

# Jet-Lag Countermeasures Used by International Business Travelers

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- INTRODUCTION:** Research has highlighted the significant impact that jet lag can have upon performance, health, and safety. International business travelers have an important role in economic growth; however, there is a lack of research investigating jet lag and jet-lag management in international business travelers. This study aimed to investigate international business travelers' use of jet-lag countermeasures.
- METHODS:** International business travelers from Australia ( $N = 107$ ) participated in a survey examining use of jet-lag countermeasures (pharmacological and nonpharmacological). Chi-squared tests were conducted examining the association between duration of stay and traveling experience on jet-lag countermeasure use.
- RESULTS:** Most subjects had traveled for business for less than 15 yr and 57% reported taking between 1–4 trips annually. Durations of stay averaged 10 d (SD 13 d). Nonpharmacological countermeasure use was high. Pharmacological countermeasure use was less common. There were no significant associations between duration of stay and countermeasure implementation. Travel experience was only associated with nonpharmacological countermeasures after arrival home.
- CONCLUSION:** Education programs delivered through businesses would be beneficial for providing information on jet lag, its implications, and recommended countermeasures to travelers.
- KEYWORDS:** jet lag, international travel, jet-lag countermeasures, duration of stay, experience.

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Business travel refers to traveling for employment to an irregular place of work and can involve activities such as conducting meetings, negotiating important deals, raising finances, and selling products and services. International business travel involves the transfer of goods, services, and ideas across national borders, and is critical to continued globalization and development of the world economy.<sup>3</sup> International business travel has become increasingly prevalent and is one of the defining features of working life for millions of people around the world. Approximately 900,000 international business departures from Australia were reported in 2018, an increase of ~29% from 2016.<sup>2</sup> While the benefits of international business travel are obvious, there are also a number of unfavorable aspects associated with travel. Many business travelers report suffering from extreme feelings of stress, anxiety, and a sense of disempowerment, both in the anticipation of travel and while away.<sup>13</sup> One important under-researched consequence of international business travel is jet lag.

Jet lag is primarily caused by rapid travel through multiple time zones, resulting in a mismatch between the circadian system, which is synchronized to time cues in the departure time zone, and the desired timing of sleep and wake, which needs to be resynchronized to time cues in the destination time zone.<sup>11</sup> Symptoms of jet lag include difficulties sleeping at night, excessive daytime sleepiness, impaired cognitive and physical performance, mood changes, and gastrointestinal upset.<sup>8</sup> To date, jet lag research has been predominantly conducted with cohorts that fly frequently as part of their occupation such as elite

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athletes,<sup>11,16</sup> airline crew,<sup>14</sup> and military personnel.<sup>10</sup> Across these groups, jet lag impairs judgement, leading to problematic implications for personal health and safety.<sup>4</sup> While as many as ~80% of international business travelers report experiencing jet lag, there is a paucity of research investigating jet-lag consequences, symptoms, and management strategies in this group.

In an effort to reduce the effects of jet lag, there are many simple recommendations provided to travelers.<sup>1,4</sup> Evidence-based jet-lag countermeasures can be nonpharmacological or pharmacological. Nonpharmacological countermeasures include well-timed bright light exposure (a method which will slowly shift one's sleep schedule), physical exercise, and diet.<sup>4</sup> Pharmacological countermeasures typically include hypnotics, stimulants, and chronobiotics.<sup>1</sup> The implementation of jet-lag countermeasures are typically recommended at different times throughout travel (i.e., before, during, and after a flight).<sup>4</sup> Given that the symptoms of jet-lag gradually remit as the circadian system realigns, ensuring the timing of countermeasure implementation is appropriate will allow this biological process to occur more effectively.<sup>15</sup> For example, before travel, obtaining adequate sleep and exposure to well-timed bright light is recommended.<sup>15</sup> Similarly, specific countermeasures for in-flight use include napping and attempting to improve sleep during the flight (e.g., use of noise cancellation earphones and changing clothes for greater comfort).<sup>15</sup> Lastly, once at the destination, staying awake until bed time, naps, appropriately timed administration of melatonin or medication, as well as alternating exposure to and the avoidance of bright light are recommended strategies.<sup>15</sup>

There are two features of international business travel that may impact on travelers' use of jet-lag countermeasures; these include: 1) duration of stay, and 2) traveling experience. On average, international business travelers are away from home for 12 d at a time<sup>5</sup> and, during that time, are often expected to maintain high levels of performance and productivity. When the duration of stay is extended in populations that travel regularly (e.g., athletes), improvements in performance across time have been reported.<sup>6</sup> Traveling experience is the number of business trips taken per year as well as the number of years spent traveling for business. It is possible that those travelers with greater experience have more developed strategies for managing jet lag compared to less experienced travelers.

Despite the abundance of findings which have highlighted the significant impact that jet lag can have upon performance, health, and safety, and the vital role that international business travelers hold in economic growth, there is a lack of research specifically investigating jet lag and countermeasure use in international business travelers. Therefore, the primary aim of the current study was to examine international business travelers' use of jet-lag countermeasures. Specifically, this study will explore the impact of duration of stay and traveling experience upon the implementation of both nonpharmacological and pharmacological countermeasures. Given the lack of previous research investigating jet lag in international business travelers, this research is exploratory rather than hypothesis driven.

## METHODS

### Subjects

A sample of 144 international business travelers volunteered to participate in this study; however, 37 did not complete the survey, resulting in a final sample of  $N = 107$  subjects. Ethical approval was obtained from CQUniversity Human Research Ethics (Project Number 2018-083) and followed international ethical standards. Subjects' demographic data are reported in **Table I**.

**Table I.** Characteristics of Business Travel ( $N = 107$ ).

PARTICIPANT CHARACTERISTICS	TOTAL	
	N	%
N	107	
Duration of stay (days)		
0–3 d	15	14
4–7 d	53	50
8–13 d	14	13
14+ days	25	23
Number of years spent traveling >6 h for international business		
1–4 yr	23	22
5–9 yr	28	27
10–14 yr	22	20
15–19 yr	9	8
20–24 yr	10	9
>25 yr	15	14
Number of business trips with a travel time of >6 h taken each year:		
1–4 trips	61	57
5–9 trips	25	23
10–14 trips	15	14
15–19 trips	2	2
20–24 trips	1	1
>25 trips	3	3
Experience of business traveler in total estimated trips (annual trip frequency × number of years traveling for business):		
Low (2 to 16 trips, Tertile 1)	35	33
Medium (18 to 39 trips, Tertile 2)	36	34
High (40 to 1248 trips, Tertile 3)	36	34
Class of travel:		
Economy class (includes Premium Economy)	60	56
Business class	46	43
First class	1	1
Most frequent business travel destination:		
North America	25	23
South America	2	2
Europe	30	28
Africa	3	3
Asia	32	30
Other	15	14
Perceived prevalence of jet-lag		
Always	35	33
Fairly often	37	35
Sometimes	28	25
Rarely	7	7
Never	0	0
Perceived ability to manage jet-lag on business trips:		
Very good	13	12
Good	59	55
Neutral	26	24
Poor	8	8
Very poor	1	1

## Materials

A total of 34 questions were included in the online survey. Demographic questions sought the age, gender, and educational attainment of international business travelers. Questions pertaining to jet-lag management, such as countermeasure use, were adapted from current literature.<sup>1,4</sup> Based on these same studies, jet-lag countermeasures were allocated to nonpharmacological and pharmacological categories to measure the impact of international business travelers' duration of stay and travel experience upon countermeasure type. As the current literature also highlights the importance of implementing jet-lag countermeasures at specific times,<sup>15</sup> the current study divided countermeasures into three time frames: 1) before travel, 2) during travel, and 3) after travel. That is, there were six main outcomes of interest: 1) use of nonpharmacological countermeasures before the flight; 2) use of pharmacological countermeasures before the flight; 3) use of nonpharmacological countermeasures during flight; 4) use of pharmacological countermeasures during flight; 5) use of nonpharmacological countermeasures after flight; and 6) use of pharmacological countermeasures after flight. Each of these countermeasure variables were binary, i.e., any use vs. no use.

Duration of stay was comprised of the total number of days spent at the destination. For the analysis, duration of stay was dichotomized ( $\leq 7$  d/8+ d) to investigate the influence of a quick turn-around on the use of countermeasures. Travel experience was calculated by multiplying the number of years spent traveling for business by the average number of business trips taken each year. For example, a participant who traveled an average of 6 times per year for 10 yr had a travel experience score of 60, equivalent to an estimate of the total number of trips taken for business. The distribution of travel experience was strongly right-skewed and, therefore, tertiles of travel experience were used for the analysis (Tertile 1, Low: 2 to 16 trips; Tertile 2, Medium: 18 to 39 trips; and Tertile 3, High: 40 to 1248 trips).

## Procedure

This was a cross-sectional study conducted as an online questionnaire (using Survey Monkey®). Subjects were recruited through social media (e.g., Twitter, Facebook), email, and via word of mouth from July 8<sup>th</sup> through September 1<sup>st</sup>, 2019. Subjects were required to meet the following inclusion criteria: 1) were Australian residents; 2) over 18 yr of age; and 3) travel at least twice per year for work (with a flight duration of 6 h or greater per trip; defined as a long-haul flight).<sup>16</sup> Subjects completed a consent form confirming they met the inclusion criteria, that participation was voluntary, and that they had read and understood the information sheet. The survey took 15–20 mins to complete and subjects were instructed that they were able to exit the survey at any time, although once responses had been submitted, responses could not be changed or retracted. At the conclusion of the survey subjects were provided with a link to a separate webpage where they were given the option of providing their email address to receive a plain English summary of results and whether they wanted to enter the draw for a prize voucher.

## Statistical Analysis

Descriptive analyses were used to characterize business travelers' use of jet-lag countermeasures. Statistical analyses were conducted using SPSS Version 26. To determine whether 1) duration of stay and 2) traveling experience influenced jet-lag countermeasure implementation, Chi-squared tests were used. Where expected cell sizes were  $<5$ , Fisher's exact test was used instead of the Chi-squared test. Due to the relatively small number of subjects, no statistical modeling was undertaken.

## RESULTS

The sample was 60% men (40% women), with an average age of  $45 \pm 12$  yr. When asked the highest level of educational attainment achieved, more than half (57%) of subjects had completed a Post Graduate degree, with the remaining having completed either an Undergraduate degree (including Honors) (23%), Diploma or Certificate (15%), High School (4%), or Other (1%).

Table I includes data pertaining to business travel characteristics. Upon arrival at the destination, the duration of stay averaged  $9.9 \pm 12.7$  d, with 64% of international business travelers spending up to 7 d at the destination. Most subjects (57%) reported taking between 1–4 international business trips (with flights of  $>6$  h in duration) annually. The majority (69%) of subjects had traveled for business for less than 15 yr.

The majority (56%) of the sample reported traveling Economy class (including Premium Economy) to the most frequently visited destination of Asia (30%), Europe (28%), and North America (23%). The majority (68%) of subjects experienced jet lag 'always' or 'fairly often' in comparison to 7% of subjects reporting 'rarely' experiencing jet lag when traveling for business. Interestingly, over half (67%) rated their ability to manage jet lag as either 'very good' or 'good'.

Table II summarizes the implementation of jet-lag countermeasures among business travelers. Before the flight, subjects reported being more likely to implement the following countermeasures: deliberately choosing a flight that arrives at your destination at a particular time of day (e.g., morning, afternoon, night) (59%), making sure you sleep well before the flight (36%), and doing exercise before the flight (31%). Just under a quarter (23%) of subjects reported not implementing any jet-lag strategies before the flight.

During the flight, subjects reported being more likely to implement the following countermeasures: water consumption (staying hydrated) during the flight (78%), naps (62%), noise canceling headphones (60%), walking on the plane or stretching exercises (37%), changing clothes (37%), and alcohol avoidance during the flight (34%). After the flight, a significant portion (83%) of subjects said that staying awake until bedtime was likely to be implemented, as well as exposure to bright light (e.g., going outside) (40%), and gentle exercise in bright light after the flight (e.g., a game of golf or tennis) (35%). When asked where subjects typically obtained information about jet-lag management, the most prominent responses included:

**Table II.** Jet-Lag Countermeasures Used by Business Travelers (*N* = 107).

COUNTERMEASURES	TOTAL	
	<i>N</i>	%
<i>N</i>	107	100
Countermeasures implemented before flight		
Use of any nonpharmacological countermeasure	84	79
Deliberately choosing a flight that arrives at your destination at a particular time of day (e.g., morning, afternoon, night)	63	59
Making sure you sleep well before the flight	39	36
Doing exercise before the flight	33	31
I do not use any strategies before the flight	25	23
Other (e.g., drinking plenty of water before flying to stay hydrated)	16	14
Adapting your body clock to the new time zone before the flight	15	14
Staying up the night before so I can sleep on the plane	15	14
Planning important activities at a time when you would be awake and alert back home	14	13
Using an anti-jet-lag diet or timing your meals to adjust your body clock	8	8
Change sleep schedule 2–3 d before trip	6	5
Using jet-lag calculators/jet-lag apps	0	0
Use of any pharmacological countermeasure	17	16
Drink alcohol so that I can relax	17	16
Countermeasures implemented during flight		
Use of any nonpharmacological countermeasure	104	97
Water consumption (staying hydrated) during flight	83	78
Naps	66	62
Noise canceling headphones	64	60
Trying to eat healthy	41	38
Changing clothes	40	37
Walking on plane or stretching exercises	40	37
Trying to have light meals	39	36
Avoiding bright light on the plane (e.g., use of sunglasses/dark glasses, closing window shade)	30	28

advice from colleagues (46%), advice from family or friends (45%), and the internet (31%).

**Table III** shows the associations between the use of countermeasures by travel characteristics. Use of nonpharmacological measures appeared lower before the flight (75% vs. 81%) and on arrival home (90% vs. 96%) for those with longer durations of stay compared to those staying for a week or less, but these were not statistically significant differences ( $P = 0.50$  and  $P = 0.26$ , respectively). Similarly, use of pharmacological measures was highest during flight, and on arrival home, compared to before flight, but there was no significant associations between use and duration of stay.

For travel experience, use of nonpharmacological countermeasures prior to flight appeared to decrease with increasing travel experience. However, the only statistically significant association observed was between travel experience and use of countermeasures on arrival home, with those with medium amounts of travel experience being least likely to implement nonpharmacological countermeasures (83% vs. nearly 99% of passengers with low and 100% of those with high levels of travel experience,  $P = 0.02$ ). The use of pharmacological countermeasures was not associated with travel experience,

**Table II.** (Continued)

COUNTERMEASURES	TOTAL	
	<i>N</i>	%
Using an antijet lag diet or timing your meals to adjust your body clock	10	9
Other (e.g., trying to have heavy meals, jet-lag calculators)	10	9
I do not use any strategies during the flight	3	3
Use of any pharmacological countermeasure	75	70
Alcohol avoidance during flight	36	34
Use of medication to sleep	29	27
Alcohol consumption during flight	22	21
Use of melatonin	14	13
Consumption of alertness-promoting products (e.g., coffee, energy drinks)	13	12
Strategies implemented upon arriving home		
Use of any nonpharmacological countermeasure	100	94
Staying awake until bedtime	89	83
Exposure to bright light (e.g., going outside)	43	40
Gentle exercise in bright light after flight (e.g., a game of golf or tennis)	37	35
Napping after flight	24	22
Plan important activities at a time when you would be awake and alert back in the destination	14	13
Other (e.g., go back to work, intense exercise, housework)	12	11
Avoiding bright light (e.g., use of sunglasses/dark glasses)	4	4
Using jet-lag calculators/jet-lag apps	0	0
Use of any pharmacological countermeasure	58	54
Consumption of alertness-promoting products (e.g., coffee, energy drinks)	26	24
Use of medication to sleep	20	19
Use of melatonin	18	17
Alcohol avoidance after flight	11	10
Alcohol consumption after flight	10	9

although more experienced travelers appeared to use fewer pharmacological measures on arrival home, but rates of use were similar before and after travel to those with lower amounts of travel experience.

## DISCUSSION

International business travel is a common requirement of employment. For those international business travelers who experience jet lag, impairments to their performance and productivity, as well as their health and safety, is of particular concern.<sup>4,13</sup> The current study aimed to explore the implementation of jet-lag countermeasures in international business travelers. We found that the majority of subjects reported experiencing jet lag while traveling for business. Interestingly, 23% of subjects reported not implementing any jet-lag strategies before a flight, but despite that over half of the subjects had confidence in their ability to manage jet lag.

The most common nonpharmacological countermeasure implemented was staying hydrated during the flight, and the most common pharmacological countermeasure implemented



**Table III.** Use of Countermeasures by Duration of Stay and Travel Experience (N = 107).

	USE OF NONPHARMACOLOGICAL COUNTERMEASURES			USE OF PHARMACOLOGICAL COUNTERMEASURES		
	BEFORE FLIGHT N (COL%)	DURING FLIGHT N (COL%)	ON ARRIVAL HOME N (COL%)	BEFORE FLIGHT N (COL%)	DURING FLIGHT N (COL%)	ON ARRIVAL HOME N (COL%)
Duration of stay						
≤7 d	54 (81%)	65 (97%)	64 (96%)	10 (15%)	50 (75%)	36 (54%)
8+ days	30 (75%)	39 (98%)	36 (90%)	7 (18%)	25 (63%)	22 (55%)
Test-statistic, P-value	$\chi^2(1) = 0.47$ P = 0.50	$\chi^2(1) = 0.02$ P = 0.88	$\chi^2(1) = 1.25$ P = 0.26	$\chi^2(1) = 0.12$ P = 0.72	$\chi^2(1) = 1.76$ P = 0.19	$\chi^2(1) = 0.02$ P = 0.90
Travel experience						
Low	31 (87%)	35 (100%)	<b>35 (100%)</b>	5 (14%)	23 (66%)	22 (63%)
Medium	28 (78%)	34 (94%)	<b>30 (83%)</b>	7 (19%)	26 (72%)	19 (53%)
High	25 (68%)	35 (97%)	<b>35 (97%)</b>	5 (14%)	26 (72%)	17 (47%)
Test-statistic, P-value	$\chi^2(1) = 3.86$ P = 0.15	Fisher's exact = 1.82, P = 0.77	Fisher's exact = 7.70, P = 0.02	$\chi^2(1) = 0.52$ P = 0.77	$\chi^2(1) = 0.48$ P = 0.79	$\chi^2(1) = 1.79$ P = 0.41

Bold indicates only use of nonpharmacological countermeasures on arrival home was significantly associated with travel experience, Fisher's exact = 7.70, P = 0.02.

was avoiding alcohol during the flight. To the authors' knowledge, only one other study has investigated the prevalence of jet-lag countermeasures in international business travelers.<sup>12</sup> The current descriptive results add to this previous study, where subjects reported using strategies such as prescription and nonprescription medication (including melatonin), dietary changes, and exposure to sunlight.<sup>12</sup> These findings help to provide a greater understanding of subjective jet-lag experiences in an international business traveler sample, which could help to inform future education efforts in this wider population group.

This study also aimed to explore the impact of duration of stay and traveling experience upon the implementation of different types of jet-lag countermeasures. There was no significant association between countermeasure use and duration of stay. Further, travel experience was only associated with the use of nonpharmacological countermeasures after arrival home, with lowest use in those with medium levels of travel experience. There appeared to be a decrease in the use of nonpharmacological countermeasures prior to the flight in those with increasing travel experience. This may have to do with travelers being self-selected into roles requiring extensive travel—those who prepare may be more inexperienced travelers, whereas those who do not prepare may be those who naturally deal well with jet lag. Duration of stay and traveling experience are two factors that have previously been explored using experimental study designs in other frequent flying occupation populations such as airline crews<sup>7</sup> and professional athletes.<sup>5</sup> For example, Cho et al.<sup>7</sup> found that when flight crew populations had an extended stay at their home base of 14 d or more between outbound long-haul flights, the association between memory deficits and transmeridian travel was no longer apparent. However, countermeasure implementation has not been the focus of previous research, therefore the current study adds to the current body of literature and identifies possible future directions for research in this field.

Interestingly, international business travelers reported most commonly obtaining jet-lag management information by seeking advice from colleagues or family and friends, as well as via the internet. Given the significant consequences jet lag can have on both personal health and safety, evidence-based educational programs outlining information related to jet lag, its implications, and recommended management strategies would be beneficial.

Given that approximately a third of subjects reported referring to the internet for jet-lag management strategies, internet-based programs (e.g., existing evidence-based eHealth and mHealth programs) may provide good targets for intervention. Future research is needed to determine the best ways to engage subjects to ensure they have easy access to these resources. One recommendation is that these programs be delivered through businesses that have prominent business travel as part of their job requirements. Additionally, there is an opportunity to partner with airlines and explore ways of disseminating information on jet-lag countermeasures as part of standard booking or ticketing processes, similar to how information regarding deep vein thrombosis is currently provided.

Current findings should be interpreted in consideration of study limitations. First, the data is based on participant self-report, which may be impacted by desirability and/or recall bias. Second, the subjects involved in this study were only recruited from Australia and comprised a convenience sample, which may impact the generalizability of the findings to all international business travelers. Future research is warranted to investigate how levels of awareness about jet-lag countermeasures and the need for their use differs between Australians and international business travelers from other countries, given Australia's location and distance from other countries, which may create a distinct profile of travel and impact of jet lag. Third, the majority (78%) of the subjects were 35 yr or older. Future research should explore whether jet lag is more prevalent in older populations, as age has been shown to have a significant impact upon the severity of jet-lag symptoms and recovery.<sup>9</sup> Fourth, specific details of the different flight lengths undertaken by subjects was not collected in this study. Future research should consider examining jet-lag countermeasure use in ultralong haul flights (14+ hours) given that business travelers may implement different countermeasures in flights of various durations.

In conclusion, the present study has provided a broad understanding of how jet lag is currently being managed by international business travelers within Australia. The findings reveal that the vast majority of subjects report experiencing some degree of jet lag and, to counteract this, the vast majority of subjects implemented countermeasures before, during, and after travel. Within nonpharmacological countermeasures, those pertaining

to hydration during the flight were found to be the most prominent, while the avoidance of alcohol during flight was most prominent of the pharmacological countermeasures. Duration of stay and traveling experience were not associated with the implementation of nonpharmacological and pharmacological jet-lag countermeasures. Given that limited research has been conducted upon international business travelers to date, the current study promotes much-needed academic interest into international business travelers and provides an initial foundation on which further research can be conducted. As international business travelers remain a vital asset to the economy and upcoming growth worldwide, more research is still required which meets the diverse needs of the population, as well as how their current awareness of jet lag can be translated into useful strategies.

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