# Musculoskeletal Disorders and Ergonomic Factors among the Cabin Crews of the National Airline of Bangladesh

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## ABSTRACT

**Introduction:** Cabin crews on aircraft are at risk of developing musculoskeletal disorders as a result of their workload and the nature of their profession. This study is an attempt to identify work-related musculoskeletal disorders suffered by cabin crews and the associated ergonomic factors. **Methods:** This was a cross-sectional study conducted among the cabin crews. The cabin crews, regardless of gender, who had worked at least one year, were selected by simple random sampling. A total of 246 cabin crews were the respondents in this study. A Nordic Musculoskeletal Questionnaire was used to assess the respondents' MSDs. To determine the predictors of MSDs, a binary logistic regression analysis was performed.. **Results:** Out of 246 cabin crew, 55.3% were males, and the mean age was 39.83±9.289 years. The mean flight duration was 85 hours, and the maximum flying hours was 123. Of the total participating crews, more than half (55.7%) suffered from musculoskeletal disorders (MSDs). The common sites of MSDs were the low back, shoulder, neck, and knee joints. Poor ergonomic factors such as awkward posture, repetitive movement, carrying loads, and standing for a prolonged time were reported to be responsible for MSDs. Logistic analysis revealed that in addition to ergonomic risk factors; increasing age and flight duration were also contributing factors to MSDs. **Conclusion:** The study revealed that over half of the cabin crew suffered from work-related musculoskeletal disorders. A number of ergonomic factors, including age and flight duration, were found to be associated with MSDs.

**Keywords:** airlines, crews, ergonomic factors, musculoskeletal disorders, bangladesh

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## INTRODUCTION

The air transportation industry is regarded as a special sector nationally and internationally. The air transportation business plays a significant role in the economy of a country. The industry supports local, regional, as well as international economies. It contributes to the growth of national income, increases tax revenues through its many branches, facilitates tourism both nationally and internationally, and expands world trade (Dimitrios and Maria, 2018; International Air Transport Association, 2019; Gittens *et al*., 2019; Sultana, 2018). Flight crews play an important role in the air transport business. They ensure that passengers are comfortable, safe, and secure while in the air, with little consideration for their personal safety and comfort. Customer satisfaction with an airline is largely determined by the crew's services and behaviour (Gammon, McFall and Villarreal, 2018). The flight crews have to deal with many occupational hazards while on the job on the flights. In addition, flight crews work longer periods on long-distance flights for different national and international commercial airline companies. Flying crews are more likely to have prolonged exposure to hazards while they work in flight for a longer duration (Valentine-Bryant, 2017; Geklaw, 2021).

The occupational hazards of the crews on flight, which were reported in different studies, are irregular schedules, poor sleep quality, heavy workloads, lack of breaks to rest, stressful work, and other ergonomic factors. The ergonomic stressors in flights like standing for long time, walking, constant stretching, load lifting, pushing, pulling trolleys, and working in narrow spaces can the cabin crews to develop various musculoskeletal disorders (MSDs) (Chen *et al*., 2021; Rice, 2018; Mulay *et al*., 2019;

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National Institute for Occupational Safety and Health, 2017). Moreover, among the crews, job-induced stress is a common workplace problem. A number of work-related psychosocial variables, including psychological job demands and decision latitude, as well as external environmental concerns like flight turbulence and frequent encounters with demanding passengers, particularly furious ones, are responsible for workplace stress among crews. Because of the work-related stress and strain that crews endure, they are susceptible to a wide range of illnesses, including work-related musculoskeletal disorders (WMSDs) (Geklaw, 2021; Ihlebæk and Rustad, 2022; Mulay *et al*., 2019).

Studies have shown that musculoskeletal diseases are common among flight crews due to a number of risk factors (Chen *et al*., 2021; Geklaw, 2021; Mulyawan *et al*.,2021; National Institute for Occupational Safety and Health, 2017). According to one previous study, musculoskeletal disorders were found to contribute to 33 percent of work-related injuries and illnesses among crews in the USA (Mulay *et al*., 2019). In the recent studies conducted in India and Malaysia, WMSDs were shown to be highly prevalent among crews, which were 82% and 88.3% respectively (Mulay *et al*., 2019; Nur *et al*., 2018). Once in the United States, WMSDs were noted as a major health problem among flight attendants, accounting for one-third of all lost workdays (Mulay *et al*., 2019). However, increased competitions among commercial airlines in the previous decades and the advent of jumbo-sized jets have exacerbated the situation in recent years. Long-haul flights have increased in frequency, the number of passengers has increased, security and safety demands have increased, and passengers' desire for greater comfort has also increased. All of these factors expose the crews on the flight to a variety of occupational hazards, which contribute to the occurrence of various WMSDs among crews (Ihlebæk and Rustad, 2022; Omholt, Tveito and Ihlebæk, 2017).

Biman Bangladesh Airlines, the national airline of Bangladesh, has been in operation for 50 years. It has an agreement with 42 countries for air service and now serves 25 destinations. Around 426 flight crews work for this airline, and they are responsible for the safety, security, and comfort of the passengers on board (Rahman, 2019; Sultana, 2018). Like crews of other airlines, national airline crews in Bangladesh are exposed to various hazards, putting them at risk for a variety of occupational illnesses, including MSDs. The purpose of this study is to determine the occurrence of WMSDs and the associated factors among crews working for national airlines.

## METHODS

This cross-sectional study was carried out among the flight crews of Biman Bangladesh Airlines. The duration of the study was from June 2019 to May 2020. The sample size was calculated by using the formula n=z2 pq/d2, with an 82% prevalence, according to previous study findings (Mulay *et al*., 2019). The calculated sample size was increased by 10% to compensate for non-response. Ultimately, a total of 246 crews became the respondents of the study. One of the inclusion criteria for being a respondent in this study was the aircrews who had served at least one year on the flight. Aircrews who did not give consent to take part in the study were not included. Based on inclusion criteria, a list of aircrews was prepared. From the list, 246 respondents, regardless of age and sex, were selected by a simple random sampling technique. A pre-tested questionnaire was used to collect data during face-to-face interviews with respondents. A Nordic Musculoskeletal Questionnaire (NMQ) was utilized to assess the respondents' MSDs. The respondents' self-reported pain or discomfort at the nine sites on the NMQ body map was identified as either MSDs or not. The crews were asked to recall any pain or discomfort they had experienced at any of the nine sites in the previous six months. The study physicians, on the other hand, gathered pertinent information in order to determine the crews' MSDs and categorize them as mild, moderate, or severe. In this study, to define the ergonomic risk factor, the exposure to ergonomic hazards was divided into two categories: <2 hours and ≥2 hours. The crews were at an ergonomic risk factor if they were exposed to an ergonomic hazard for ≥2 hours on average per day on the flight.

The obtained data were entered into a computer and analyzed with data processing software. The analysis was carried out in accordance with the objectives of the study and pre-designed variables. The frequency with percentage, mean, and standard deviation was calculated for descriptive analysis. For quantitative variables, the student's t-test was used, and the chi-square test was used to determine correlations between MSDs and socio-demographic factor and other factors. A binary logistic regression analysis was performed to determine the predictors of MSDs.

As part of the ethical consideration, the study was ethically approved vide number BUHS/BIO/EA/19/214 by the Ethical Review Committee of the Bangladesh University of Health Sciences (BUHS). The objective of the study and the data collection procedure were explained to the participant crews before data collection. The respondents were also informed that their participation was optional and that they could withdraw from the research at any time without penalty. The respondents were also told that the collected information would be kept confidential, and their identities would not be disclosed.

## RESULTS

Out of 246 participant crews, 55.3% (136) were males and 44.7% (110) were females. In terms of age, the majority (37.0%) of the participants were between 26 and 35 years old, and the mean age was 39.83 ± 9.289 years. Four-fifths (80.5%) of the respondents were married, and a maximum (41.9%) were graduates. The mean monthly income was BDT 104324±72877.94 (Table 1). More than four-fifths of the participating crews (81.3%) were non-smokers, and only 8.9% were smokers. Most of the respondents (96.3%) worked on mixed type flights (both long haul and short haul flights) and at multiple stations. The majority (63.4%) of the participants had shift duties. The mean flying duration in the preceding one month was 85±16.01 hours (Table 2).

Table 3 shows that about two-thirds (66.7%) of respondents worked in a standing posture, followed by half (52.0%) of them working in an awkward posture, and 47.6% working with repetitive movements of the arms daily for 2 hours or more. Only 17.1% of the respondents worked in a seated position for 2 hours or more daily.

Regarding complaints of musculoskeletal disorders (MSDs), 55.7% (137) of the respondents stated that they suffered from pain and discomfort in various parts of the body, with males (56.2%)

**Table 1.** Distribution of the respondents by socio-demographic characteristics (N=246)

| Characteristics | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 136 | 55.3 |
| Female | 110 | 44.7 |
| **Age (Years old)** | | |
| 26 to 35 | 91 | 37.0 |
| 36 to 45 | 67 | 26.2 |
| 46 to 55 | 88 | 35.8 |
| Mean | 39.83 ± 9.289 | |
| **Marital status** | | |
| Married | 198 | 80.5 |
| Unmarried | 32 | 13.0 |
| Divorced/Widow | 16 | 6.5 |
| **Education** | | |
| Higher secondary | 54 | 22.0 |
| Graduate | 103 | 41.8 |
| Masters | 89 | 36.2 |
| **Monthly income (Taka)** | 104324± 72877 | |

**Table 2.** Distribution of the respondents by job-related information (N=246)

| Job-related information | | Frequency | Percentage |
|---|---|---|---|
| Shift Duty | Yes | 156 | 63.4 |
| | No | 90 | 36.6 |
| Duty Station | Multiple | 237 | 96.3 |
| | Non-multiple | 09 | 3.7 |
| Flight types | Long haul | 6 | 2.4 |
| | Short haul | 3 | 1.2 |
| | Mixed type | 237 | 96.3 |
| Flying hours in the previous month | Mean | 85±16.01 | |
| | Minimum-Maximum | 20-123 | |

**Table 3.** Distribution of respondents by working posture and duration (n=246)

| Working Posture | <2 hours per day | | ≥ 2 hours per day | |
|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage |
| Awkward Posture | 118 | 48.0 | 128 | 52.0 |
| Sitting posture | 204 | 82.9 | 42 | 17.1 |
| Standing posture | 82 | 33.3 | 164 | 66.7 |
| Work with raised arms | 165 | 67.1 | 81 | 32.9 |
| Repetitive hand movement | 129 | 52.4 | 117 | 47.6 |
| Loads carry | 158 | 64.2 | 88 | 35.8 |

being more affected. A higher proportion (52.6%) of them was found to suffer from moderate to severe pain (Table 4). The most common sites of pain or discomfort as reported by the respondents were the low back (25.6%), shoulders (22.8%) and neck (20.7%) (Table 5). On the other hand, participants who experienced pain and discomfort at different sites had a substantially higher mean age and mean duration of flying hours in the preceding months than respondents who did not experience such pain, except for elbow joint pain. However, the mean age and mean flying hours of those who suffered from MSDs were 40.99±8.980 years and 88.71±15.429 hours, respectively (Table 6).

Regarding ergonomic hazards, participants who worked in awkward posture (67.2%), stood for long periods (60.4%), engaged in repetitive movements (65.0%), and carried loads (65.9%) had a significantly higher proportion of MSDs ($\chi2$=14.293; p=.000, $\chi2$ =4.357; p=.037, $\chi2$=7.764; p=.005, and $\chi2$ =5.797; p=.016 respectively) than those who did not (Table 7).

Logistic regression analysis (Table 8) was performed to predict the likelihood of musculoskeletal disorders among the respondents. The influence of age, flying hours in the previous month, as well as ergonomic risk factors such as awkward posture, sitting posture, standing posture, and work with hanging arms, repetitive movements, and carrying loads were analyzed. The dependent factors were MSDs, neck pain, shoulder pain, wrist pain, pain in the upper back and lower back, and knee joint pain, which were analyzed separately in the models. The analysis revealed that increasing age, duration of the flight, working in an awkward posture (twisting and bending), and repetitive

**Table 4.** Distribution of the Respondents by Complaints of MSDs

| Suffering from Pain | | Frequency | Percentage |
|---|---|---|---|
| Suffering (n=246) | Yes | 137 | 55.7 |
| | No | 109 | 44.3 |
| Severity (n=137) | Mild | 65 | 47.4 |
| | Moderate | 62 | 45.3 |
| | Severe | 10 | 7.3 |
| Gender (n=137) | Male | 77 | 56.2 |
| | Female | 60 | 43.8 |

**Table 5.** Distribution of the Respondents by Musculoskeletal Pain and Discomforts

| Sites of pain/ discomforts | Frequency* | Percentage |
|---|---|---|
| Neck | 51 | 20.7% |
| Shoulders | 56 | 22.8% |
| Elbow | 25 | 10.2% |
| Wrist hand | 37 | 15.0% |
| Upper Back | 43 | 17.5% |
| Low back | 63 | 25.6% |
| Knee joints | 46 | 18.7% |

* Multiple responses

**Table 6.** Distribution of the Respondents by Age and Flying Duration and Sites of MSDs

| Pain Sites | Attributes | Suffering from pain | | Test of Significance |
|---|---|---|---|---|
| | | Yes | No | |
| MSDs | Age (Years old) | 40.99±8.980 | 38.38±9.504 | t= -2.212; p=0.028 |
| | Flying (Hours) | 88.71±15.429 | 80.79±15.697 | t= -3.968; p=0.000 |
| Neck | Age (Years old) | 40.24±8.666 | 39.73±9.463 | t=--.346; p=0.729 |
| | Flying (Hours) | 91.75±14.638 | 83.49±15.945 | t=-3.347; p=0.001 |
| Shoulder Joint | Age (Years old) | 43.04±8.628 | 38.89±9.287 | t= -2.983; p=0.003 |
| | Flying (Hours) | 92.27±13.047 | 83.12±16.234 | t= -3.865; p=0.000 |
| Elbow Joint | Age (Years old) | 39.08±8.436 | 39.92±9.394 | t= .427; p=0.670 |
| | Flying (Hours) | 87.24±13.374 | 84.97±16.291 | t= -.672; p=0.502 |
| Wrist Joint | Age (Years old) | 42.65±8.196 | 39.33±9.399 | t=-2.013; p=0.045 |
| | Flying (Hours) | 93.41±13.278 | 83.75±16.040 | t= -3.458; p=0.001 |
| Upper Back | Age (Years old) | 42.51±9.219 | 39.22±9.396 | t=-2.281; p=0.023 |
| | Flying (Hours) | 91.65±19.202 | 83.83±14.048 | t=-2.956; p=0.003 |
| Lower back | Age (Years old) | 41.10±7.927 | 39.40±9.695 | t= -1.252; p=0.212 |
| | Flying (Hours) | 88.90±16.776 | 83.98±15.603 | t= -2.390; p=0.018 |
| Knee Joints | Age (Years old) | 40.07±9.064 | 39.78±9.361 | t= -.187; p=0.851 |
| | Flying (Hours) | 91.24±15.302 | 83.81±15.882 | t= -2.880; p=0.004 |

movements (arms) significantly (p<.05) predicted the likelihood of MSDs independently among the participating crews. However, among the risk factors, awkward posture, repetitive movements, and carrying loads (lifting, pulling, and pushing) independently had a strong ability to predict the likelihood of shoulder pain (2.8 times), wrist joint pain (7.0 times), and upper back pain (2.7 times). The longer duration of the flight could predict the development of neck pain (1.03 times), shoulder pain (1.04 times), wrist joint pain (1.06 times) and knee joint pain (1.03 times) independently. On the other hand, the increasing age of the respondents independently predicted the likelihood of shoulder pain (1.05 times) and wrist joint pain (1.07 times). Furthermore, the analysis revealed that carrying loads had an independent ability to predict the occurrence of neck pain (2.5 times), low back pain (2.6 times), and knee joint pain (2.6 times).

## DISCUSSION

This study was conducted among crews working for the national airlines of Bangladesh. Almost all (96.3%) of the participant crews worked on mixed types of flights (both long haul and

**Table 7.** Distribution of the respondents by ergonomic hazards and pain

| Ergonomic hazards | Exposure duration (daily) | Occurrence of MSDs | | Test of Significance |
|---|---|---|---|---|
| | | Yes | No | |
| Awkward Posture | < 2 hours | 51(43.2%) | 67 (56.8%) | $\chi2$ =14.293; p=.000 |
| | ≥ 2 hours | 86 (67.2%) | 42 (32.8%) | |
| Sitting posture | < 2 hours | 117 (57.6%) | 87 (42.6%) | $\chi2$ =1.377; p=.248 |
| | ≥ 2 hours | 20 (47.6%) | 22 (52.4%) | |
| Standing Posture | < 2 hours | 38 (46.3%) | 44 (53.7%) | $\chi2$ =4.357; p=.037 |
| | ≥ 2 hours | 99 (60.4%) | 65 (38.6%) | |
| Arms raised | < 2 hours | 88 (53.3%) | 77 (46.7%) | $\chi2$ =1.129; p=.288 |
| | ≥ 2 hours | 49 (60.5%) | 32 (39.5%) | |
| Repetitive movement | < 2 hours | 61 (47.3%) | 68 (52.7%) | $\chi2$ =7.764; p=.005 |
| | ≥ 2 hours | 76 (65.0%) | 41(35.0%) | |
| Loads carry | < 2 hours | 79 (50.0%) | 79 (50.0%) | $\chi2$ =5.797; p=.016 |
| | ≥ 2 hours | 58 (65.9%) | 30(34.1%) | |

**Table 8.** Logistic regression analysis of the occurrence of pain and independent factors

| Dependant Factors | Independent Factors* | B | Sig | Exp(B) | CI (95%) | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| MSDs | Age | .035 | .045 | 1.035 | 1.001 | 1.071 |
| | Fly duration | .033 | .003 | 1.032 | 1.011 | 1.053 |
| | Awk Posture | .608 | .040 | 1.836 | 1.028 | 3.281 |
| | Rept Movement | .747 | .016 | 2.111 | 1.149 | 3.879 |
| Neck Pain | Fly duration | .029 | .030 | 1.029 | 1.003 | 1.057 |
| | Load carry | .894 | .028 | 2.446 | 1.101 | 5.430 |
| Shoulder pain | Age | .046 | .033 | 1.047 | 1.004 | 1.092 |
| | Fly duration | .038 | .006 | 1.039 | 1.011 | 1.067 |
| | Awk Posture | 1.011 | .008 | 2.749 | 1.310 | 5.769 |
| Wrist Joint | Age | .070 | .005 | 1.073 | 1.021 | 1.127 |
| | Fly duration | .057 | .001 | 1.059 | 1.024 | 1.096 |
| | Rept Movement | 1.947 | .000 | 7.006 | 2.788 | 17.601 |
| Upper back | Load carry | .975 | .023 | 2.651 | 1.145 | 6.137 |
| Low Back | Load carry | .937 | .011 | 2.552 | 1.238 | 5.259 |
| Knee joint | Fly duration | .027 | .046 | 1.027 | 1.000 | 1.054 |
| | Load carry | .799 | .020 | 2.605 | 1.163 | 5.835 |

* Factors significantly influenced the models

short haul flights), with an average of 85 hours of flight duration in the preceding month and a maximum flight duration of 123 hours. The average flight hours of the participating crews were within Bangladesh's Civil Aviation Regulations (2002). This study revealed that over half (55.7%) of the participating crews suffered from MSDs, with the majority (52.6%) suffering from moderate to severe MSDs. This might be as a result of exposure to various ergonomic factors by the crews found in this study.

According to previous studies, a greater proportion of crew members were found to suffer from MSDs, and the occurrence was higher among female crew members than in the current study (Chen *et al*., 2021; Khrisnapandit *et al*., 2016; Mulay *et al*., 2019). On the other hand, a recent study revealed that there was not much gender difference in the occurrence of MSDs (Ihlebæk and Rustad, 2022). In the current study, a higher proportion of male crews were found to suffer more from MSDs. There is a possibility that more males have become flight attendants in recent years. Although both male and female flight crews have the same job duties and working circumstances, the male crews may be exposed more to poor ergonomic conditions because of their physical response and preference for their female coworkers, which may lead to developing more MSDs (Ihlebæk and Rustad, 2022; Mulay *et al*., 2019). However, further study is needed to determine why male crews are more likely to suffer from MSDs and the associated factors.

Previous studies also revealed the multisite occurrence of MSDs among the crews, which became a common health issue among the crews. In addition, the studies reported that the neck, shoulders, and low back were the common sites for MSDs (Chen *et al*., 2021; Ihlebæk and Rustad, 2022; Mulay *et al*., 2019; Mulyawan *et al*., 2021; Nur *et al*., 2018; Omholt, Tveito and Ihlebæk, 2017). Similarly, in the current study, a higher proportion of the participating crews were found to suffer from MSDs in the low back, shoulders, and neck. Additionally, the knee joint and upper back were also frequent sites (Nur *et al*., 2018). The reason might be that the participating cabin crews on the flights had to work in poor working conditions, such as in tight and confined areas, lift loads overhead, push and drag heavy trolleys, and work while standing up and walking frequently, thus exposing them to various ergonomic hazards in their occupation.

The common ergonomic risk factors for the crews identified in this study were awkward (bending and twisting) posture, working on standing, repetitive movements of the arms, and carrying loads. The poor working conditions, exposure to ergonomic hazards, and the MSDs suffered by the crews in this study were also evident in various other studies (Chen *et al*., 2021; Mulay *et al*., 2019; National Institute for Occupational Safety and Health, 2017). Furthermore, the current study revealed that the increasing age and flight duration were significant factors in the occurrence of MSDs among the crews, which was also found in previous studies (Khrisnapandit *et al*., 2016; Mulay *et al*., 2019).

The univariate analysis revealed that the increasing age was a significant risk factor associated with overall MSDs and MSDs in the shoulder joint, wrist joint, and upper back. On the other hand, the increasing flight duration was found to be a significant risk factor for MSDs overall and MSDs in multisites except in the elbow. After controlling the ergonomic factors, age remained an independent risk factor responsible for overall MSDs and MSDs in the neck and wrist joint. Similarly, flight duration was identified as an independent risk factor for overall MSDs as well as MSDs in the neck, shoulder joint, wrist joint, and knee joint.

Further univariate analysis showed that ergonomic factors exposed by the crews in the flights, such as awkward posture (bending and twisting), standing for a prolonged time, repetitive movements of arms, and carrying loads (lifting, pulling, and pushing), were the significant risk factors associated with MSDs. After controlling the predictors, awkward posture, repetitive movement, and carrying loads were identified as the independent ergonomic risk factors for developing MSDs. However, repetitive movements were found to be the strongest ergonomic risk factor (7 times) responsible for MSDs in the wrist joint, followed by awkward posture (2.75 times) responsible for MSDs in the shoulder joint. Nonetheless, carrying loads was found to be the independent risk factor (more or less 2.6 times) responsible for MSDs in the upper back, lower back, and knee joint.

Thus, the findings of this study indicate that cabin crews suffered from work-related musculoskeletal disorders (WMSDs) and that the ergonomic factors in their occupation, such as awkward posture, repetitive movements, and

carrying loads, were responsible for the MSDs. In addition, the increasing age and flight duration were found to contribute to the occurrence of MSDs.

## CONCLUSION

More than half of the participating crews suffered from WMSDs, and musculoskeletal pain was common in the lower and upper back, as well as in the shoulders, neck, and knee joints. A number of ergonomic risk factors, including the increasing age and long flight duration were found to be responsible for the occurrence of MSDs.

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