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Exploring relationships between health-related lifestyle habits and fatigue among flight attendants and trainees

Hong Rei Mei[a], Chen Yuan Hsu[b] and Chia Jung Hu[b,*]
[a]*Chang Gung University of Science and Technology, Chiayi Campus, Puzi City, Taiwan*
[b]*Department of Nursing, Da-Yeh University, Changhua, Taiwan*

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Abstract.
BACKGROUND: Fatigue in flight attendants is an important issue concerning flight safety and occupational health. It is well known that work-related factors and certain lifestyle habits can cause fatigue. But very few studies have focused on the difference between having work experience flight attendants and no flight experience trainees.
OBJECTIVE: The present study was performed to compare and investigate the relationships between fatigue and health-related lifestyle habits among flight attendants and trainees.
METHODS: A questionnaire-based cross-sectional study with convenience sampling was conducted. A total of 107 flight attendants and 109 trainees were recruited in an international airline. The research was using a self-developed health-related lifestyle habits questionnaire and the Checklist Individual Strength (CIS) scale. The relationships between health-related lifestyle habits and fatigue were examined by Pearson's chi-square test and Fisher's exact test. Logistic regression was used to identify factors predicting fatigue among flight attendants and trainees.
RESULTS: Nearly half of the participants had fatigue and poor health-related lifestyle habits. Logistic regression showed that trainees with sleeping hours less than 7 hours, had a higher probability of fatigue than those who sleep more than 7 hours. In addition, the flight attendants with an irregular sleep pattern, unbalanced diet, sedentary leisure-time, no use relaxation technique, and an exercise frequency below once a week had a higher probability of fatigue.
CONCLUSION: The flight attendants' sleep patterns, diet, activity, and relaxation had a more significant impact on fatigue than trainees. Therefore, a healthy lifestyle is important in this population for good workplace performance.

Keywords: Fatigue, habits, flight attendant, occupational health

1. Introduction

Fatigue is an important issue in flight safety, and fatigue among cabin crew is a complex phenomenon affected by new routes and additional flights. Rapid and frequent time zone changes varied working hours, and extreme workloads can lead to fatigue and affect the health of flight crews [1, 2]. The International Civil Aviation Organization (ICAO) defines fatigue as "a physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload." This state can impair the alertness of flight crews and reduce their ability to safely operate the aircraft or perform safety duties [3]. Rosskam et al. investigated fatigue among global aviation industry workers from 2000 to 2007 and reported two-thirds of cabin crew members had fatigue problems [4]. Nearly 70% of the cabin crew members reported feeling exhausted at the end of their shift. Fatigue-related

*Address for correspondence: Chia Jung Hu, RN. Ph.D, Assistant Professor, Nursing Department, Da-Yeh University, No. 168 University Rd., Dacun, Changhua 51591, Taiwan. E-mail: cjhu@mail.dyu.edu.tw.

factors included psychological factors, long working hours, lack of rest, and working overtime. The Federal Aviation Administration (FAA) studied flight attendants from 30 airlines in 2008 and found that up to 84% of cabin crew members had fatigue problems [5]. Moreover, half of the crew reported that fatigue was mainly due to their shift schedules and workload. Overall, the study showed that most flight attendants have fatigue problems, and fatigue was related to workload and the working environment.

However, there have been no in-depth investigations to determine whether health-related lifestyle habits are associated with the risk of fatigue in flight attendants.

It is well known that certain lifestyle habits, such as lack of exercise, poor diet, and insufficient sleep can also cause fatigue [6]. High carbohydrate food can make us feel tired within an hour [7]. Overeating and eating wrong food can cause fatigue, but eating too little can cause fatigue as well [6, 8]. Caffeine can temporarily increase energy but may also cause insomnia [9]. Exercise can maintain muscle strength and energy, as well as facilitate sleep [4]. Therefore, appropriate sleep time, exercise, and healthy eating habits can all effectively reduce fatigue [6]. In a mobile health (m-health) study, van Drongelen et al. used a smartphone app to provide pilots with a personalized light exposure schedule to improve sleep quality, physical activity, and nutrition [10]. Their results showed that sleep quality improved; moreover, the pilots showed increased physical activity, improved eating habits, and a significantly improved fatigue index. In addition, van Drongelen et al. investigated risk factors for fatigue among pilots and found that in addition to age and work-related factors, health-related lifestyle habits were also related to fatigue, i.e., less physical activity and moderate alcohol consumption [11]. In addition, people who go to bed late (evening types) take longer to recover from fatigue. Thus, in addition to work and sleep, fatigue risk management is an important consideration.

Flight attendants reported that, due to time zone differences, long working hours, and a heavy workload, they sometimes have no appetite, do not have enough time to eat, or have no access to nutritious and healthy foods so instead eat snacks [5, 12, 13]. They also reported excessive caffeine consumption and gastrointestinal discomfort [13]. These findings led us to perform this preliminary study to discuss (1) the current situation and differences between flight attendants and trainees in fatigue and related health-related lifestyle habits, (2) whether health-related lifestyle habits increase the risk of fatigue among flight attendants and trainees. The results can be used as a reference basis for flight attendants and trainees in fatigue management and workplace health promotion.

2. Methods

2.1. Participants

This study had a cross-sectional design. The study population consisted of flight attendants working for an international airline in Taiwan with an average flight time of at least 60 hours in the previous month. The flight attendants have completed three months of training as well as flight attendant trainees. All participants were able to speak and understand Chinese agreed to participate in the questionnaire survey. The sample size was estimated based on the recommendations of Peduzzi et al., i.e., $n = 10$ k/p, where p is the proportion of positive cases in the population and k is the number of independent variables [14]. The preferenced to FAA, 84% of cabin crew members had fatigue problems [5]. And there are 8 predictive variables for the k-based study, requiring a total of 95 [14]. Long suggested that if the value generated by the above formula is less than 100, the sample size should be increased to 100 [15]. Therefore, via convenience sampling, 142 flight attendants and 113 flight attendant trainees were initially enrolled in the study; 35 flight attendants were subsequently excluded due to insufficient flight hours and four flight attendant trainees were excluded due to missing data, so the final study population consisted of 107 flight attendants and 109 flight attendant trainees.

2.2. Equipment

This study used a self-developed health-related lifestyle habits questionnaire and the Chinese version of the Checklist Individual Strength (CIS) scale [16]. First, sociodemographic data were obtained, i.e., sex, age (years), marital status (married or unmarried), BMI, flight hours in the last month, red eye flight (2–5 AM) flight duty times in the last month, late night (10 PM-6 AM) flight duty times in the last month, one-way commuting times(mins), work-life stress (1–10 likers scale), Insomnia (Athens Insomnia Scale; AIS-8).

AIS-8 is a questionnaire for insomnia. It comprises eight items (5 nighttime and 2 daytime symptoms)

and each item is rated on a 4-point Likert scale from 0 to 3. The suggested cutoff points for insomnia among this ethnic Chinese population are 8. The AIS-8 has a Cronbach's α of 0.84 [17].

The self-developed health-related lifestyle habits questionnaire was based on the fatigue prevention recommendations for flight attendants of the FAA, surveys on risk factors for fatigue in pilots, and the results of m-health studies [5, 11]. Data were obtained on eight lifestyle habits related to fatigue: (1) sleep pattern, (2) sleeping hours, (3) balanced diet, (4) caffeine taken 6 hours before bedtime, (5) consuming alcohol before bedtime, (6) sedentary leisure-time, (7) use relaxation techniques, and (8) frequency of exercise.

Regarding the response options, for (1) sleep pattern they were "normal type", "early type", "late type", and "irregular type"; "early type". For (2) sleeping hours, the response options were "less than 5 hours", "5-6 hours", "more than 7 hours." For (3) balanced diet, (4) caffeine taken 6 hours before bedtime, (5) consuming alcohol before bedtime, (6) sedentary leisure-time and (7) use relaxation techniques, the options were "always", "often", "occasionally", "rarely", and "never". Finally, the response options for (8) frequency of exercise were "more than three times a week", "twice a week", "once a week", "less than once a week", and "almost never".

The CIS has a Cronbach's α of 0.88. It comprises 20 questions spread over four dimensions: subjective fatigue (8 items), working motivation (5 items), activity (4 items), and attention (3 items). Responses are made on a Likert scale ranging from 1 to 7, so the total possible score ranges from 20 to 140 points. A score of 76 is taken to indicate a high risk of fatigue (Wang et al., 2000) [16].

2.3. Procedure

This study was approved by the research ethics committee of NTNU (IRB number: 201709HS005). The participants were flight attendants employed at an international airline from November to April 2018. The informed consent was read and agreed by all participants. The data were anonymous.

2.4. Statistical analysis

Data analysis was performed using SPSS statistical software (ver. 22.0; SPSS Inc., Chicago, IL, USA). Descriptive statistics were obtained for sociodemographic and fatigue data. The *t* test, Pearson's chi-square test, and Fisher's exact test were used to compare the groups on the variables of interest and determine their relationships with fatigue. Based on the small size, bootstrap logistic regressions were performed to identify health-related lifestyle habits predicting fatigue after adjusting for sociodemographic and work characteristics. In all analyses, $P < 0.05$ was taken to indicate statistical significance.

3. Results

The study population consisted of 107 flight attendants and 109 trainees working for an international airline, including 89.7% female flight attendants, with an average age of 35.0 years, 38.3% married, average flight time of 75.8 hours in the last month, average 2.2 times of red eye (2–5 AM) flight duty in the last month. 80.7% of trainees were female, their average age was 24.7 years, only 2.8% married. In total 57–67% flight attendants and trainees had fatigue, 22–28% had insomnia. The fatigue prevalence of flight attendants significantly differed by gender, marital status, insomnia and stress, but not by average flight hours, red-eye and late-night flight duty times in the last month. The prevalence of fatigue among trainees are significantly differed just by commuting times and insomnia (Table 1).

The health-related lifestyle habits among flight attendants, the fatigue showed significant differences according to sleep pattern, balanced diet, sedentary leisure-time, use relaxation techniques, and frequency of exercise (Table 2). The fatigue in the trainees only showed significant differences according to sleeping hours, balanced diet and use relaxation techniques (Table 3). Among flight attendants, nearly half of the participants reported poor health-related lifestyle habits, such as sleep pattern (irregular type 43%, late type 13.1%), insufficient total hours of sleep (5–6 hours 31.8%, less than 5 hours 15%), infrequently balanced diet (rarely/never 21.5%, occasionally 41.1%), using relaxation techniques (rarely/never 33.6%, occasionally 41.1%), and exercising less than once a week (62.6%). However, the most common poor health-related lifestyle habits were only shown insufficient sleep hours and exercise among trainees. The difference of health-related lifestyle habits between flight attendants and trainees are sleep pattern, sleeping hours, frequency of exercise.

Bootstrap logistic regression analysis was performed after adjusting for sex and marital status

Table 1
Sociodemographic, work characteristics, insomnia and stress in flight attendants and trainees (N = 216)

Variable	Flight attendants (N = 107)				Trainees (N = 109)			
	M(SD) or n(%)	Non-fatigue M(SD) or n(%)	Fatigue M(SD) or n(%)	T or χ^2	M(SD) or n(%)	Non-fatigue M(SD) or n(%)	Fatigue M(SD) or n(%)	T or χ^2
Sociodemographic characteristics								
Fatigue		46(42.9)	61(57.0)			36(33.0)	73(67.0)	
Age (yr)	35.0(9.7)	34.6(10.6)	35.5(8.6)	–0.4	24.7(2.8)	24.1(3.0)	24.2(2.2)	1.4
Gender				0.0[a]**				1.0
Male	11(10.3)	10(16.4)	1(2.2)		21(19.3)	16(21.9)	5(13.9)	
Female	96(89.7)	51(83.6)	45(97.8)		88(80.7)	57(78.1)	31(86.1)	
BMI	19.6(2.3)	19.8(2.4)	19.5(2.1)	0.7	19.2(1.8)	19.3(1.8)	19.9(1.8)	0.4
Marital status				8.8**				0.6[a]
Single	66(61.7)	45(73.8)	21(45.7)		106(97.2)	70(95.9)	36(100)	
Married	41(38.3)	16(26.2)	25(54.3)		3(2.8)	3(4.1)	0(0)	
Education				0.0				0.6 [a]
Bachelor	95(88.8)	54(88.5)	41(89.1)		106(97.2)	70(95.9)	36(100)	
Master	12(11.2)	7(11.5)	5(10.9)		2(2.8)	3(4.1)	0(0)	
Work characteristics								
Working experience in airlines (yr.)				6.0				
0–5 yrs	55(51.4)	35(57.4)	20(43.5)			NA	NA	
6–10 yrs	12(11.2)	3(4.9)	9(19.6)			NA	NA	
≥11yrs	40(37.4)	23(37.7)	17(37.0)			NA	NA	
Flight hours	75.8(9.6)	75.0(7.9)	76.9(11.5)	–0.2		NA	NA	
Red eye duty	2.18(1.47)	2.2(1.5)	2.2(1.5)	0.8		NA	NA	
Late night duty	3.1(1.8)	3.2(1.8)	3.0(1.8)	0.5		NA	NA	
Commuting(mins)	45.8(21.6)	44.5(20.9)	47.5(22.7)	–0.7	44.3(15.2)	42.3(15.0)	48.5(15.0)	–2.0*
Insomnia & stress								
Insomnia				23.3***				12.1**
Yes	30(28.0)	6(9.8)	24(52.2)		24(22.0)	9(12.3)	15(41.7)	
No	77(72.0)	55(90.2)	22(47.8)		85(78.0)	64(87.7)	21(58.3)	
Stress	6.1(1.9)	5.8(2.2)	6.6(1.2)	–2.5*	7.7(1.97)	7.5(2.0)	8.1(1.9)	–1.5

Fatigue: CIS scores ≥ 76; Flight hours: Flight hours in the last month; Red eye duty: Red eye (2–5AM) flight duty times in the last month; Late night duty: Late night (10pm–6am) flight duty times in the last month; Commuting: One-way commuting times(mins); Insomnia: AIS-8 scores > 8; Stress: Work-life stress. [a]Fisher's exact test; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Table 2
Comparison of health-related lifestyle habits and fatigue among flight attendants ($n = 107$)

Variable	Flight attendants			
	n (%)	Non-fatigue *n* (%)	Fatigue *n* (%)	χ^2
(1) Sleep pattern				9.1*
Normal type	20(18.7)	16(26.2)	4(8.7)	
Early type	27(25.2)	18(29.5)	9(19.6)	
Late type	14(13.1)	7(11.5)	7(15.2)	
Irregular type	46(43.0)	20(32.8)	26(56.5)	
(2) Sleeping hours				0.4
More than 7 hours	57(53.3)	34(55.7)	23(50.0)	
5–6 hours	34(31.8)	18(29.5)	16(34.8)	
Less than 5 hours	16(15.0)	9(14.8)	7(15.2)	
(3) Balanced diet				8.7*
Always/often	40(37.4)	29(47.5)	11(23.9)	
Occasionally	44(41.1)	24(39.3)	20(43.5)	
Rarely/never	23(21.5)	8(13.1)	15(32.6)	
(4) Caffeine taken 6 hours before bedtime				1.4
Always/often	59(55.1)	35(57.4)	24(52.2)	
Occasionally	16(15.0)	7(11.5)	9(9.6)	
Rarely/never	32(29.9)	19(31.1)	13(28.3)	
(5) Consuming alcohol before bedtime				3.3 [a]
Always/often	2(1.9)	0(0.0)	2(4.3)	
Occasionally	11(10.3)	8(13.1)	3(6.5)	
Rarely/never	94(87.9)	53(86.9)	41(89.1)	
(6) Sedentary leisure-time				12.4**
Always/often	32(29.9)	10(16.4)	22(47.8)	
Occasionally	36(33.6)	25(41.0)	11(23.9)	
Rarely/never	39(36.4)	26(42.6)	13(28.3)	
(7) Use relaxation techniques				7.6*
Always/often	27(25.2)	19(31.1)	8(17.4)	
Occasionally	44(41.1)	28(45.9)	16(34.8)	
Rarely/never	36(33.6)	14(23.0)	22(47.8)	
(8) Frequency of exercise			12.5**	
More than twice a week	26(24.3)	22(36.1)	4(8.7)	
Once a week	14(13.1)	9(14.8)	5(10.9)	
Less than once a week	67(62.6)	30(49.2)	37(80.4)	

[a]Fisher's exact test; *$p < 0.05$; **$p < 0.01$;***$p < 0.001$.

in flight attendants. The probability of fatigue was 5.6 times higher among flight attendants with an irregular than those with normal type sleep (95% confidence interval [CI] = 0.3–4.3). The flight attendants who reported always or often with sedentary leisure-time had 7.4 times higher of fatigue than those who rarely or never with sedentary leisure-time (95% CI = 0.8–3.6). Flight attendants who reported exercising less than once a week had 6.3 times more probability of fatigue than those who exercised more than twice a week (95% CI = 0.6–4.0). Among trainees, who reported sleeping hours less than 5 hours and 6 hours had more probability of fatigue than those who sleep less more than 7 hours (AOR = 15.6, 95% CI = 1.4–21.3 vs AOR = 9.0, 95% CI = 0.7–20.8). Among flight attendants and trainees, who reported rarely or never having a balanced diet was more probability of fatigue than those with always or often balanced diet (AOR = 4.6, 95% CI = 0.1–3.3 vs AOR = 2.1, 95% CI = 0.1–2.5). Flight attendants and trainees who reported rarely or never use relaxation techniques had more probability of fatigue than those with always or often use relaxation techniques (AOR = 3.6, 95% CI = 0.1–2.7 vs AOR = 21.65, 95% CI = 1.5–22.0) (Table 4).

4. Discussion

The flight attendants are responsible for ensuring all passengers have a safe and comfortable travel journey. They have to understand the upcoming flights, check the equipment, deal in case of an emergency, make flight announcements, serve food and drinks to customers, and sell duty-free products. But frequently crossing time zones, irregular working hours, and long-haul flights may cause fatigue, affect health and safety. The analyses of this research are impor-

Table 3
Comparison of health-related lifestyle habits and fatigue among trainees ($n = 109$)

Variable	n (%)	Trainees		χ^2
		Non-fatigue n (%)	Fatigue n (%)	
(1) Sleep pattern				0.9[a]
Normal type	35(32.1)	25(34.2)	10(27.8)	
Early type	60(55.0)	38(52.1)	22(61.1)	
Late type	8(7.3)	6(8.2)	2(5.6)	
Irregular type	6(5.5)	4(5.5)	2(5.6)	
(2) Sleeping hours				10.8**
More than 7 hours	21(19.3)	20(27.4)	1(2.8)	
5–6 hours	34(31.2)	23(31.5)	11(30.6)	
Less than 5 hours	54(49.5)	30(41.1)	24(66.7)	
(3) Balanced diet				6.3*
Always/often	57(52.3)	44(60.3)	13(36.1)	
Occasionally	38(34.9)	20(27.4)	18(50.0)	
Rarely/never	14(12.8)	9(12.3)	5(13.9)	
(4) Caffeine taken 6 hours before bedtime				1.8
Always/often	68(62.4)	47(64.4)	21(58.3)	
Occasionally	12(11.0)	6(8.2)	6(6.7)	
Rarely/never	29(26.6)	20(27.4)	9(25.0)	
(5) Consuming alcohol before bedtime				0.6 [a]
Always/often	1(0.9)	1(1.4)	0(0.0)	
Occasionally	6(5.5)	4(5.5)	2(5.6)	
Rarely/never	102(93.6)	68(93.2)	34(94.4)	
(6) Sedentary leisure-time				3.0
Always/often	40(36.7)	25(34.2)	15(41.7)	
Occasionally	33(30.3)	26(35.6)	7(19.4)	
Rarely/never	36(33.0)	22(30.1)	14(38.9)	
(7) Use relaxation techniques				10.8**
Always/often	19(17.4)	18(24.7)	1(2.8)	
Occasionally	43(39.4)	30(41.1)	13(36.1)	
Rarely/never	47(43.1)	25(34.2)	22(61.1)	
(8) Frequency of exercise				0.3
More than twice a week	8(7.3)	6(8.2)	2(5.6)	
Once a week	17(15.6)	14(19.2)	3(8.3)	
Less than once a week	84(77.1)	53(72.6)	31(86.1)	

[a]Fisher's exact test; *$p < 0.05$; **$p < 0.01$;***$p < 0.001$.

tant in aviation fatigue risk management, finding the knowledge of the non-work-related reasons for fatigue among flight attendants and trainees to prevent fatigue in poor lifestyle habits.

The results of this study showed that more than half of the flight attendants and trainees in this study had fatigue and poor health-related lifestyle habits, including sleep patterns, insufficient total hours of sleep, without a balanced diet, sedentary leisure-time, no relaxation, and less exercise. The flight attendants had more poor health-related lifestyle habits than trainees. These factors were significantly associated with fatigue, especially irregular sleep type, less than 5 sleeping hours, rarely or never using relaxation techniques, and exercise less than once a week.

Overall, the health-related lifestyle habits of sleep patterns, sleep hours, diet, and level of activity of flight attendants were closely related to fatigue, similar to previous studies on flight attendants and pilots [5]. Unlike the present study, the moderate levels of alcohol consumption, respectively, were risk factors for fatigue [11]. The lack of association of these factors with fatigue in this study may have been because we did not investigate alcohol consumption in detail.

More than half of the participants reported relatively few total hours of sleep, consistent with previous surveys [4, 18, 19]. The ICAO reported that lack of sleep is one of the four main causes of fatigue, consistent with the present study [3]. Irregular working hours and rapid circadian rhythm changes across time zones shorten sleep times in flight attendants, who may also experience interrupted sleep and daytime sleepiness [18, 19]. Abbott et al. noted that jetlag and circadian rhythm changes affect cortisol and melatonin secretion, and in severe cases cause circadian rhythm sleep-wake disorders, including delayed sleep-wake phase disorder, as well as irregular sleep [20]. Compared to the trainees in this study, nearly

Table 4
Bootstrap logistic regression analysis of health-related lifestyle habits and fatigue among flight attendants and trainees

	Flight attendant ($n = 107$)				Trainees ($n = 109$)			
Variable	β	AOR	95% CI	p	β	OR	95% CI	p
(1) Sleep pattern								
Normal	ref				ref			
Early type	0.6	1.9	–0.7–3.2	0.32	0.3	1.4	0.6–1.3	0.41
Late type	1.3	3.7	–0.2–4.2	0.89	–0.2	0.7	–20.8–1.6	0.68
Irregular type	1.7	5.6	0.3–4.3	0.01*	0.0	1.1	–20.8 –2.2	0.77
(2) Sleeping hours								
More than 7 hours	ref				ref			
5–6 hours	0.3	1.4	–0.6–1.4	0.87	2.1	9.0	0.7–20.8	0.1*
Less than 5 hours	0.0	1.0	–0.1–1.4	0.47	2.7	15.6	1.4–21.3	<0.01**
(3) Balanced diet								
Always/often	ref				ref			
Occasionally	0.9	2.5	–0.0–2.1	0.06	0.7	4.0	–0.8–2.4	0.26
Rarely/never	1.5	4.6	0.1–3.3	0.02*	1.3	2.1	0.5–2.5	<0.01**
(4) Caffeine taken 6 hours before bedtime								
Rarely/never	ref				ref			
Occasionally	0.6	1.8	–0.9–2.2	0.37	0.7	2.1	–0.5–2.5	0.30
Always/often	0.3	1.3	–0.6–1.6	0.57	–0.0	0.9	1.0–1.1	0.94
(5) Consuming alcohol before bedtime								
Rarely/never	ref				ref			
Always/often/ occasionally	–0.2	0.7	–2.1–1.2	0.74	–0.0	0.9	–20.5–1.4	0.77
(6) Sedentary leisure-time								
Rarely/never	ref				ref			
Occasionally	0.1	1.1	–0.9–1.4	0.70	–0.8	0.4	–2.1–0.2	0.15
Always/often	2.0	7.4	0.8–3.6	<0.01**	0.1	1.1	1.0–1.1	0.84
(7) Use relaxation techniques								
Always/often					ref			
Occasionally	0.3	1.3	–0.8–1.5	0.54	2.0	7.8	0.3–21.0	0.04*
Rarely/never	1.2	3.6	0.1–2.7	0.02*	3.0	21.6	1.5–22.0	<0.01**
(8) Frequency of exercise								
More than twice a week	ref				ref			
Once a week	1.4	4.0	–0.5–4.5	0.11	–0.4	0.6	–0.20.0–20.1	0.51
Less than once a week	1.8	6.3	0.6–4.0	<0.01**	–0.5	1.6	–1.3–20.9	0.45

AOR: adjusted odds ratio (Flight attendants: for gender, marital status; Trainees: for commuting times); CI: confidence interval; Bootstrap results are based on 1000 bootstrap samples; *$p < 0.05$; **$p < 0.01$, ***$p < 0.001$.

56% of the flight attendants in this study reported late or irregular sleep habits, and the fatigue possibility of these individuals was significantly higher than that of the early and normal sleep groups. We assume that their sleep was adversely affected by jetlag and circadian rhythm changes.

Gupta et al. pointed out that irregular working hours were the major factors influencing the eating behaviors of shift workers [21]. In this study, we found the participants frequently did not eat a balanced diet, and their fatigue possibility was significantly high. There are similar findings, that poor dietary habits are related to fatigue [5]. Nyberg and Lennernäs Wiklund found that flight attendants are often tired or lethargic, and sometimes skip meals or only eat simple snacks or bread for reasons of availability and convenience [12]. Görlich and Stadelmann also found that irregular eating habits have significant positive correlations with stress [22]. In this study, stress was also found to be significantly high among the fatigue group in flight attendants. However, we also found that the participants with good relaxation and a balanced diet, the risk of fatigue were significantly lower. Therefore, we supposed that the poor diet habit of flight attendants may be affected by workload, duty time and stress. A healthy and balanced diet has been reported to improve performance and reduce the risk of fatigue [23, 24]. According to the evidence, we suggest maintaining a healthy diet and increasing the intake of the Mediterranean diet, instead of highly processed foods and red meat as daily habits [8].

The flight attendants in this study who often have sedentary leisure time and exercise less than once a week had an increased risk of fatigue, similar to those in previous investigations [11, 25]. Sports participation affects the internal biological clock, which in turn affects sleep and fatigue [1]. As a similar research

finding, we recommend the intervention on exercise can be a more flexible schedule, not at home and face-to-face instruction [26].

Fatigue management policies for aircrew should also emphasize healthy lifestyle habits, such as sleep, circadian rhythm adjustment, nutrition, relaxation, and exercise. Quality onboard meals should also be provided. Sleep and fatigue interventions can effectively reduce fatigue, increase knowledge of fatigue management, and improve sleep quality, physical activity, and eating habits among flight attendants [6, 13]. As fatigue management is among the most important factors for ensuring flight safety, appropriate employee education programs thereon are necessary. Thus, airlines should provide training for flight attendants on health-related lifestyle habits and behaviors associated with fatigue.

5. Conclusion

This is the first pilot study to identify different factors of fatigue among flight attendants and trainees. Undoubtedly, irregular working across multiple time zones work interferes cause flight attendants' circadian rhythms, sleep, and diet, causes which can result in fatigue, and affect flight safety. The results showed that nearly half of flight attendants and trainees generally have an unbalanced diet, poor exercise habits, insufficient sleep, and irregular sleep-wake patterns. Compared to flight attendants, this study found that the trainees who have no flight experiences had higher prevalence rates of fatigue, may have fatigue problems due to training stress. When the trainees are officially launched, in addition to the stress of the trainees, coupled with irregular and cross-time zone work, they may increase their fatigue problem. Therefore, it is recommended that airlines, in addition to the original fatigue risk management, should strengthen the healthy life behaviors of these flight attendants and trainees. Also, it needs to provide flexible health promotion plans to improve their physical and mental health and enhance their work execution ability to ensure flight safety and services.

5.1. Limitations

This study was a pilot study conducted in an airline in Taiwan, using a convenience sampling method with a limited number. This study might exist some bias, even the results were adjusted by controlling the social demography, working condition factors, and using a bootstrap method. Such as, literature has reported that sleeping hours, alcohol and caffeine may play a factor in fatigue. We suggest the sample size and the characteristics need to be extended to include such factors as having a second job, mental health, and staffing and working conditions as control items.

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Conflict of interest

None to report.

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