Self-Rated Health (SRH), Recovery From Work, Fatigue, and Insomnia Among Commercial Pilots in Relation to Occupational and Non-Occupational Factors

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Abstract

Background: This study investigates associations between self-rated health (SRH), recovery from work, fatigue, and insomnia and work conditions, psychosocial work environment, lifestyle and sense of coherence (SOC) among commercial pilots.

Methods: A standardized questionnaire was sent to all pilots in an airline company, 354 (61%) participated. Associations were analysed by ordinal and logistic regression with mutual adjustment.

Results: Totally 21.8% reported low SRH, 13.0% did not recover from work during free time, 61.9% had fatigue and 70.6% had insomnia symptoms. SRH was associated with high work demands, SOC, exercise, and overweight/obesity. Recovery from work was associated with part-time work, being a co-pilot, low social support at work and SOC. Fatigue was associated with female gender, high work demands, SOC, and younger age. Insomnia was associated with low social support, SOC, and free hours after work. Moreover, insomnia was associated with flying MD80 and intercontinental flights with Airbus 330/340, using Boeing 737 as reference.

Conclusion: The psychosocial environment at work is important for health among pilots and a high sense of coherence can be protective. Occupational conditions may have an influence on recovery from work, fatigue, and insomnia. Moreover exercise, being fit, working part-time and having more free hours after work could improve health.

Background

The volume of commercial flight is rapidly increasing globally, and more than 4 billion passengers were transported by commercial airlines in 2017. Globally, 20,000 cities have flight connections, which is twice as much as 1995 (The International Air Transport Association 2017). Due to the increased competition between airlines, the number of off duty days has been cut down and work stress has increased among commercial pilots. Mental health, fatigue, and sleep problems is an important issue related to flight safety, especially highlighted after the Germanwings crash in 2015 (O'Hagan, McGinley et al. 2018, Pasha and Stokes 2018).

Though commercial pilots are initially selected to be healthy, questionnaire surveys have found a high prevalence of different types of medical illnesses. A recent study among Norwegian commercial pilots found that musculoskeletal complaints (53%) and gastrointestinal problems (60%) were very common, while allergies, depression, and respiratory symptoms were less common (Omholt, Ihlebæk et al. 2016). A study among Swedish pilots found that 39.5% had eye symptoms, 39.9% nasal symptoms (rhinitis) and 19.8% reported non-specific airway hyperactivity (Fu, Lindgren et al. 2015, Fu, Lindgren et al. 2016). Incidence of doctors' diagnosed asthma among commercial pilots was 2.4 cases per 1000 person-years, slightly higher than the asthma incidence in the general population (Fu, Lindgren et al. 2016).

Sleep disturbances are common, especially among pilots operating international flights across time zones (Gander 1986). The study among Norwegian commercial pilots found that 68% had sleep problems, and fatigue was very common (81%) (Omholt, Ihlebæk et al. 2016). Another study from Portugal found that the majority of commercial pilots reported fatigue, after long-haul (84.4%) as well as after short-haul (93%) flights (Reis, Mestre et al. 2016). Pilots traveling across different time zones have longer sleep after homeward-bound flights than before the outward-bound flights (Anne Eriksen and Åkerstedt 2006), and they can usually recover to the baseline level at the third recovery sleep (Lowden and Åkerstedt 1999). Risk factors for fatigue among pilots include long duty hours, circadian disruptions from an inter-continental flight, and multi-segment duty during a day (Federal Aviation Administration, Samel, Wegmann et al. 1997, Bourgeois-Bougrine, Carbon et al. 2003, Fu, Lindgren et al. 2015, Honn, Satterfield et al. 2016). The chronic health problems may influence flight safety, but only a few pilots admit that they have ever made mistake during a flight because of fatigue (Aljurf, Olaish et al. 2018).

Self-rated health (SRH), also called self-reported health or perceived health, is a widely used indicator of health (De Bruin 1996). SRH, measured by a single question, has been proved to be a reliable predictor of mortality (Taloyan, Leineweber et al. 2015) and the development of chronic diseases (Latham and Peek 2013). SRH in the general population is influenced by social differences between countries (Schütte, Chastang et al. 2013), social-economic status (Alvarez-Galvez, Rodero-Cosano et al. 2013) and occupational factors (Niedhammer, Chastang et al. 2008). We found no previous study on risk factors for SRH among commercial pilots.

The concept of sense of coherence (SOC) was raised by Antonovsky. A high SOC is a personality trait reflecting the health-promoting capability to cope with stress (Antonovsky 1979, Antonovsky 1987). SOC is constructed with comprehensibility, manageability, and meaningfulness, and has been demonstrated to predict various aspects of health (Flensburg-Madsen, Ventegodt et al. 2005). The SOC scale has been used in occupational studies (Lundberg and Peck 1995, Schumann, Hapke et al. 2003, Ohta, Higuchi et al. 2015, Grodal, Innstrand et al. 2018) but we found no previous study on SOC among commercial pilots.

The psychosocial work environment can influence health and is usually studied by using the demands-control-support model (Del Pozo-Antunez, Ariza-Montes et al. 2018, Lecca, Campagna et al. 2018). The work condition with high demands, low control, and low social support is the most harmful (Johnson 1986, Johnson and Hall 1988). Among commercial pilots, low social support has been reported to be associated with sleep problems (Runeson, Lindgren et al. 2011). Recovery is an essential psychological process for detachment from work, and preparation for new work challenges. Recovery from work can be affected by psychological demands at work, sleep quality, leisure style (Zijlstra and Sonnentag 2006), and vacation (Bloom, Kompier et al. 2009, de Bloom, Geurts et al. 2010, de Bloom, Geurts et al. 2013). We found few studies on associations between psychosocial work conditions among commercial pilots and health (Lindgren, Andersson et al. 2002, Runeson, Lindgren et al. 2011), and no previous study on recovery from work in this occupational group.

When investigating health risks among pilots it is important to have a holistic perspective, including occupational as well as non-occupational risk factors. The aim is to study associations between occupational and non-occupational factors and SRH, recovery from work, fatigue and insomnia among commercial pilots. Our hypothesis in this study is that these four health variables can be influenced by work conditions (type of aircraft, type of flights, the psychosocial work environment) as well as SOC and socio-economic and life-style factors.

Methods

This study is a part of a project on work conditions and self-reported health among commercial pilots. A self-administered questionnaire was sent to all Stockholm-based pilots (captains and co-pilots) on duty in a Scandinavian airline company (N = 585), 61% participated (N = 354). The study protocol was approved by the Regional Ethical Board in Uppsala, Sweden, and all participants gave their informed consent. All methods were carried out in accordance with relevant guidelines and regulations. Details about the questionnaire have been previously published (Runeson, Lindgren et al. 2011). The questionnaire included questions on demographic factors, work conditions, psychosocial work environment, lifestyle (like exercise habit, free hour after work), home environment, and SOC. Body mass index (BMI) was defined as the body mass divided by the square of body length. BMI variable was categorized as: underweight (< 18.5), normal (18.5-24.99), overweight (25.00-29.99), and obese (> = 30.00). The psychosocial model has been described before (Runeson, Lindgren et al. 2011), which included work demand, work control, and social support. These questions were validated by Theorell (Theorell, Michelsen H et al. 1993). A short version of SOC was adapted from Lundberg and Nyström (Lundberg and Peck 1995). There was one question for each of three SOC dimensions: a) Manageability: do you usually see a solution to problems and difficulties that other people find hopeless? b) Meaningfulness: do you usually feel that your daily life is a source of personal satisfaction? c) Comprehensibility: do you usually feel that the things that happen to you in your daily life are hard to understand? Details about categories the exposure variables are listed in Table 1.

Table 1
Prevalence of occupational factors among commercial pilots (N = 354).

Age	
31–40	8.8
41–50	60.2
51–60	28.7
61–	2.3
Gender	
Man	91.0
Woman	9.0
Smoking	
Non-smoker	72.1
Ex-smoker	22.8
Current smoker	5.1
Oral tobacco (snuff) use	
Never used	67.0
Have used but quit	14.8
Current snuff user	18.2
BMI ^a	
Underweight	0
Normal	54.4
Overweight	41.5
Obese	4.1
Exercise frequency	
Sometimes	10.7
1 time /week	17.5
2–4 times /week	62.2
> 5 times /week	9.6
Marital status	
Married/couple	89.4
Weekend couple	3.5
a. Body mass index (BMI) was defined as the body mass divided by the square of body length. BMI variable was categorized as: underweight (< 18.5), normal (18.5-24.99), overweight (> = 25.00), and obese (> = 30.00). Overweight and obese were merged into one group for the statistical model.	
b. The prevalence of work year is presented in three ranges, but in the statistical models, it was treated as a continuous variable.	

Age	
Single	7.1
Children age	
None	26.8
7–18 yr	53.1
< 6 year.	20.1
Amount of free hours after work	
Half an hour /day	25.1
1–2 hr. /day	45.5
3–4 hr. /day	20.6
5–6 hr./day	7.9
Sleep length	
6–8 h	87.6
4–5 h	3.8
> 8 h	8.6
Years of employment ^b	
5–20	44.7
21–30	36.8
31–50	18.5
Employment	
Fulltime	68.9
75–80%	28.0
50%	3.1
Position	
Captain	61.0
Co-pilot	39.0
Type of aircraft	
B737	34.3
MD80serie	32.0
A330/340	25.8

a. Body mass index (BMI) was defined as the body mass divided by the square of body length. BMI variable was categorized as: underweight (< 18.5), normal (18.5-24.99), overweight (> = 25.00), and obese (> = 30.00). Overweight and obese were merged into one group for the statistical model.

b. The prevalence of work year is presented in three ranges, but in the statistical models, it was treated as a continuous variable.

Age	
Saab 2000	7.9
a. Body mass index (BMI) was defined as the body mass divided by the square of body length. BMI variable was categorized as: underweight (< 18.5), normal (18.5-24.99), overweight (> = 25.00), and obese (> = 30.00). Overweight and obese were merged into one group for the statistical model.	
b. The prevalence of work year is presented in three ranges, but in the statistical models, it was treated as a continuous variable.	

Assessment of the four dependent variables

There was one question assessing SRH: “In general, how would you like to describe your health?” (Idler and Angel 1990). There were four options: “excellent”, “very good”, “fair”, and “poor”. The question on recovery from work was adapted from Gustafsson: “Do you feel rested and recovered when you start working again after a couple of days off?” (Gustafsson, Lindfors et al. 2008). There were five options: “very often”, “quite often”, “sometimes”, “seldom”, and “never”. One question asked about fatigue during work or leisure time. Three questions on sleep disturbances were adapted from a previous sleep questionnaire by Åkerstedt (Åkerstedt 1984). These sleep questions asked about the difficulty to fall asleep, repeated awakenings during sleep, and too early final awakening, with a three-month recall period. There were four options for each question: “most of the time”, “sometimes”, “seldom” or “never”. Insomnia was defined as reporting at least one of the three symptoms most of the time or sometimes. Both fatigue and insomnia were dichotomous variables.

Statistical methods

Multiple logistic regression was used to analyse the association for fatigue and insomnia (yes/no variables). Ordinal regression was used to analyse associations for SRH and recovery from work. For all ordinal regression models, tests of parallel lines were done, to verify that ordinal regression could be used. Initially, health associations were analysed in models with one exposure factors, adjusting for age and gender (single-factor models). As a next step, mutual regression models for occupational factors were constructed, including factors with a p-value of less than 0.1 from the single factor analysis, with age and gender adjustment. The occupational mutual model was then further adjusted for SOC. The finally, associations from the occupation/non-occupational models were selected for the final mutual analysis ($p < 0.1$ as inclusion criteria). Pearson’s correlation coefficients were calculated for the independent variables. The correlation between age and year of employment was above 0.7. Therefore, only age was included in the final mutually adjusted models. The psychosocial factors were all included if any of them had a $p < 0.1$. For the logistic and ordinal regression models, odds ratios (OR) with a 95% confidence interval (CI) were calculated. A p -value < 0.05 was considered statistically significant. Calculations were done by IBM SPSS Statistics 21.

Results

The majority (88.9%) of participants were 40–60 years old, and 91.0% were males. Current smokers consists 5.1%, and 22.8% were ex-smokers. A total of 18.2% used snuff and 14.8% had quit (ex-snuff users). Almost half were overweight (41.5%), and 4.1% were obese (Table 1). Around half (55.3%) had been employed by the same airline company for over 20 years, and 68.9% were full-time employees. Doing exercise was very popular, and 71.8% exercised at least twice a week (Table 1).

A total of 78.2% of the pilots reported good or excellent SRH, and 64.4% of the pilots reported quite or very often feeling recovered after several days off work. Fatigue (61.9%) and insomnia (70.6%) were commonly reported (Table 2). The ranges of scores for high work demands, low work control and low social support at work were 1–15, 3–18, and 0–42, and the interquartile ranges are 6–10, 8–11, and 10–19 respectively. The prevalence of SOC dimensions are displayed in Table 3. The range of total SOC scores was 1–9, and the interquartile range was 5–6.

Table 2

Prevalence of self-rated health (SRH), recovery from work, fatigue, and insomnia among commercial pilots (N = 354).

SRH/personal factors	Prevalence (%)
SRH ^a	
Poor	0.8
Fair	21.0
Good	50.7
Excellent	27.5
Recovery after work ^a	
Never	1.1
Seldom	11.9
Sometimes	22.6
Quite often	43.5
Very often	20.9
Fatigue ^a	
Never	3.7
Seldom	34.4
Sometimes	53.4
Often	8.5
Insomnia ^b	
Yes	70.6
No	29.4
a. The scales of the health variables were listed above. Some of the groups were merged because of small numbers in the group. The categories of these health variables in the statistic models are as following: SRH- poor or fair, good, excellent; Recovery- never or seldom, sometimes, quite often, very often; Fatigue- never or seldom, sometimes or often.	
b. Insomnia represents either of the following symptoms were reported sometimes or most of the time during last 3 months: difficulty to sleep, repeated awakenings with difficulty falling back to sleep, and too early final awakening.	

Table 3
Prevalence of SOC dimensions.

SOC dimension ^a	Prevalence (%)
Manageability	
Seldom or never	2.5
Sometimes	36.2
Quite often	48.0
Very often	13.0
Meaningfulness	
Seldom or never	4.8
Sometimes	26.0
Quite often	51.4
Very often	17.5
Comprehensibility	
Very or quite often	3.1
Sometimes	16.1
Seldom	64.7
Never	16.1
Total SOC	Medium (Min, 25th, 75th, Max)
SoCtot	6 (1, 5, 6, 9)
a. For SOC: There were five scale level for each dimension: never, seldom, sometimes, quite often, and very often. Some groups with a small number were merged to one, including "seldom or never" for manageability and meaningfulness, and "very or quite often" for comprehensibility.	

Table 4 shows associations between the four dependent variables and single occupational and non-occupational factors, adjusted for age and gender. Part-time pilots had better recovery ($p = 0.021$). Pilots operating Saab 2000 ($p = 0.041$) had less fatigue and those who operating MD 80 series ($p = 0.012$) and Airbus 330/340 ($p = 0.007$) had more insomnia, compared to those who operated Boeing 737 (reference). Higher demands and lower social support at work were associated with all the four dependent variables. Lower control was associated with less recovery from work. Total SOC was associated with higher SRH ($p < 0.001$), better recovery from work ($p < 0.001$), less fatigue ($p < 0.001$), and less insomnia ($p < 0.001$). Those with a higher sense of manageability, higher meaningfulness, or higher comprehensibility reported higher SRH, better recovery from work, less fatigue, and less insomnia, respectively. Overweight or obese pilots reported poorer SRH ($p < 0.001$), and more fatigue ($p = 0.026$). Ex-smokers ($p = 0.003$) and current snuff users ($p = 0.017$) reported poorer SRH as compared to non-smokers and non-snuff users, respectively. The pilots with a weekend couple relationship had lower SRH ($p = 0.037$), and less recovery from work ($p = 0.021$). Those with pre-school children at home (0–6 y) had less recovery from work ($p = 0.009$). Pilots doing frequent exercise had higher SRH ($p < 0.001$) and better recovery from work ($p = 0.009$). Those with more free hours after work had higher SRH ($p = 0.040$), better recovery from

work ($p < 0.001$), and less insomnia ($p = 0.005$). The pilots who slept less than 5 h per night (short sleepers) had lower SRH ($p = 0.042$) and less recovery from work ($p = 0.014$) (Table 4)

Table 4

Associations between SRH, recovery after work, fatigue, and insomnia and occupational and life style factors. ^a

Factor	SRH estimate (95% CI)	p value	Recovery estimate (95% CI)	p value	Fatigue OR (95% CI)	p value	Insomnia OR (95% CI)	p value
Years of employment ^b	1.02 (1.00, 1.05)	0.08	1.02 (1.00, 1.05)	0.08	0.98 (0.96, 1.01)	0.21	0.99 (0.96, 1.02)	0.65
Part time	0.94 (0.65, 1.38)	0.76	1.54 (1.06, 2.20)	0.021	1.17 (0.78, 1.76)	0.46	0.82(0.54,1.25)	0.36
Co-pilot	0.76 (0.49, 1.16)	0.21	0.70 (0.46, 1.06)	0.09	1.26 (0.79, 2.02)	0.87	1.54(0.93,2.57)	0.10
Type of aircraft								
B737	Ref		Ref		Ref		Ref	
MD80serie	1.25 (0.76, 2.03)	0.37	1.27 (0.79, 2.05)	0.32	0.84 (0.49, 1.44)	0.52	2.08(1.17,3.68)	0.012
A330/340	1.35 (0.79, 2.27)	0.27	0.79 (0.47, 1.30)	0.35	1.01(0.57, 1.79)	0.98	2.38(1.28,4.46)	0.007
Saab 2000	1.32 (0.59, 2.94)	0.49	1.22 (0.57, 2.66)	0.61	0.41 (0.17, 0.97)	0.041	1.02(0.42,2.47)	0.96
High demands ^c	0.45 (0.34, 0.60)	< 0.001	0.52 (0.40, 0.68)	< 0.001	2.22 (1.63, 3.13)	< 0.001	1.46 (1.08, 2.01)	0.018
Low control ^c	0.87 (0.72, 1.10)	0.25	0.66 (0.52, 0.84)	0.001	1.16 (0.88, 1.52)	0.26	1.00 (0.78, 1.33)	0.94
Low support ^c	0.50 (0.37, 0.66)	< 0.001	0.38 (0.29, 0.50)	< 0.001	2.00 (1.55, 3.00)	< 0.001	2.00 (1.42, 2.77)	< 0.001
SOctot ^c	1.63 (1.40, 1.88)	< 0.001	1.80 (1.62, 2.08)	< 0.001	0.64 (0.54, 0.76)	< 0.001	0.70(0.60, 0.83)	< 0.001

a. The associations between dependent variables and each factor, except years of employment, were calculated by ordinal regression models, adjusted by age, gender, BMI, smoking habit, and oral tobacco (snuff) use.

b. The associations between dependent variables and years of employment were only adjusted by gender, because of the strong correlation between years of employment and age.

c. The associations between dependent variables and the SOctot and psychosocial variables were calculated by their interquartile range.

d. Some people are in a stable relationship, and they live together with their partner. They are defined as couple. Some people are in a relationship, but they live separately from their partner, and they usually meet on weekends. They are defined as weekend couple.

e. NA: Not available.

Factor	SRH estimate (95% CI)	p value	Recovery estimate (95% CI)	p value	Fatigue OR (95% CI)	p value	Insomnia OR (95% CI)	p value
Manageability	1.88 (1.40, 2.51)	< 0.001	1.67 (1.27, 2.19)	< 0.001	0.59 (0.43, 0.81)	0.001	0.62 (0.45, 0.86)	0.004
Meaningfulness	2.44 (1.16, 3.19)	< 0.001	3.11 (2.36, 4.10)	< 0.001	0.50 (0.37, 0.68)	< 0.001	0.59 (0.43, 0.81)	0.001
Comprehensibility	1.68 (1.23, 2.27)	0.001	2.03 (1.51, 2.73)	< 0.001	0.53 (0.37, 0.76)	0.001	0.62 (0.43, 0.89)	0.010
BMI	0.39 (0.26, 0.61)	< 0.001	0.73 (0.49, 1.09)	0.13	1.67 (1.06, 2.63)	0.026	1.24(0.77,2.00)	0.38
Smoking								
Non-smokers	Ref		Ref		Ref		Ref	
Quit	0.46 (0.28, 0.78)	< 0.003	0.86 (0.53, 1.40)	0.56	1.76 (0.99, 3.12)	0.05	1..49(0.81,2.73)	0.20
Current smokers	0.52 (0.21, 1.30)	0.16	0.49 (0.20, 1.16)	0.10	1.09 (0.41, 2.93)	0.86	1.20(0.41,3.47)	0.74
Habit of using snuff								
Non	Ref		Ref		Ref		Ref	
Quit	0.73 (0.41, 1.30)	0.28	1.06 (0.61, 1.86)	0.83	1.09 (0.59, 205)	0.78	1.22(0.62,2.42)	0.56
Current use	0.52 (0.30, 0.89)	0.017	0.74 (0.44, 1.25)	0.26	1.31 (0.73, 2.36)	0.37	1.15(0.62,2.14)	0.66
Marital status ^d								
Married/ couple	Ref		Ref		Ref		Ref	

a. The associations between dependent variables and each factor, except years of employment, were calculated by ordinal regression models, adjusted by age, gender, BMI, smoking habit, and oral tobacco (snuff) use.

b. The associations between dependent variables and years of employment were only adjusted by gender, because of the strong correlation between years of employment and age.

c. The associations between dependent variables and the SOCtot and psychosocial variables were calculated by their interquartile range.

d. Some people are in a stable relationship, and they live together with their partner. They are defined as couple. Some people are in a relationship, but they live separately from their partner, and they usually meet on weekends. They are defined as weekend couple.

e. NA: Not available.

Factor	SRH estimate (95% CI)	p value	Recovery estimate (95% CI)	p value	Fatigue OR (95% CI)	p value	Insomnia OR (95% CI)	p value
Weekend Couple	0.33 (0.12, 0.93)	0.037	0.31 (0.12, 0.84)	0.021	1.69(0.52,5.56)	0.39	2.76(0.60,12.64)	0.19
Single	0.48 (0.22, 1.05)	0.07	0.50 (0.24, 1.06)	0.07	2.06(0.80,5.31)	0.14	1.79(0.65,4.92)	0.26
Age of children								
None	Ref		Ref		Ref		Ref	
7–18	1.14 (0.68, 1.90)	0.62	0.71 (0.44, 1.16)	0.18	0.84 (0.49, 1.46)	0.54	0.90(0.50–1.59)	0.70
0–6	0.85 (0.43, 1.68)	0.64	0.42 (0.22, 0.81)	0.009	0.98 (0.47, 2.03)	0.95	1.98(0.87,4.54)	0.11
Exercise frequency	1.80 (1.39, 2.34)	< 0.001	1.39 (1.08, 1.77)	0.009	0.79 (0.60, 1.05)	0.11	0.82(0.61,1.11)	0.20
Free hour after work	1.26 (1.01, 1.58)	0.04	1.49 (1.20, 1.86)	< 0.001	0.82 (0.64, 1.05)	0.12	0.69(0.53,0.90)	0.005
Sleep length								
6–8 h	Ref		Ref		Ref		Ref	
4–5 h	0.09 (0.11, 0.96)	0.042	0.90 (0.11, 0.96)	0.014	0.65 (0.30, 1.41)	0.28	NA ^e	NA ^e
> 8 h	0.56 (0.27, 1.16)	0.12	0.56 (0.27,1.16)	0.71	3.60 (0.78, 16.62)	0.10	0.51 (0.24, 1.11)	0.09
a. The associations between dependent variables and each factor, except years of employment, were calculated by ordinal regression models, adjusted by age, gender, BMI, smoking habit, and oral tobacco (snuff) use.								
b. The associations between dependent variables and years of employment were only adjusted by gender, because of the strong correlation between years of employment and age.								
c. The associations between dependent variables and the SOCtot and psychosocial variables were calculated by their interquartile range.								
d. Some people are in a stable relationship, and they live together with their partner. They are defined as couple. Some people are in a relationship, but they live separately from their partner, and they usually meet on weekends. They are defined as weekend couple.								
e. NA: Not available.								

Table 5 presents the results from the final mutually adjusted models. The psychosocial work environment was associated with all health outcomes. High demands reduced SRH ($p = 0.044$) and increased fatigue ($p < 0.001$). Low social support reduced recovery from work ($p < 0.001$), and increased insomnia ($p = 0.006$). The type of aircraft was related to fatigue ($p = 0.032$) and insomnia ($p = 0.003$). Pilots operating MD80-series aircraft (OR = 2.27, 95%CI = 1.21–4.29) and Airbus330/340 (OR = 4.16, 95%CI = 1.98–8.74) had insomnia, using Boeing737 as reference. Co-pilots reported less recovery from work

than captains ($p = 0.008$) and older pilots had less fatigue ($p = 0.005$). Part-time work increased recovery from work ($p = 0.001$). Overweight/obese pilots had lower SRH ($p < 0.001$) and pilots with doing frequent exercise had higher SRH ($p = 0.004$). More free hours after work reduced insomnia ($p = 0.021$).

Table 5

Associations between SRH, recovery after work, fatigue, and insomnia and selected occupational and non-occupational factors.^a

Factor	SRH estimate (95% CI)	p value	Recovery estimate (95% CI)	p value	Fatigue OR (95% CI)	p value	Insomnia OR (95% CI)	p value
Age	1.16 (0.51, 1.67)	0.40	1.00 (0.68, 1.46)	0.996	0.53 (0.34, 0.83)	0.005	0.82 (0.54, 1.25)	0.36
Gender	0.86 (0.38, 1.93)	0.71	0.65 (0.30, 1.45)	0.30	3.19 (1.16, 9.12)	0.031	1.23 (0.47, 3.19)	0.68
Part time	/	/	2.01 (1.32, 3.03)	0.001	/	/	/	/
Co-pilot	/	/	0.52 (0.32, 0.84)	0.008	/	/	/	/
Type of aircraft						0.032		0.003
B737	/	/	/	/	Ref		Ref	
MD80serie	/	/	/	/	0.77 (0.41, 1.44)	0.41	2.27 (1.21, 4.29)	0.011
A330/340	/	/	/	/	1.83 (0.88, 3.79)	0.11	4.16 (1.98, 8.74)	< 0.001
Saab 2000	/	/	/	/	0.44 (0.17, 1.14)	0.09	1.22 (0.47, 3.18)	0.69
High demands ^c	0.70 (0.49, 0.99)	0.044	0.82 (0.57, 1.13)	0.24	2.22 (1.41, 3.52)	< 0.001	1.13 (0.72, 1.75)	0.67
Low control ^c	1.16 (0.86, 1.52)	0.34	0.84 (0.64, 1.13)	0.24	1.03 (0.75, 1.44)	0.83	0.94 (0.68, 1.30)	0.69
Low support ^c	0.84 (0.58, 1.20)	0.33	0.49 (0.34, 0.70)	< 0.001	1.20 (0.69, 1.84)	0.35	1.84 (1.20, 3.00)	0.006
SOctot ^c	1.54 (1.30, 1.80)	< 0.001	1.62 (1.38, 1.90)	< 0.001	0.69 (0.57, 0.83)	< 0.001	0.74 (0.62, 0.90)	0.002
BMI	0.43 (0.27, 0.68)	< 0.001	/	/	1.50 (0.89, 2.53)	0.13	/	/
Smoking						0.25	/	/

a. The associations between dependent variables and included factors were calculated by ordinal regression models, adjusted by age and gender.

b. The associations between dependent variables and years of employment were adjusted by gender, BMI, smoking habit, and oral tobacco (snuff) use except age, because of the strong correlation between years of employment and age.

c. The associations between dependent variables and the SOctot and psychosocial variables were calculated by their interquartile range.

d. Some people are in a stable relationship, and they live together with their partner. They are defined as couple. Some people are in a relationship, but they live separately from their partner, and they usually meet on weekends. They are defined as weekend couple.

NA: Not available

Factor	SRH estimate (95% CI)	p value	Recovery estimate (95% CI)	p value	Fatigue OR (95% CI)	p value	Insomnia OR (95% CI)	p value
Non-smokers	/	/	/	/	Ref		/	/
Quit	/	/	/	/	1.77 (0.90, 3.46)	0.10	/	/
Current smokers	/	/	/	/	1.02 (0.35, 2.93)	0.98	/	/
Marital status ^d					/			
Married/ couple	Ref		Ref		/	/	/	/
Weekend Couple	0.36 (0.10, 1.28)	0.12	0.39 (0.13, 1.21)	0.10	/	/	/	/
Single	0.59 (0.25, 1.42)	0.24	0.70 (0.30, 1.60)	0.39	/	/	/	/
Age of children					/			
None	/	/	Ref		/	/	/	/
7–18	/	/	0.82 (0.47, 1.45)	0.49	/	/	/	/
0–6	/	/	0.63 (0.29, 1.36)	0.24	/	/	/	/
Exercise frequency	1.55 (1.15, 2.10)	0.004	1.04 (0.79, 1.38)	0.76	/	/	/	/
Free hour after work	1.02 (0.79, 1.32)	0.87	1.07 (0.83, 1.39)	0.61	/	/	0.74 (0.62, 0.90)	0.021
Sleep length								
6–8 h	Ref		Ref		/	/	/	/
4–5 h	0.66 (0.19, 2.29)	0.52	0.91 (0.28, 2.94)	0.88	/	/	/	/
> 8 h	0.51 (0.22, 1.17)	0.11	1.03 (0.46, 2.32)	0.95	/	/	/	/
a. The associations between dependent variables and included factors were calculated by ordinal regression models, adjusted by age and gender.								
b. The associations between dependent variables and years of employment were adjusted by gender, BMI, smoking habit, and oral tobacco (snuff) use except age, because of the strong correlation between years of employment and age.								
c. The associations between dependent variables and the SOCtot and psychosocial variables were calculated by their interquartile range.								
d. Some people are in a stable relationship, and they live together with their partner. They are defined as couple. Some people are in a relationship, but they live separately from their partner, and they usually meet on weekends. They are defined as weekend couple.								
NA: Not available								

Discussion

The psychosocial environment at work can influence self-rated health, recovery from work, fatigue and insomnia and the operating type of airplanes can influence insomnia. A high sense of coherence, avoiding overweight or obesity, regular physical exercise and working part-time were found to be health-promoting factors for commercial pilots.

Our study has some strengths. It is a unique study on risk factors and health-promoting factors for self-rated health, recovery from work, fatigue, and insomnia among commercial pilots. The study had a reasonable response rate (61%), and there were no differences in age or gender between participants and non-participants (Runeson, Lindgren et al. 2011). Thus, selection bias after employment is not likely to have any major influence on our results. However, since pilots are initially selected to be healthy, they are not comparable with the general adult population. Another strength is that we used statistical models with mutual adjustment for different occupational and non-occupational factors.

One limitation of the study is that we only used self-reported data, which could create information bias. However, we found associations between specific dependent variables and specific risk factors, rather than a general increase of many associations with the same order of magnitude. Thus, information bias is not likely. Another limitation is that we only included pilots from one airline, which limits the external validity of the study. Moreover, the cross-sectional study design limits the possibility to draw conclusions on causality.

We will limit our discussion to factors significant in the mutually adjusted models. Sense of coherence (SOC) and the psychosocial work environment were the most important factors. SOC was associated with all four health variables in single factor analysis as well as in mutually adjusted models. We found no previous study on SOC among commercial pilots. SOC represents a salutogenic coping ability and is considered to be relatively stable in adulthood (Eriksson and Lindström 2005, Wippermann, Grevenstein et al. 2015). However, SOC can increase due to positive life events (Vastamaki, Moser et al. 2009). A high SOC was associated with better SRH among Japanese factory workers (Urakawa, Yokoyama et al. 2012). A Canadian population study reported that SOC can buffer stressors in life (Richardson and Ratner 2005).

In the single-factor analysis, the psychosocial work environment was related to all four health outcomes. In the mutually adjusted models, high work demands were associated with poor SRH and fatigue, and low social support at work was associated with poor recovery from work and insomnia. Our results concerning high work demands and lower SRH and is in agreement with some previous large European studies (Alvarez-Galvez, Rodero-Cosano et al. 2013, Schütte, Chastang et al. 2014). To improve the psychosocial work environment, the airline companies should focus on optimizing social support, and if possible reduce the demands.

In the following part of the discussion, we focus on other factors than SOC and the psychosocial work environment, discussing associations for each health variable. A total of 21.8% of the pilots reported poor or fair SRH. We found no previous study on SRH in commercial pilots. Pilots with overweight or obesity had poorer SRH and those with frequent physical exercise (at least twice a week) had better SRH. Associations between obesity and lower SRH has been reported previously in large population studies (Alvarez-Galvez, Rodero-Cosano et al. 2013, Niedhammer, Kerrad et al. 2013). Physical activity was reported to be associated with SRH among employees from high-tech companies in China (Jia, Gao et al. 2014), and in the general population in Ireland (Niedhammer, Kerrad et al. 2013).

Our question on recovery from work was adapted from a previous publication among government employees (Gustafsson, Lindfors et al. 2008). We found that one third (35.6%) of the pilots did not feel recovered after several days off work. Co-pilots had less recovery from work than flight captains and those working part-time reported better recovery from work. The main differences between captains and co-pilots are rank and salary. The captains take responsibility for the flight, and the co-pilots takes the order from the captain. To our knowledge, our study is the first on recovery from work among commercial pilots.

A majority (61.9%) of the pilots reported fatigue (sometimes or often). In our previous study, using a different question on fatigue, 29.9% of pilots reported weekly fatigue, and 82.8% of pilots reported any fatigue during the last three months (Fu, Lindgren et al. 2015). Female pilots had more fatigue which is in agreement with a previous study. A similar gender difference has been reported previously (Hughes and Kumari 2018). Moreover, older pilots had less fatigue. This is opposite results as reported in a large population study from the UK reporting that fatigue increases with age (Hughes and Kumari 2018). However, older pilots are more experienced and have a less tight duty schedule.

More than two-thirds of the pilots (70.6%) reported insomnia. Besides SOC and the psychosocial work environment, overweight or obesity and increased insomnia and free hours after work reduced insomnia. Moreover, type of operated aircraft influenced the prevalence of insomnia. Airbus 330/340 was the only aircraft type used for intercontinental flights. As expected, pilots on these intercontinental flights had more insomnia, as compared to Boeing 737, used for flights within Europe (reference group). Moreover, pilots who operated MD80s had more insomnia, as compared to those operating Boeing 737. Boeing 737 and MD80 are both narrow body aircraft operated for short/medium range. This difference could be caused by some other reason except flight duration.

Conclusion

In conclusion, for commercial pilots the psychosocial environment is important for a good health and a high sense of coherence can be an important health-promoting personality factor for self-rated health, recovery from work, fatigue, and insomnia. Avoiding overweight or obesity and regular physical exercise are important health promoting life style factors. Operating intercontinental flights can increase insomnia and working part-time can increase recovery from work. Having more free time after work can reduce insomnia. The airline companies should put more effort to improve the work environment for their pilots and the pilots should contribute by keeping a healthy lifestyle.

Abbreviations

SRH- self-rated health

SOC- sense of coherence

Declarations

Ethics approval and Consent to participate

The study protocol was approved by the Regional Ethical Board in Uppsala, Sweden. All participants gave their consent to participate.

Consent for publication

All participants gave their consent for publication.

Availability of data and material

All the data included in this article is available by contacting the authors.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Conceptualization:DN.

Data curation: XF, TL.

Formal analysis: XF.

Funding acquisition: RRB

Investigation: TL, RRB

Methodology:DN, RRB

Project administration:DN.

Resources:DN, TL.

Supervision:DN.

Visualization: XF.

Writing – original draft: XF.

Writing – review& editing: DN, TL, QH, CJ, RRB

All authors have read and approved the manuscript.

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Questionnaire

Details about the questionnaire have been previously published (Runeson, Lindgren et al. 2011).

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