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# **Associations between work-related psychosocial factors and musculoskeletal complaints in Norwegian aircrew – a cross-sectional study**

**Assosiasjonar mellom arbeidsrelaterte psykososiale faktorar og muskelskjelettlidingar hos norske besetningsmedlemmar – ei tverrsnittstudie**

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## Preface.

For this master's thesis project, I have chosen to explore a subject that I knew little about before I started, to allow myself to be purely curious. A large proportion of the adult population spend a significant amount of time at work, and the occupational setting is a source of exposures both potentially health promoting and detrimental to health. Therefore, it is an important realm for public health work.

I want to thank NMBU and the Institute of Landscape and Society for offering a great master's program. Thanks to my supervisor, Camilla Ihlebæk, for sound advice and optimism. To Geir Aamodt for answering my (probably quite annoying) methodological questions, and to Mona Tønnessen Omholt for collecting the data I have used in my project.

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Ås, September 2018

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## Abstract.

Background. Aircrew have high-risk occupations for musculoskeletal complaints (MSC), still there is limited recent knowledge of the prevalence of MSC in this occupational group. Furthermore, there is scarce knowledge about the relationship between work-related psychosocial factors and MSC in aircrew, and the potential differences between cabin crew and cockpit crew. The aim of this study was therefore to investigate differences in MSC and work-related psychosocial factors, and the associations between them, in the two groups.

Method. In a cross-sectional study conducted in 2013, 843 aircrew members in the three major airline companies in Norway completed a questionnaire covering MSC in eight body sites (The Subjective Health Complaints Inventory), and eighteen work-related psychosocial risk factors on individual, organizational and task level (QPS Nordic 34+). The associations between work-related psychosocial factors and MSC were investigated by multiple logistic regression analyses for cockpit and cabin crew separately.

Results. Cabin crew reported a higher prevalence of all MSC, except for low back pain. The complaints reported most frequently in both occupational groups were low back pain, headache, neck pain and shoulder pain. Cabin crew reported higher levels of low positive challenge at work, low role clarity, high role conflict, low control of decisions, and high inequality, while cockpit crew reported higher levels of high learning demands, low control of work pacing, low support from coworkers, low support from friends, low perception of group work, and low innovative climate. The risk of reporting a high level of musculoskeletal complaints was significantly increased by reporting high quantitative demands, low social climate and high inequality in cockpit crew, and high role conflict and low control of decisions in cabin crew.

Conclusions. The prevalence of musculoskeletal complaints was higher in cabin crew compared to cockpit crew. Musculoskeletal complaints were associated with different work-related psychosocial factors in cabin crew and cockpit crew, indicating that preventing musculoskeletal complaints in the two occupational groups requires different interventions. However, longitudinal studies on specific work-related psychosocial factors is needed to confirm the findings.

Keywords.

Occupational health, aircrew, cabin crew, flight attendants, cockpit crew, pilots, musculoskeletal complaints, work-related psychosocial factors, QPS Nordic, SHC Inventory.

## Samandrag.

**Bakgrunn.** Til tross for at besetningsmedlemmar har yrke med høg risiko for muskelskjelettlidingar (MSL), er det begrensa kunnskap om forekomsten av MSL i denne yrkesgruppa. Vidare er det lite kunnskap om høvet mellom arbeidsrelaterte psykososiale faktorar og MSL hos besetningsmedlemmar, samt potensielle skilnader mellom kabin- og cockpitpersonale. Føresegna med denne studien var derfor å undersøke skilnader i MSL og arbeidsrelaterte psykososiale faktorar, samt assosiasjonane mellom dei, hos dei to yrkesgruppene.

**Metode.** I ei tverrsnittstudie som vart utført i 2013, fylte 843 besetningsmedlemmar tilsett i dei tre største flyselskapa i Norge ut eit spørreskjema med spørsmål om MSL på åtte stader på kroppen (The Subjective Health Complaints Inventory), og atten arbeidsrelaterte psykososiale risikofaktorar på individuelt-, organisatorisk- og oppgåvenivå (QPS Nordic 34+). Assosiasjonane mellom arbeidsrelaterte psykososiale faktorar og MSL vart utforska med logistiske regresjonsanalyser for cockpit- og kabinpersonale kvar for seg.

**Resultat.** Kabinpersonale rapporterte høgare forekomst av alle MSL, med unntak av korsryggsmerter. Dei hyppigast rapporterte lidingane i begge yrkesgruppene, var korsryggsmerter, hovudverk, nakkesmerter og skuldersmerter. Kabinpersonale rapporterte høgare nivå av låg positiv utfordring på jobb, låg rolleklårheit, høg rollekonflikt, låg kontroll over avgjerder og høg ulikskap, medan cockpitpersonale rapporterte høgare nivå av høge læringskrav, låg kontroll over arbeidstempo, låg støtte frå medarbeidarar, låg støtte frå vener, låg oppfatning av gruppearbeid og låg innovativt klima. Risikoen for å rapportere høgt nivå av muskelskjelettlidingar auka signifikant ved rapportering kvantitative krav, lågt sosialt klima og høg ulikskap for cockpitpersonale, og høg rollekonflikt og låg kontroll over avgjerder for kabinpersonale.

**Konklusjonar.** Forekomsten av muskelskjelettlidingar var høgare hos kabinpersonale enn hos cockpitpersonale. Vidare var muskelskjelettlidingar assosiert med ulike arbeidsrelaterte psykososiale faktorar hos kabinpersonale og cockpitpersonale, noko som indikerer at førebygging av muskelskjelettlidingar krev ulike intervensjonar hos dei to yrkesgruppene. Like fullt er det behov for kohortstudier av spesifikke arbeidsrelaterte psykososiale faktorar for å bekrefte resultatane.

## Contents

Preface.....	1
Abstract.....	2
Samandrag.....	4
Figure and tables in the article.....	7
Figure and table in the mantel.....	7
Abbreviations.....	8
Structure of the thesis.....	9
1. Introduction.....	10
2. Background.....	12
2.1 Theoretical framework.....	12
2.1.1 Work environment.....	12
2.1.2 Stress.....	12
2.1.3 The Job Strain model.....	13
2.1.4 Work-related psychosocial factors and musculoskeletal complaints.....	14
2.2 The work environments of aircrew.....	15
2.2.1 Physical environment.....	15
2.2.2 Mechanical factors.....	16
2.2.3 Organizational factors.....	16
2.2.4 Psychosocial factors.....	16
2.3 Aircrew health.....	17
2.3.1 General health.....	17
2.3.2 Musculoskeletal complaints.....	18
3. Aim and research questions.....	20
4. Methods.....	21
4.1 Design of the study.....	21
4.2 Respondents and data collection.....	21
4.3 The questionnaire.....	22
4.4 Included variables.....	22
4.4.1 Dependent variables: Musculoskeletal complaints.....	22
4.4.2 Independent variables: Work-related psychosocial factors.....	22
4.4.4 Potential confounders.....	23
4.5 Ethical considerations.....	23
4.6 Statistical analyses.....	24
5. Results.....	26
5.1 Demographic and work-related factors.....	26

5.2 Musculoskeletal complaints.....	26
5.3 Work-related psychosocial factors.....	27
5.4 Work-related psychosocial factors and high levels of musculoskeletal complaints.....	27
5.4.1 Bivariate analyses.....	27
5.4.2 Multiple logistic regression analyses.....	28
6. Discussion.....	30
6.1 Summary of main results.....	30
6.2 Methodological considerations.....	30
6.2.1 Selection bias.....	30
6.2.2 Information bias.....	32
6.2.3 Confounding.....	32
6.2.4 Statistics.....	33
6.3 Differences in musculoskeletal complaints.....	34
6.4 Difference in work-related psychosocial factors.....	35
6.5 Associations between work-related psychosocial factors and musculoskeletal complaints.....	36
6.5.1 Associations in cabin crew.....	36
6.5.2 Associations in cockpit crew.....	36
7. Conclusion and implications.....	38
References.....	39
Appendix 1: Questback Questionnaire.....	48
Appendix 2: Approval from REK.....	61
Article.....	64

### [Figure and tables in the article.](#)

Figure 1 (a) and (b): Prevalence and severity of musculoskeletal complaints in cockpit crew and cabin crew. *Page 9 (in the article).*

Table 1: Sociodemographic and work-related factors in cockpit and cabin crew. Differences tested with chi-square tests. *Page 8 (in the article).*

Table 2: Work related psychosocial factors in cockpit and cabin crew. *Page 10 (in the article).*

Table 3: Multiple logistic regression analyses of work-related psychosocial risk factors associated with high levels of musculoskeletal pain. *Page 11 (in the article).*

### [Figure and table in the mantel.](#)

Figure 1: Explanatory model of how work-related psychosocial factors may impact the development of musculoskeletal complaints, based on published models, developed by Hauke et al. (2011). *Page 15.*

Table 1: Bivariate analyses of work-related psychosocial risk factors on high levels of musculoskeletal complaints in cockpit and cabin crew. *Page 28.*



## Abbreviations.

CI confidence interval

HWE healthy worker effect

MSC musculoskeletal complaints

OR odds ratio

QPS Nordic 34+ General Questionnaire for Psychological and Social factors at work

## Structure of the thesis.

This master thesis project is written as an article with a mantel, where the mantel is presented first. The mantel supplements the article with a more extended review of the empirical knowledge and an account of relevant theories, in addition to a more elaborate discussion of methods and results. Following the mantel is the article *“Associations between work-related psychosocial risk factors and musculoskeletal complaints in Norwegian aircrew – a cross-sectional study”*. The article is written in accordance with the author guidelines of BMC Musculoskeletal Disorders, and the aim is to get it published there. While the article is presented as an independent product, the mantel cites the article in chapters regarding methods and results.

## 1. Introduction.

A large proportion (70%) of the adult population in Norway are employed (The Norwegian Institute of Public Health 2018), and the workplace is recognized as a major source of health promoting resources (Dahl et al. 2014). However, the work environment could also be an important risk factor for a range of disorders, such as MSC and psychological complaints (Knudsen et al. 2017; Lærum et al. 2013; Naidoo & Wills 2009). The socio-economic cost of work-related disorders and injuries is high (Hem et al. 2016), and musculoskeletal complaints (MSC) is the diagnostic group with the highest prevalence and financial cost (Lærum et al. 2013); twenty percent of the non-mortal loss of health in Norway is due to MSC (Knudsen et al. 2017). On the individual level, MSC is associated with pain, and reduced functionality and quality of life (Ihlebaek et al. 2010).

A health promoting work environment is considered an important tool to increase working life participation (St.meld. nr. 29 (2016-2017) ; The National Institute of Occupational Health 2018), and through the Working Environment Act, employers are committed to work systematically with prevention to protect employees from potentially harmful effects of their work environment (Arbeidsmiljøloven § 3-1). To extend and update the knowledge base to inform this work, more research is needed of how specific work-related psychosocial factors affect the well-being, work capacity and health of employees in specific occupations (Knardahl 2014; Odeen et al. 2012).

Work-related MSC is pain or reduced functionality of muscles, tendons, nerves, ligaments, joints or spinal disks that is caused or made worse by work conditions (Knardahl et al. 2008; Punnett 2014; The National Institute of Occupational Health 2018). Headache is commonly included in the MSC category (Eriksen et al. 1999; Kuorinka et al. 1987). MSC is the largest category of work-related disorders in many industrialized countries, and low back pain is especially recognized as a source of the global burden of work-related health problems (Hem et al. 2016; Murray et al. 2015; Punnett & Wegman 2004). In Norway, MSC are common reasons for reduced work capacity (Brage et al. 2010; Ihlebaek et al. 2007; Morken et al. 2004; The Norwegian Institute of Public Health 2018); 38 percent of doctor-certified sick leave and 29 percent of disability pensions are related to MSC (Hem et al. 2016; Murray et al. 2015; Punnett & Wegman 2004). Around 75% of the adult population in Norway experience some kind of pain or complaint related to the musculoskeletal system

within a period of thirty days (Lærum et al. 2013). The prevalence of MSC in Swedish and Norwegian aircrew has been found to be high compared to the general working population (Omholt et al. 2016; Runeson-Broberg et al. 2014; Wahlstedt et al. 2010a).

Work-related MSC are often a result of physical or mechanical factors at work (Ijmker et al. 2007; Knardahl et al. 2008; Mayer et al. 2012; Punnett 2014; van Rijn et al. 2010). However, there is increasing evidence that they also may be initiated or modified by work-related psychosocial factors (Christensen & Knardahl 2010; Christensen & Knardahl 2012a; Hauke et al. 2011; Lang et al. 2012; Macfarlane et al. 2009). In air crew, work-related psychosocial factors have been associated with MSC, sleep disturbances, headaches, concentration difficulties, fatigue and gastrointestinal symptoms (Lee et al. 2008; Runeson-Broberg et al. 2014; Runeson et al. 2011; Wahlstedt et al. 2010a).

Despite having stressful and physically demanding occupations, and thus being at risk for work-related MSC, there is little recent knowledge about the relationship between MSC and work-related psychosocial factors in cockpit and cabin crew. The current study addresses this knowledge gap by investigating a wide range of specific work-related psychosocial factors and their associations to MSC in Norwegian aircrew. The work environment of aircrew does not compare to that of any other occupational group, and though the physical work environments of cockpit and cabin crew are similar, their working conditions are very different and presents the two groups with distinct challenges regarding work-related psychosocial factors. Therefore, the aim of the present study is to compare how cockpit and cabin crew assess their work environment and their level of MSC, and to investigate what work-related factors are associated with reporting a high level of MSC within each occupational group.

## 2. Background.

In this chapter, a theoretical framework is presented, to support the understanding of the relationship between work-related psychosocial factors and MSC in aircrew.

Earlier research of MSC in aircrew will be accounted for, as will important features of the cockpit and cabin work environments

### 2.1 Theoretical framework.

#### 2.1.1 Work environment.

For the individual, paid work provides health promoting resources, such as financial income, social networks, personal development, structure, and purpose (Dahl et al. 2014; Naidoo & Wills 2009; St.meld. nr. 29 (2016-2017)). However, the work environment may also be a risk factor for injury and health complaints (Aagestad et al. 2014; Foss et al. 2011; Knardahl et al. 2008; Sterud & Tynes 2013).

The term “work environment” refers to the content and organization of work tasks, as well as characteristics of the physical and psychosocial work environment (Skogstad 2011). In the current thesis the term “work-related psychosocial factors” refers to psychological, social and organizational factors at work.

Work-related psychosocial factors appear as both resources with potentially positive effects, and constraints with potentially negative effects (Skogstad 2011). Certain work-related psychosocial factors, such as experiencing a supportive leadership and a sense of control, have been found to be protective, and when present, may buffer the detrimental effect of high demands (Christensen & Knardahl 2010; Christensen & Knardahl 2012a; Christensen & Knardahl 2012b; Finne et al. 2014; House 1981; Karasek & Theorell 1990; Knardahl et al. 2008).

#### 2.1.2 Stress.

In research of occupational health psychology, the term “stress” is defined in three different ways (Espenes & Smedslund 2009; Knardahl 2014; Skogstad 2011); as external exposure (demand), internal response (experience), and the process relating the exposure to the response (interpretation). Lazarus and Folkman (1984 p. 21) defined stress as *“A relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being”*. In this definition, the “environment” represents the exposure, “well-being” the response, and “appraisals” the interpretations made by the individual, considering the relevance of the exposure, and the resources available for

coping; the interpretation acts as a mediator between the exposure and the response, and is influenced by the perceived ability to cope with the exposure. Recourses may be physical, cognitive, or social (e.g., social support).

### 2.1.3 The Job Strain model.

The Job Strain model developed by Karasek and Theorell (1990), is one of the dominating models in research of work-related psychosocial factors in relation to various health outcomes (Aagestad 2016; Knardahl 2014; Lindström et al. 1997). According to this model, the ratio of psychological job demands to job control predicts the level of work strain affecting the health of the worker, while social support acts as a potential modifier (Karasek & Theorell 1990). Psychological job demands is operationalized mainly as time pressure and role conflict, while job control is defined as decision latitude, consisting of skill discretion (using your own intellect to make decisions) and task authority (freedom to decide your own schedule) (Karasek & Theorell 1990; Knardahl 2014; Lindström et al. 1997). Social support may be provided by coworkers, supervisors, and others. According to the model, there are four categories of psychosocial work experience in jobs (Karasek & Theorell 1990): high-strain (high demands/low control), active (high demands/high control), low-strain (low demands/high control), and passive (low demands/low control). The high-strain jobs are considered the most detrimental to health, and, while low strain jobs are better for health, they are not good for productivity. In the active job situation, high control counteracts the harmful effects of high demands and leads to learning, motivation, and productivity. The combination of a high-strain job situation and low social support is considered the most detrimental to health.

The Job Strain model has been criticized for applying factors that consist of exposures with potentially contradictory health effects, rendering ambiguous results (Christensen 2014; Knardahl 2014; Lindström et al. 1997; Skogstad 2011). Moreover, the use of conceptual models in occupational health research have led to only a few broad concepts being investigated well (Knardahl 2014; Lindström et al. 1997). Nevertheless, the notion that stressors and protective factors exert a combined effect, is supported by other theoretical models (Bakker & Demerouti 2007; Lazarus & Folkman 1984).

#### 2.1.4 Work-related psychosocial factors and musculoskeletal complaints.

The effect of the work environment on MSC is complex, often indirect, and difficult to measure (Hem et al. 2016; Knardahl et al. 2008). Most theoretical models assume that work-related psychosocial factors lead to MSC by evoking physiological stress response mechanisms, such as increased muscle tension (Figure 1) (Bongers et al. 1993; Feuerstein et al. 1993; Feuerstein et al. 1999; Feuerstein et al. 2004; Hauke et al. 2011; Lang et al. 2012; McEwen 1998; Melin & Lundberg 1997; Schleifer et al. 2002; Theorell et al. 2002). The physiological response is assumed to be modified by individual characteristics and mental processes (e.g., coping strategies). Repeated activation of the physiological response mechanisms due to ongoing exposure to work-related psychosocial stressors, may over time induce MSC (Hauke et al. 2011; Lang et al. 2012). Moreover, repeated activation may lead to sensitization within neural loops with increased efficiency in the transferal of nerve impulses (Eriksen & Ursin 2002; Ursin & Eriksen 2007). This causes a lower tolerance for stress, and more pronounced pain reactions.

As shown below the dotted line in Figure 1, certain work-related psychosocial factors, such as low control of work pacing and high quantitative demands, may increase the risk of MSC through increased physical strain (Hauke et al. 2011; Lang et al. 2012).

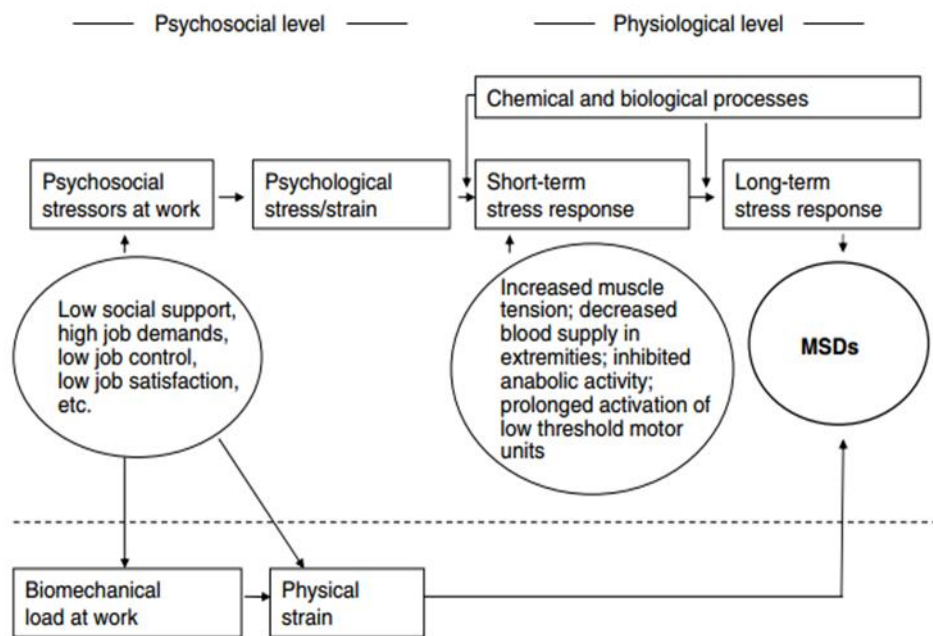


Figure 1: Explanatory model of how work-related psychosocial factors may impact the development of musculoskeletal complaints, based on published models. The figure is copied from Hauke et al. (2011).

## 2.2 The work environments of aircrew.

The physical work environments of cockpit and cabin crew are similar and include known MSC risk factors. However, different working conditions present the two occupational groups with distinct challenges (Haugli et al. 1994).

### 2.2.1 Physical environment.

The cockpit and cabin environments expose crew members to known health hazards, such as cosmic radiation (ozone), air contaminants, low humidity in the air, noise, vibration, gravitational forces, circadian rhythm disruption due to the crossing of time zones, and hypoxia (low blood levels of oxygen) induced by reduced atmospheric pressure (Boice Jr et al. 2000; DeHart 2003; Grajewski et al. 2011; Griffiths & Powell 2012; Haldorsen et al. 2001; Lindgren et al. 2000; McNeely et al. 2014; Nagda & Koontz 2003). Full body vibration is associated with increased risk of back pain (Knardahl et al. 2008; Pietri et al. 1992).



### 2.2.2 Mechanical factors.

Cockpit crew are sitting for most of the duration of their work day (Runeson-Broberg et al. 2014). Long hours sitting in a vehicle has been associated with low back pain (Alperovitch-Najenson et al. 2010; Chen et al. 2005).

For cabin crew, the main tasks during flight are related to passenger service and safety (Ballard et al. 2004). Manual materials handling, such as pushing and pulling the heavy trolley and lifting passenger cabin baggage in and out of overhead storage (Griffiths & Powell 2012; Lee et al. 2008; Sharma 2007), is associated with shoulder pain (Hoozemans et al. 2002; Knardahl et al. 2008); twisting, bending, and lifting in awkward postures is associated with low back pain (Jansen et al. 2004).

### 2.2.3 Organizational factors.

Working conditions for air crew members have changed during the last couple of decades (Runeson-Broberg et al. 2014; Runeson et al. 2011; Wahlstedt et al. 2010a), due to increased competition, and alterations in organizational structure and legislations (Årva & Wagstaff 2004). Changes include downsizing (Lee et al. 2008), and increased work demands; yearly work hours have increased, while time off duty after long-haul flights have decreased (Runeson-Broberg et al. 2014; Årva & Wagstaff 2004). Organizational instability and organizational change are associated with increased stress levels and poorer health (Greubel & Kecklund 2011), while high quantitative demands may increase the risk of shoulder pain (Miranda et al. 2001).

### 2.2.4 Psychosocial factors.

Few studies have investigated the psychosocial work environment of aircrew. Moreover, the results are difficult to compare due to different measurements and theoretical concepts. The Job Strain model has not been applied in the current study. However, the results were compared to findings of studies using the Job Strain model.

Two studies of Swedish cockpit crew have found associations between work-environment and occupational health (Runeson-Broberg et al. 2014; Runeson et al. 2011); Runeson-Broberg et al. (2014) found high demands and low social support to be related to MSC, while Runeson et al. (2011) found low social support to be associated with sleep problems. Lindgren et al. (2002) compared cockpit crew to cabin crew and office workers from the same company and found that cockpit crew

perceived their control at work to be lower than office workers and higher than cabin crew, and experienced less work stress than the other occupational groups.

In an international study of cabin crew from 32 countries, 83% of participants reported high demands, 47% low control, and 56% low support (Morley-Kirk & Griffiths 2003); high work demands, and low support were associated with MSC. A Swedish study conducted by Wahlstedt et al. (2010a), found high demands to be related to headache, fatigue, and gastrointestinal symptoms, and low control to concentration difficulties, while low social support increased the risk of reporting symptoms.

In a study of American female cabin crew, the participants perceived their work as psychologically demanding due to high work pace, insufficient time to complete tasks, and conflicting demands (Lee et al. 2008). Moreover, participants reported high job insecurity, and concern for having to deal with violent or aggressive passengers. High psychological demands and high job insecurity were associated with low back pain. Sveinsdottir et al. (2007) compared the working environments of female cabin crew to nurses and teachers in Iceland, and found that cabin crew experienced less social support from coworkers, and more job insecurity. In a qualitative study from Italy, female cabin crew described their relationships with coworkers as generally good, but that the change of crew composition with each flight limited the development of friendships and mutual support (Ballard et al. 2004). Furthermore, participants reported lack of control over their work schedule, difficulties in balancing work and home life, and having to deal with violent and aggressive passengers without the protection of their employers.

## 2.3 Aircrew health.

### 2.3.1 General health.

Due to regular mandatory health assessments and strict demands to be in good health, cockpit crew are healthier and have lower rates of most diseases than the general population (Griffiths & Powell 2012; Nicholas et al. 2001; Paridou et al. 2003; Sykes et al. 2012; Årva & Wagstaff 2004). However, studies comparing the health of cockpit crew to the general population or office workers, have found higher rates of melanoma (Blettner et al. 2003; Irvine & Davies 1992; Nicholas et al. 2001; Sanlorenzo et al. 2015; Sykes et al. 2012), kidney disease (Sykes et al. 2012), motor

neuron disease (Nicholas et al. 2001), MSC (Runeson-Broberg et al. 2014), and gastrointestinal complaints (Lindgren et al. 2012).

Prior studies of cabin crew health compared to other occupational groups or the general population, have found higher rates of melanoma (Buja et al. 2006; Griffiths & Powell 2012; McNeely et al. 2018; Reynolds et al. 2002; Sanlorenzo et al. 2015; Tokumaru et al. 2006), respiratory complaints (Beatty et al. 2011; Haugli et al. 1994; Lindgren et al. 2002; McNeely et al. 2014), heart disease (women) (McNeely et al. 2014), sleep disorders (Haugli et al. 1994; McNeely et al. 2014), fatigue (McNeely et al. 2014; Nagda & Koontz 2003), depression (McNeely et al. 2014), reproductive cancers (Buja et al. 2006; Griffiths & Powell 2012; McNeely et al. 2014; McNeely et al. 2018; Reynolds et al. 2002; Tokumaru et al. 2006), gastrointestinal complaints (Haugli et al. 1994; Nagda & Koontz 2003; Sveinsdóttir et al. 2007), earache (Nagda & Koontz 2003), dryness of skin or mucous membranes (Haugli et al. 1994; Lindgren et al. 2002; Nagda & Koontz 2003; Wahlstedt et al. 2010b), and MSC (Lee et al. 2008; Sharma 2007; Wahlstedt et al. 2010a).

#### 2.3.2 Musculoskeletal complaints.

Runeson-Broberg et al. (2014) found the three months prevalence of neck pain (40%), shoulders (44%), upper back (22%), and low back (55%) in Swedish pilots to be high compared to the general working population in Sweden (21%, 21%, 10%, and 34%, respectively) (Runeson-Broberg et al. 2014; Wahlstedt et al. 2010b).

Wahlstedt et al. (2010a) found the prevalence of weekly headaches in Swedish cabin crew to be 72 percent. This is high compared to Swedish office workers (4%) (Lindgren & Norbäck 2005). The prevalence of back pain (73%) and headache (58%) in female Indian cabin crew was high compared to women in the general population (40% and 13%, respectively). In a study of female American cabin crew working on long-haul flights, the prevalence of monthly low back pain was 60 percent (Lee et al. 2008), which was higher than the general female population (17%) (Strine & Hootman 2007). McNeely et al. (2014) also studied American cabin crew, and found the lifetime prevalence of diagnosed low back pain to be 53%, and severe headache needing medical attention in the last 12 months to be 23%. In an international study of cabin crew from 32 countries, the prevalence of MSC was 87 percent (Morley-Kirk & Griffiths 2003).

Haugli et al. (1994) compared Norwegian cockpit and cabin crew working for the same company, and found the prevalence of all MSC to be significantly higher in cabin crew. The complaints reported most frequently in both occupational groups were shoulder pain (54% in cabin crew and 20% in cockpit crew), low back pain (53% and 40%), and neck pain (49% and 23%).

### 3. Aim and research questions.

The aim of the present study was to explore the prevalence of MSC and the level of work-related psychosocial factors in aircrew, and the relationships between work-related psychosocial risk factors and MSC in cockpit and cabin crew members. Three specific research questions have been investigated:

- 1) Are there any differences in self-assessed MSC between cockpit and cabin crew?
- 2) Are there any differences in self-assessed work-related psychosocial factors between cockpit and cabin crew?
- 3) How are work-related psychosocial factors associated with MSC in the two occupational groups?

## 4. Methods.

The methods and statistical analyses used in the study is described in the article, and a summary is given in this chapter. Furthermore, a more detailed account of the questionnaire and the variables used in the statistical analyses is presented.

### 4.1 Design of the study.

The present study has a quantitative, observational, cross-sectional design. A quantitative design is suitable for exploring associations between different exposures and responses (Laake et al. 2007), which was the aim of this study. The observational design yields knowledge of associations in a real-life setting that may be utilized to make improvements, while a cross-sectional design allows for the inclusion of many subjects and variables in a cost-effective way (Veierød & Thelle 2007). The design is suitable for generating hypotheses for further investigation in later studies. In an organizational setting, a snapshot of the current situation provided by a cross-sectional survey may be used as a diagnostic tool, or to inform organizational change (Knardahl et al. 2008; Lindstrøm et al. 2000).

### 4.2 Respondents and data collection.

The data was collected in 2013 as part of a public health master's thesis project at the Norwegian University of Life Sciences (NMBU) (Tønnessen 2013). An electronic questionnaire was emailed to 4044 air crew members employed by Scandinavian Airlines (SAS), Norwegian Air Shuttle (Norwegian), and Widerøe with an invitation to partake in the study. The selected companies are the major airlines operating from Norway and were chosen for this reason. The questionnaire service was delivered by Questback, and the questionnaire, including information about the study, was distributed by the eight unions representing the employees: Norske SAS-Flygeres Forening, SAS Norge Kabinforening, Norsk Kabinforening, Norwegian Kabinforening, SAS Norge Pilotforening, Norwegian Pilotforening, Widerøes Flyverforening and Widerøes Kabinforening. The questionnaire was completed by 843 (21%) air crew members, and the response rate was 28% (n=416) for cockpit crew and 17% (n=427) for cabin crew.

### 4.3 The questionnaire.

The questionnaire consisted of 110 questions (Appendix 1): 14 questions concerning demographic and work-related factors, 31 related to prevalence of health complaints, 27 questions regarding whether the respondent relates any experienced health complaints to factors at work, 38 questions concerning social and organizational factors at work, and 10 related to self-efficacy. In the present study, 50 of the questions mentioned above were used: 10 questions regarding demographic and work-related factors, 8 concerning the prevalence of health complaints, and 32 related to social and organizational factors at work.

### 4.4 Included variables.

#### 4.4.1 Dependent variables: Musculoskeletal complaints.

The prevalence and severity of eight specific MSC (headache, migraine, neck pain, shoulder pain, pain in arms, pain in upper back, low back pain, and leg pain) as experienced in the last 30 days, was measured by 8 questions from the standardized questionnaire “The Subjective Health Complaints Inventory” (Eriksen et al. 1999). The response is rated on a four-point scale (0= not at all, 1= a little, 2= some, 3= severe) indicating severity of the complaint. A total sum score of MSC was calculated (range 0-24) and dichotomized into low/high MSC by the median of the occupational group. To calculate prevalence of MSC, variables were constructed by dichotomizing the response into complaints/no complaints.

#### 4.4.2 Independent variables: Work-related psychosocial factors.

Work-related psychosocial factors were measured by a short version of the form «General Questionnaire for Psychological and Social factors at work» (QPS-Nordic 34+) (Lindstrom et al., 2000). In the QPS Nordic 34+, each factor is measured by one or two questions. However, in the current study the factor “innovative climate” is measured by three questions; the question; “Is there sufficient communication in your department?” was replaced by the questions “Is there sufficient communication between you and your colleagues?” and “Is there sufficient communication between you and your immediate superior?”. Questions are divided into three conceptual levels: task, individual, and social and organizational level. Included in the present study, are 8 factors on the task level (quantitative demands, learning demands, positive challenge at work, role clarity, role conflict, control of decisions, control of work pacing, predictability during next month) measured by 14 questions, 1 factor on the individual level (perception of mastery) measured by 1 question, and 10 factors

on the social and organizational level (support from coworkers, support from superior, empowering leadership, support from friends and relatives, social climate, perception of group work, innovative climate, inequality, human resource primacy) measured by 17 questions. The response is given on a five-point scale to indicate the frequency of the event. To investigate what work-related psychosocial factors were associated with a high level of MSC in this sample of aircrew, a mean score was calculated for each factor and dichotomized into low/high by the median of the occupational group (see Table 2 in the article for median values).

#### 4.4.4 Potential confounders.

The study includes 10 questions related to demographic and work-related factors. Responses to questions regarding age, marital status, education level, percentage of full-time employment, and number of years working in aviation were dichotomized (see article for the complete list of demographic and work-related factors, and description of cut-off values for dichotomization). This was done to be able to see if e.g. low or high age, rather than specific age categories, was associated with MSC. Results are thus easier to compare to finds in other studies. Furthermore, the multifactorial origin of MSC creates a high background risk that makes additional causes more difficult to detect, and associations must be robust to be identified (Punnett 2014).

#### 4.5 Ethical considerations.

The air crew members that were invited to take part in the study received written information on the purpose of the study, and that completing and returning the questionnaire was voluntary and implied consent to be included. The project has been approved by the Regional Committees for Medical and Health Research Ethics in Norway (REK) (2013/404) (Appendix 2).



#### 4.6 Statistical analyses.

MSC is more common in women than in men, and in older than younger (Kinge et al. 2015; Lærum et al. 2013). Therefore, age, gender, and airline company affiliation were included in all multiple logistic regression models, while the other demographic and work-related factors were subjected to the same selection criteria as other eligible predictors. A difference between the airline companies were observed in the data. However, these differences were not of interest to the current study. Thus, adjusting for airline company affiliation increased the external validity of the results.

All analyses were conducted with JMP Pro version 13.0.0. Results were considered statistically significant at a 5 per cent level of significance. Descriptive statistics were calculated for all variables. Chi-square tests were used to compare individual and demographic variables between cockpit and cabin crew. Mean scores of work-related psychosocial variables were tested for difference using *t*-tests.

The associations between work-related psychosocial factors and MSC were calculated by multiple logistic regression analyses for cockpit and cabin crew separately, as odds ratios (ORs) with 95% confidence intervals (CIs). Potential confounders were included in the models. To avoid overfitting the models, while still being able to include all work-related psychosocial variables and demographic variables, a purposeful variable selection method was used, following the directions of Hosmer et al (2013). First, univariable analyses of each individual work-related and demographic variable were performed by standard contingency tables (Hosmer et al. 2013). P-values were calculated by the likelihood ratio chi-square test. Variables with p-values smaller than 0.25, and variables of clinical importance, were considered as model candidates. Age, gender and airline company affiliation were included in all models. In the second step, a multivariate model was fitted with the variables selected in step one, assessing the importance of each variable using the partial likelihood ratio test. Covariates that were non-significant at a five percent level were eliminated, and the smaller model compared to the initial model using the Akaike Information Criterion (Bozdogan 1987). In the third step, the values of the estimated coefficients in the smaller model were compared to those in the initial model. The covariates that were excluded in the second step were added back into the model one at a time, to assess their effect on the estimated coefficient values. If the change was 20% or more, the variable was considered important for providing adjustment to

the model and retained. In the fourth and final step, covariates not considered eligible in step one, were added to the model one at a time, to see if they made an important contribution in the presence of other variables, even if they are not directly associated with the outcome. Covariates that were significant on a five percent level were included in the final model (model 2, Table 3 in the article).

To separate the effects of individual and demographic factors from the effects of work-related psychosocial factors in the final model, reduced model analyses were carried out for each of the work-related psychosocial factors separately (Model 1, Table 3 in the article). In Model 1 each work-related psychosocial factor was adjusted for all individual and demographic factors in the final model, but not for other work-related psychosocial factors.

## 5. Results.

In this chapter, the main results of the study are presented. In addition to the results presented in the article, the bivariate associations between work-related psychosocial factors and MSC are accounted for.

### 5.1 Demographic and work-related factors.

The differences between cockpit and cabin crew were statistically significant for all individual and demographic factors measured in this study ( $p < 0.01$ ) (Table 1 in the article).

A larger proportion of the cabin crew (74.9%) were women than in the cockpit crew (4.3%) (Table 1 in the article). More cabin (34.4%) than cockpit (16.2%) crew were single, worked on European (77.5% and 67.2% respectively) and intercontinental (15.1% and 6.3%) flights, and had temporary employment (2.6% and 0.2%).

A larger proportion of the cockpit crew (70.4%) were older than forty years of age compared to the cabin crew (40.5%) (Table 1 in the article). More cockpit (64.7%) than cabin (51.8%) crew had university level education, had worked in aviation for more than ten years (79.8% and 50.8% respectively), were married or cohabiting (83.8% and 65.6%), worked on Scandinavian flights (26.5% and 7.3%), and were employed in more than 80 percent of full time position (82.0% and 70.5%).

### 5.2 Musculoskeletal complaints.

The prevalence of MSC and all single MSC, apart from low back pain, was significantly higher in cabin crew compared to cockpit crew ( $p < 0.01$ ) (Figure 1 (a) and (b) in the article). The complaints reported most frequently were headache (63% and 41% for cabin and cockpit crew, respectively), neck pain (59% and 39%), shoulder pain (54% and 36%), and low back pain (53% for both occupational groups). For cockpit crew the most frequently MSC reported as severe were low back pain (3.9%) followed by shoulder pain (2.7%) and headache (2.2%). For cabin crew the complaint most frequently reported as severe were shoulder pain (9.5%) followed by low back pain (6.2%) and neck pain (6.0%).

### 5.3 Work-related psychosocial factors.

Compared to cockpit crew, a significantly larger proportion of cockpit crew reported high learning demands, low control of work pacing, low support from immediate superior, low support from friends, low perception of group work, and low innovative climate (Table 2 in the article). A significantly larger proportion of cabin crew experienced a low level of positive challenge at work, low role clarity, high role conflict, low control of decisions, and high inequality (Table 2 in the article).

### 5.4 Work-related psychosocial factors and high levels of musculoskeletal complaints.

#### 5.4.1 Bivariate analyses.

In the bivariate analyses (not included in the article), a high level of MSC was for cockpit crew associated with high quantitative demands and inequality, and low control of work pacing and social climate (Table 1). For cabin crew, a high level of MSC was associated with high quantitative demands, learning demands, role conflict and inequality, and low control of decisions, control of work pacing, support from immediate superior, empowering leadership, social climate, and innovative climate.

**Table 1** Bivariate analyses of work-related psychosocial risk factors<sup>a</sup> on high levels of musculoskeletal complaints (MSC)<sup>b</sup> in cockpit and cabin crew.

Work-related psychosocial factors	Cockpit crew (n=416)		Cabin crew (n=427)	
	Median (range)	MSC [OR(95%CI)]	Median (range)	MSC [OR(95%CI)]
Quantitative demands	2.5 (1-5)	1.93 (1.29-2.90) **	2.5 (1-5)	1.88 (1.27-2.79) **
Learning demands	1.5 (1-4)	1.40 (0.93-2.10) †	1.0 (1-3.5)	1.57 (1.06-2.32) *
Positive challenge at work	2.0 (1-5)	0.85 (0.52-1.37)	2.5 (1-5)	0.99 (0.67-1.46)
Role clarity	1.0 (1-5)	1.20 (0.81-1.79)	1.5 (1-5)	0.94 (0.64-1.38)
Role conflict	2.0 (1-5)	1.57 (0.99-2.48) †	2.0 (1-5)	1.78 (1.20-2.64) **
Control of decisions	4.0 (1-5)	1.31 (0.87-1.97) †	4.0 (1-5)	1.96 (1.32-2.89) ***
Control of work pacing	4.5 (1.5-5)	1.82 (1.22-2.73) **	4.0 (1-5)	1.91 (1.30-2.82) **
Predictability during the next month	2.0 (1-5)	1.35 (0.91-2.02) †	2.0 (1-5)	0.95 (0.64-1.39)
Perception of mastery	2.0 (1-5)	1.85 (1.00-3.40) †	2.0 (1-5)	0.85 (0.50-1.44)
Support from coworkers	2.0 (1-5)	1.30 (0.85-1.99) †	2.0 (1-5)	1.13 (0.70-1.82)
Support from superior	3.5 (1-5)	1.39 (0.93-2.07) †	3.5 (1-5)	1.53 (1.03-2.26) *
Empowering leadership	4.5 (1-5)	1.17 (0.77-1.77)	4.5 (1-5)	1.55 (1.05-2.29) *
Support from friends	2.0 (1-5)	1.41 (0.87-2.29) †	1.0 (1-5)	1.32 (0.90-1.95) †
Social climate	2.5 (1-5)	2.45 (1.63-3.69) ***	2.5 (1-5)	1.87 (1.27-2.75) **
Perception of group work	1.5 (1-4)	1.19 (0.80-1.77)	1.5 (1-3.5)	1.06 (0.71-1.58)
Innovative climate	3.0 (1-5)	1.03 (0.68-1.56)	3.7 (1-5)	1.64 (1.10-2.43) *
Inequality	1.5 (1-5)	1.61 (1.07-2.41) *	2.0 (1-5)	1.69 (1.14-2.52) **
Human resources primacy	4.5 (1-5)	1.24 (0.82-1.87)	4.5 (1-5)	1.48 (0.99-2.23) †

\*P < 0.05; \*\*P < 0.01; \*\*\*P < 0.001.

†P < 0.25; indicating eligibility for inclusion in the multiple logistic regression models.

OR, odds ratio; CI, confidence interval.

<sup>a</sup>Above median mean factor score; high score indicating assumed negative exposure.

<sup>b</sup>Above median score of MSC in the last 30 days.

#### 5.4.2 Multiple logistic regression analyses.

In the multiple logistic regression analyses, McFadden's pseudo R squared was used to estimate how much of the variability in MSC is explained by the model (UCLA 2011). According to the model, 10.1% of the variability in MSC in cockpit crew was explained by differences in quantitative demands, social climate, inequality, flight length, marriage status, age, gender, and airline company affiliation (Table 3 in the article). In cabin crew, 4.7% of the variability in MSC was explained by differences in role conflict, control of decisions, age, gender, and airline affiliation. The largest odds ratio (OR) for cockpit crew was for social climate, where reporting low social climate was associated with a more than doubled risk of reporting high levels of MSC. High

quantitative demands and inequality increased the risk by respectively 62% and 64%. For cabin crew, reporting high role conflict was associated with a 73% increased risk of reporting high levels of MSC, while low control of decisions increased the risk by 59%.

Tests of ORs and confidence intervals (CI) are Wald based. All models were assessed by a Goodness of Fit-test and have a good fit ( $p > 0.05$ ). Model assumptions were checked using a multicollinearity test and residual plots (studentized Pearson residuals plots and studentized deviance residuals plots).

## 6. Discussion.

This chapter is an extension of the discussion in the article. Further methodological considerations are presented, and findings related to the three specific research questions investigated are discussed in view of the theoretical framework and relevant empirical knowledge presented above.

### 6.1 Summary of main results.

Cabin crew reported significantly more MSC compared to cockpit crew. They also reported lower positive challenge at work, role clarity, and control of decisions, and higher role conflict and inequality, than cockpit crew. Cockpit crew reported higher levels of learning demands, but lower control of work pacing, support from coworkers, support from friends, perception of group work, and innovative climate. Furthermore, a high level of MSC was associated with high role conflict and low control of decisions in cabin crew, and high quantitative demands, low social climate, and high inequality in cockpit crew.

### 6.2 Methodological considerations.

This study had several weaknesses that need to be considered when the results are discussed.

#### 6.2.1 Selection bias.

Selection bias is a systematic difference between the participants of a study and the individuals in the study population that are not included (Webb & Bain 2011). It makes the study sample not representative of the study population or the target population, and inferences of the results to these populations will be invalid.

Selection bias is a challenge in observational studies, and arises from mechanisms inherent in the design of the study; participation in a study is voluntary, and the reasons people have for participating or not, may be related to the exposure or outcome of interest (Webb & Bain 2011).

In occupational studies, the healthy worker effect (HWE) is omnipresent on several levels (Kristensen & Bakke 2007; Webb & Bain 2011); worker populations are generally healthier than the general population because they are able to work; selection to different professions may be directly or indirectly related to health; selection out of a job may be related to the exposures in the work environment that are under study. HWE is related to selection processes in to and out of the work force, e.g. that workers that became ill from exposure to the psychosocial work

environment have quit the job, or were on sick leave and did not participate in the study for this reason (Kristensen & Bakke 2007). Thus, the prevalence in a sample from a population of workers (which will be used to estimate the prevalence in the population) may be lower than the (true) prevalence in the population. In the current study, HWE may have led to false low risk estimates for the association between work-related psychosocial factors and MSC. In cockpit crew HWE may be more pronounced than in cabin crew, due to stricter and more frequent health controls (Haugli et al. 1994), which might influence the findings as will be discussed later.

The response rate in the present study was low, which increases the possibility of self-selection bias (Veierød & Thelle, 2007). The sampling error is systematic if the respondents differ from the target population in a systematic way, and this may threaten the internal validity (Webb & Bain, 2011). However, a higher response rate would not permit generalization to aircrew working in other airline companies in any case, as the sample was not randomly selected from the total population of all air crew. Nagda and Koontz (2003) found that cabin crew with health complaints had a greater tendency to respond to study invitations and participate. Without information on the non-responders, such a bias cannot be ruled out in the current study. The prevalence of MSC observed in the sample would then be higher than the true population prevalence. However, if both occupational groups are affected in the same way, the differences and associations between them will not be affected (Webb & Bain 2011). Furthermore, assumed that the (hypothetical) selection bias is not based on both work-related psychosocial factors and MSC, the association between them will not be affected (Kristensen & Bakke 2007).

Another source of possible selection bias is that only workers organized in a union were invited to take part. However, a large percentage (79%) of the air crew members were unionized, thus it is not likely to have affected the results significantly.



### 6.2.2 Information bias.

To ensure validity and reliability of the measurements, the questionnaires included in this study (QPS Nordic 34+ and The Subjective Health Complaints Inventory) have been validated (Dallner et al. 2000; Eriksen et al. 1999).

All data were collected by self-report; MSC are normally measured by subjective reports, since there are no objective finds (Knardahl et al. 2008), and work-related psychosocial factors as predictors of health outcomes, are more relevant when measured subjectively (Knardahl 2011). When both exposure and outcome measures are subjective, misclassification due to the common method bias (e.g. due to negative affectivity) may inflate associations (Kasl 1998; Podsakoff et al. 2003). However, the items in the QPS Nordic questionnaire are constructed to avoid emotion and social desirability; frequency of occurrence rather than degrees of agreement or satisfaction is reported (Dallner 2000).

### 6.2.3 Confounding.

The low R-squared in the multiple logistic regression models indicate that several other factors influence the level of MSC. In the present study, many factors known to influence MSC such as physical work environment and lifestyle factors were not measured and could therefore not be included in the statistical models. However, some known mechanical risk factors (e.g., full body vibration and long hours sitting) may have been partially controlled for in the logistic regression models by flight-length. Other mechanical factors, such as twisting, bending, and lifting in awkward postures, may be more related to the beginning and end of the flight and less to flight-length, and will therefore not have been adjusted for.

A significant difference in socioeconomic status between cockpit and cabin crew was observed, which may be associated with a social gradient in lifestyle factors related to MSC (Hagen et al. 2000; Kristensen & Bakke 2007).

#### 6.2.4 Statistics.

Responses to questions regarding age, marital status, education level, percentage of full-time employment, and number of years working in aviation were dichotomized to be able to see if e.g. low or high age, rather than specific age categories, was associated with MSC. This makes the results easier to compare to finds in other studies. Furthermore, the multifactorial origin of MSC creates a high background risk that makes additional causes more difficult to detect, and associations must be robust to be identified (Punnett 2014). No single categories of the dichotomized variables stood out in the initial analyses as strong predictors of MSC.

The mean values of QPS factors are dichotomized by the median of the occupational group. Information is lost by dichotomizing, and initially I wanted to divide factors in three score groups as suggested by the authors of the QPS Nordic 34+ (Lindstrøm et al. 2000), to also be able to see trends. However, the uneven distribution in some of the scales (see Table 2 in the article for median values) caused empty cells and unstable coefficients in the statistical analyses. The strength of dichotomizing by the occupational group, is that associations are more robust.

T-tests were used to test the difference in mean QPS factor scores between cockpit and cabin crew because this yielded more information; when tested with chi-square tests, the two groups had the same median and range in three factors that showed a statistically significant difference between them. Thus, the results table did not show which group had the higher mean score. Similar ordinal data has been tested with *t*-tests as continuous data in another study (Aagestad et al. 2016).

A strength in the present study is that a standardized method for model building was used for multiple logistic regression models. To find the best fitting and parsimonious model to describe the relationship between work-related psychosocial factors and MSC, the purposeful variable selection method was used, following the directions of Hosmer et al. (2013). This allowed for the inclusion of a lot of potential predictors without overfitting the model. Minimizing the number of predictors gives more stable estimates with smaller standard errors that are less dependent on the observed data (Harrell et al. 1996). Moreover, the results are more comprehensive and easier to adapt for practical use. Purposeful variable selection has been found to be superior to stepwise selection (Bursac et al. 2008).

### 6.3 Differences in musculoskeletal complaints.

Significantly higher MSC total score (a measure that includes both severity of complaints and number of sites affected) in cabin crew compared to cockpit crew was found in this study. Further, cabin crew had a significantly higher prevalence of all single MSC, apart from low back pain which was reported by 53% of participants in both occupational groups. Low back pain was the single MSC reported most frequently by cockpit crew, while it was number four in cabin crew. In comparison, the prevalence of low back pain is 40% in the adult population in Norway (Lærum et al. 2013), 55% in Swedish cockpit crew (Runeson-Broberg et al. 2014), and 60% in American cabin crew (Lee et al. 2008), while the prevalence in Norwegian aircrew 25 years ago was 53% in cabin crew and 40% in cockpit crew (Haugli et al. 1994). Hence, our finds indicate that the prevalence of low back pain in Norwegian aircrew today is high compared to the general population, and comparable to aircrew in other countries and Norwegian cabin crew 25 years ago, while it has increased for cockpit crew.

The complaints reported most frequently in both occupational groups were headache, and pain in neck, shoulders, and low back. This is consistent with other findings in studies of aircrew (Haugli et al. 1994; Nagda & Koontz 2003; Runeson-Broberg et al. 2014), and in the general population in Norway (Lærum et al. 2013).

The etiology of MSC is multifactorial (Knardahl et al. 2008; Punnett 2014), and contributing causes explaining the observed differences in MSC between cockpit and cabin crew may include mechanical, demographic, lifestyle, and work-related psychosocial factors (Kinge et al. 2015; Lærum et al. 2013). Furthermore, bias, such as a stronger healthy worker effect in cockpit crew (Haugli et al. 1994), may constitute a part of the explanation.

In the current study we observed significant differences between the two groups in sociodemographic factors related to potential risk factors for MSC such as lower socioeconomic status (Gillen et al. 2007) and social support at home (Yan et al. 2018) in cabin crew. Furthermore, the gender difference between cockpit and cabin crew was highly significant, with only 4% of the cockpit crew being women, as opposed to 80% of the cabin crew (Table 1 in the article). MSC being more common in women than in men (Kinge et al. 2015; Lærum et al. 2013) suggests that differences in MSC might be due to gender representation. However, in the present

study no differences were found in the prevalence of MSC between male and female cabin crew, apart from leg pain (results not shown). Moreover, Haugli et al. (1994) found a significantly higher prevalence of MSC for all body sites in male cabin crew compared to male cockpit crew. This indicates that other factors are more important than gender in explaining the observed differences in MSC between cockpit and cabin crew.

#### 6.4 Difference in work-related psychosocial factors.

Significant differences in self-assessed work-related psychosocial factors between cockpit and cabin crew were observed and, as stated above, may partly cause the observed differences in MSC between the groups. Further, a significant difference between groups may indicate either a high score in one group or a low score in the other, or both. I have not found other studies comparing work-related psychosocial factors between cockpit and cabin crew. As a comparison, Aagestad et al. (2016) found the mean role conflict score to be 2.23 in female Norwegian health and social workers, and 2.07 in women from the general working population in Norway. In the present study, the mean role conflict score was 1.94 in cockpit crew and 2.32 in cabin crew (Table 2 in the article).

Cabin crew reported a significantly higher score on factors regarding positive challenge at work, role clarity, role conflict, control of decisions, and inequality, while cockpit crew reported a higher score in learning demands, control of work pacing, support from coworkers, support from friends, group work, and innovative climate (Table 2 in the article). Four out of the five factors where cabin crew scored higher are on the task level, while for cockpit crew, four out of six factors are on the social and organizational level. This may indicate that psychosocial stressors tend to be related to work tasks in cabin crew, and to organizational factors in cockpit crew.

The notion that a higher score in factors related to role conflict, control of decisions, and inequality in cabin crew may partially explain the higher total score and prevalence of MSC, is supported by findings in previous studies of Norwegian workers from different business sectors; role conflict and low control of decisions predicted neck pain (Christensen & Knardahl 2010), back pain (Christensen & Knardahl 2012a), and headache (Christensen & Knardahl 2012b). Furthermore, organizational injustice, a concept related to inequality (Kaufmann & Kaufmann

2015), has been associated with disability pension due to MSC in Finnish public sector workers (Juvani et al. 2016).

## 6.5 Associations between work-related psychosocial factors and musculoskeletal complaints.

### 6.5.1 Associations in cabin crew.

In the bivariate analyses, a high level of MSC was associated with high quantitative demands, learning demands, role conflict, and inequality, and low control of decisions, control of work pacing, support from superior, empowering leadership, social climate, and innovative climate (Table 1). After adjusting for age, gender, and airline company affiliation (Model 1, Table 3 in the article), high role conflict, and low control of decisions and work pacing, were still statistically significant. However, when all three work-related psychosocial factors were included in the same model, low control of work pacing was no longer significant (Model 2, Table 3 in the article). The strongest association was to role conflict, with a 73 percent increase in the risk of reporting high levels of MSC, while low control of decisions represented an increased risk of 59 percent.

Role conflicts are role demands that are mutually exclusive; contradicting messages from one or several persons, conflict between the different roles of one person, or moral conflicts (Dallner et al. 2000). One source of role conflict for cabin crew, is having to deal with violent or aggressive passengers while hiding their true feelings (Ballard et al. 2004). This may lead to emotional dissonance (The National Institute of Occupational Health 2018), which has been associated with sick leave in workers dealing with customers (Indregard et al. 2017).

### 6.5.2 Associations in cockpit crew.

A high level of MSC was in the bivariate analyses for cockpit crew associated with high quantitative demands and inequality, and low control of work pacing and social climate (Table 1). After including age, gender, airline company affiliation, flight length, and marriage status in the model (Model 1, Table 3 in the article), control of work pacing was no longer significant. The strongest association was to social climate; reporting low social climate more than doubled the risk of reporting high levels of MSC. High quantitative demands and inequality increased the risk of MSC by 62 and 64 percent, respectively.

Perceptions of the social climate affects how events are interpreted (Parker et al. 2003), and in the QPS Nordic 34+, one of the two questions measuring social climate is related to social support (“Is the climate in your work unit encouraging and supportive?”) (Lindstrøm et al. 2000). The high quantitative demands may reflect the long working hours of cockpit crew due to regulations for civil aviation that invalidates some of the paragraphs in the Working Environment Act, such as regulations for work hours (Karlsen 2016).

## 7. Conclusion and implications.

Cockpit and cabin crew are working under very different conditions, in similar physical environments. The prevalence of MSC was higher in cabin crew compared to cockpit crew. MSC was associated with high quantitative demands, low social climate, and high inequality in cockpit crew, and high role conflict and low control of decisions in cabin crew. Interventions intended to improve the work environment should focus on the factors that are known to be important to health, motivation, and well-being (Knardahl 2014). Both the reduction of stressors and implementation of protective factors may contribute to a healthier work environment (Christensen & Knardahl 2010; Christensen & Knardahl 2012a; Christensen & Knardahl 2012b; Finne et al. 2014; House 1981; Karasek & Theorell 1990; Knardahl 2014; Skogstad 2011). The different work-related psychosocial factors associated with MSC in cabin crew and cockpit crew, indicates that preventing MSC in the two occupational groups requires different interventions, such as looking into scheduling to reduce quantitative demands for cockpit crew and going through routines to eliminate sources of role conflict for cabin crew (Knardahl 2014). However, increasing social support and the employees' control of their own work situation, may reduce the risk of MSC in both cockpit and cabin crew; to buffer the strain of high quantitative demands in cockpit crew, and role demands in cabin crew. Conclusions are limited by the cross-sectional design and possible selection bias due to low response rate. Longitudinal studies on specific work-related psychosocial factors are needed to confirm findings.

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## Vedlegg 1

### **Psykososiale faktorer og subjektive helseplager i norsk sivil luftfart**

Denne undersøkelsen er sendt elektronisk til alle flygere og kabinansatte som er ansatt i SAS, Norwegian eller Widerøe, og som er medlemmer av en fagforening.

Undersøkelsen er en del av en mastergradsoppgave ved Universitetet i miljø- og biovitenskap. Prosjektleder og veileder er Professor Camilla Martha Ihlebæk. Prosjektmedarbeider og mastergradsstudent er Mona Linge Tønnessen.

Hensikten med studien er å kartlegge psykososiale faktorer og subjektive helseplager blant flygere og kabinansatte i norsk sivil luftfart

Innsamlet informasjon vil bli behandlet konfidensielt og vil bli lagret og håndtert etter gjeldende etiske forskrifter.

Undersøkelsen tar 8-10 minutter å gjennomføre. Det er frivillig å delta. Du som deltakerne velger selv om du ønsker å svare på spørsmålene. Ved å svare på undersøkelsen samtykker du til deltakelse i studien. Du kan når som helst under utfyllingen av skjemaet velge å ikke fullføre eller å ikke sende inn skjemaet, uten å oppgi grunn.

Hjertelig takk for at du bidrar til å gjøre denne studien mulig!

Din identitet vil holdes skjult

Les om retningslinjer for personvern. (Åpnes i nytt vindu)



### **2) Hvor gammel er du?**

- Yngre enn 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 eller eldre

### **3) Kjønn**

- Kvinne
- Mann



### **4) Sivilstatus**

- Gift
- Samboer
- Singel u/barn
- Singel m/barn

**5) Utdanning – sett kryss for høyeste avsluttede utdanning**

- Grunnskole
- Videregående, yrkesfaglig, fagbrev o. l.
- Videregående allmennfaglig skole, gymnas o.l.
- Høyskole/universitet (0-3 år)
- Høyskole/universitet (mer enn 3 år)

**6) Arbeidsgiver**

- SAS
- Norwegian
- Widerøe

**7) Er du fast eller midlertidig ansatt?**

- Fast ansatt
- Midlertidig ansatt

**8) Stilling**

- Kaptein
- Styrmann
- Air Purser
- Air steward/Air host
- Annet

**Denne informasjonen vises kun i forhåndsvisningen**

Følgende kriterier må være oppfylt for at spørsmålet skal vises for respondenten:

- (  Hvis "Arbeidsgiver" er lik "SAS"
- )

**9) Arbeidstid/Schedulering/Arbeidsprogram**

- Fast gruppe
- Variabel gruppe
- Spesial scedulering
- Annet

**Denne informasjonen vises kun i forhåndsvisningen**

Følgende kriterier må være oppfylt for at spørsmålet skal vises for respondenten:

- (  Hvis "Arbeidsgiver" er lik "Norwegian"
- )

**10) Arbeidstid/Schedulering/Arbeidsprogram**

- Hovedsakelig fast scedulering (5/4)
- Hovedsakelig variabel scedulering
- Annet

**Denne informasjonen vises kun i forhåndsvisningen**

Følgende kriterier må være oppfylt for at spørsmålet skal vises for respondenten:

- (  Hvis "Arbeidsgiver" er lik "Widerøe"
- )
- og (  Hvis "Stilling" er lik "Styrmann"
- eller
- Hvis "Stilling" er lik "Kaptein"
- )

**11) Arbeidstid/Schedulering/Arbeidsprogram**

- TS-1 (7/7)
- TS-2
- TS-3/TS-flex
- Annet

**Denne informasjonen vises kun i forhåndsvisningen**

Følgende kriterier må være oppfylt for at spørsmålet skal vises for respondenten:

- (  Hvis "Arbeidsgiver" er lik "Widerøe"
- )
- og (  Hvis "Stilling" er lik "Air steward/Air host"
- eller
- Hvis "Stilling" er lik "Air Purser"
- )

**12) Arbeidstid/Schedulering/Arbeidsprogram**

- FOA1  
 FOA2  
 Annet

**13) Stillingsprosent**

- Under 40%  
 41-60%  
 61-70%  
 71-80%  
 81- 90%  
 91-100%

**14) Rutenett**

- Norge  
 Skandinavia  
 Europa  
 interkontinental

**15) Antall år i bransjen**

- Mindre enn 2 år  
 2 - 5 år  
 6 - 10 år  
 11 - 20 år  
 21 år eller mer



De neste spørsmålene går på noen vanlige helseplager. Vurder hvert enkelt problem/symptom og oppgi i hvilken grad du har vært plaget av dette i løpet av de siste 30 døgn.

**16) Har du hatt helseproblemer siste 30 døgn?**

	Ikke plaget	Litt plaget	En del plaget	Alvorlig plaget
Forkjølelse, influensa	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hoste, bronkitt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Astma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hodepine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nakkesmerter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smerter øverst i rygg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smerter i korsrygg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smerter i armene	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smerter i skuldre	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Migrene	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**17) Har du hatt helseproblemer siste 30 døgn?**

	Ikke plaget	Litt plaget	En del plaget	Alvorlig plaget
Hjertebank, ekstraslag	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brystsmerter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pustevansker	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smerter i føttene ved anstrengelser	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sure oppstøt, "halsbrann"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sug eller svie i magen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Magekatarr, magesår	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mageknip	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
"Luftplager"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Løs avføring, diaré	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**18) Har du hatt helseproblemer siste 30 døgn?**

	Ikke plaget	Litt plaget	En del plaget	Alvorlig plaget
Forstoppelse	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eksem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allergi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hetetokter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Søvnproblemer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tretthet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Svimmelhet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Angst	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nedtrykt, depresjon	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Synsforstyrrelser	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Øresus, smerter i ørene	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**19) Har du hatt helseproblemer siste 30 døgn som du tror kan relateres til arbeidet ditt?**

- Ja
- Nei
- Vet ikke om helseproblemer er relatert til arbeidet
- Har ikke hatt helseproblemer siste 30 døgn

**Denne informasjonen vises kun i forhåndsvisningen**

Følgende kriterier må være oppfylt for at spørsmålet skal vises for respondenten:

- (  Hvis "Har du hatt helseproblemer siste 30 døgn som du tror kan relateres til arbeidet ditt?" er lik "Ja"
- )

De neste spørsmålene går på vanlige faktorer/forhold ved arbeidet som kan være belastende for helsen. Vurder hvert enkelt forhold, og oppgi i hvilken grad faktoren har innvirkning på din helse.

**20) Hvis du har helseplager som du tror skyldes arbeidet ditt, hvilke forhold i arbeidet ditt mener du har negativ innvirkning på din fysiske og psykiske helse?**

	Ingen innvirkning	Lite innvirkning	En del innvirkning	Stor innvirkning
Lange arbeidsdager	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Variabel skiftordning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ubekvem arbeidstid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mangel på fleksibel arbeidstid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Usikkerhet i bransjen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Omorganisering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Svak eller blendende belysning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Støy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vibrasjoner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Luftkvalitet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dårlige værforhold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tid borte fra familie/venner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Passasjerer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kollegaer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Får sjelden tilbakemelding fra overordnede	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nødvendig å arbeide i høyt tempo/tidspress	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tunge løft	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Statiske arbeidsstillinger	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stadig gjentatte arbeidsoppgaver	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dårlig søvnkvalitet på hotell	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mangel på matpauser	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
For mye pause/venting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Manglende tilgang på ønskelig mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lite mosjonsmuligheter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Andre forhold ved arbeidet som ikke er nevnt her	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Denne informasjonen vises kun i forhåndsvisningen**

Følgende kriterier må være oppfylt for at spørsmålet skal vises for respondenten:

- (  Hvis "Har du hatt helseproblemer siste 30 døgn som du tror kan relateres til arbeidet ditt?" er lik "Ja"
- )

**21) Har noen av disse forholdene ved arbeidet også negativ innvirkning på din prestasjon på jobb?**

- Ja
- Nei
- Vet ikke



Du vil nå få spørsmål og påstander om arbeidet ditt og bedriften du arbeider i. Formålet med denne delen av undersøkelsen er å samle informasjon for å utvikle og forbedre din arbeidssituasjon og ditt arbeidsmiljø.

Ta den tiden du trenger for å svare. Du avgir svar på de fleste spørsmål ved å sette kryss ved det svaralternativet som passer best med din oppfatning.



**22) Din arbeidssituasjon og ditt arbeidsmiljø**

	Meget sjelden eller aldri	Nokså sjeldent	Noen ganger	Nokså ofte	Meget ofte eller alltid
Er arbeidsmengden din ujevn slik at den hoper seg opp?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Har du for mye å gjøre?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er arbeidsoppgavene vanskelige for deg?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Utfører du oppgaver som du trenger mer opplæring for å kunne utføre?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er dine spesialkunnskaper og ferdigheter nyttige i arbeidet ditt?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er arbeidet ditt utfordrende på en positiv måte?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er det fastsatt klare mål for din jobb?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vet du nøyaktig hva som forventes av deg i jobben?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mottar du motstridende forespørsler fra to eller flere personer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kan du påvirke mengden arbeid som blir tillagt deg?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**23) Din arbeidssituasjon og ditt arbeidsmiljø (forts.)**

	Meget sjelden eller aldri	Nokså sjeldent	Noen ganger	Nokså ofte	Meget ofte eller alltid
Kan du bestemme ditt arbeidstempo?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kan du selv bestemme når du skal ta pauser?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kan du påvirke beslutninger som er viktige for ditt arbeid?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vet du hva slags oppgaver du kan få en måned fram i tid?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Går det rykter om forandringer på din arbeidsplass?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er du fornøyd med din evne til å løse problemer som dukker opp i arbeidet?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Om du trenger det, kan du få støtte og hjelp i ditt arbeid fra dine kollegaer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Om du trenger det, kan du få støtte og hjelp i ditt arbeid fra din nærmeste sjef?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blir dine arbeidsresultater verdsatt av din nærmeste sjef?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oppmuntrer din nærmeste sjef deg til å delta i viktige avgjørelser?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**24) Din arbeidssituasjon og ditt arbeidsmiljø (forts.)**

	Meget sjelden eller aldri	Nokså sjeldent	Noen ganger	Nokså ofte	Meget ofte eller alltid
Hjelper din nærmeste sjef deg med å utvikle dine ferdigheter?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Føler du at du kan stole på at venner og familie vil støtte deg hvis det blir vanskelig på jobben?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er klimaet på arbeidsplassen oppmuntrende og betryggende?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er klimaet på arbeidsplassen avslappet og behaglig?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er klimaet på arbeidsplassen stivbent og regelstyrt?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Setter du pris på å være medlem av arbeidsgruppen?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er du og dine kollegaer dyktige til å løse problemer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blir de ansatte oppmuntret til å tenke ut måter for å gjøre ting bedre på, på ditt arbeidssted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er det god kommunikasjon mellom deg og dine kollegaer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Er det god kommunikasjon mellom deg og din nærmeste leder?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**25) Din arbeidssituasjon og ditt arbeidsmiljø (forts.)**

	Meget sjelden eller aldri	Nokså sjeldent	Noen ganger	Nokså ofte	Meget ofte eller alltid
Har du lagt merke til forstyrrende konflikter mellom arbeidskollegaer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Har du lagt merke til om menn og kvinner blir behandlet ulikt på arbeidsstedet din?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Har du lagt merke til om eldre og yngre arbeidstakere blir behandlet ulikt på arbeidsstedet ditt?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Får du belønning for velgjort arbeid i din bedrift/virksomhet (penger, oppmuntring)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hvor meget er ledelsen i din bedrift opptatt av den ansattes helse og velvære?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jeg liker å være opptatt av jobben min mesteparten av tiden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Den største tilfredsstillelsen i mitt liv kommer fra jobben	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
"Stress" innebærer en situasjon der en person føler seg anspent, urolig, nervøs eller engstelig, eller ikke er i stand til å sove om natten fordi hans eller hennes tanker er opprørt hele tiden. Føler du denne typen stress nå for tiden?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**26) Hvordan opplever du at du mestrer arbeidsdagen din?**

	Helt galt	Nokså galt	Nokså riktig	Helt riktig
Jeg klarer alltid å løse vanskelige problemer hvis jeg prøver hardt nok	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hvis noen motarbeider meg, så kan jeg finne måter og veier for å få det som jeg vil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Det er lett for meg å holde fast på planene mine og nå målene mine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jeg føler meg trygg på at jeg vil kunne takle uventede hendelser på en effektiv måte	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Takket være ressursene mine så vet jeg hvordan jeg skal takle uventede situasjoner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jeg kan løse de fleste problemer hvis jeg går tilstrekkelig inn for det	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jeg beholder roen når jeg møter vanskeligheter fordi jeg stoler på mestringsevnen min	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Når jeg møter et problem, så finner jeg vanligvis flere løsninger på det	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hvis jeg er i knipe, så finner jeg vanligvis en vei ut	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Samme hva som hender så er jeg vanligvis i stand til å takle det	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Hage Holden Andreassen	22845514	03.04.2013	2013/404 REK sør-øst II
			Deres dato:	Deres referanse:
			13.02.2013	

Vår referanse må oppgis ved alle henvendelser

Til Camilla Ihlebæk

### 2013/404b Luftfart og helse

Forskningsansvarlig: Universitetet for miljø- og biovitenskap  
Prosjektleder: Camilla Ihlebæk

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst) i møtet 13.03.2013. Vurderingen er gjort med hjemmel i helseforskningsloven (hfl.) § 10, jf. forskningsetikklovens § 4.

#### Prosjektomtale

*Formålet med prosjektet er å kartlegge grad av subjektive helseplager blant piloter og kabinansatte i norsk sivil luftfart. Problemstillinger i prosjektet: - Hvor stor andel av piloter og kabinansatte i norsk sivil luftfart er plaget med subjektive helseplager? - Er det sammenhenger mellom flygere og kabinpersonells subjektive helseplager og grad av arbeidsbelastning (målt etter arbeidsmengde, yrke og skiftordning), mestring, kontroll og sosial støtte? Studien skal gjennomføres ved hjelp av Questback. Det elektroniske spørreskjema vil inneholde spørsmål om kjønn, alder, yrke, antall år i yrket, ruteneit, arbeidstidsordning og fysisk skap. I tillegg vil det benyttes standardiserte spørreskjema for å måle subjektive helseplager. 5000 norske flygere og kabinansatte i SAS, Widerøe og Norwegian forespørres om å delta i studien*

#### Vurdering

Komiteen har vurdert søknaden og har ingen forskningsetiske innvendinger til at prosjektet gjennomføres.

Prosjektet skal gjennomføres ved å benytte Questback. Komiteen forutsetter at det foreligger en databehandleravtale for prosjektet. For å minske faren for bakveisidentifisering ber komiteen om at man lager aldersgrupperinger når man spør om alder og ikke ber om eksakt alder. For eksempel grupperinger på 20-30år, 30-40år osv.

#### Vedtak

Komiteen godkjenner prosjektet i henhold til helseforskningsloven § 9 og § 33

Godkjenningen er gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknaden.

Tillatelsen gjelder til 31.12.2014. Av dokumentasjonsb hensyn skal opplysningene likevel bevares inntil 31.12.2019.

Forskningsprosjektets data skal oppbevares forsvarlig, se personopplysningsforskriften kapittel 2, og Helsedirektoratets veileder "Personvern og informasjonssikkerhet i forskningsprosjekter innenfor helse- og omsorgssektoren".

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*Klageadgang*

Du kan klage på komiteens vedtak, jf. forvaltningslovens § 28 flg. Klagen sendes til REK sør-øst B. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst B, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Komiteens avgjørelse var enstemmig.

Vi ber om at alle henvendelser sendes inn med korrekt skjema via vår saksportal: <http://helseforskning.etikkom.no>. Dersom det ikke finnes passende skjema kan henvendelsen rettes på e-post til: [post@helseforskning.etikkom.no](mailto:post@helseforskning.etikkom.no).

Med vennlig hilsen

Grete Dyb  
førsteamanuensis dr. med.  
nestleder REK sør-øst B

Hege Holde Andersson  
Komitésekretær

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# **Associations between work-related psychosocial risk factors and musculoskeletal complaints in Norwegian aircrew – a cross-sectional study.**

## **Abstract.**

Background. Aircrew have high-risk occupations for musculoskeletal complaints (MSC), still there is limited recent knowledge of the prevalence of MSC in this occupational group. Furthermore, there is scarce knowledge about the relationship between work-related psychosocial factors and MSC in aircrew, and the potential differences between cabin crew and cockpit crew. The aim of this study was therefore to investigate differences in MSC and work-related psychosocial factors, and the associations between them, in the two groups.

Methods. In a cross-sectional study conducted in 2013, 843 aircrew members in the three major airline companies in Norway completed a questionnaire covering MSC in eight body sites (The Subjective Health Complaints Inventory), and eighteen work-related psychosocial risk factors on individual, organizational and task level (QPS Nordic 34+). The associations between work-related psychosocial factors and MSC were investigated by multiple logistic regression analyses for cockpit and cabin crew separately.

Results. Cabin crew reported a higher prevalence of all MSC, except for low back pain. The complaints reported most frequently in both occupational groups were low back pain, headache, neck pain and shoulder pain. Cabin crew reported higher levels of low positive challenge at work, low role clarity, high role conflict, low control of decisions, and high inequality, while cockpit crew reported higher levels of learning demands, low control of work pacing, low support from coworkers, low support from friends, low perception of group work, and low innovative climate. The risk of reporting a high level of musculoskeletal complaints was significantly increased by reporting high quantitative demands, low social climate and high inequality in cockpit crew, and high role conflict and low control of decisions in cabin crew.

Conclusions. The prevalence of musculoskeletal complaints was higher in cabin crew compared to cockpit crew. Musculoskeletal complaints were associated with different work-related psychosocial factors in cabin crew and cockpit crew, indicating that

preventing musculoskeletal complaints in the two occupational groups requires different interventions. However, longitudinal studies on specific work-related psychosocial factors is needed to confirm the findings.

Keywords.

Occupational health, aircrew, cabin crew, flight attendants, cockpit crew, pilots, musculoskeletal complaints, work-related psychosocial factors, QPS Nordic, SHC Inventory.

## **Introduction.**

Musculoskeletal complaints (MSC) is the major work-related health problem in many industrialized countries (Punnett & Wegman 2004), and a major cause of sick leave and disability in the Norwegian working population (The National Institute of Occupational Health 2018). The etiology of MSC is multifactorial and predictors can be both physical and psychosocial (Christensen & Knardahl 2010; Punnett 2014). The evidence for the etiological role of work-related physical risk factors is substantial (Ijmker et al. 2007; Mayer et al. 2012; van Rijn et al. 2010). However, there is increasing evidence that they may be initiated or modified by work-related psychosocial factors (Christensen & Knardahl 2010; Christensen & Knardahl 2012a; Hauke et al. 2011; Lang et al. 2012; Macfarlane et al. 2009).

The work of aircrew is stressful and physically demanding, causing them to be high-risk occupations for MSC (Haugli et al. 1994; McNeely et al. 2014; Nagda & Koontz 2003; Pukkala et al. 2012; Runeson-Broberg et al. 2014; Sharma 2007; Sveinsdóttir et al. 2007; Wahlstedt et al. 2010a). The physical demands consist of heavy work in the restricted cabin quarters, often in awkward positions (cabin crew) (Griffiths & Powell 2012; Sharma 2007), or sitting for many hours (cockpit crew) (Alperovitch-Najenson et al. 2010; Chen et al. 2005; Runeson-Broberg et al. 2014). Psychosocial stressors include dealing with passenger relations (cabin crew), monotonous work, time pressure, job insecurity, responsibility for safety and dealing with emergencies (McNeely et al. 2014; Sveinsdóttir et al. 2007; Wahlstedt et al. 2010a). Furthermore, increased competition and alterations in organizational structure and legislations during the last couple of decades have led to changes in the working conditions of aircrew (Lee et al. 2008; Runeson-Broberg et al. 2014; Runeson et al. 2011; Wahlstedt et al. 2010a; Årva & Wagstaff 2004). This might affect the health of aircrew members.

Although both cockpit and cabin crew have high-risk occupations for MSC, few studies have been conducted to evaluate the occurrence of, and relationships between, MSC and work-related psychosocial factors in these occupational groups. Runeson-Broberg et al. (2014) found the three month prevalence of neck pain, shoulder pain and low back pain in Swedish pilots to be 40, 44 and 55 percent, respectively, which is higher than the general working population in Sweden (Wahlstedt et al. 2010b). Pain in the neck, shoulders and low back was found to be

associated with high work demands and low social support (Runeson-Broberg et al. 2014). Wahlstedt et al. (2010a) found the prevalence of headache in Swedish cabin crew to be 72 percent, and to be associated with high job demands and low social support. A general methodological shortcoming in previous research of the relationship between work-related psychosocial factors and MSC, is that only a small number of broad and ill-defined concepts of work-related psychosocial factors have been investigated well (Christensen & Knardahl 2010; Macfarlane et al. 2009). To our knowledge, no previous studies have investigated the effect of a wide range of specific work-related psychosocial factors on the health of air crew.

More knowledge about the relationships between specific work-related factors and MSC in cockpit- and cabin crew is important in order to create a healthier work environment for these occupational groups (Lee et al. 2008; Omholt et al. 2016; Runeson-Broberg et al. 2014).

## **Methods.**

The aim of the present study was to explore the prevalence of MSC and the level of work-related psychosocial factors in aircrew, and the relationships between work-related psychosocial risk factors and MSC in cockpit and cabin crew members. Three specific research questions were investigated: are there any differences in self-assessed MSC between cockpit and cabin crew? Are there any differences in self-assessed work-related psychosocial risk factors between cockpit and cabin crew? How are work-related psychosocial risk factors associated with MSC in the two occupational groups?

### Respondents and data collection.

An invitation to partake in the study and a link to an electronic questionnaire was distributed by the help of the eight unions representing the three major airline companies in Norway in 2013 to 4044 aircrew members. The majority (79%) of aircrew working for the three airlines were unionized. The link to the questionnaire was open for ten days, and a reminder was e-mailed to all invited aircrew on the fifth day. Of the invited aircrew members 843 (21%) responded and completed the

questionnaire. For cockpit and cabin crew, the response rate was 28% (n=416) and 17% (n=427), respectively.

### Measurements.

#### *Musculoskeletal complaints.*

The standardized questionnaire «The Subjective Health Complaints Inventory» was used to measure MSC (Eriksen et al. 1999). The questionnaire lists 29 common complaints to be rated on a four-point scale (0= not at all, 1= a little, 2= some, 3= severe) as experienced in the last 30 days. In the present study, the eight single items from the musculoskeletal factor (headache, migraine, neck pain, shoulder pain, pain in arms, pain in upper back, low back pain and leg pain) were used. A total sum score of MSC (range 0-24) was calculated and dichotomized into low/high MSC by the median of each occupational group; 5 (range 0-24) and 3 (range 0-19) for cabin- and cockpit crew respectively.

#### *Work-related psychosocial factors.*

Work-related psychosocial factors were measured by a short version of the form «General Questionnaire for Psychological and Social factors at work» (QPS-Nordic 34+) (Lindstrom et al., 2000). The QPS-Nordic questionnaire is developed for Nordic conditions and has been validated (Dallner et al. 2000). Eighteen work-related psychosocial factors on individual level (perception of mastery), task level (quantitative demands, learning demands, positive challenge at work, role clarity, role conflict, control of decisions, control of work pacing, predictability during next month) and organizational level (support from coworkers, support from superior, empowering leadership, support from friends and relatives, social climate, perception of group work, innovative climate, inequality, human resource primacy) are measured by 31 questions. In the present study the 18 factors were measured by 32 questions; the question “Is there sufficient communication in your department?” was replaced by the questions “Is there sufficient communication between you and your colleagues?” and “Is there sufficient communication between you and your immediate superior?”. The response is given on a five-point scale to indicate the frequency of the event (1= never/very rarely, 2= quite rarely, 3= sometimes, 4= quite often, 5= very

often/always). All variables were recoded such that high score indicated assumed negative exposure, like high quantitative demands or low control of decisions. A mean score was calculated for each factor and dichotomized into low/high by the median of the occupational group (see Table 2 for median values).

#### *Potential confounders.*

The questionnaire included questions about demographic and work-related factors such as age, gender, marital status, education level, airline company affiliation, temporary employment, percentage of full-time employment, flight length, and number of years working in aviation. Age was dichotomized into 40 years or less, and more than 40 years. Marital status was dichotomized into cohabiting or single, education level into less than university level and university level, and number of years working in aviation into 10 years or less, and more than 10 years. Percentage of full time employment was dichotomized into 80 percent or less, and more than 80 percent.

#### Ethical considerations.

The aircrew members that were invited to take part in the study received written information on the purpose of the study, and that completing and returning the questionnaire was voluntary and implied consent to be included. The project was approved by the Regional Committees for Medical and Health Research Ethics in Norway (REK) (2013/404).

#### Statistical analyses.

All analyses were conducted with JMP Pro version 13.0.0. Results were considered statistically significant at a 5 per cent level of significance. Descriptive statistics were calculated for all variables. Chi-square tests were used to compare individual and demographic variables between cockpit and cabin crew. Mean scores of work-related psychosocial variables were tested for difference using *t*-tests.

The associations between work-related psychosocial factors and MSC were calculated by multiple logistic regression analyses for cockpit and cabin crew separately, as odds ratios (ORs) with 95% confidence intervals (CIs). Potential confounders were included in the models. To avoid overfitting the models, while still being able to include all work-related psychosocial variables and demographic

variables, a purposeful variable selection method was used, following the directions of Hosmer et al (2013). First, univariable analyses of each individual work-related and demographic variable were performed by standard contingency tables (Hosmer et al. 2013). P-values were calculated by the likelihood ratio chi-square test. Variables with p-values smaller than 0.25, and variables of clinical importance, were considered as model candidates. Age, gender and airline company affiliation were included in all models. In the second step, a multivariate model was fitted with the variables selected in step one, assessing the importance of each variable using the partial likelihood ratio test. Covariates that were non-significant at a five percent level were eliminated, and the smaller model compared to the initial model using the Akaike Information Criterion (Bozdogan 1987). In the third step, the values of the estimated coefficients in the smaller model were compared to those in the initial model. The covariates that were excluded in the second step were added back into the model one at a time, to assess their effect on the estimated coefficient values. If the change was 20% or more, the variable was considered important for providing adjustment to the model and retained. In the fourth and final step, covariates not considered eligible in step one, were added to the model one at a time, to see if they made an important contribution in the presence of other variables, even if they are not directly associated with the outcome. Covariates that were significant on a five percent level were included in the final model (model 2).

To separate the effects of individual and demographic factors from the effects of work-related psychosocial factors in the final model, reduced model analyses were carried out for each of the work-related psychosocial factors separately (Model 1). In Model 1 each work-related psychosocial factor was adjusted for all individual and demographic factors in the final model, but not for other work-related psychosocial factors.

## **Results**

### Demographic and work-related factors.

Among the cockpit crew, 209 (50.2%) were pilots and 207 (49.8%) second pilots (Table 1). In the cabin crew, 159 (37.2%) worked as air pursers and 268 (62.5%) as air stewards or air hosts.

A larger proportion of the cabin crew were women compared with the cockpit crew (Table 1). More cabin than cockpit crew were single, worked on European and intercontinental flights, and had temporary employment. More cockpit crew were older than forty years of age compared to the cabin crew and had university level education. Furthermore, cockpit crew had worked longer in aviation and more were married or cohabiting (Table 1).

**Table 1** Sociodemographic and work-related factors of cockpit and cabin crew. Differences tested with chi-square tests.

Individual and demographic factors	Cockpit crew (n = 416) N (%)	Cabin crew (n = 427) N (%)	p-value
Position			
<i>Captain</i>	209 (50.2)	-	
<i>Second pilot</i>	207 (49.8)	-	
<i>Air purser</i>	-	159 (37.2)	
<i>Air steward/ air host</i>	-	268 (62.8)	
Female gender	18 (4.3)	320 (74.9)	<.001
Age >40 years	293 (70.4)	173 (40.5)	<.001
University level education	269 (64.7)	221 (51.8)	<.001
Years in aviation >10	331(79.8)	216 (50.8)	<.001
Marriage status			<.001
<i>Married/ cohabiting</i>	346 (83.8)	280 (65.6)	
<i>Single</i>	67 (16.2)	147 (34.4)	
Flight length			<.001
<i>Scandinavian flights</i>	110 (26.5)	31 (7.3)	
<i>European flights</i>	279 (67.2)	328 (77.5)	
<i>Intercontinental flights</i>	26 (6.3)	64 (15.1)	
Percent of full-time position >80	341 (82.0)	301 (70.5)	<.001
Temporary employment	1 (0.24)	11 (2.62)	<.001

### Musculoskeletal complaints.

The prevalence of self-assessed MSC was significantly higher for cabin crew (89.6%) than for cockpit crew (78.4%) ( $p < 0.01$ ).

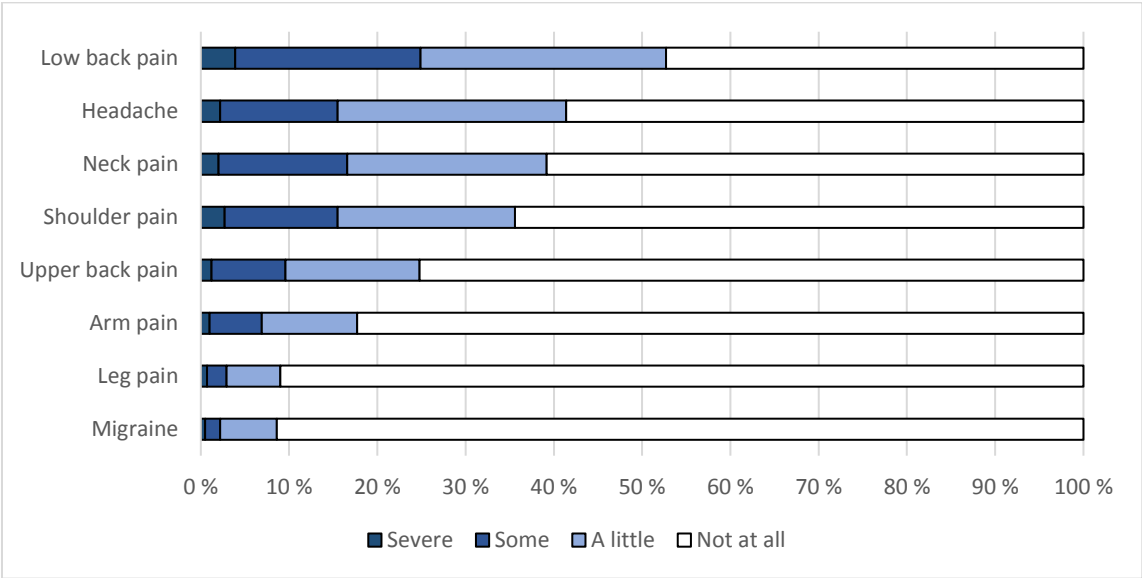
Furthermore, the prevalence of all single MSC, apart from low back pain, was significantly higher in cabin crew compared to cockpit crew ( $p < 0.01$ ) (Figure 1 (a) and (b)). For cockpit crew the most frequently reported complaints were low back pain (52.7%), headache (41.4%), neck pain (39.2%), and shoulder pain (35.6%)



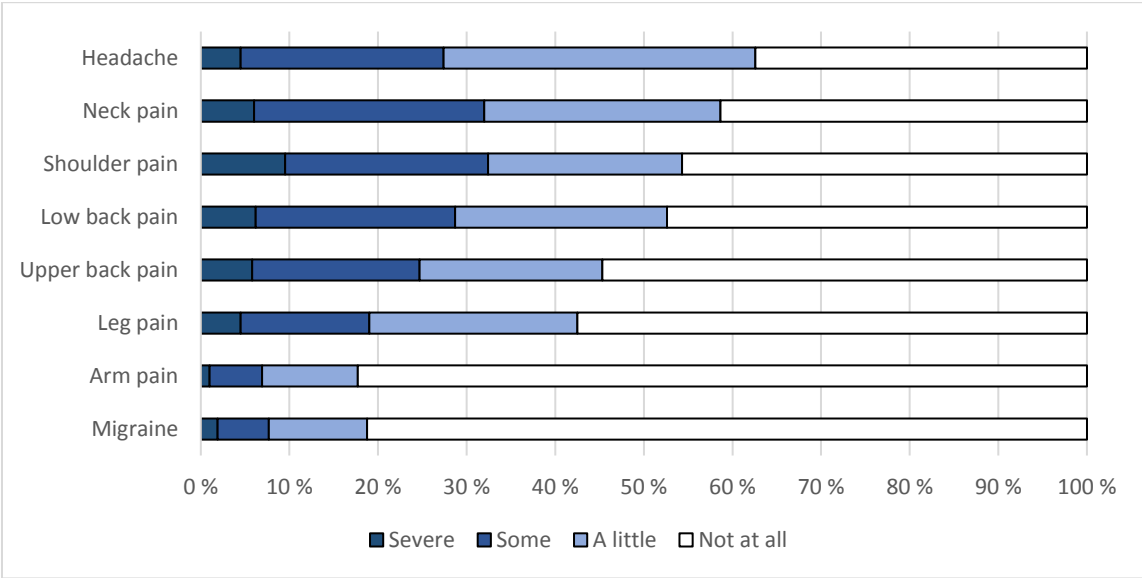
(Figure 1 (a)). The complaints most often reported as severe were low back pain (3.9%) followed by shoulder pain (2.7%) and headache (2.2%). For cabin crew the complaints most frequently reported were headache (62.6%), neck pain (58.6%), shoulder pain (54.3%), and low back pain (52.6%) (Figure 1 (b)). The complaint most often reported as severe were shoulder pain (9.5%) followed by low back pain (6.2%) and neck pain (6.0%).

**Figure 1** Prevalence and severity of musculoskeletal complaints (%) in (a) cockpit crew (n= 416) and (b) cabin crew (n= 427).

(a)



(b)



### Work-related psychosocial risk factors.

Compared to cabin crew, cockpit crew reported significantly higher learning demands and lower control of work pacing, support from coworkers, support from friends, perception of group work, and innovative climate (Table 2). Cabin crew experienced a higher level of role conflict and inequality, and a lower level of positive challenge at work, role clarity, and control of decisions (table 2).

**Table 2** Work-related psychosocial risk factors in cockpit and cabin crew.

Work-related psychosocial factors	Cockpit crew (n=416)		Cabin crew (n=427)		p-value <sup>b</sup>
	Mean (SD) <sup>a</sup>	Median	Mean (SD) <sup>a</sup>	Median	
Quantitative demands	2.55 (0.88)	2.5	2.56 (1.01)	2.5	0.845
Learning demands	1.63 (0.63)	1.5	1.36 (0.52)	1.0	<.001
Positive challenge at work	1.90 (0.74)	2.0	2.65 (0.98)	2.5	<.001
Role clarity	1.51 (0.69)	1.0	1.74 (0.82)	1.5	<.001
Role conflict	1.94 (1.01)	2.0	2.32 (1.21)	2.0	<.001
Control of decisions	3.83 (0.93)	4.0	4.00 (0.89)	4.0	0.007
Control of work pacing	4.37 (0.78)	4.5	4.06 (0.89)	4.0	<.001
Predictability	2.49 (1.27)	2.0	2.56 (1.41)	2.0	0.450
Perception of mastery	1.82 (0.65)	2.0	1.87 (0.71)	2.0	0.350
Support from coworkers	2.12 (1.00)	2.0	1.89 (0.91)	2.0	<.001
Support from immediate superior	3.44 (1.20)	3.5	3.30 (1.22)	3.5	0.099
Empowering leadership	4.09 (0.98)	4.5	4.13 (1.04)	4.5	0.601
Support from friends	1.87 (0.96)	2.0	1.73 (0.99)	1.0	0.046
Social climate	2.67 (1.05)	2.5	2.71 (1.05)	2.5	0.537
Perception of group work	1.69 (0.64)	1.5	1.54 (0.59)	1.5	0.003
Innovative climate	2.84 (0.79)	3.0	2.56 (0.80)	3.7	<.001
Inequality	1.69 (0.79)	1.5	2.11 (0.98)	2.0	<.001
Human resource primacy	4.23 (0.85)	4.5	4.13 (0.92)	4.5	0.084

SD, standard deviation.

<sup>a</sup>Low score is considered benign for all scales.

<sup>b</sup>Tested with *t*-tests.

### Work-related psychosocial factors and high levels of musculoskeletal complaints.

Table 3 shows the results from multiple logistic regression analyses of the association between high mean scale scores of QPS factors and high total score of

MSC, adjusted for individual and demographic factors (Model 1), and for other work-related psychosocial factors (Model 2). Cockpit crew members that reported high quantitative demands (OR=1.62), low social climate (OR=2.19), and high inequality (OR=1.64) had significantly higher odds of reporting high levels of MSC. In cabin crew high role conflict (OR=1.73), low control of decisions (OR=1.59), and low control of work pacing (OR=1.61) were associated with high levels of MSC. However, low control of work pacing was no longer statistically significant after adjusting for other work-related psychosocial factors.

**Table 3** Multiple logistic regression analyses of work-related psychosocial risk factors associated with high levels of musculoskeletal complaints<sup>a</sup>.

Work-related psychosocial factors	Crude OR (95% CI)	Model 1 [OR (95% CI)] <sup>b</sup>	Model 2 [OR (95% CI)] <sup>b,c</sup>	R <sup>2</sup> (U) <sup>d</sup>
Cockpit crew				0.101
Quantitative demands	1.93 (1.29-2.90) ***	1.79 (1.16-2.76) ** <sup>ef</sup>	1.62 (1.03-2.54) * <sup>ef</sup>	
Social climate	2.45 (1.63-3.69) ***	2.59 (1.58-3.50) *** <sup>ef</sup>	2.19 (1.31-3.67) ** <sup>ef</sup>	
Inequality	1.61 (1.07-2.41) *	1.73 (1.12-2.67) * <sup>ef</sup>	1.64 (1.05-2.57) * <sup>ef</sup>	
Cabin crew				0.047
Role conflict	1.78 (1.20-2.64) **	1.70 (1.13-2.54) *	1.73 (1.15-2.61) **	
Control of decisions	1.96 (1.32-2.89) ***	1.90 (1.26-2.85) **	1.59 (1.00-2.52) *	
Control of work pacing	1.91 (1.30-2.82) **	1.93 (1.27-2.95) **	1.61 (1.00-2.59)	

\*P < 0.05; \*\*P < 0.01; \*\*\*P < 0.001.

OR, odds ratio; CI, confidence interval.

<sup>a</sup>Above median total score of musculoskeletal complaints in the last 30 days.

<sup>b</sup> Adjusted for age, gender and airline company affiliation.

<sup>c</sup>+Other work-related psychosocial factors.

<sup>d</sup>McFadden's pseudo R square for the full model (Model 2).

<sup>e</sup>Flight length.

<sup>f</sup> Marriage status.

## Discussion.

Cabin crew reported significantly more MSC compared to cockpit crew. They also reported lower positive challenge at work, role clarity, and control of decisions, and higher role conflict and inequality, than cockpit crew. Cockpit crew reported higher

levels of learning demands, but lower control of work pacing, support from coworkers, support from friends, perception of group work, and innovative climate. Furthermore, a high level of MSC was associated with high role conflict and low control of decisions in cabin crew, and high quantitative demands, low social climate, and high inequality in cockpit crew.

In the present study, the prevalence of self-assessed MSC in the past month was found to be high for both cabin crew (90%) and cockpit crew (78%) compared to the general working population in Norway (75%) (Indregard et al. 2013). This is in accordance with studies from Sweden comparing prevalence of MSC in aircrew with the general working population (Runeson-Broberg et al. 2014; Wahlstedt et al. 2010a).

Cabin crew reported a significantly higher prevalence of MSC, and of all single MSC apart from low back pain, compared to cockpit crew. The complaints most often reported in both occupational groups, were low back pain, headache, neck pain, and shoulder pain. This is consistent with finds from other studies of aircrew (Haugli et al. 1994; Nagda & Koontz 2003; Runeson-Broberg et al. 2014). Women have been found to have a higher prevalence of work-related MSC in general (Foss et al. 2011; Gerr et al. 2002; Hooftman et al. 2004; Krause et al. 1997; Wahlstedt et al. 2010a), suggesting that the difference in gender representation between the two occupational groups may explain the observed results. However, in the present study we found no significant differences in the prevalence of MSC between male and female cabin crew, apart from leg pain (results not shown). Moreover, Haugli et al. (1994) found a significantly higher prevalence of MSC for all body sites in male cabin crew compared to male cockpit crew. In the current study, we found more cabin crew compared with cockpit crew to have a low educational level, to be living alone, and working on European and intercontinental flights. Hence, the higher prevalence and total score of MSC observed in cabin crew may be related to factors known to be associated with MSC such as lower socioeconomic status (Gillen et al. 2007), lower social support at home (Yan et al. 2018), or working on long-haul flights (Haugli et al. 1994; Nagda & Koontz 2003).

Furthermore, the higher prevalence and total score of MSC observed in cabin crew, may be related to differences in the reported psychosocial and organizational work environment between cabin and cockpit crew. Cabin crew reported a higher score

(indicating assumed negative exposure) on factors regarding positive challenge at work, role clarity, role conflict, control of decisions, and inequality. We have not found any other studies comparing work-related psychosocial factors between the two occupational groups. However, our finds are in accord with prospective studies of the general working population in Norway, associating high role conflict and low decision control with neck pain (Christensen & Knardahl 2010), back pain (Christensen & Knardahl 2012a) and headache (Christensen & Knardahl 2012b). Moreover, in a qualitative study from Italy, female cabin crew described a lack of control over their work schedule, and how they experienced relating to passengers as demanding (Ballard et al. 2004).

Most theoretical models describing the relationship between work-related psychosocial factors and MSC assume the pathway to involve psychological stress reactions (depending on individual factors, available resources, and coping strategies) that trigger physiological responses (e.g. biochemical processes), leading to increased muscle tension and over time increased risk of MSC (Bongers et al. 1993; Feuerstein et al. 1999; Hauke et al. 2011; Melin & Lundberg 1997; Schleifer et al. 2002; Theorell et al. 2002). Some work-related psychosocial factors, such as high quantitative demands and low control of work pacing, may also increase the risk of MSCs through increased physical strain (Hauke et al. 2011).

In the multiple logistic regression analyses, we found a high level of MSC in cockpit crew to be associated with high quantitative demands, low social climate, and high inequality. The strongest association was to low social climate, where respondents had more than twice the risk of reporting high levels of MSC. Runeson-Broberg et al. (2014) found high work demands and low social support to be associated with MSC in the neck, shoulders and low back in Swedish pilots. Social climate is in the QPS Nordic 34+ measured by questions related to emotional support (e.g., “Is the climate in your work unit encouraging and supportive?”) and, hence, the finds in the current study corresponds to those of Runeson-Broberg et al. Results are also consistent with results from a review of review studies of work-related psychosocial factors and MSC, that found a high degree of consistency of findings associating high work demands to neck, shoulder and back pain (Macfarlane et al. 2009). Items measuring inequality (e.g., “Have you noticed any inequalities in how older and younger employees are treated in your workplace?”) could correspond to the concept of

procedural justice in organizations (Kaufmann & Kaufmann 2015). Organizational injustice was found to be predictive of disability pension due to MSC in Finnish public sector employees (Juvani et al. 2016).

In Cabin crew, a high level of MSC was associated with role conflict and control of decisions. The strongest association was to role conflict. Wahlstedt et al. (2010a) found the prevalence of headache in Swedish cabin crew to be associated with high job demands measured by The Job Content Questionnaire (Karasek et al. 1998). Role conflict is included in the broad concept of Job Demands and, hence, the results of Wahlstedt et al. (2010a) may correspond to the finds in the present study. Furthermore, role conflict predicted MSC in prospective studies of the general working population in Norway (Christensen & Knardahl 2010; Christensen & Knardahl 2012a; Christensen & Knardahl 2012b; Sterud & Tynes 2013; Sterud et al. 2014). Low control of decisions predicted MSC in the general Norwegian working population (Christensen & Knardahl 2010; Christensen & Knardahl 2012a; Christensen & Knardahl 2012b), and the related concept of low decision authority was in a meta analyses associated with the onset of MSCs in all body regions (Hauke et al. 2011; Karasek & Theorell 1990).

#### Strengths and limitations of the present study.

It is a strength of the present study that we have investigated specific categories of work-related psychosocial factors, which is the foundation of knowledge based prevention of work-related illness (Knardahl et al. 2008; Knardahl 2014; The National Institute of Occupational Health 2018). The QPS Nordic Questionnaire was developed for Scandinavian working conditions, and is designed for being used both for research purposes, and for facilitating improvements in organizations (Lindström et al. 2000; Lindström et al. 1997).

A major weakness of the study is that the response rate was low and given that we have no information on the non-responders, a selection bias cannot be ruled out. Several studies have found the prevalence of a range of health complaints not to differ between responders and non-responders (Fejer et al. 2006; van den Akker et al. 1998). However, Nagda and Koontz (2003) found in a review of studies of health in cabin crew a greater tendency to respond among cabin crew with complaints.

Nevertheless, assumed that both occupational groups are affected in the same way, the interpretation of the differences and associations between them will not be affected (Webb & Bain 2011). A further limitation of the study is the lack of information on lifestyle and physical work-related factors that might have affected the prevalence and severity of MSC. The low R-squared indicates that several other factors influence MSC. Moreover, the cross-sectional design prevents drawing conclusions about the causal direction, and the causal assumptions are solely based on theoretical knowledge and models.

All data were collected by self-report. The common method bias (e.g. due to negative affectivity) may influence both exposure and outcome measures and inflate associations (Kasl 1998; Podsakoff et al. 2003). However, the items in the QPS Nordic questionnaire are constructed to avoid emotion and social desirability; frequency of occurrence rather than degrees of agreement or satisfaction is reported (Dallner 2000).

The health requirements and controls for cockpit crew are stricter than for cabin crew, and the observed differences in MSC may therefore be affected by a stronger healthy worker effect in cockpit crew (Haugli et al. 1994). However, this possible bias would negatively affect the risk estimates of the associations between work-related psychosocial factors and MSC, rendering the observed risk estimates conservative (Kristensen & Bakke 2007).

## **Conclusion.**

Cockpit and cabin crew are working under very different conditions, in similar physical environments. The prevalence of MSC was higher in cabin crew compared to cockpit crew. MSC was associated with high quantitative demands, low social climate, and high inequality in cockpit crew, and high role conflict and low control of decisions in cabin crew. The different work-related psychosocial factors associated with MSC in cabin crew and cockpit crew, indicates that preventing MSC in the two occupational groups requires different interventions. However, conclusions are limited by the cross-sectional design and possible selection bias due to low response rate. Longitudinal studies on specific work-related psychosocial factors are needed to confirm findings.

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