AVIATION
ISSN: 1648-7788 / eISSN: 1822-4180
2019 Volume 23 Issue 3: 97–103
https://doi.org/10.3846/aviation.2019.11847

ASSESSMENT OF MENTAL WORKLOAD OF FLIGHT ATTENDANTS BASED ON FLIGHT DURATION: AN EFFORT TO PROVIDE SAFE WORKING CONDITION

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Received 23 November 2018; accepted 18 December 2019

Abstract. Flight attendants play a crucial role in the service of the airline industry. The aim of this present study is to examine the mental workload of flight attendants, and it possible relation to the flight duration. Two hundred and one Indonesian flight attendants participate voluntarily in this study by filling out a mental workload questionnaire, the NASA-TLX questionnaire, in the end of their flight schedule. Results show that the mental workload of flight attendants regardless the flight duration is on a range of medium mental workload. Based on flight duration, the optimal mental workload is for 1–2 hours of flight. Implications of the result are discussed.

Keywords: mental, workload, flight attendants, flight duration, the NASA-TLX.

Introduction

Flight attendants play a crucial role in the service of the airline industry. In fact, flight attendants' in-flight service is the most direct and crucial airline service to customers. This is because passengers tend to evaluate airlines based on their degree of satisfaction with the in-flight service (Park, Robertson, & Wu, 2004). Factors influence service quality of flight attendants can be divided into personal factors and operational factors (Ratanakomut & Kitcharoen, 2013). Personal factors include personality, language proficiency, attitude, health, and income/benefits. Whereas operational factors include workloads, working environment, equipment and machine, training, company policy, and quality control (Mellert et al., 2008).

Over the last 20 years, research has been concerned with operational factors that might affect flight attendants' health such as irregular work schedules, lifting and handling of heavy objects, and workload (Damos, Boyett, & Gibbs, 2013; Nagda & Koonts, 2003; Griffiths & Powell, 2012). Nyberg and Lennernäs (2017) and Hsu and Liu (2012) also found that flight attendants are confronted with demanding situations such as a long hour and overload. The implications of operational factors have been observed as well, such as stress (see Yeh, 2012; Karatepe & Talebzadeh, 2016; Chen & Kao, 2011 for examples), various health problems (e.g., sleep disorders, dermatology and eye problem due to cabin air quality, high exposure to contagious diseases, and of being injured; Lee et al., 2006).

In particular related to flight attendants' workload (defined as difference between demand of the task and capacity available in worker, Gopher & Donchin, 1986), it is important to provide optimal workload since under load leads to boredom and long-term heavy workload can affect an employee's physical or mental health, performance, or productivity including service quality, accidents or illness (see Chen et al., 2010; Davidson, Guilding, & Timo, 2006 for examples). However, as far as acknowledged by authors, only a limited study has been concerned with identifying the activities a flight attendant performs as well as the workload.

Most research in the context or workload of the flight attendants fall into categories of physical and psychosocial workload. In the context of physical workload, for example, Lee et al. (2006) reviewed physically strenuous activities of flight attendants that are handling carry-on baggage, handling carts (beverage, meal, and duty-free), service to passengers, and safety checks. Other research has also reported physical workload and musculoskeletal disorder (defined as disorders of the nerve, tendons, muscles, and supporting tissues that result from or are made worse by work conditions; Cohen et al., 1997) among flight attendants. In particular, the body region of flight attendants that most affected by musculoskeletal

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symptoms or disorder is the lower back (Lee et al., 2006; Schaub et al., 2007).

A limited number of study focus on psychosocial workload (defined as the peceptions or beliefs that workers have about the way their work environment is organized and referred to as work organizational factors or job stressor; Karasek, 1985; Karasek, Brisson, & Kawakami, 1998; Buckle & Devereux, 2002). As far as acknowledge by authors, only Lee et al. (2008), Wahlstedt et al. (2010), and Warner (2011) has reported work-related psychosocial load experienced by flight attendants. Lee stated that the work-related psychosocial load increase job strain of flight attendants and influence change in performance of job tasks.

It should be underlined, however, that flight attendants also have to perform mentally demanding work such as safety and security check (Damos et al., 2013). Therefore mental workload of flight attendants is important to be observed as well. In addition, Federal Aviation Administration (FAA, 2007) also noted the importance of considering mental aspect of flight attendants in the management of fatigue of flight attendants.

Mental workload can be understood as general term to describe the mental cost of executing task requirements (Hart & Wickens, 1990; Wickens, 1992). Mental workload is crucial in work system design since mental overload is associated with decreased performance, increased errors, and decreased of human' wellbeing (Johnson & Widyanti, 2011). In particular when worker experience extensive mental workload with insufficient rest time, there arise health problems such as stress (Cinaz et al., 2013). In contrast, mental underload correlates with boredom (Johnson & Widyanti, 2011). Therefore assessment and evaluation of mental workload is very important and has been recognized for decades (Jo, Myung, & Yoon, 2012).

Assessment of mental workload can be conducted based on performance, objective, and subjective method. Performance can be measured by accuracy and reaction time. Objective evaluation can be conducted through physiological indices such as heart rate variability (Widyanti et al., 2013, eye blink rate (Widyanti et al., 2017) and skin conductance (Widyanti et al., 2017b). The objective measures give advantages as it require a relatively small number of samples and can provide accurate result. However, the disadvantages of this objective method is that they are requiring special technical skill and operational experience (Lean & Shan, 2012). In contrast, subjective measures of mental workload are inexpensive and easily administered. However, this measures are unable to provide precise reports and often require a large number of samples (Lean & Shan, 2012). The most widely employed subjective rating scales are the subjective workload assessment technique (SWAT) and the NASA-TLX (Dey & Mann, 2010).

The NASA-TLX is a multidimensional scale consist of six subscales: mental demand (defined as how much mental and perceptual activity was required e.g. thinking, deciding, calculating, remembering, looking, searching, etc? Was the task easy or demanding, simple or complex, exacting or forgiving?), physical demand (defined as how much physical activity was required e.g. pushing, pulling, turning, controlling, activating, etc? Was the task easy or demanding, slow or brisk, slack or strenuous, restful or loborious?), temporal demand (defined as how much time pressure did you feel due to the rate or pace at which the tasks or task elements occured? Was the pace slow and leisurely or rapid and frantic?), performance (defined as how succesful do you think you were in accomplishing the goals of the task set by experimenter or yourself? How satisfied were you with your performance in accomplishing these goals?), effort (defined as how hard did you have to work mentally and physically to accomplish your level of performance?), and frustration level (defined as how insecure, discourage, irritated, stressed, and annoyed versus secure, gratified, content, relaxed, and complacent did you feel during the task?). Participants was asked to give rating on each subscale ranging from 0–100. Final score was obtained by averaging the score of the six subscales.

The aim of the study is therefore to observe mental workload of flight attendants. Yet, research on this areas is lacking. It should be noted that the airline in all over the world has increased in a very significant number, calling an urgent need of assessment of the workload of flight attendant to ensure the service quality of flight attendants, which in the end also influence the safety of the airline. It is expected by evaluating the existing workload, rearrange of workload can be conducted to provide optimal workload, in particular optimal mental workload for the flight attendants.

1. Method

1.1. Participants

The study population is flight attendants of the biggest Indonesian airline. Two hundred and one flight attendants (mean age = 24.6 years, SD = 3.8 years, all female) participate voluntarily in this study. Average work time of the participants was 3.5 year. Permit is obtained from human resources management of the airline for data collection. Participants are recruited based on convenience sampling due to restricted work hours of data collection. Flight attendants that have been finished their flight duty are obligated to come to Human Resource Management office for reporting their finished flight. After the reporting process, the questionnaire is requested to be filling out by the flight attendants. Overall, 5 minutes is needed to complete the questionnaire.

1.2. Instruments

An open question about factors that influence flight attendants' performance and need to be improved is given to the participants as well as the Indonesian version of the raw NASA-TLX (Hart & Staveland, 1988; Johnson & Widyanti, 2011; Widyanti et al., 2013; Widyanti, Johnson, & de Waard, 2013 that is used to measure mental workload of flight attendants.

2. Result and analysis

Demographic data of the respondents can be seen in Table 1.

Table 1. Demographic data of the respondents

Demographic factors		Number (percentage)
Age	Less than 24.6 years	105 (52.2%)
	Equal or more than 24.6 years	96 (47.8%)
Work experience	Less than 3.5 years	126 (62.7%)
	Equal or more than 3.5 years	75 (37.3%)

Factors that are stated to influence performance of flight attendants and needs to be improved can be seen in Table 2.

Table 2. Factors that are complaining by the flight attendants

Factors	Number of complaints
Duration of rest period	136
Jet lag	95
Scheduling	94
Duration of work	94
Management (example: salary, management support, etc)	94
Other (health problems, family time)	5

Mean and standard deviation of mental workload of Indonesian flight attendants measured using the NASA-TLX is 76. 08 (SD = 12.66) out of 100. The score for each dimension of the NASA-TLX can be seen in Figure 1.

Additional analysis is applied to observe mental workload based on demographic data of the respondents. Based on category of age and work experience, no significant differences are found in mental workload of the flight attendants.

Since mental workload is related to time or temporal demand, coupled with the fact that the most complaints of the flight attendants in this study is related with scheduling as well as work and rest duration, further analysis of mental workload based on the flight duration is conducted. The categorization of the flight duration is based on Standard Operation Procedure SOP of the airline that can be seen in Table 3.

Table 3. Flight category based on flight duration and the corresponding number of participants

Flight category	Flight duration, hour(s)	Number or participants
Extra short	< 1	22
Short	1–2	61
Medium	2–3	55
Extra medium	3–8	28
Long	> 8	35

ANOVA reveals no significant differences in mental work load based on flight duration, as well as no significant differences in all dimensions of the NASA-TLX, except for the temporal demand. As can be seen in Figure 2, there is a slightly difference between mental workload in extra short and short duration ($F = 6.05$, $\rho = 0.05$, $MSE = 3.14$), in which mental workload is lowest during short flight and highest during extras short duration.

In addition, Figure 3 shows the NASA-TLX dimensions based on flight duration category. For all dimensions of the NASA-TLX, significant differences are found in physical demand ($F = 8.36$, $\rho < 0.05$, $MSE = 4.10$), temporal demand ($F = 13.88$, $\rho < 0.05$, $MSE = 4.97$), and effort ($F = 7.09$, $\rho < 0.05$, $MSE = 3.48$).

3. Discussion

This study is aimed to observe mental work load of Indonesian flight attendants. Results show that the average mental workload of the flight attendants regardless the flight duration, measured using the NASA-TLX, is 76. 08 (SD = 12.66) out of 100. The score indicates a medium level of mental workload. This result is not surprising, since Damos et al. (2013) and Schaub et al. (2007) already state that flight attendants has also to perform mentally demanding task such as safety and security check, instead of passenger service only. In addition, Federal Aviation Administration (FAA) also underlined the issue of fatigue of flight attendant, which caused by not only physical, but also mental demanding task of flight attendants.

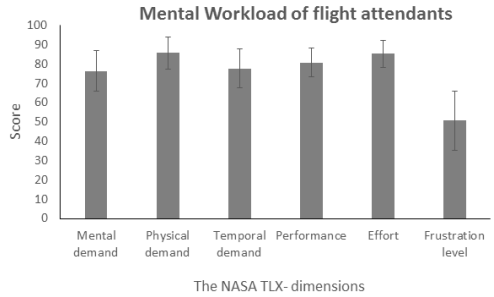


Figure 1. Mental workload of flight attendants

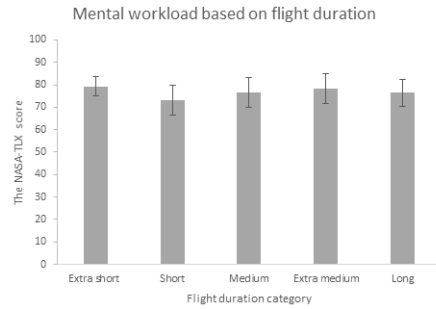


Figure 2. Mental workload on flight duration

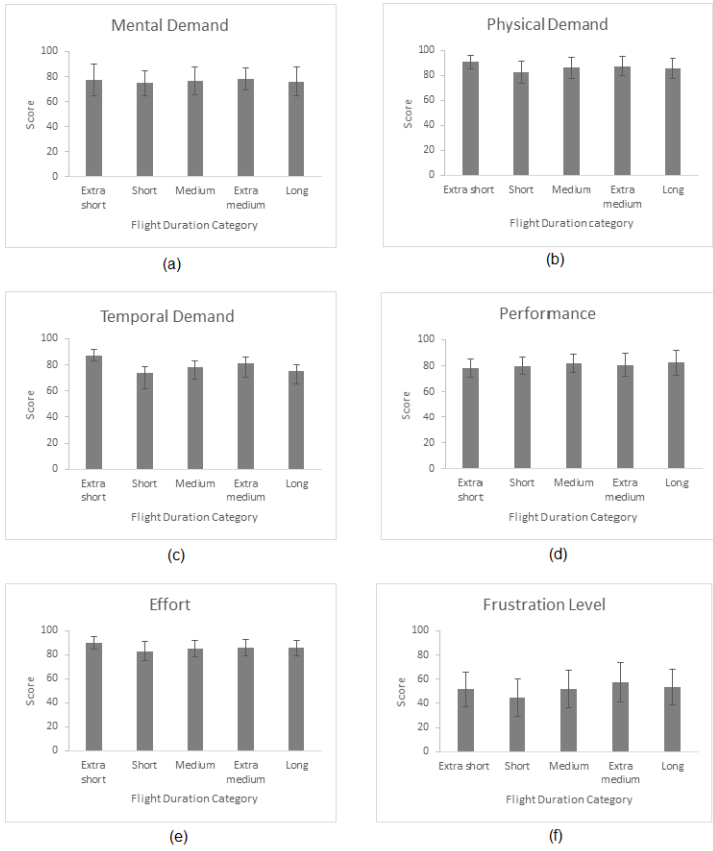


Figure 3. Mental workload of flight attendants

Demographic condition of the respondents in term of age and work experience do not influence the mental workload of the flight attendants. Considering that mental workload is involve two conditions that are task demand and capacity/capability of the worker, this present study gives valuable result about the source of mental demand among flight attendants, in which the task demand plays a more important role in the mental workload than the worker condition or capability. This result is in line with result of previous study by Pérusse-Lachance et al. (2012) who stated that demographic condition of respondents (i.e, gender differences) did not affect the physiological response induced by the cognitive demand of similar mental tasks.

The NASA-TLX is used in this study with the reason of practicability, since objective measure of mental workload using Electroencephalograph (EEG), eye tracker, and heart rate variability are not possible to be conducted in real work system of flight attendants due to its intrusiveness. Whereas other subjective method of mental workload measures such as Subjective Workload Assessment Technique (SWAT) needs particular procedure that cannot be applied in flight attendants' work setting.

Breaking down the NASA-TX based on the dimensions or the source of mental workload, the highest scores of the NASA-TLX dimensions in this study are physical demand, effort, and performance. This result of high physical demand is in line with studies conducted by Lee et al. (2006), Glitsch et al. (2007), Han (2003), Jager et al. (2007), and Schaub et al. (2007) who reviewed physically strenuous activities of flight attendants such as handling carry-on baggage and service to passengers. The high value of dimension effort in the NASA-TL needed by the flight attendants are therefore as the consequences of the demanding task. Last, the high score of the NASA-TLX' performance is related to the requirement of high performance and service quality of the flight attendants, which in the end influence the quality of the airline (Park et al., 2004).

In depth-analysis of the mental workload based on the flight duration shows that optimal duration flight based on mental workload point of view is the short category of flight duration that is 1 hour–2 hours. Whereas the most mentally demanding light duration is the extras short flight duration. Additional interview to the flight attendants and airline management reveals that for extra short flight duration, flight attendants have very tight and mentally demanding schedule (several extra flight duration for a day). Flight duration 1 hour–2 hours shows lower mental workload due it appropriate transit schedule so that flight attendants can take enough rest during the transit time.

This study is a first study in the mental workload of flight attendants, in which the kind of study is particularly important in providing optimal workload to enhance

performance as well as safety and health of flight attendants. Since literature of mental workload measures of flight attendants is absent, the present study gives valuable contributions in providing a picture of mental workload of flight attendants and optimal mental workload analysis based on flight duration category. Although there was no study that directly quantify mental workload of flight attendants, the result of this study is supporting the result of previous studies conducted by Feijo, Luis, and Camara (2014), Ballard et al. (2006), and Heuven and Bakker (2003) who found mental disorder among flight attendants as the consequences of excessive mental workload. Final report of FAA (2007) also underlined the importance of issue of mental workload and mental fatigue among flight attendants.

This study has several limitations worth noting. First, caution is called for in generalizing the findings. The sample of the Indonesian flight attendants is only limited for one airline. Therefore, generalizability is limited. Second, the participants of this study are limited to female flight attendants due to its naturall work of flight attendants that are dominated by female workers. Further research involves male flight attendants may enrich the result and the analysis. Third, analyze of the mental workload based on flight duration is designed as between subject study due to difficulty to match every flight attendants to every possible flight duration. Further research with a design of within subject comparison will enrich the analysis.

The result of this study is valuable in giving a picture of mental workload among flight attendants. Airline industries should find ways to obtain and maintain work load of flight attendants that are safe and comfort, which in the end making the flight attendants to be motivated to perform the job and deliver service perfectly. Such way is for example rearrange flight schedule that give optimal mental workload. As stated by Vatankhah, Javid, and Raoofi (2017), airline industries must provide organizational support for the best performance of flight attendants.

Conclusions

In conclusion, the task performed by Indonesian flight attendants can be classified as hazardous as it gives medium – almost high - mental workload, beside high physical workload and musculoskeletal symptoms. In particular for the relation of mental workload and flight duration, it can be concluded that the optimal duration of a flight is 1–2 hours. However, further research to explore this would be valuable in particular in the context of flight duration and other factors than mental workload.

Acknowledgements

Authors thank to all the flight attendants' respondents for their participations in this study.

Funding

There is no funding for this study.

Author contributions

AW and MF conceived the study and were responsible for the design and development of the data collection and analysis. AW wrote the article and responsible for the submission process.

Disclosure statement

Authors declare there are no competing financial, professional, or personal interests from other parties.

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