent results regarding the relation between working hours and mental health. Moreover, while Bernstrøm and Houkes [51] established a negative correlation between long work hours and sickness absence, they argued that this might be due to health worker effect. Watanabe, Imamura [52], also did not detect a significant relationship between long working hours and increased risk of psychological disorders.

Despite plethora of studies analyzing the relation between working hours and different aspects of health, the findings are limited due to small sample size of these studies. There are a few exceptions, one of which used the National Longitudinal Survey of Youth (NLSY) dataset, a nationally representative dataset for the United States [53]. Their analysis depended on Cox regression analysis, and they found that working at least 60 hours per week significantly increased the probability of injury. Another exception found that longer working hours translated in negative self-reported physical and psychological effects [54]. Other exceptions measured the relationship between working hours and obesity [55, 56]. Both found a positive relationship between obesity and working hours.

To our knowledge there are no studies examining the relation between working hours and arthritis, especially for older workers. However, there are studies focusing on individual occupations, which may include conditions regarding arthritis. For instance, in an early study WÆRsted and Westgaard [57] identified that working longer hours resulted in earlier sick leave for musculoskeletal complaints for sewing machine operators compared to part-time workers. Similarly, Karlqvist, Hagberg [58] put forth that computer assisted design operators which worked longer hours were prone to developing musculoskeletal symptoms. Furthermore, Bergqvist, Wolgast [59] established that long working hours for visual display terminal workers can cause arm/hand discomfort.

3. Data and Methodology

This study relies on the Health and Retirement Study (HRS), which is conducted by University of Michigan and supported by National Ageing Institute and Social Security administration. HRS is a longitudinal panel survey, which has been conducted biennially since 1992. HRS's original cohort comprised more than 26,000 Americans older than 50 years old and includes information about respondents such as their sociodemographic characteristics and detailed work histories. Moreover, the study questionnaire includes specific questions regarding health status, health care utilization and health care costs. The dataset provides an accurate portrait of the older population in the US. The data used in this article comes from the RAND user-friendly version of the HRS. The analysis was based on 12 biennially data regarding arthritis.

The RAND user-friendly version is advantageous for our purposes as it includes harmonized occupation categories, which changed through the years, increasing from 17 to 23. The version used contains 17 occupation categories, namely 01. Managerial specialty operation, 02. Professional specialty operation and technical support, 03. Sales, 04. Clerical, administrative support, 05. Service: private household, cleaning and building services, 06. Service: protection, 07. Service: food preparation, 08. Health services, 09. Personal services, 10. Farming, forestry, fishing, 11. Mechanics and repair, 12. Construction trade and extractors, 13. Precision production, 14. Operators: machine, 15. Operators: transport, etc., 16. Operators: handlers, etc. and 17. Member of Armed Forces. To depict civilian

workforce 17th category was excluded from the analysis.
Our statistical analysis depends on survival analysis. This type of analysis is appropriate for explaining the factors that can contribute to the risk of developing arthritis. The Cox proportional hazards regression model states that the hazard rate for the jth subject in the data is

$$h(t|x1j,x2j,\ldots xkj) = h0\,(t)\exp\,(\beta_1\ \ x1j + \ \beta_2\ \ x2j + \ldots + \ \beta_k\ \ xkj\,) \qquad (1)$$

As Cox model does not make potentially untenable distributional assumptions about the hazard rate, it is advantageous to rely on. In addition, a positive Cox regression coefficient for an independent variable means that the hazard probability is higher. The dependent variable in the survival analysis carried out in this study was the risk that a subject is diagnosed with arthritis in a given year. Our main independent variable was the person's working hours. The covariates included their age, history of smoking, alcohol use, level of education, gender, white dummy, obese dummy, self-reported health (1 = excellent and 5 = poor), and 16 occupations. These are the main results of the paper.

Table 1: Summary statistics

Men	**Mean**	**S.D.**	**Min**	**Max**
Arthritis Dummy	0.35	0.48	0	1
Workhours	40.61	15	0	168
Obese[1]	0.27	0	0	1
Age	60.67	7	22	100
Self-Reported Health[2]	2.43	1	1	5
White	0.84	0	0	1
Education	13.05	3	0	17
Drink[3]	0.66	0	0	1
Smoke[4]	0.19	0	0	1
N	28,617			
Women	Mean	S.D.	Min	Max
Arthritis Dummy	0.46	0.50	0	1
Workhours	34.69	14.06	0	168
Obese[1]	0.30	0.46	0	1
Age	59.69	6.28	23	95
Self-Reported Health[2]	2.43	0.99	1	5
White	0.79	0.41	0	1
Education	12.97	2.68	0	17
Drink[3]	0.54	0.50	0	1
Smoke[4]	0.17	0.38	0	1
N	27,326			

[1] *BMI≥30*

[2] 1 means excellent and 5 means poor

[3] Have you ever drunk alcohol? 1 means yes.

[4] Have you ever smoked cigarettes? 1 means yes.

According to Table 1, which shows the summarized statistics of the dataset, 84% and 79% of the sample were white men and women, respectively. According to the census, 77.9% of the people who reported membership of only one racial group were white. The respective average ages for men and women were approximately 61 and 60 years old. In addition, the respective average weekly working hours for men and women in our sample were approximately 41 and 35 hours. According to the OECD, the average American worker worked 34.4 hours per week in 2012 (1,790 hours/52 weeks).

4. Results

Table 2: Cox regression results

	Men		Women	
	Coefficient	S.E.	Coefficient	S.E.
Workhours	0.99***	0.00	0.99***	0.00
Obese[1]	1.06**	0.03	1.03	0.02
Age	0.98***	0.00	0.98***	0.00
Self-Reported Health[2]	1.22***	0.02	1.28***	0.02
White	1.55***	0.06	1.21***	0.03
Education	0.94***	0.00	0.97***	0.01
Drink[3]	0.86***	0.03	0.90***	0.02
Smoke[4]	1.01	0.04	1.21***	0.04
Occupations[5]				
02. Prof specialty opr/tech sup	0.87***	0.04	0.89***	0.04
03. Sales	0.85***	0.04	1.00	0.05
04. Clerical/admin supp	0.90*	0.05	0.90***	0.03
05. Svc: prv hhld/clean/bldg svc	0.98	0.18	1.42***	0.10
06. Svc: protection	1.31***	0.09	1.06	0.12
07. Svc: food prep	1.02	0.10	1.21***	0.07
08. Health svc	1.44***	0.20	1.12**	0.06
09. Personal svc	0.90	0.06	0.92*	0.05
10. Farming/forestry/fishing	1.06	0.06	0.84	0.11
11. Mechanics/repair	0.94	0.05	0.84	0.19
12. Constr trade/extractors	0.97	0.05	0.63**	0.13
13. Precision production	1.12	0.07	1.23**	0.10
14. Operators: machine	1.09	0.07	1.19***	0.08
15. Operators: transport	1.05	0.05	1.10	0.11
16. Operators: handlers	0.98	0.06	0.84**	0.07
N	28,617		27,326	

**** p<0.01 ** p<0.05 * p<0.10*

[1] *BMI≥30*

[2] 1 means excellent and 5 means poor

[3] Have you ever drunk alcohol? 1 means yes.

[4] Have you ever smoked cigarettes? 1 means yes.

[5] The reference group is "1. Managerial specialty oper."

Table 2 shows the results of the Cox regressions that depend on Equation (1). The table shows that the coefficient of working hours is 0.99 (standard error: 0.00) for both men and women, suggesting that working more is associated with a lower probability of developing arthritis.

Upon looking at the occupations, we can observe that being classed as (02) Professional specialty operation and technical support, (03) Sales and (04) Clerical, administrative support reduces the probability of developing arthritis for men, while being classed as a member of the (08) Health Services or (06) Service Protection occupation groups increased the probability of developing arthritis for men. Meanwhile, (02) Professional specialty operation (04) Clerical, administrative support (12) Construction trade and extractors and (16) Operator: handlers reduce the probability of developing arthritis for women, while (05) Service: Private household, cleaning and building services, (07) Service food preparation, (08) Health services, (13) Precision production and (14) Operators machine significantly increased their probability of developing arthritis.

5. Discussions

The proportion of older workers in the United States has increased over time in line with global trends. Old age dependency ratio will reach 36.4 per 100 in 2050 [2] and the number of people that are older than 55 in the work force will reach 44,5 million. Therefore, studies investigating the effect of working conditions on older age workers is important for policy prescriptions and design of interventions for a healthy ageing workforce. This study was a first attempt to investigate the relationship between working hours and the probability of developing arthritis among older adults in the United States. This analysis of 12 biennial surveys based on HRS data suggests that working more hours is associated with a lower probability of developing arthritis for older workers. We, further disclosed that considering probability of developing arthritis, higher and lower risk occupations differ by gender. Low-risk occupations for both sexes are (02) professional specialty operation and technical support and (04) clerical, administrative support. The only common high-risk occupation is (08) health services.

In the occupational categories (08) health services contains three sub-occupations, namely dental assistants; health aides except nurses as well nursing aides, orderlies and attendants. This result supports findings of Yassi, Gilbert [60], which point that compared to all occupations and professional occupations in the health sectors (e.g. physicians, registered nurses etc.), technical and assistance-related occupation in the health sector in Canada has higher injury rates, among which musculoskeletal injuries have highest prevalence. Indeed, these occupations, for instance nursing aides are prone to musculoskeletal injuries and related arthritis condition, as their work is physically demanding and involve heavy lifting [61, 62].

Professional specialty operation and technical support includes wide range of professions, varying from architects, scientists to science related technicians, which are associated with higher socio-economic group. Low risk of development of

arthritis in these professions backs conclusions reached by Callahan, Martin [63] and Busija, Hollingsworth [64], where both of the studies find lower risk for higher socioeconomic groups. The other low risk profession for both sexes is clerical and administrative, support, the occupational category which includes office assistants, clerks and receptionists, who are mainly office workers. Even though office workers are prone to neck and shoulder pain due to computer use [65], Croft, Coggon [66], Walker-Bone and Palmer [67] and Kim, An [68] lend support to our finding in their studies which compare their target occupation to office workers.

Although this is the first study in the literature, that has examined the relationship between working hours and arthritis among US older workers, it has some shortcomings. First, the sample only examines older people. The results might differ when all age groups are considered. Therefore, findings should be regarded only for older population. Second, our results depend on self-reported variables, which may have caused measurement errors. Another possible problem that may arise is related to healthy worker effect (HWE), a type of sample selection problem. HWE suggests that sample in the study have better health status compared to the general population. The main argument behind the effect is that seriously ill and severely disabled people are excluded from employment. Accordingly, they are not included in the sample. However, in a recent study by Nielsen and Knardahl [69] showed that HWE is in fact very small.

In conclusion, we strongly believe that we require further studies on this topic. We think that there are two areas upon which studies should focus. First, we need studies for different countries to determine this study's robustness. Future research must also focus on the mechanism behind the relationship because we need to understand what specific aspects cause this relationship between arthritis and working hours and occupations.

References

[1] United Nations, D.o.E.a.S.A., Population Division, *World Population Prospects: The 2017 Revision, Key Findings and Advance Tables*, United Nations, New York, 2017.

[2] United Nations, D.o.E.a.S.A., Population Division, *World Population Prospects: The 2017 Revision, Volume II: Demographic Profiles*, United Nations, New York, 2017.

[3] D.E. Bloom, and R. McKinnon, Social security and the challenge of demographic change, *International Social Security Review*, **63**(3-4), (2010), 3-21.

[4] S. Harper, The capacity of social security and health care institutions to adapt to an ageing world, *International Social Security Review*, **63**(3-4), (2010), 177-196.

[5] E. Vogel, A. Ludwig and A. Börsch-Supan, Aging and pension reform: extending the retirement age and human capital formation, *Journal of Pension Economics & Finance*, **16**(1), 2017, p. 81-107.

[6] K. Nilsson, Conceptualisation of ageing in relation to factors of importance for extending working life – a review, *Scandinavian Journal of Public Health*, **44**(5), (2016), p. 490-505.
[7] T. W. Strine, et al., The Associations Between Life Satisfaction and Health-related Quality of Life, Chronic Illness, and Health Behaviors among U.S. Community-dwelling Adults, *Journal of Community Health*, **33**(1), (2008), 40-50.
[8] D. Flagg, Arthritis, *Encyclopedia of Aging and Public Health,* S. Loue and M. Sajatovic, Editors, Springe, Boston, 2008.
[9] S.F. Lin, A.N. Beck, and B.K. Finch, The Dynamic contribution of chronic conditions to temporal trends in disability among U.S. adults, *Disability and Health Journal*, **9**(2), (2016), 332-340.
[10] S. E Meiner and A.S. Luggen, *Care of arthritis in the older adult*, Springer, New York, 2002.
[11] K. Theis, et al., Social Participation Restriction Among US Adults With Arthritis: A Population-Based Study Using the International Classification of Functioning, *Disability and Health. Arthritis care & research*, **65**(7), (2013), 1059-1069.
[12] J. Albers, et al., Socio-economic consequences of rheumatoid arthritis in the first years of the disease, *Rheumatology*, **38**(5), (1999), 423-430.
[13] F. Matcham, et al., Psychological correlates of fatigue in rheumatoid arthritis: A systematic review, *Clinical Psychology Review*, **39**, (2015), 16-29.
[14] S. Nikolaus, et al., Fatigue and factors related to fatigue in rheumatoid arthritis: a systematic review, *Arthritis care & research*, **65**(7), (2013), 1128-1146.
[15] J. Widdifield, et al., Causes of death in rheumatoid arthritis: How do they compare to the general population? *Arthritis care & research*,**70**(12), (2018), 1748-1755.
[16] Kamil E. Barbour, et al. Vital Signs: Prevalence of Doctor-Diagnosed Arthritis and Arthritis-Attributable Activity Limitation - United States, 2013-2015, *Morbidity and mortality weekly report*, **66**,(2017), 246-253
[17] J. M. Hootman, et al., Updated Projected Prevalence of Self-Reported Doctor-Diagnosed Arthritis and Arthritis-Attributable Activity Limitation Among US Adults, 2015–2040, *Arthritis & rheumatology*, **68**(7), (2016), 1582-1587.
[18] M. A Aluoch, et al., Risk factors for occupational osteoarthritis: a literature review. *AAOHN Journal*, **57**(7), (2009), 283-292.
[19] G.S. Dulay, C. Cooper, and E.M. Dennison, Knee pain, knee injury, knee osteoarthritis & work, *Best Practice & Research Clinical Rheumatology*, **29**(3), (2015), 454-461.
[20] A. Ilar, et al., Occupation and Risk of Developing Rheumatoid Arthritis: Results From a Population-Based Case–Control Study, *Arthritis Care & Research*, **70**(4), (2018), 499-509.

[21] J.A. Singh, S.G. Reddy, and J. Kundukulam, Risk factors for gout and prevention: a systematic review of the literature, *Current opinion in rheumatology*, **23**(2), (2011), p. 192.
[22] Committee on the Long-Run Macroeconomic Effects of the Aging U.S. Population, *Aging and the Macroeconomy: Long-term Implications of an Older Population*, National Academies Press, Washington DC, 2013.
[23] T. Barnay, Health, work and working conditions: a review of the European economic literature, *The European Journal of Health Economics*, **17**(6), (2016), 693-709.
[24] W. Chen and T. Wu, Occupational Health, in *Routledge Handbook of Global Public Health in Asia*, S.M. Griffiths, J.L. Tang, and E.K. Yeoh, Editors, Abigdon, Oxon, 2014, 403-431.
[25] I.R. Kelly et al., The impact of early occupational choice on health behaviors. *Review of Economics of the Household*, **12**(4), (2014), 737-770.
[26] K.M. Bang and J.H. Kim, Prevalence of cigarette smoking by occupation and industry in the United States, *American journal of industrial medicine*, **40**(3), (2001), 233-239.
[27] G. Syamlal, et al., Cigarette smoking trends among US working adult by industry and occupation: findings from the 2004–2012 National Health Interview Survey, *Nicotine & Tobacco Research*, **17**(5), (2014), 599-606.
[28] T. Hemmingsson and G.R. Weitoft, Alcohol-related hospital utilization and mortality in different occupations in Sweden in 1991-1995, *Scandinavian journal of work, environment & health*, **27**(6), (2001), 412-419.
[29] J. Pulido et al., Directly alcohol-attributable mortality by industry and occupation in a Spanish Census cohort of economically active population, *Drug & Alcohol Dependence*, **180**, (2017), 93-102.
[30] H. Barlin and M.A. Mercan, Occupation and Obesity: Effect of Working Hours on Obesity by Occupation Groups, *Applied Economics and Finance*, **3**(2), (2016), 179-185.
[31] J. K. Gu et al., Prevalence of obesity by occupation among US workers: the National Health Interview Survey 2004–2011, *Journal of occupational and environmental medicine*, **56**(5), (2014), 516.
[32] B. Han et al., Suicidal ideation, suicide attempt, and occupations among employed adults aged 18–64years in the United States, *Comprehensive Psychiatry*, **66**, (2016), 176-186.
[33] A. Lavender et al., Violent Deaths Among Georgia Workers, *American journal of preventive medicine*, **51**(5), (2016), S241-S250.
[34] K.H. Barry et al., Risk of early-onset prostate cancer associated with occupation in the Nordic countries, *European Journal of Cancer*, **87**, (2017), 92-100.
[35] J. Sritharan et al., Occupation and risk of prostate cancer in Canadian men: A case-control study across eight Canadian provinces, *Cancer epidemiology*, **48**, (2017), 96-103.

[36] C. Dillon, M. Petersen and S. Tanaka, Self-reported hand and wrist arthritis and occupation: Data from the U.S. National Health Interview Survey–Occupational Health Supplement, *American Journal of Industrial Medicine*, **42**(4), (2002), 318-327.
[37] A. R. Olsson et al., Occupations and exposures in the work environment as determinants for rheumatoid arthritis, *Occupational and Environmental Medicine*, **61**(3), (2004), 233-238.
[38] A.E. Dembe, Long working hours: The scientific basis for concern, *Perspectives on Work*, **8**(2), (2005), 20-22.
[39] K. Sparks, et al., The effects of hours of work on health: a meta-analytic review, *Journal of occupational and organizational psychology*, **70**(4), (1997), 391-408.
[40] A. Bannai and A. Tamakoshi, The association between long working hours and health: a systematic review of epidemiological evidence, *Scandinavian journal of work, environment & health*, **40**(1), (2014); 5-18.
[41] M Virtanen et al., Long working hours and coronary heart disease: a systematic review and meta-analysis, *American journal of epidemiology*, **176**(7), (2012), 586-596.
[42] M. Y. Kang et al., Long working hours and cardiovascular disease: a meta-analysis of epidemiologic studies, *Journal of occupational and environmental medicine*, **54**(5), (2012), 532-537.
[43] M. Kivimäki et al., Long working hours and risk of coronary heart disease and stroke: a systematic review and meta-analysis of published and unpublished data for 603 838 individuals, *The Lancet*, **386**(10005), (2015) 1739-1746.
[44] Bonde, J.P.E. et al., Risk of miscarriage and occupational activity: a systematic review and meta-analysis regarding shift work, working hours, lifting, standing and physical workload, *Scandinavian journal of work, environment & health*, **39**(4), (2013), 325.
[45] S. Solovieva et al., Psychosocial factors at work, long work hours, and obesity: a systematic review. *Scandinavian journal of work, environment & health*, **39(**3), (2013), 241-258.
[46] A.S. Wagstaff and J. Lie, Shift and night work and long working hours - a systematic review of safety implications, *Scandinavian Journal of Work, Environment & Health*, **37**(3), (2011), 173-185.
[47] M. Kivimäki et al., Long working hours, socioeconomic status, and the risk of incident type 2 diabetes: a meta-analysis of published and unpublished data from 222 120 individuals, *The Lancet Diabetes & Endocrinology*, **3**(1), (2015), 27-34.
[48] M. Virtanen et al., Long working hours and alcohol use: systematic review and meta-analysis of published studies and unpublished individual participant data. *Bmj*, **350**, (2015) g7772.
[49] D.C. Ganster, C.C. Rosen and G.G. Fisher, Long Working Hours and Well-being: What We Know, What We Do Not Know, and What We Need to Know. *Journal of Business and Psychology*, **33**(1), (2018), 25-39.

[50] Y. Fujino et al., A systematic review of working hours and mental health burden. *Sangyo eiseigaku zasshi= Journal of occupational health*, **48**(4), (2006), 87-97.
[51] V.H. Bernstrøm and I. Houkes, A systematic literature review of the relationship between work hours and sickness absence, *Work & Stress*, **32**(1), (2018), 84-104.
[52] K. Watanabe, K. Imamura and N. Kawakami, Working hours and the onset of depressive disorder: a systematic review and meta-analysis, *Occupational and Environmental Medicine*, **73**(12), (2016), 877.
[53] A. E. Dembe et al., The impact of overtime and long work hours on occupational injuries and illnesses: new evidence from the United States, *Occupational and Environmental Medicine*, **62**(9), (2005), 588-597.
[54] S.L. Ettner and J.G. Grzywacz, Workers' perceptions of how jobs affect health: A social ecological perspective, *Journal of occupational health psychology*, **6**(2), (2001), p. 101.
[55] C. Courtemanche, Longer Hours and Larger Waistlines? The Relationship between Work Hours and Obesity, *Forum for Health Economics & Policy*, **12**, (2009), 1-33.
[56] M. A. Mercan, A Research Note on the Relationship Between Long Working Hours and Weight Gain for Older Workers in the United States, *Research on Aging*, **36**(5), (2014), 557-567.
[57] M. WÆRsted, and R.H. Westgaard, Working hours as a risk factor in the development of musculoskeletal complaints, *Ergonomics*, **34**(3), (1991), 265-276.
[58] L. K. Karlqvist, et al., Musculoskeletal Symptoms among Computer assisted Design (CAD) Operators and Evaluation of a Self-assessment Questionnaire, *International Journal of Occupational and Environmental Health*, **2**(3), (1996), 185-194.
[59] U. Bergqvist et al., Musculoskeletal Disorders among Visual-Display Terminal Workers - Individual, Ergonomic, and Work Organizational-Factors, *Ergonomics*, **38**(4), (1995), 763-776.
[60] A. Yassi, M. Gilbert and Y. Cvitkovich, Trends in injuries, illnesses, and policies in Canadian healthcare workplaces. Canadian Journal of Public Health/Revue Canadienne de Sante'e Publique, **96**(5), (2005), 333-339.
[61] A. S. Ljungber, Å. Kilbom and G.M. Hagg, Occupational lifting by nursing aides and warehouse workers, *Ergonomics*, **32**(1), (1989), 59-78.
[62] A. Garg, B. Owen and B. Carlson, An ergonomic evaluation of nursing assistants' job in a nursing home, *Ergonomics*, **35**(9), (1992), 979-995.
[63] L.F. Callahan et al., Independent and combined influence of homeownership, occupation, education, income, and community poverty on physical health in persons with arthritis, *Arthritis Care & Research*, **63**(5), (2011), 643-653.
[64] L. Busija, et al., Role of age, sex, and obesity in the higher prevalence of arthritis among lower socioeconomic groups: A population-based survey, *Arthritis Care & Research*, **57**(4), (2007), 553-561.

[65] B. Cagnie et al., Individual and work related risk factors for neck pain among office workers: a cross sectional study, *European Spine Journal*, **16**(5), (2007), 679-686.
[66] P. Croft et al., Osteoarthritis of the hip: an occupational disease in farmers. *British Medical Journal*, **304**(6837), (1992), 1269-1272.
[67] K. Walker-Bone and K.T. Palmer, Musculoskeletal disorders in farmers and farm workers, *Occupational Medicine*, **52**(8), (2002), 441-450.
[68] D.H. Kim et al., Comparison of facet joint degeneration in firefighters and hospital office workers, *Annals of Occupational and Environmental Medicine*, **29**(1), (2017), 24.
[69] M.B. Nielsen and S. Knardahl, The healthy worker effect: Do health problems predict participation rates in, and the results of, a follow-up survey? *International archives of occupational and environmental health*, **89**(2), (2016), 231-238.