



**JAPAN HIGH
PERFORMANCE
SPORT CENTER**

Heat and Time-Zone Adaptation Strategies: The JISS Approach Toward LA2028

Masako Hoshikawa

Risa Iwata

Japan High Performance Sport Center

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1. Japan High Performance Sport Center (JHPSC)
Japan Institute of Sports Sciences (JISS)
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The JISS Approach Toward LA2028
 - (1) Time-Zone Adaptation Strategy
 - (2) Heat Adaptation Strategy

ハイパフォーマンス スポーツの拠点として。

As a hub for high performance excellence



Ajinomoto
NATIONAL TRAINING CENTER

5
AJINOMOTO NATIONAL
TRAINING CENTER Track &
Field



Ajinomoto
NATIONAL TRAINING CENTER

3
AJINOMOTO NATIONAL TRAINING
CENTER Indoor Training Center EAST

1
Japan Institute of Sports
Sciences (JISS)

Ajinomoto
NATIONAL TRAINING CENTER

2
AJINOMOTO NATIONAL TRAINING
CENTER Indoor Training Center WEST

Ajinomoto
NATIONAL TRAINING CENTER

4
AJINOMOTO NATIONAL
TRAINING CENTER Athletes'
Village

7

8

6

HPSC



Researcher's Affiliation and Areas of Expertise



Department of Sports Medicine

Clinic (Orthopaedic Surgery,
Internal Medicine, Dentistry, etc)

Athletic Rehabilitation

Strength & Conditioning

Nutrition

Psychology

Department of Sports Sciences

Fitness Assessment

Training Research

Sports Engineering

Conditioning Research

Sports Biomechanics

Social Sciences

Total conditioning: The key to our works



S&C
PT
PT



S&C
Nutritionist
Psychologist
Doctor

Total Conditioning for Athletes
Source: Total Conditioning Guidelines for Athletes, p.69, Figure 2, 2023



**Sports Medicine
/ Science
Support
Programs**

**Sports
Medicine /
Science
Research
Programs**

**Sports Clinic
Programs**

Sports Medicine / Science Research Programs



Testing in the wind tunnel lab

Purpose

Creating new knowledge that will contribute to enhancing international competitiveness.



Motion Analysis



Analysis using AI



Biochemical Analysis

Sports Medicine / Science Support Programs

Purpose

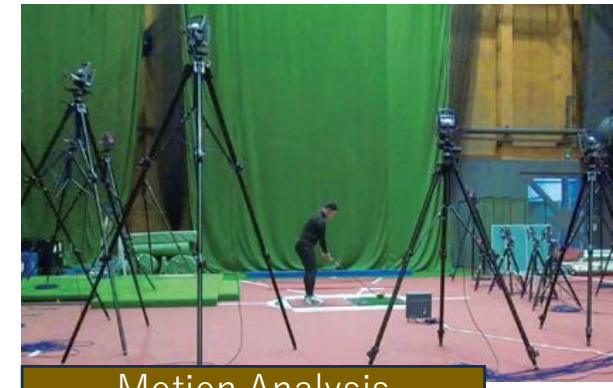
Providing solutions for performance enhancement



Fitness Support



Psychological Support



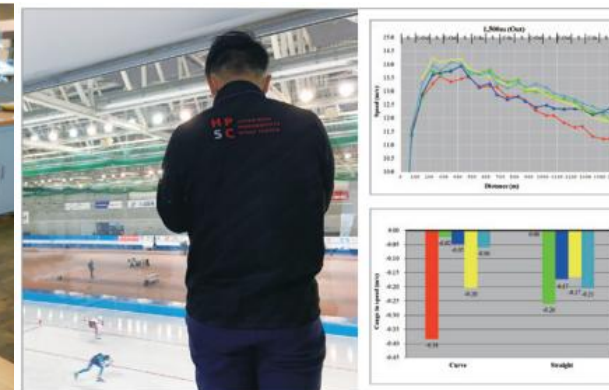
Motion Analysis



Physical Training



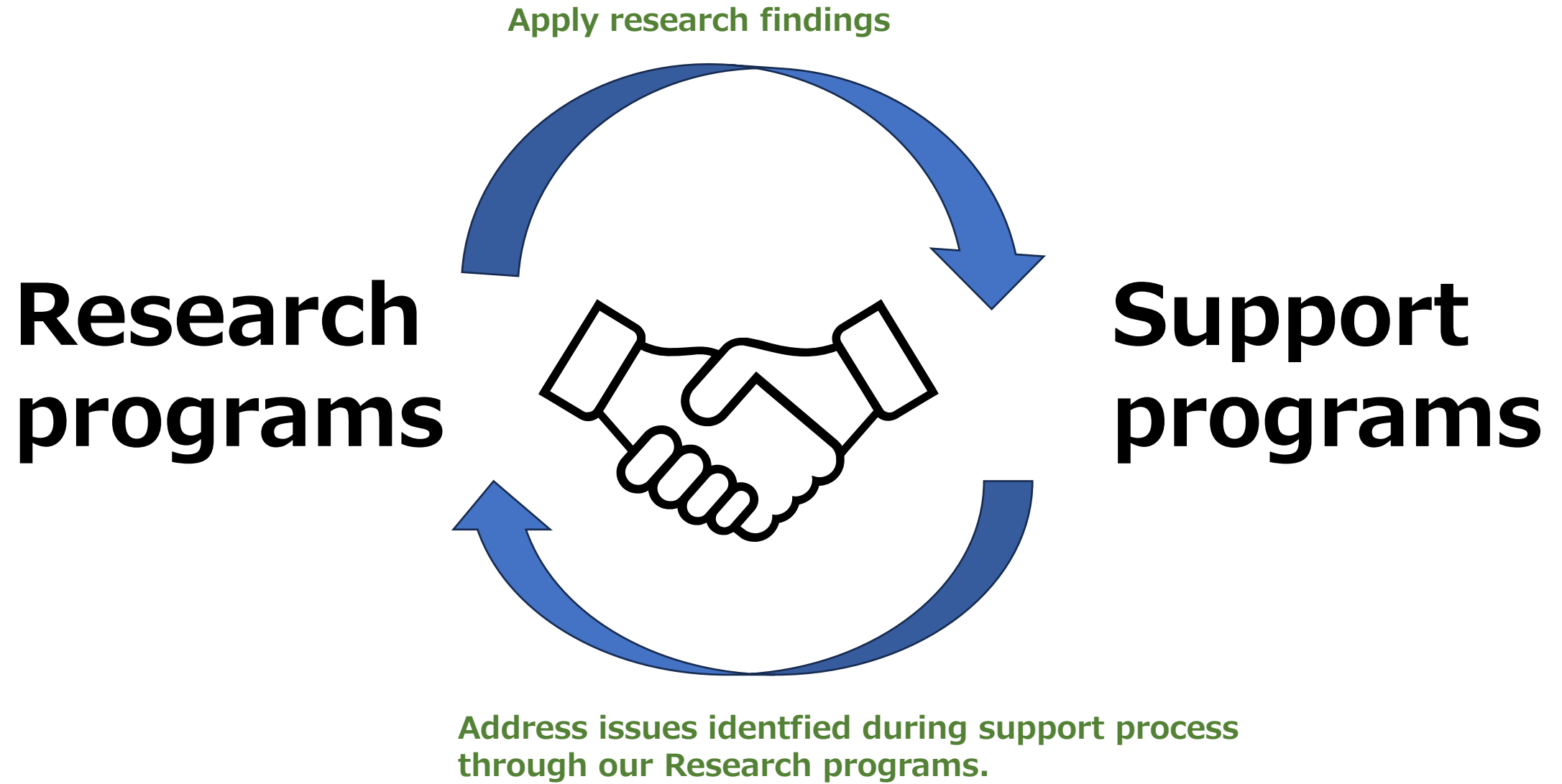
Nutritional Support



Race / Game Analysis



Video / Information
Technology Support



Sports Medicine / Science Research Programs

Six pillars of research

- 0) Research directly related to comprehensive support
- 1) Development of support procedures based on structure model
- 2) Implementation of digital technology and sports equipment enhancement
- 3) Implementation of specific environmental measures according to the competition venues
- 4) Enhancement of epidemiological approaches to sports medicine
- 5) Promotion of sports science, medicine, and information support in light of changing social contexts

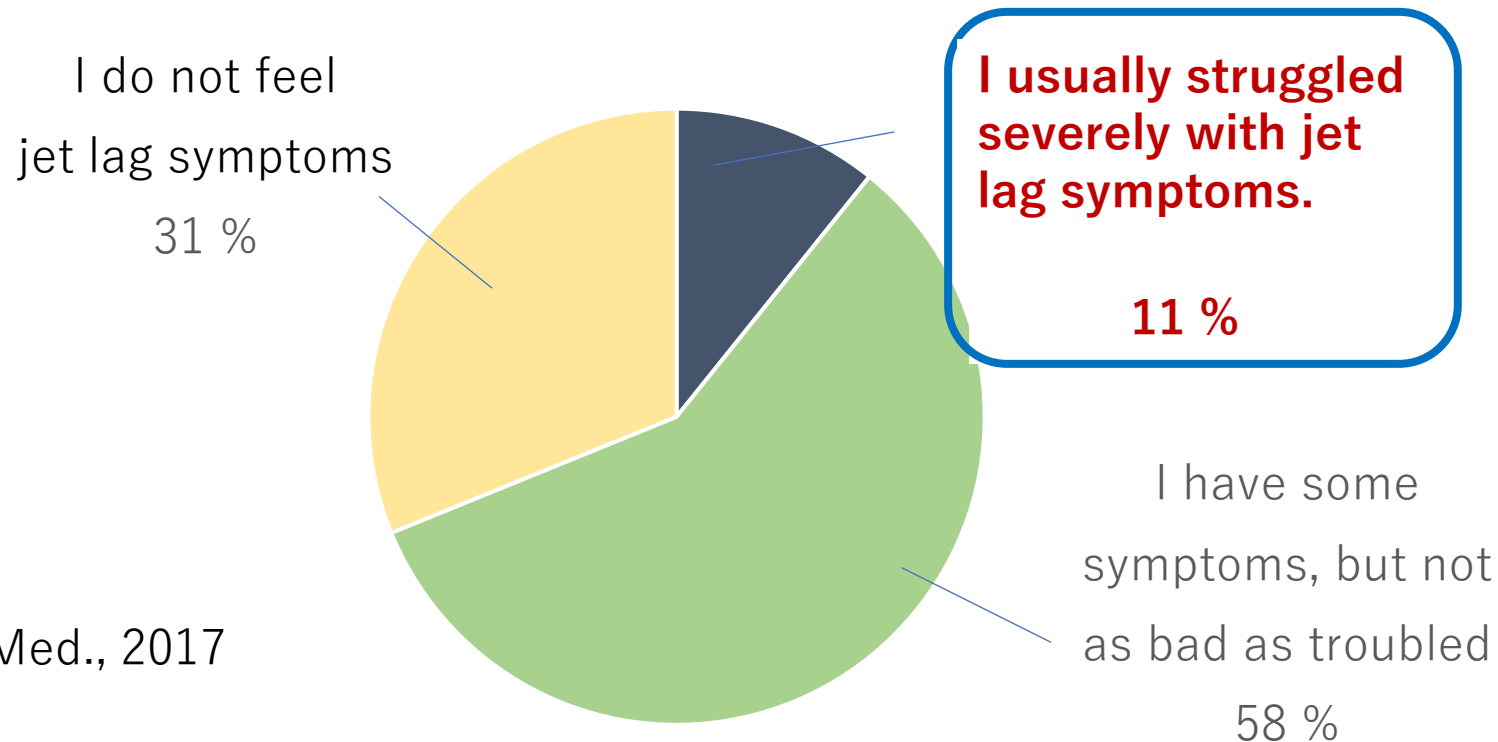
Heat and Time-Zone
Adaptation Strategies

Time-Zone Adaptation Strategies: The JISS Approach Toward LA2028



What percentage of athletes are severely struggling with jet lag symptoms?

- A Questionnaire study (Elite Japanese Athletes, n= 687)



Hoshikawa et al.,
Jpn J Clin Sports Med., 2017

Physical condition of athletes after international flights

**Jet Lag
+
Fatigue**

Mismatch between circadian rhythm and the social 24-h rhythm at the destination area

Fatigue during travel and after arriving at destination area

Sports Medicine (2021) 51:2029–2050

<https://doi.org/10.1007/s40279-021-01502-0>

CONSENSUS STATEMENT



Managing Travel Fatigue and Jet Lag in Athletes: A Review and Consensus Statement

Dina C. Janse van Rensburg^{1,2}  · Audrey Jansen van Rensburg¹  · Peter M. Fowler³  · Amy M. Bender⁴  · David Stevens^{5,6}  · Kieran O. Sullivan^{7,8}  · Hugh H. K. Fullagar⁹  · Juan-Manuel Alonso¹⁰  · Michelle Biggins⁷  · Amanda Claassen-Smithers¹¹  · Rob Collins^{12,13} · Michiko Dohi¹⁴ · Matthew W. Driller¹⁵  · Ian C. Dunican¹⁶  · Luke Gupta¹⁷ · Shona L. Halson¹⁸  · Michele Lastella¹⁹  · Kathleen H. Miles²⁰  · Mathieu Nedelec²¹  · Tony Page²² · Greg Roach¹⁹ · Charli Sargent¹⁹  · Meeta Singh²³  · Grace E. Vincent¹⁹  · Jacopo A. Vitale²⁴  · Tanita Botha²⁵ 

Athletes and coaches often need some arrangements...

Research

Support (Intervention, monitoring, and advice)

Workshop

Consultation (making a recommended schedule, lending devices, etc.)

-3 year

-2 year

-1 year

Trials

The Game

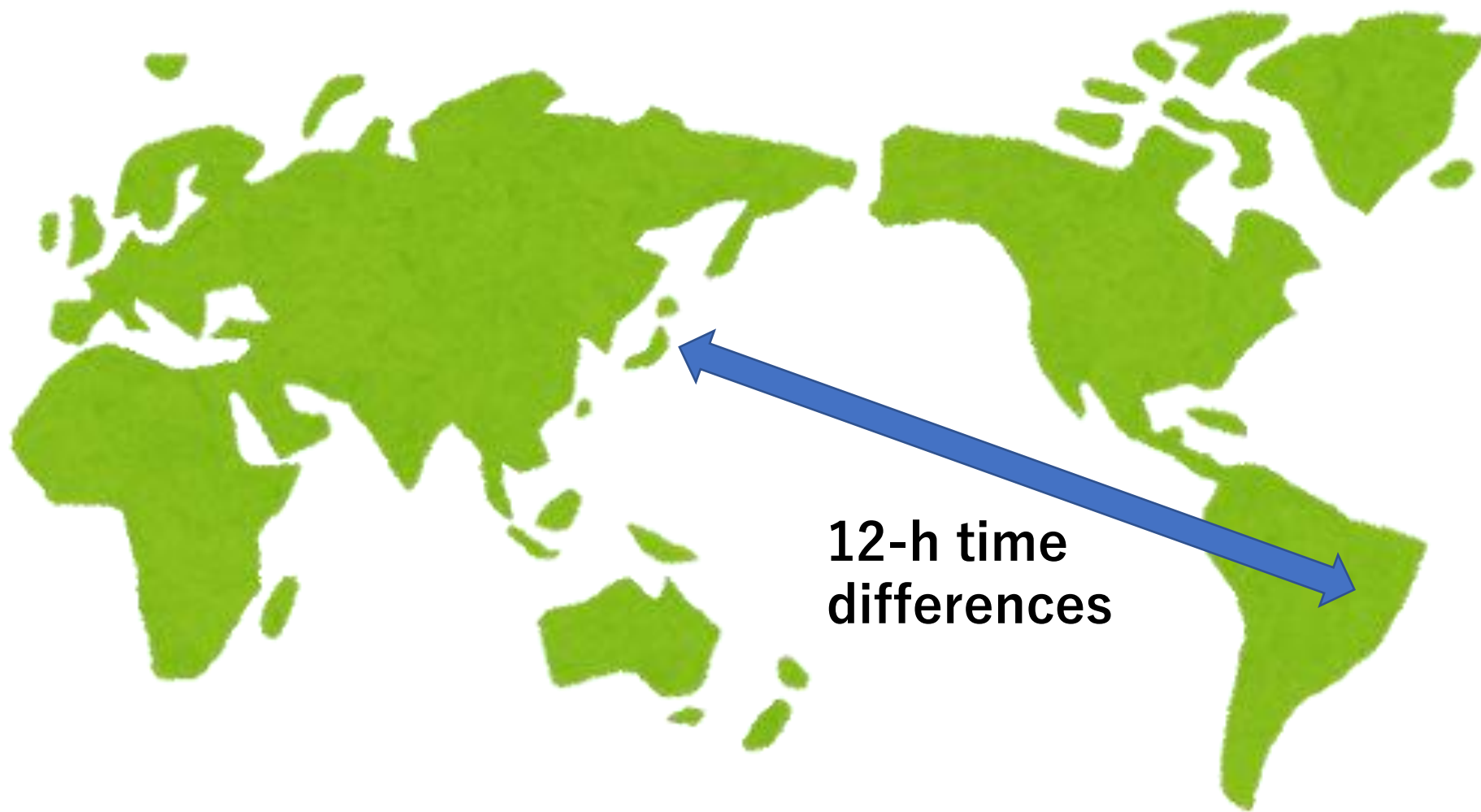


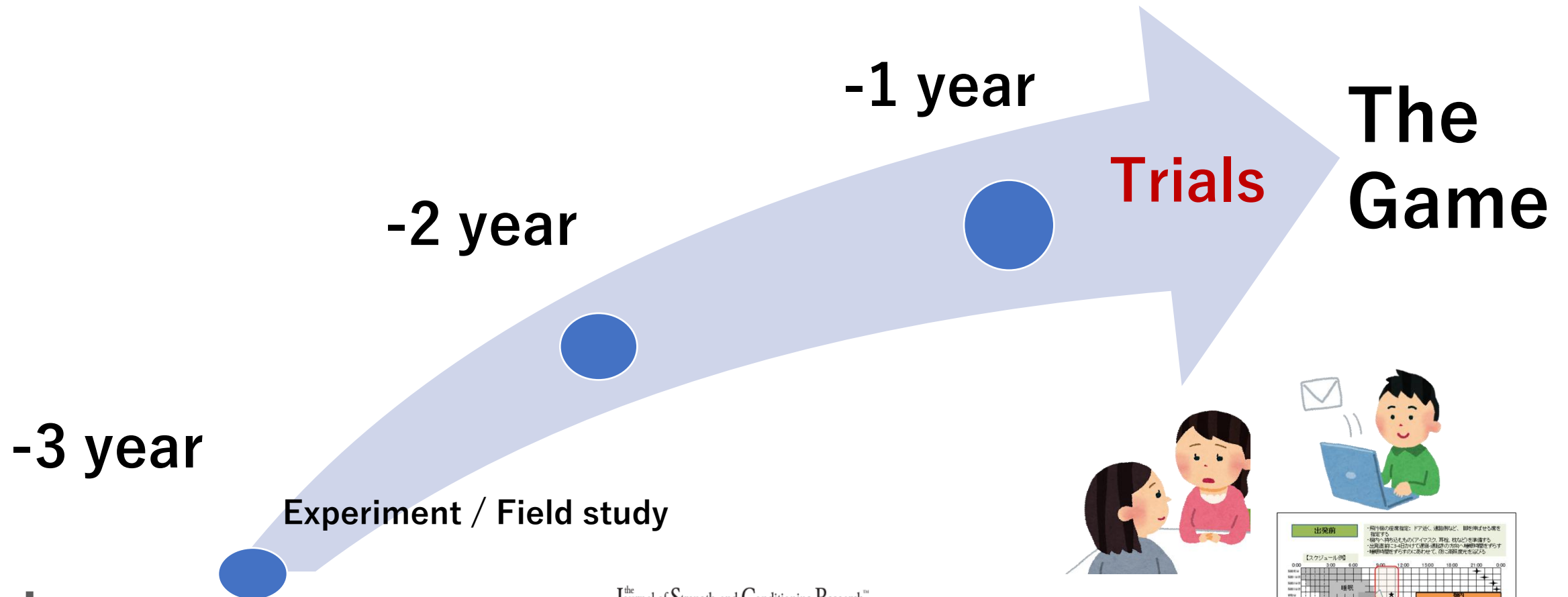
Experiment /
Field study



出発前	
・飛行機の搭乗規定: ドア近く、通路側など、移動しやすき位置に座る ・機内: 持ち込み品もすべて預け入れ、機内: 持ち込み品もすべて預け入れ ・出発直前: 3-4日前に搭乗券・搭乗口の方向へ移動時間を要する ・機内: 搭乗口を閉める前に搭乗する	
【スケジュール例】	
0:00	睡眠
3:00	睡眠
6:00	睡眠
9:00	睡眠
12:00	睡眠
15:00	睡眠
18:00	睡眠
21:00	睡眠
0:00	睡眠
空港	
14:05 成田 (Rio 2:05)	・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する
機内	
18:50 フランクフルト (Rio 1:50)	・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する
Transit	
22:15 フランクフルト (Rio 17:15)	・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する
機内	
5:05 リオデジャネイロ (Rio)	・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する
到着後	
・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する ・搭乗口/搭乗口の方向へ移動する	

Rio 2016





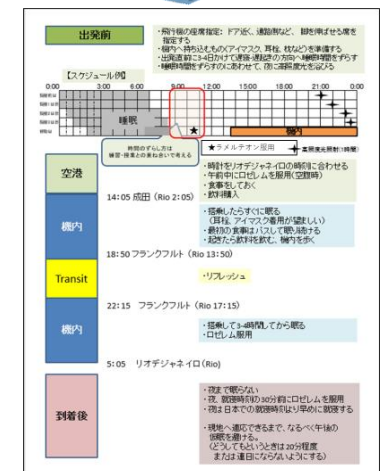
Research Note

the Journal of Strength and Conditioning Research™

Intervention for Reducing Sleep Disturbances After a 12-Time Zone Transition

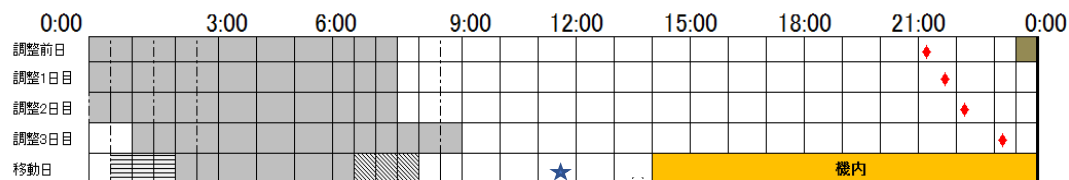
Masako Hoshikawa,¹ Sunao Uchida,² and Michiko Dohi³

Hoshikawa et al., J Strength Cond Res, 2020



At home (for 4 days before the departure)

時差調整方法



★ ラメルテオン服用

◆ 高照度光照射

5月11日(初日) 21時から光 1時間 → 23時30分就寝 → 8時30分頃起床
 5月12日(2日目) 21時30分から光 1時間 → 24時00分就寝 → 8時30分頃起床
 5月13日(3日目) 22時から光 1時間 → 24時00分~24時30分就寝 → 8時30分頃起床
 5月14日(4日目) 23時から光 1時間 → 2時に就寝 → 可能な範囲で朝寝坊

※夜更かしする分には、上記の時間でなくても構いません。
 ※起床時刻は、練習に間に合う時間で大丈夫です。

During trip

After arrival

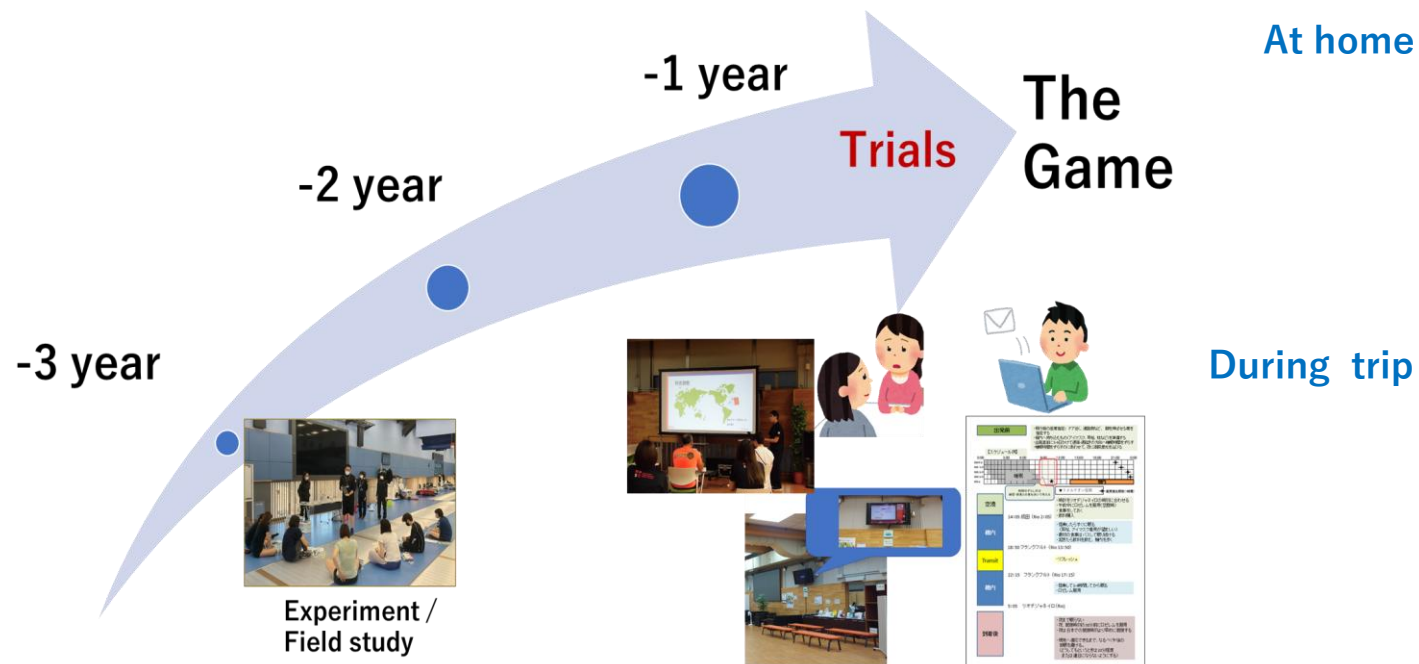
※These were written considering each athlete's training, flight schedules and preferences.



PARIS 2024

7-h time
differences





- From Japan to Paris -

- ✓ Sleep longer than usual
- ✓ Wake up as late as you can
- ✓ Stay out of the sun until after 9:00 AM (e.g., don't go outside, wear sunglasses)



- ✓ Set your watch to time at the destination
- ✓ You can sleep easier during nighttime at home
- ✓ Recline your seat when you sleep
- ✓ Use items that help you sleep better



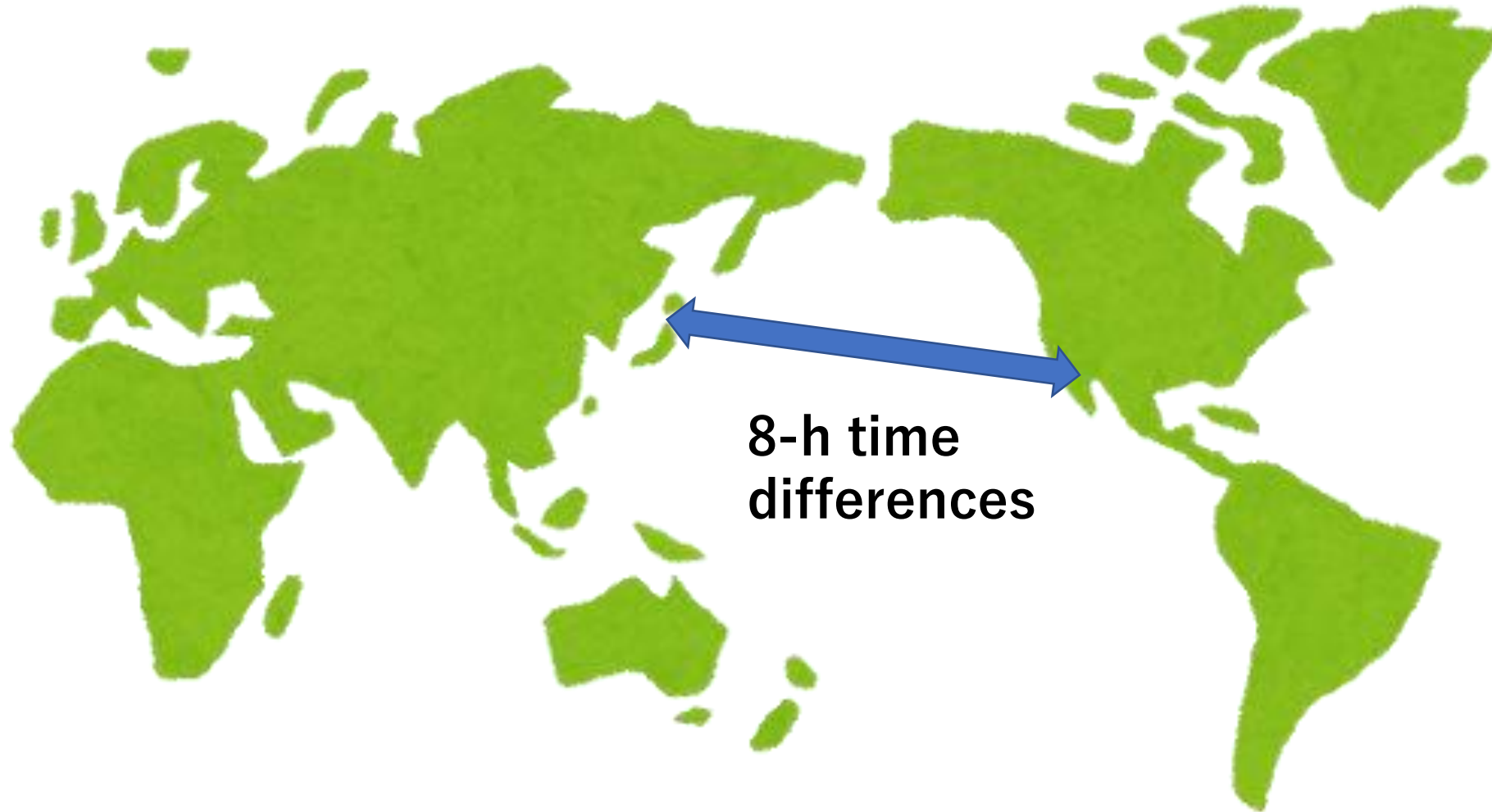
ノイズキャンセリング

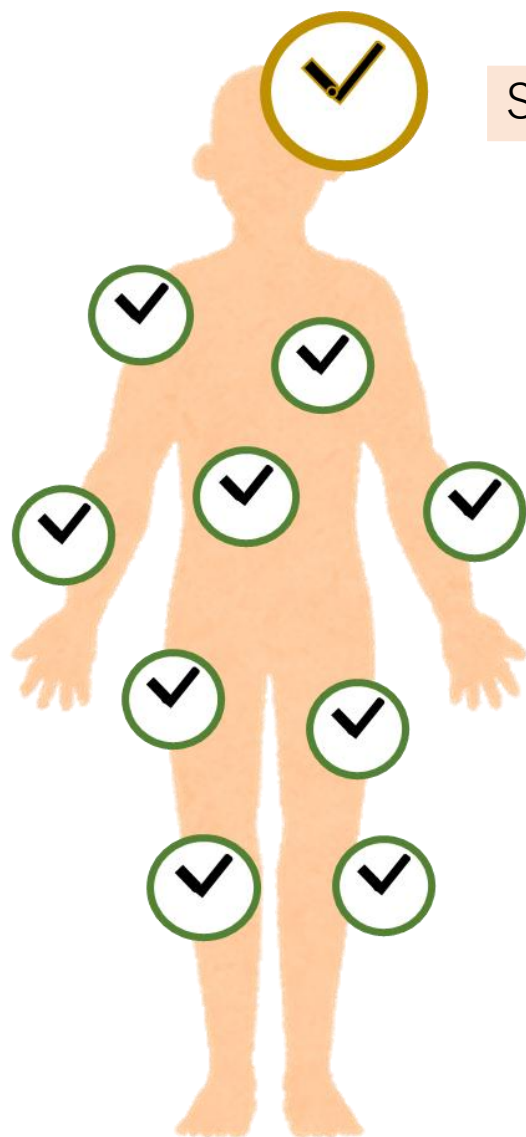


- ✓ Go to sleep by 9:30 PM on the day of arrival.
- ✓ Go to bed early for 2-3 days.
- ✓ Naps should be within 30 minutes and taken before 3:00 PM for the first three days.



LA2028





Suprachiasmatic nucleus

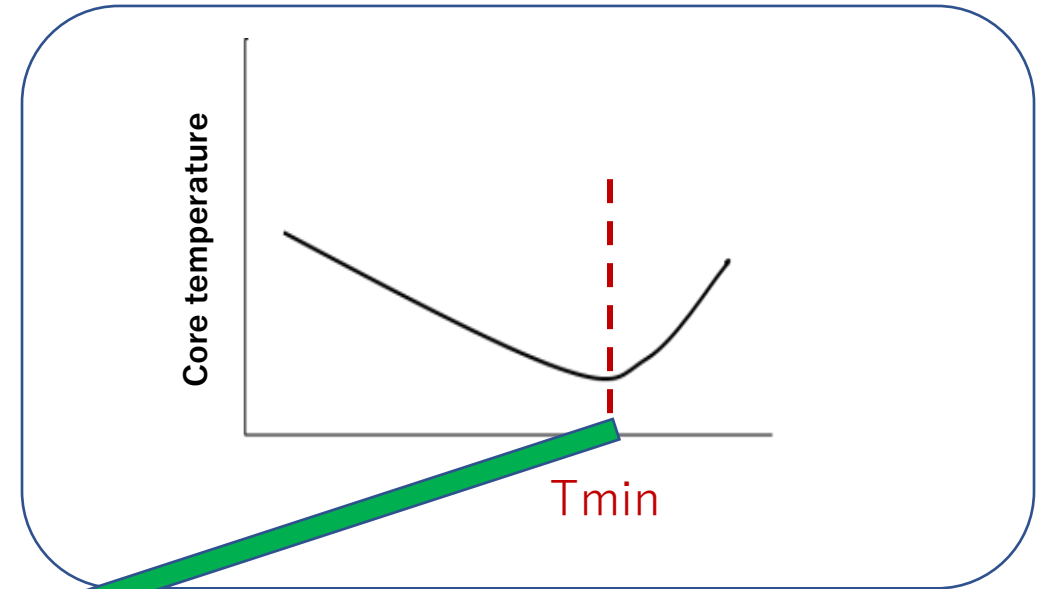
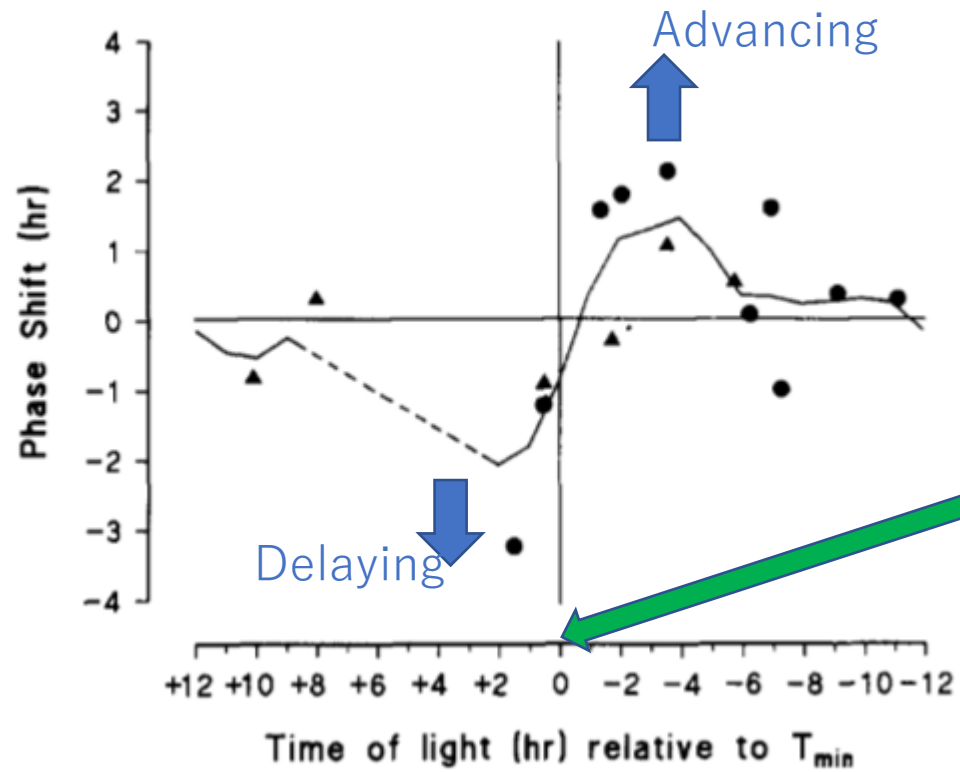
Master Clock

Light

Melatonin

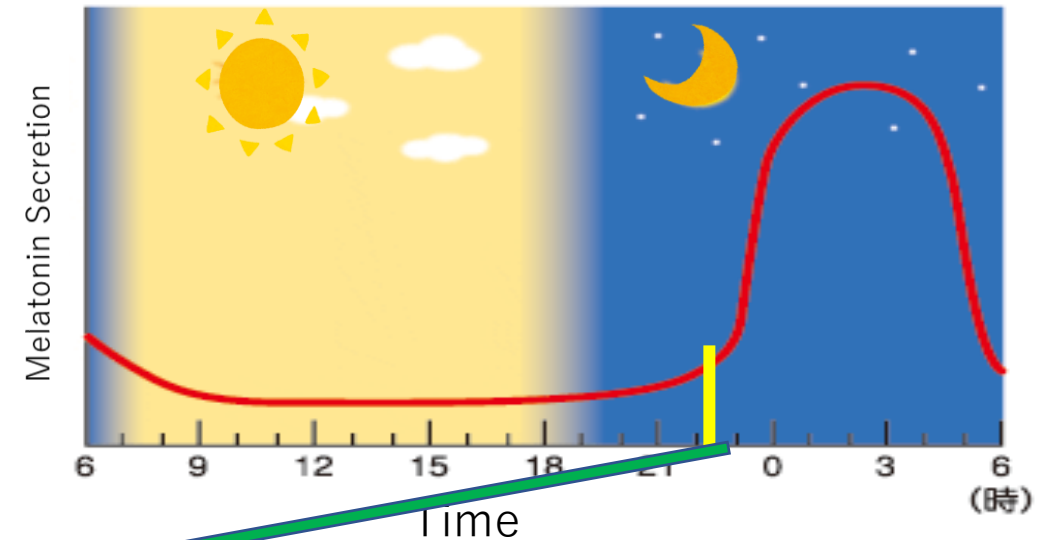
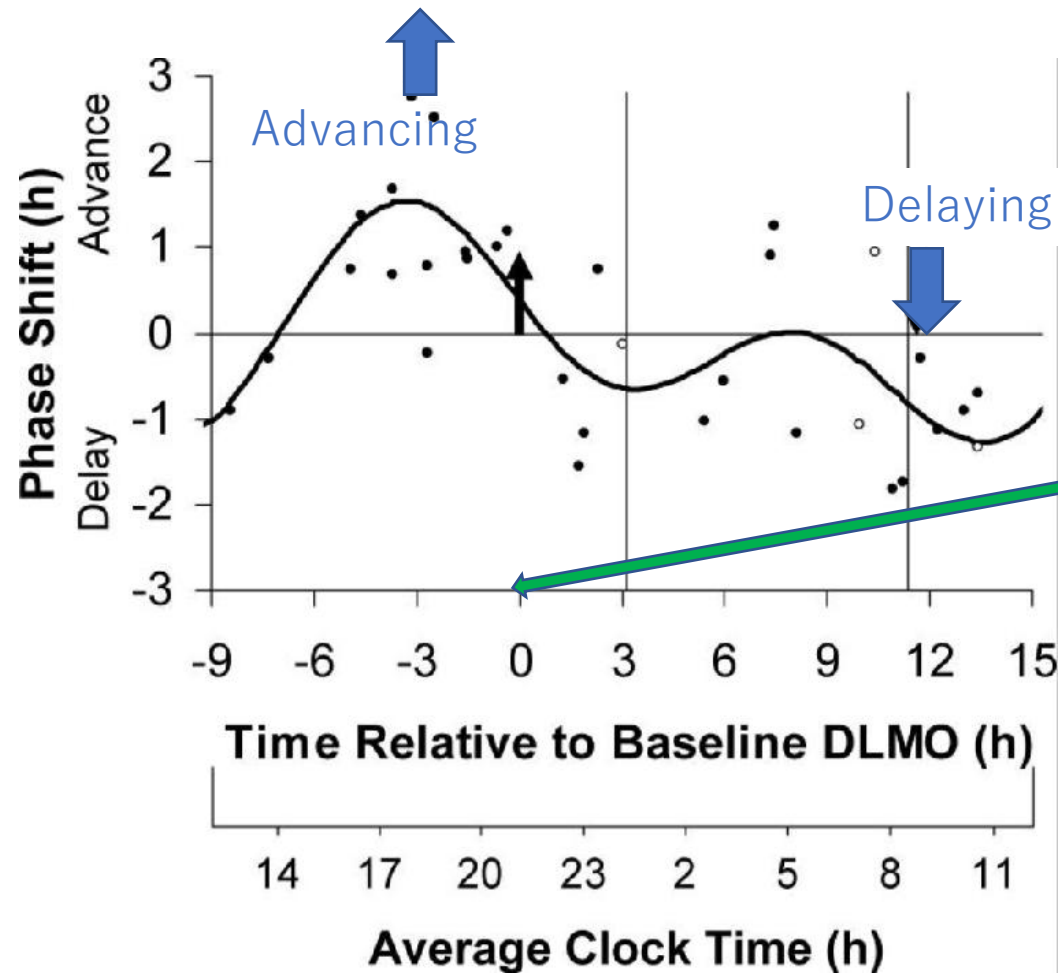


Phase Response Curve to light

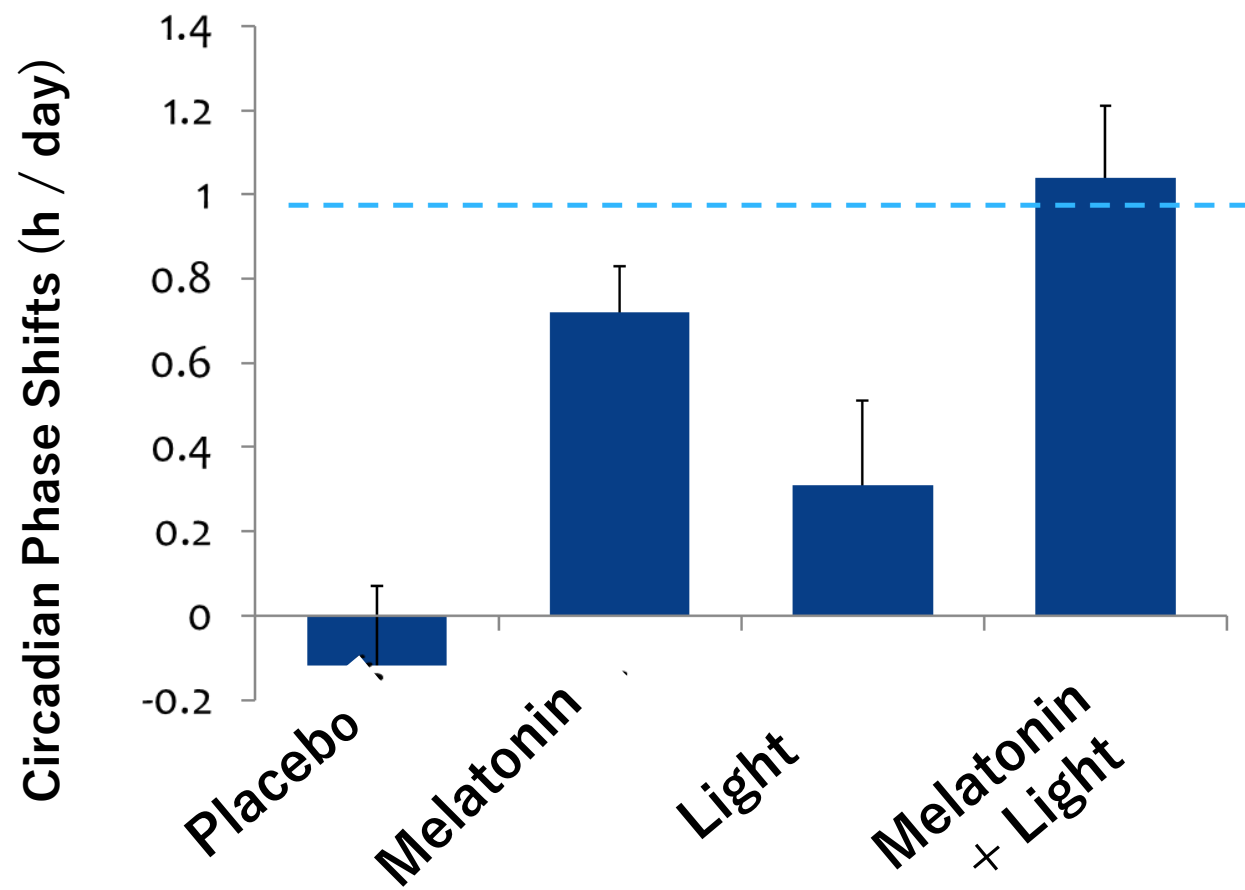


Modified from: Minors DS, et al.,
Neuroscience Letters, 133: 36-40, 1991

Phase Response Curve to melatonin



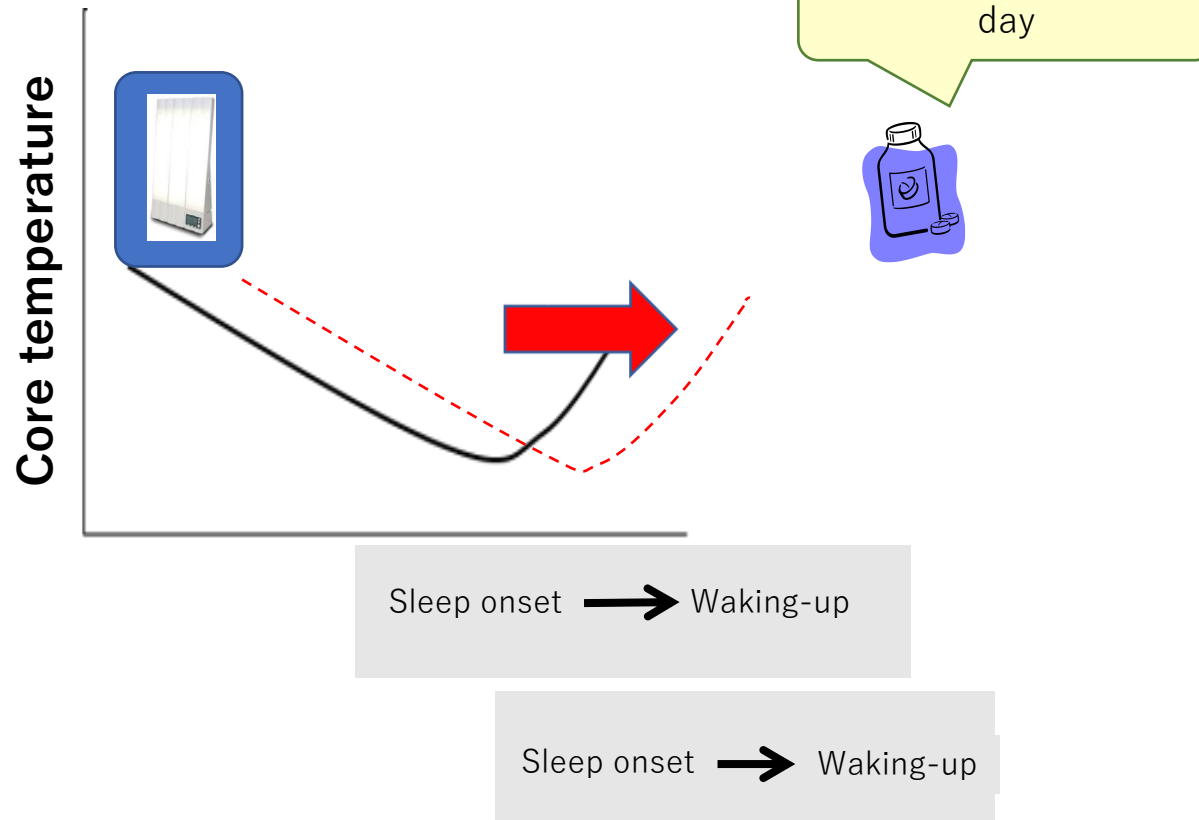
Modified from : Burgess, et al.,
[J Clin Endocrinol Metab.](#) 95(7): 3325–3331, 2010.



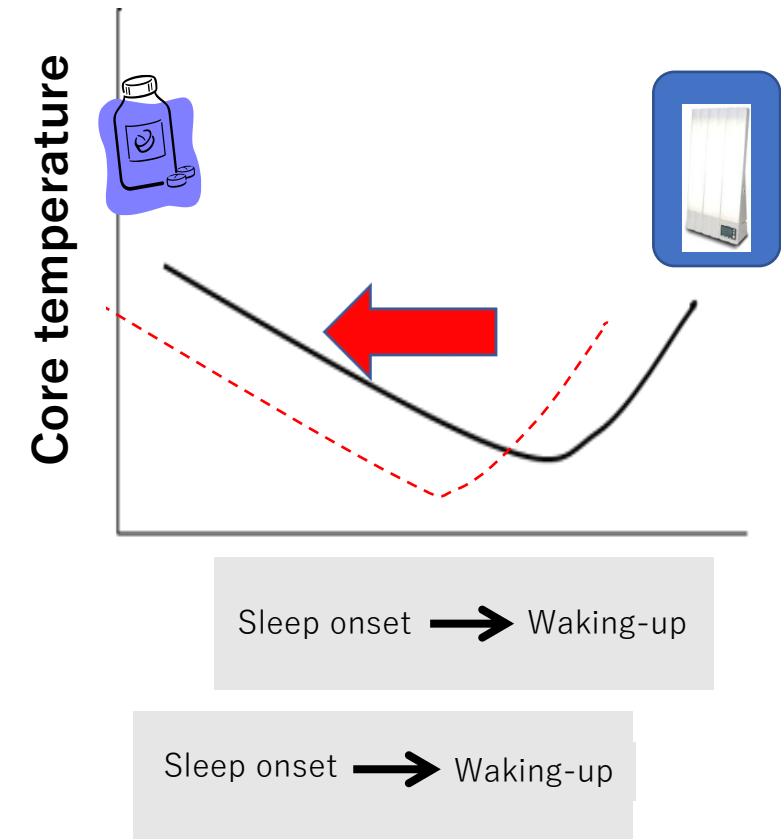
Paul et al. Psychopharmacology, 214(2):515-523, 2011

Pre-flight circadian phase-shift approach

Before westward flight



Before eastward flight



Changes of the human core body temperature rhythm and sleep structure by 6-hour phase advance treatment under a natural light-dark cycle

Alterações do ritmo da temperatura central do corpo e da estrutura do sono por seis horas de tratamento de avanço de fase sob um ciclo claro-escuro natural

Takuto Kojima¹, Junya Sumitomo¹, Ami Nishida¹, Sunao Uchida¹

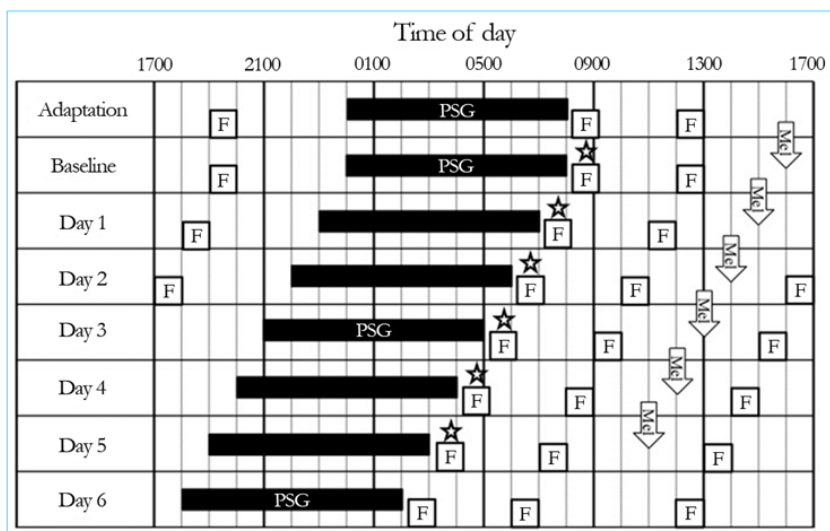


Figure 1. Experimental design: Filled black bars symbolize designated sleep periods. Symbol F, and ★ indicates food, and bright light exposure. The core body temperature was recorded throughout adaptation to day 6. PSG was recorded on adaptation, baseline, day 3, and day 6 sleep periods.

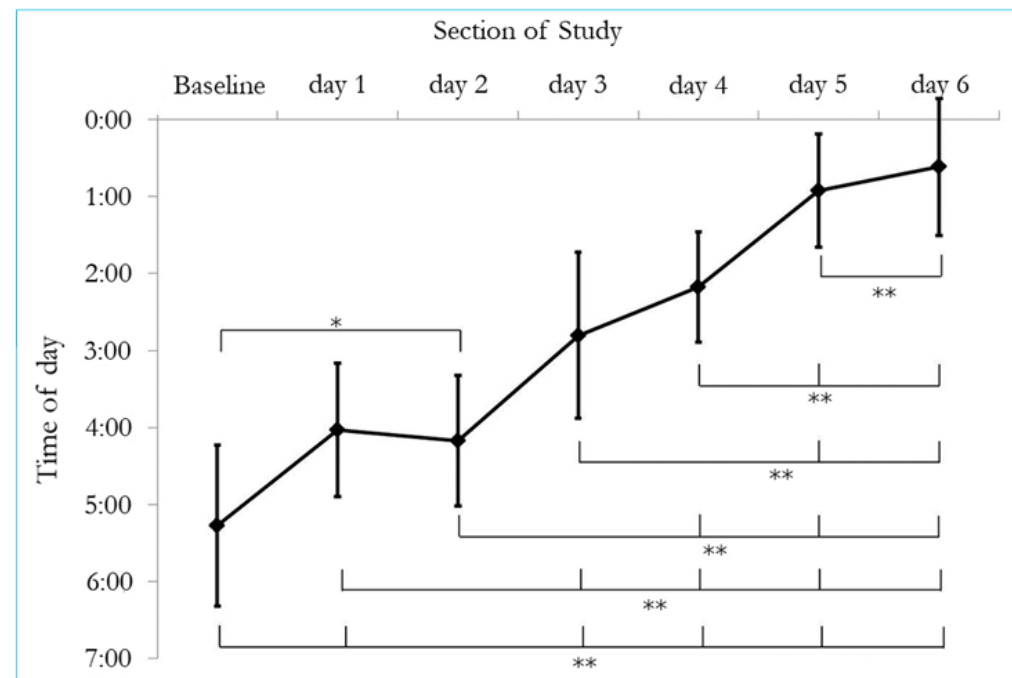
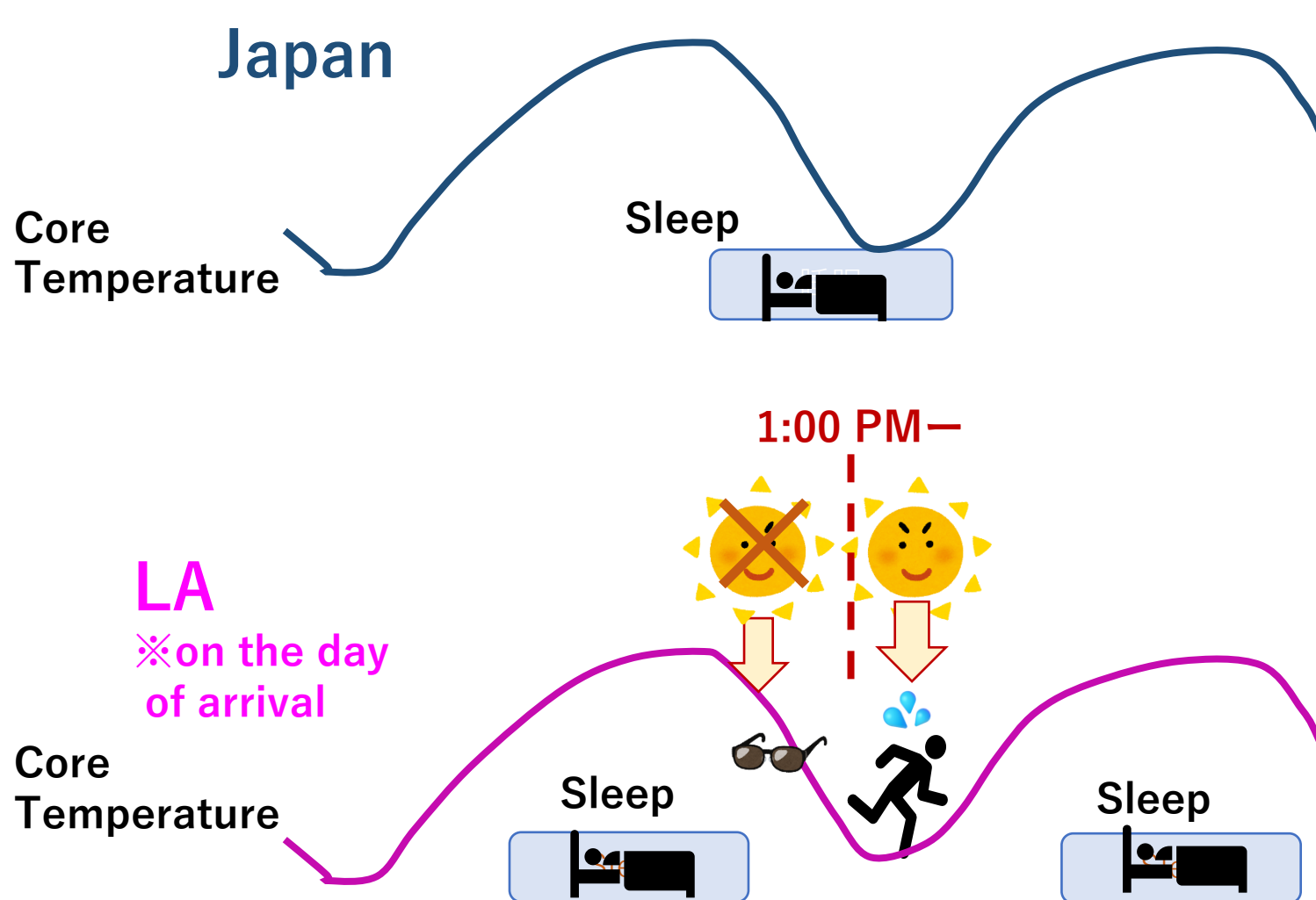


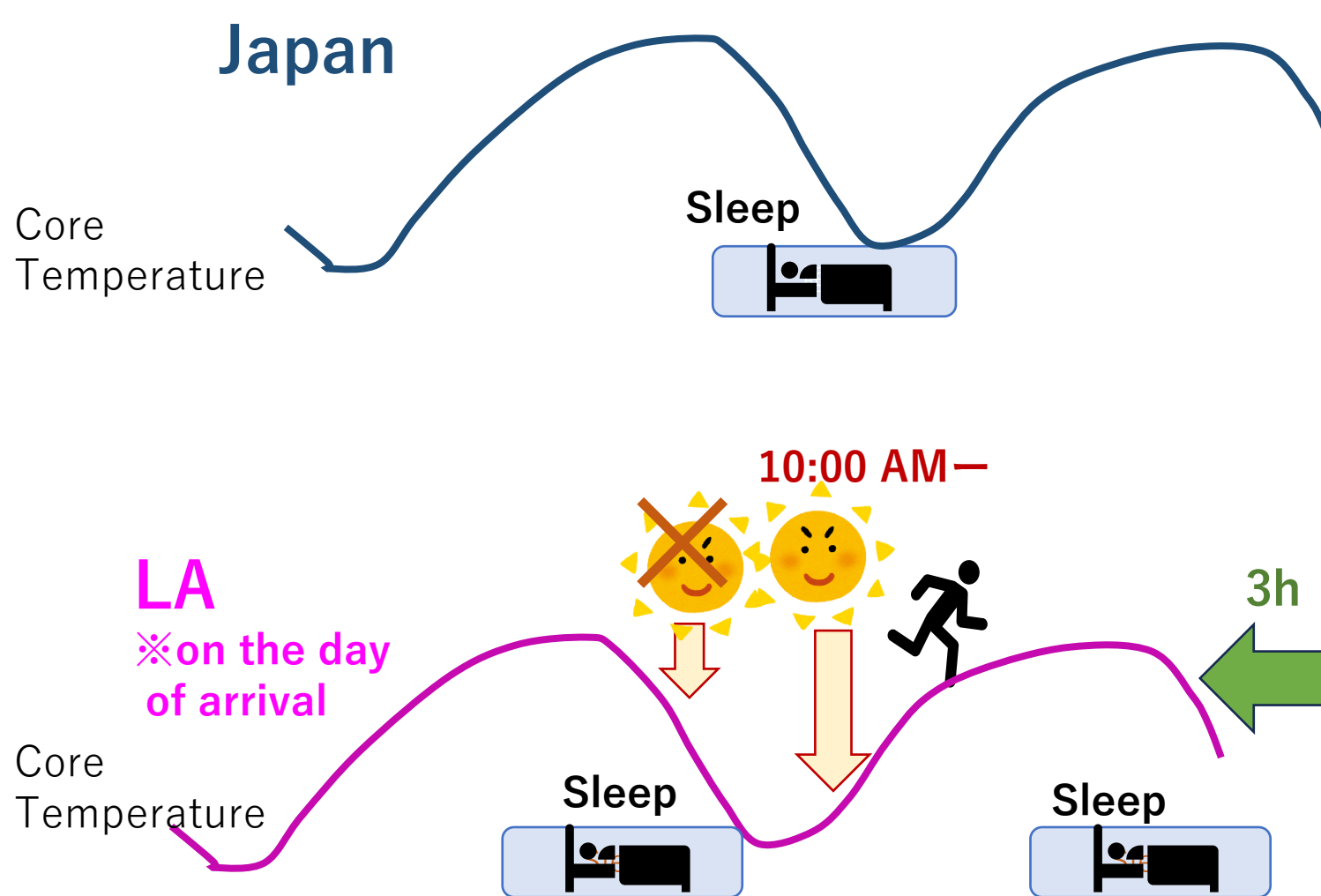
Figure 2. Core body temperature nadir phase advances on each experimental day. Statistically significant differences among days are indicated on the figure. * $p < 0.05$; ** $p < 0.01$.

4.5 h / 6 days

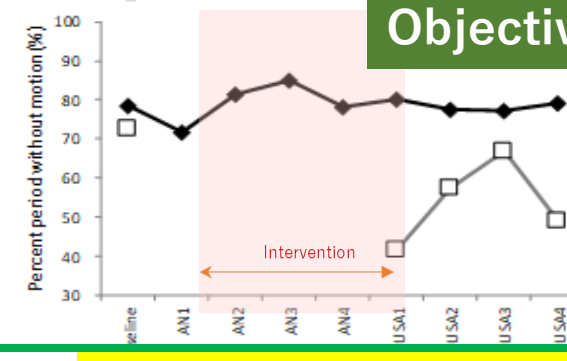
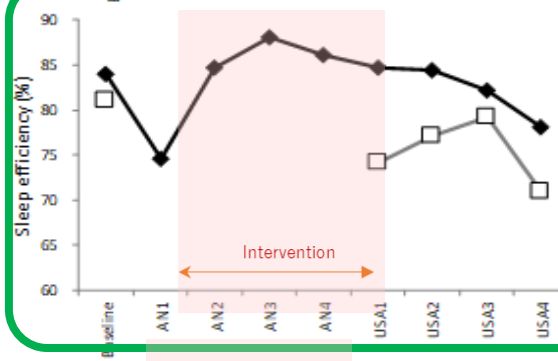
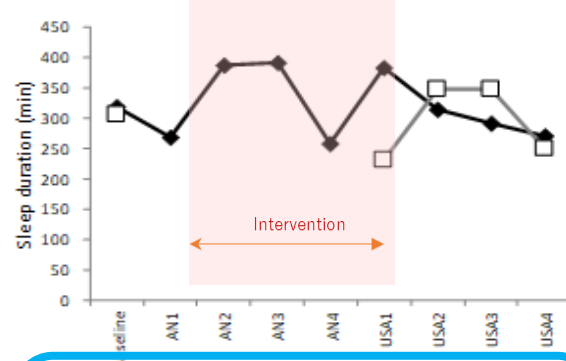
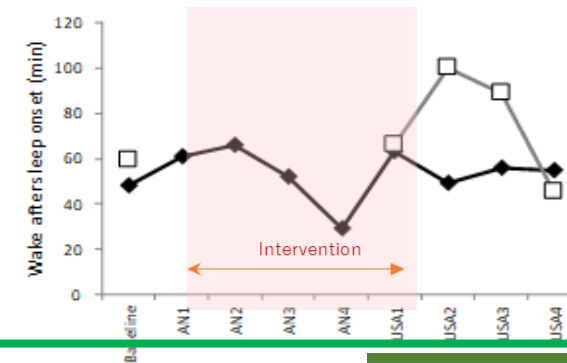
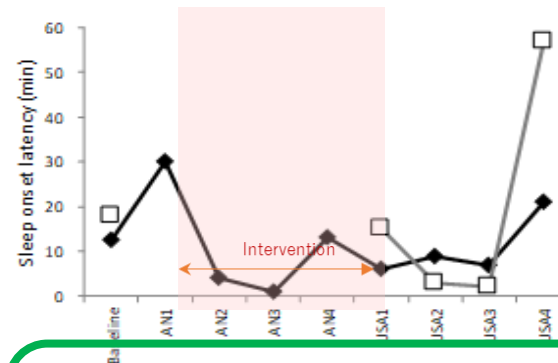
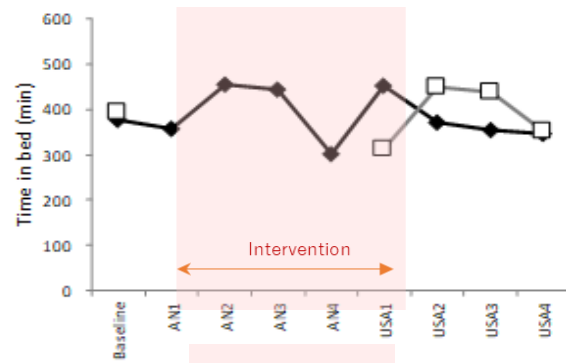
Without pre-flight circadian phase-shift



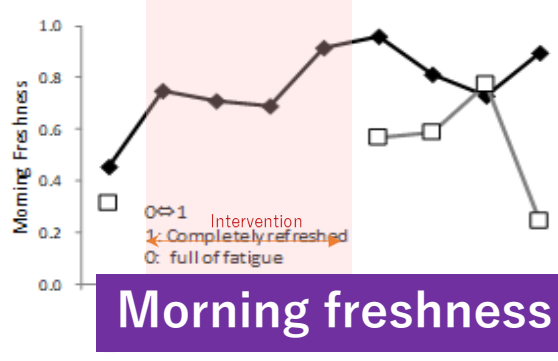
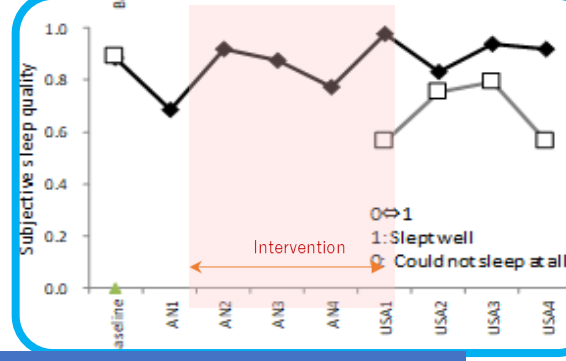
After 4days of pre-flight circadian phase-shift intervention (3h)



Effects of pre-flight circadian phase-shift intervention on sleep



Objective sleep quality



Morning freshness

The athlete traveled twice from Japan to the same city in the United States. Time difference was 9 h.

◆ : With intervention
□ : Without intervention

Subjective sleep quality

(Hosihkawa et al., Sleep Biol Rhythm, 2018)



https://brightlight-store.ovtp.net/price/post_15.html



**In our dormitory
(Athlete village)**

Gradual Advance of Sleep-Wake Schedules Before an Eastward Flight and Phase Adjustment After Flight in Elite Cross-Country Mountain Bikers: Effects on Sleep and Performance

Lucas Garbellotto,^{1,2} Elisabeth Petit,¹ Emmanuel Brunet,² Sandrine Guirronnet,² Yvan Clolus,² Valérie Gillet,³ Hubert Bourdin,^{4,5} and Fabienne Mougin¹

J Strength Cond Res 37(4): 872–880, 2023

Participants: 6 elite cross-country mountain bikers



1,500 lux, 20 min
Sleep schedule shift
melatonin

Circadian Shifts
2.5 h / 6 days

<https://weatherly.jp/SHOP/43-001.html>

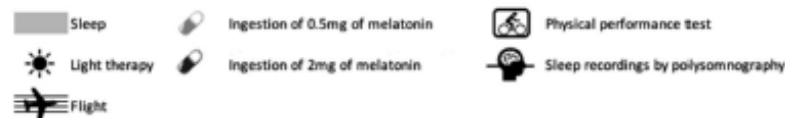
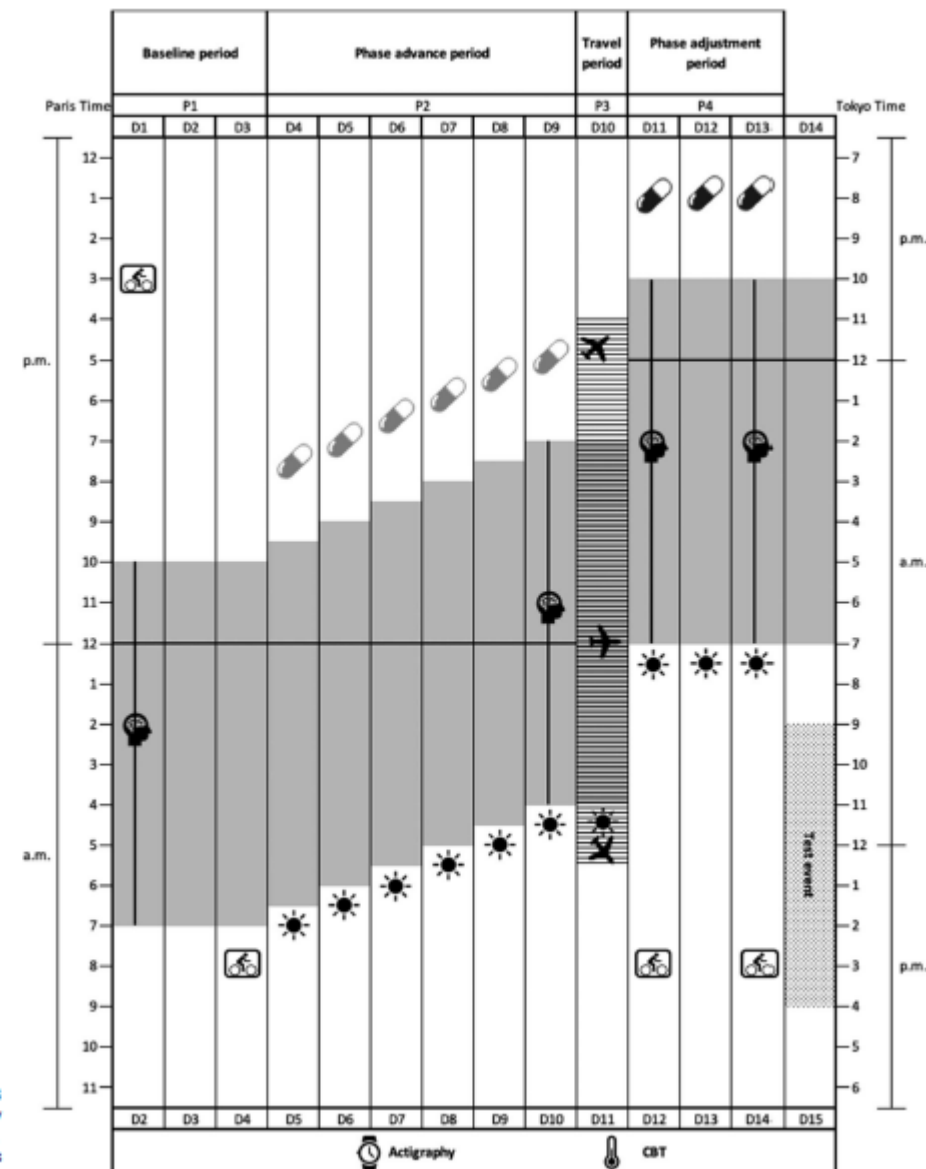


Figure 1. Raster plot of the experimental protocol for an athlete going to bed at 10:00 PM and getting up at 7:00 AM. For 3 baseline days (D1 to D3), sleep episodes were scheduled from 10:00 PM to 7:00 AM. Thereafter, the bedtime was gradually advanced resulting in a 3-hour advance (30 minutes each day) of the bedtime over 6 days (D4 to D9). Then, at destination, sleep-wake schedules were resynchronized to Japanese time (D11 to D14). Melatonin was given at a dose of 0.5 mg, 2 hours before bedtime, from D4 to D9, then the dose was increased to 2 mg from D11 to D13. Immediately after waking up, athletes were exposed to 20 minutes of light therapy at 1,500 lux from D5 to D14.



Testing Light Glasses (30 min)

Participants: healthy 8 persons

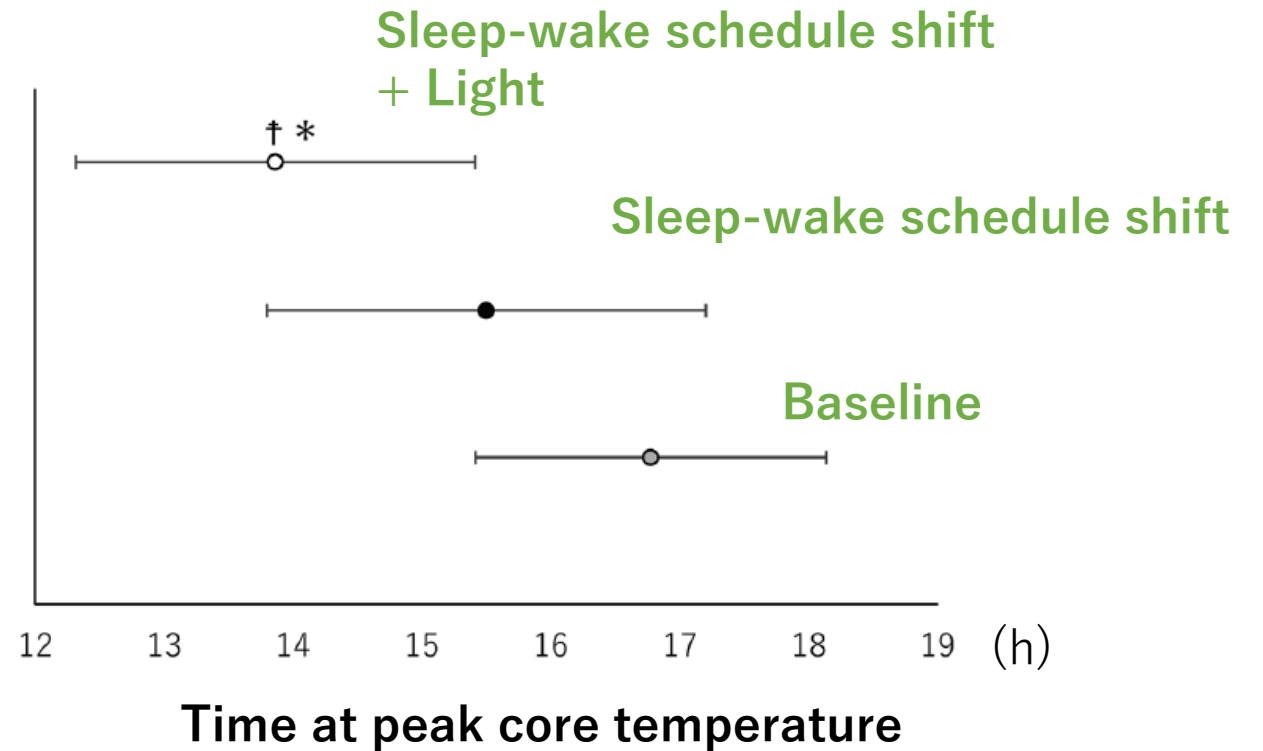


Light glasses

<https://www.dencom.co.jp/product/lg/index.html>



Core temperature
(CorTemp, HQ Inc.)



Sleep-wake schedule shift : 1 h / 6 days
Sleep-wake schedule shift + Light : 3 h / 6 days

(Ando, Journal of Training Science for Exercise and Sport, 2024)

-3 year

-2 year

-1 year

Trials

The Game



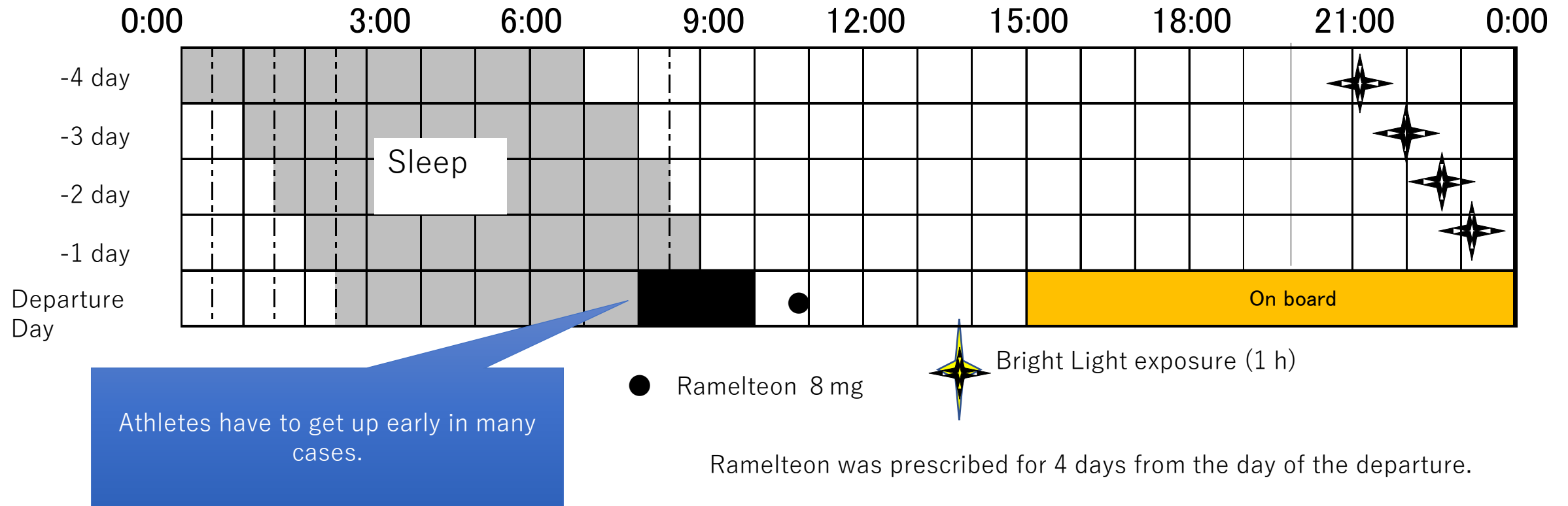
Experiment / Field study

[illegible]

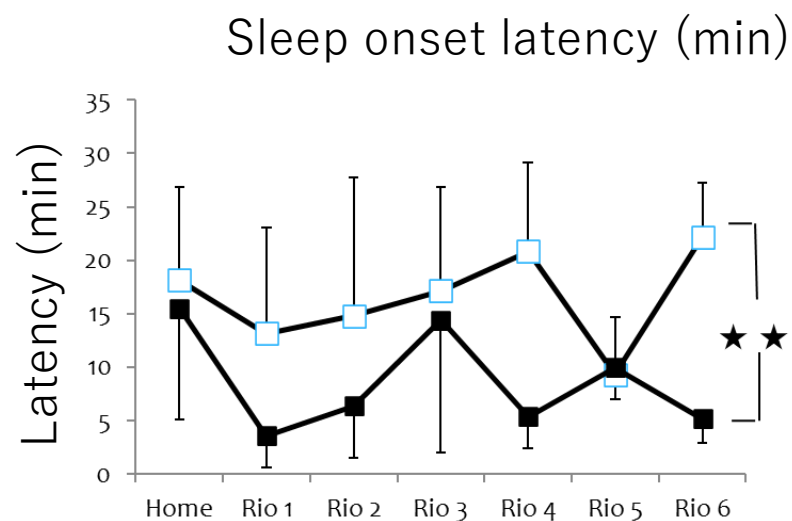
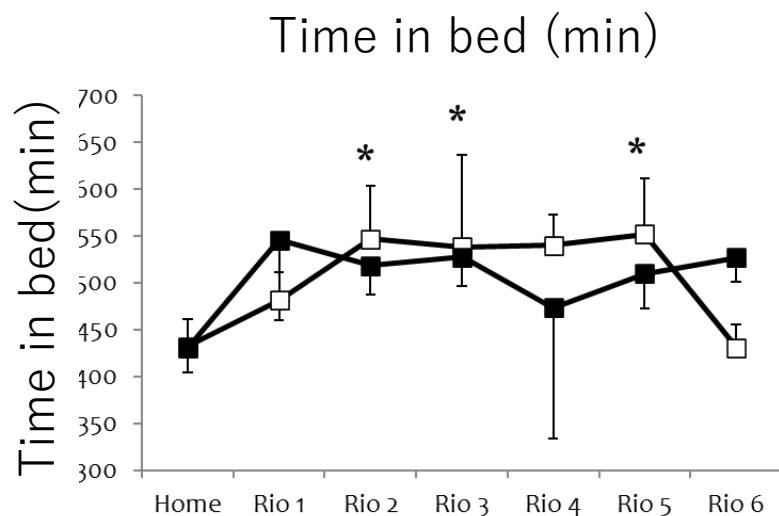
Rio 2016



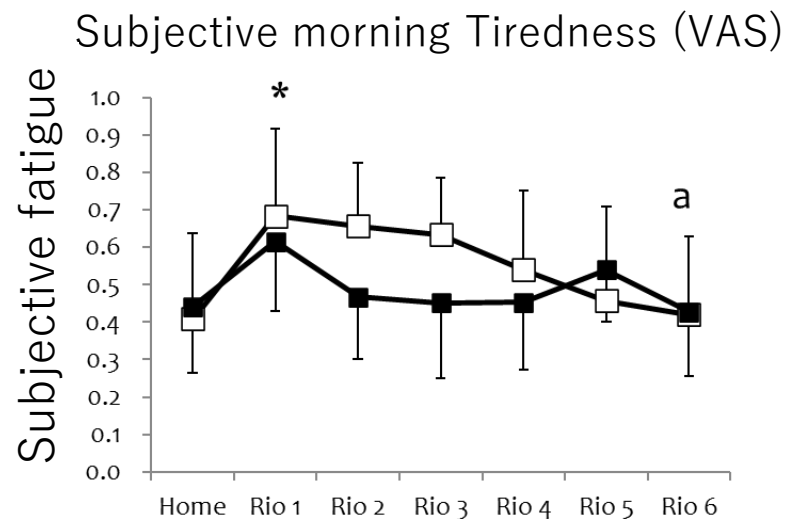
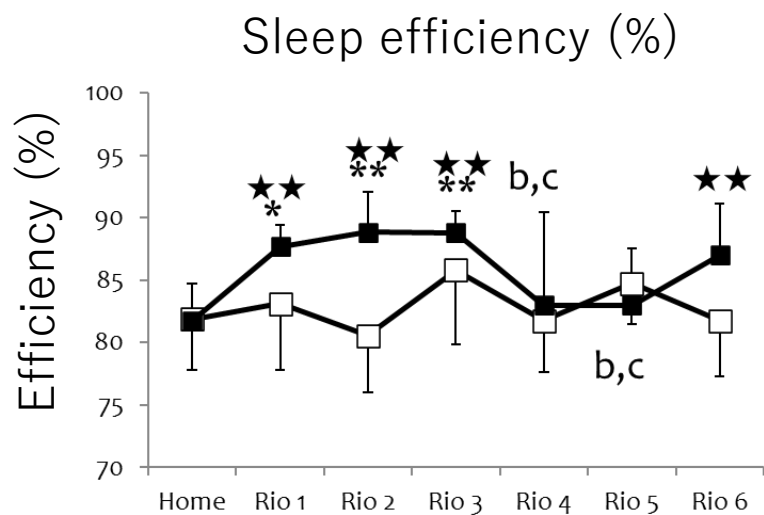
. Pre-flight circadian phase-shifting approach for westward transition



Sleep parameters after a 12-time zone transition



■ with intervention
□ without intervention



Hoshikawa et al.,
J Strength Cond Res, 2020

PARIS 2024

7-h time
differences

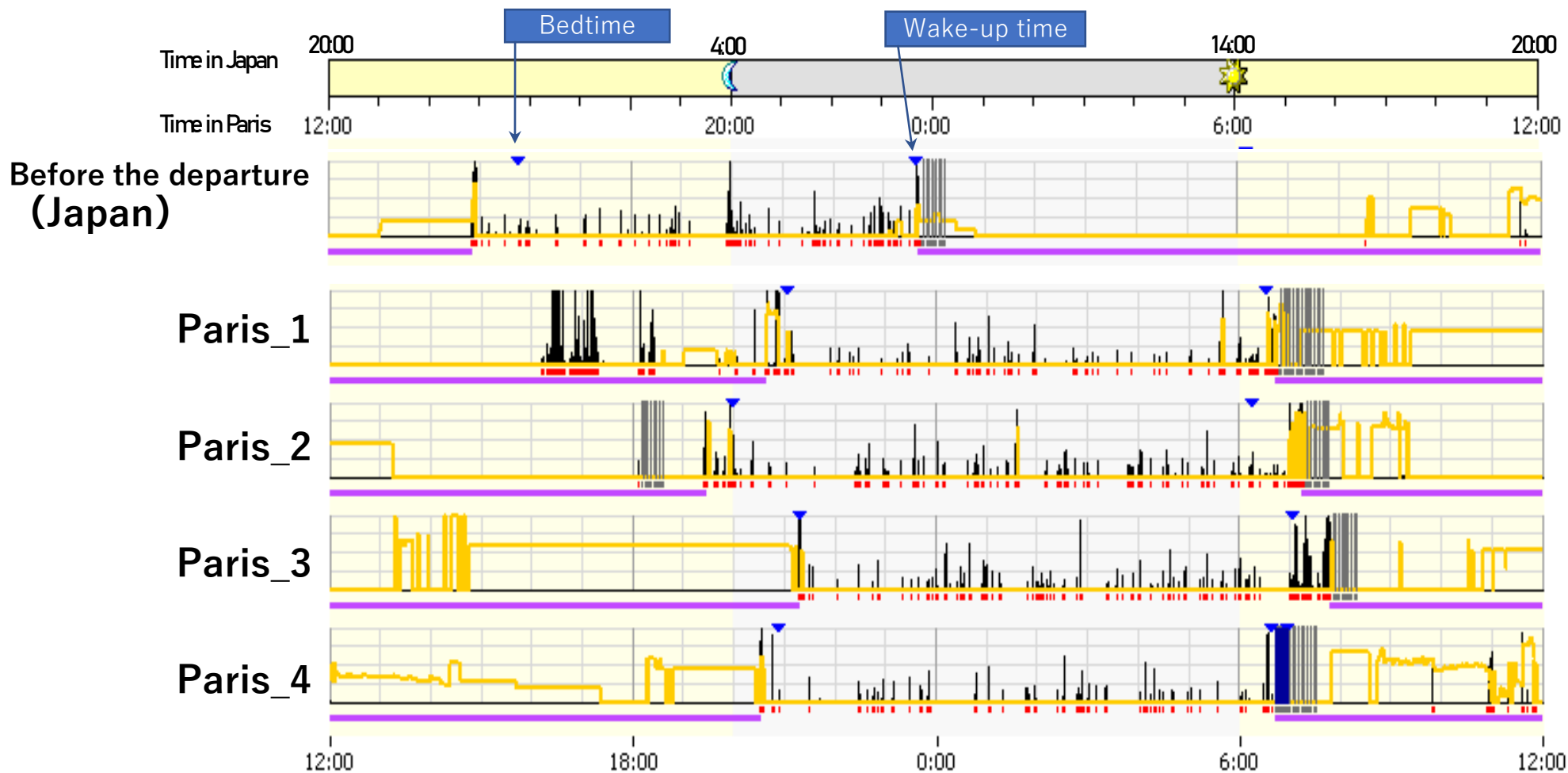


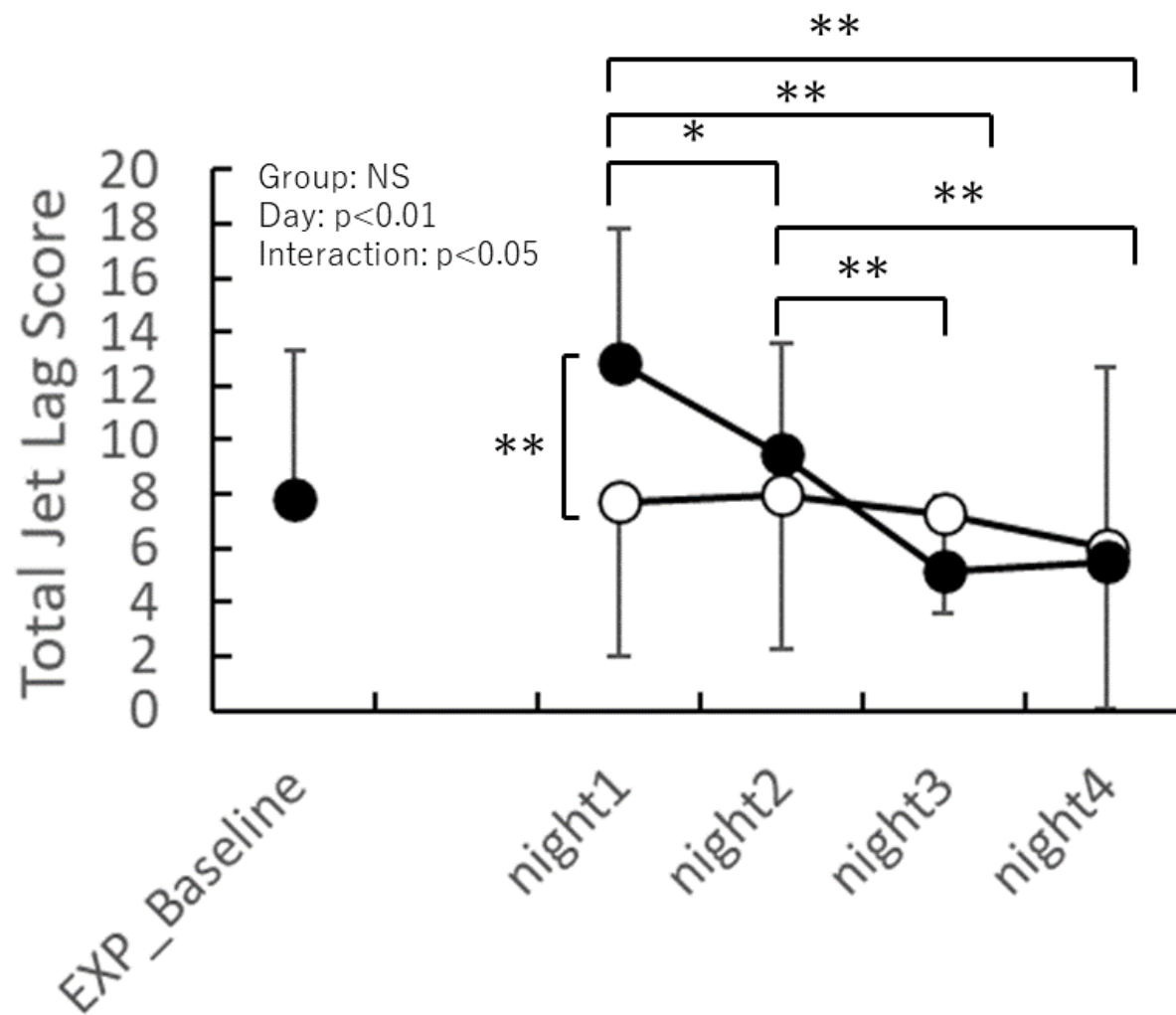
Physical condition of athletes after international flights

Jet Lag
+
Fatigue

Mismatch between circadian rhythm and the social 24-h rhythm at the destination area

Fatigue during travel and after arriving at destination area





- Japan → Paris (night1-4)
- Japan (night1-4)

