

Sleep apnea as a health-related cause of accidents

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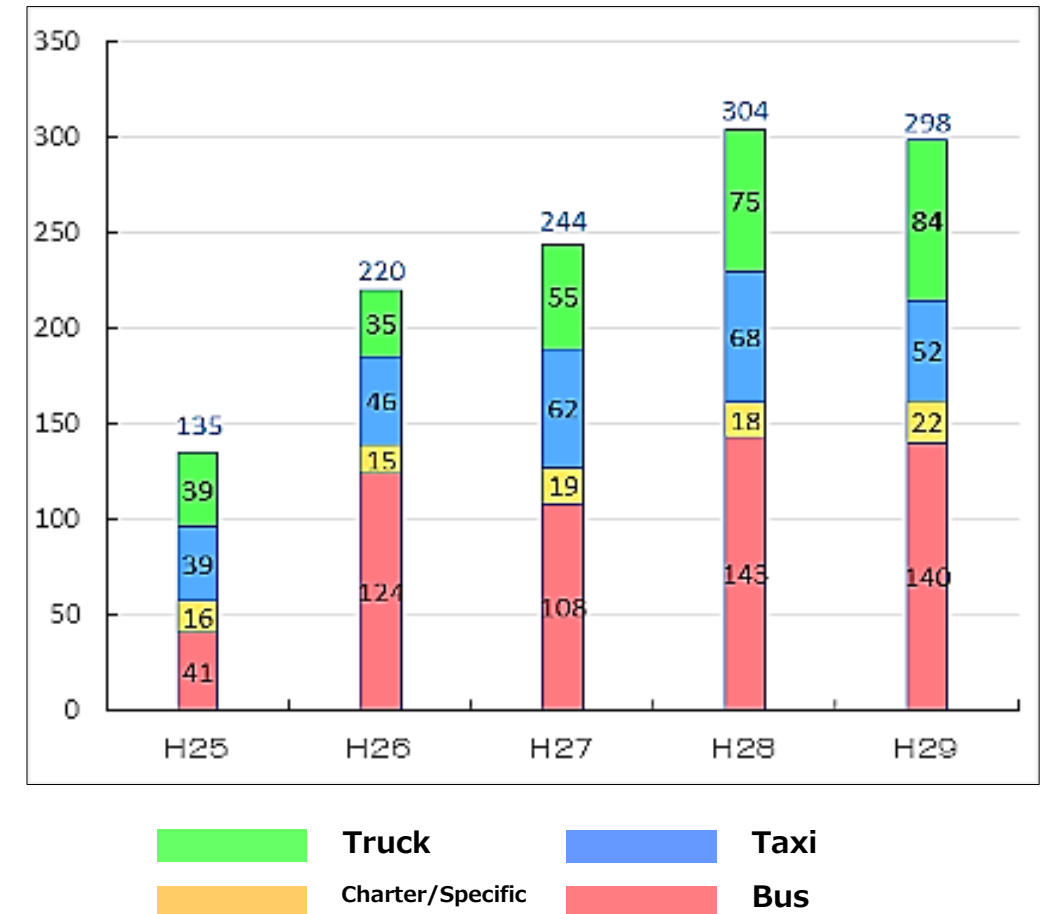
Takeshi Tanigawa M.D., Ph.D



Health-related accidents

- ❖ The Ministry of Land, Infrastructure, Transport and Tourism, Japan requires transport companies to report health-related accidents
- ❖ “The driver’s illness made it impossible to continue driving a commercial vehicle”
 - (Article 2 of the Automobile Accident Reporting Regulations)

Number of accident reports due to health condition
(Number of cases by business type)



Highway bus driving accident on the Kanetsu Expressway

❖ April 29, 2012

- Near the Kanetsu Expressway (in-bound line) Fujioka Junction
- A tour bus crashed into a soundproof wall due to drowsy driving
- 7 passengers were killed, and 39 passengers and crewmembers were injured in the crash
- **The driver was diagnosed with chronic sleep deprivation and moderate sleep apnea**

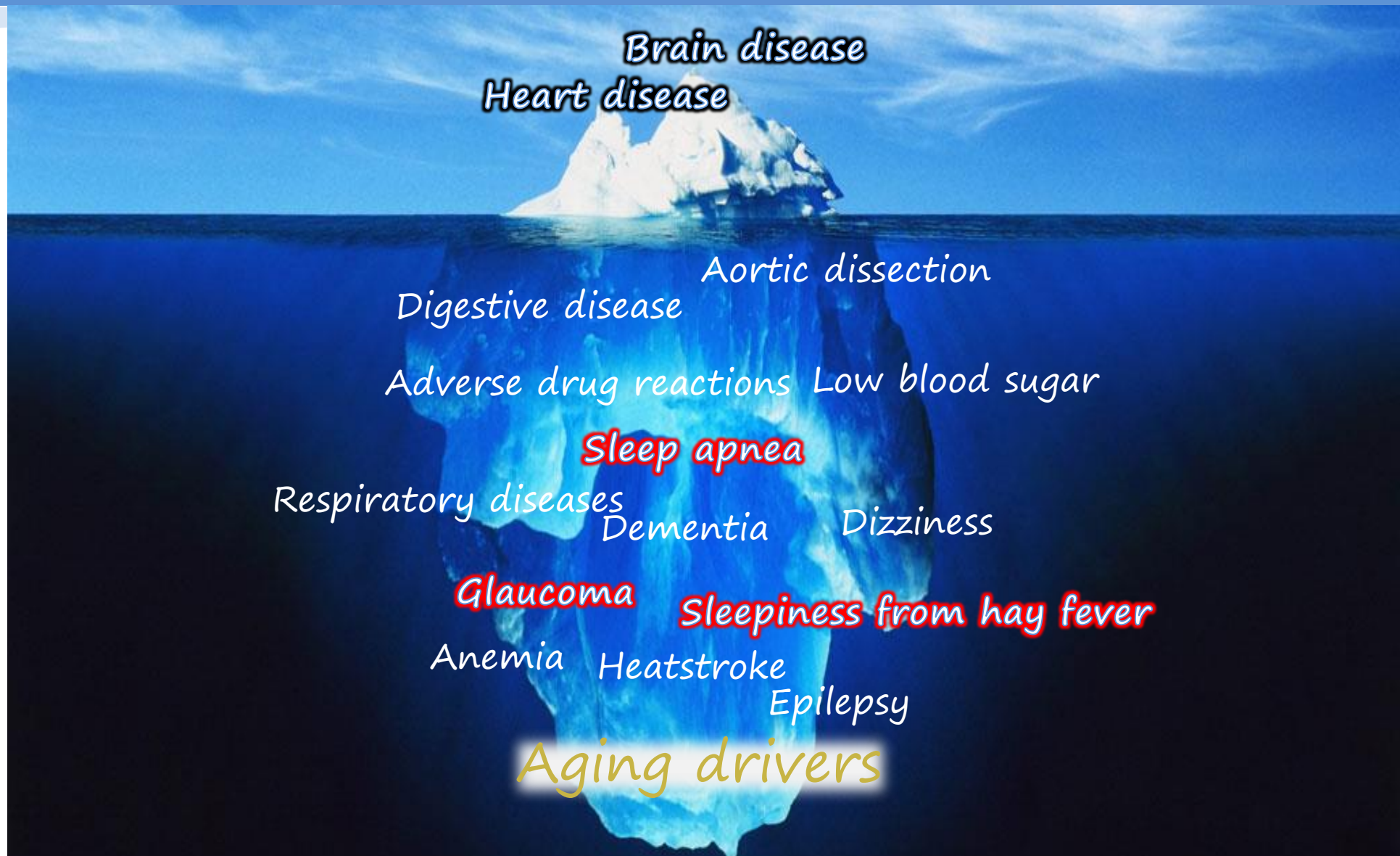


Karuizawa ski bus crash

- ❖ January 15, 2016
- ❖ In Karuizawa city, Nagano prefecture
- ❖ A large-tour bus crashed into a guardrail and fall off the side of the road **due to the loss of consciousness of the driver**
- ❖ 15 of the 41 crewmembers and passengers were killed and all other survivors were injured

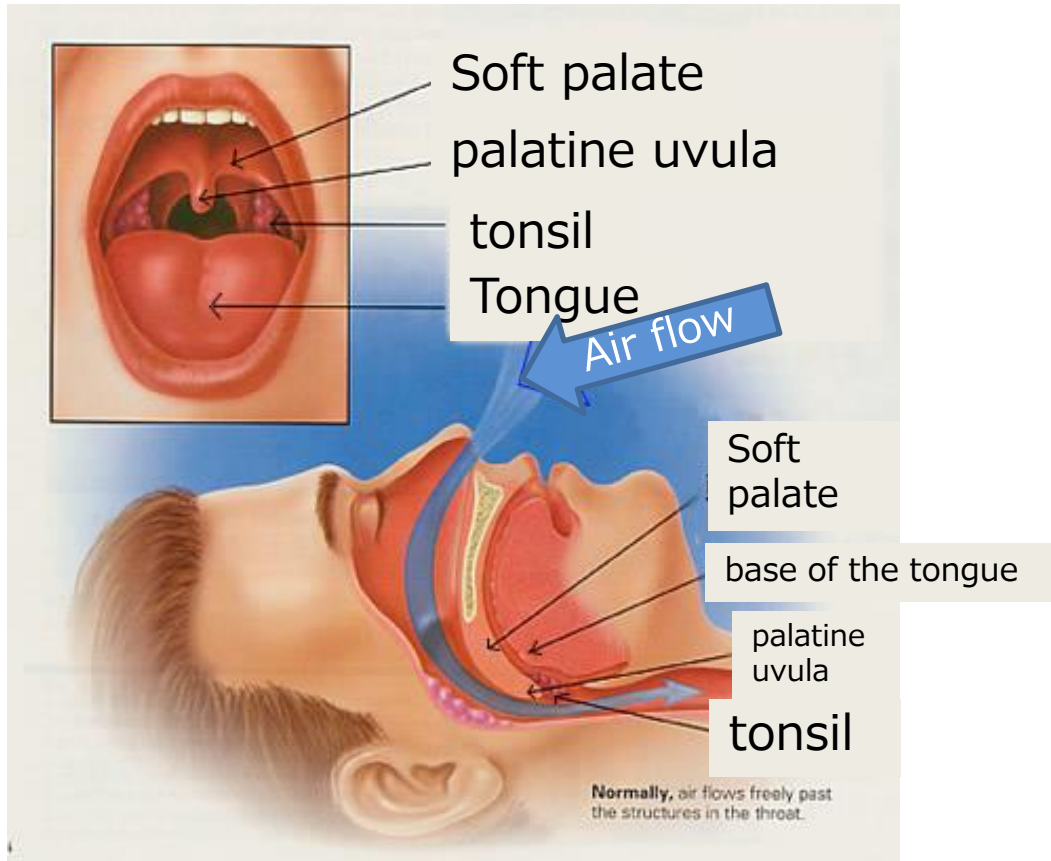


The cause of health-related accidents is just the tip of the iceberg!



Obstructive sleep apnea, OSA

Normal



In normal situations, even if you sleep in the supine position, the upper respiratory tract doesn't close and airflow is maintained

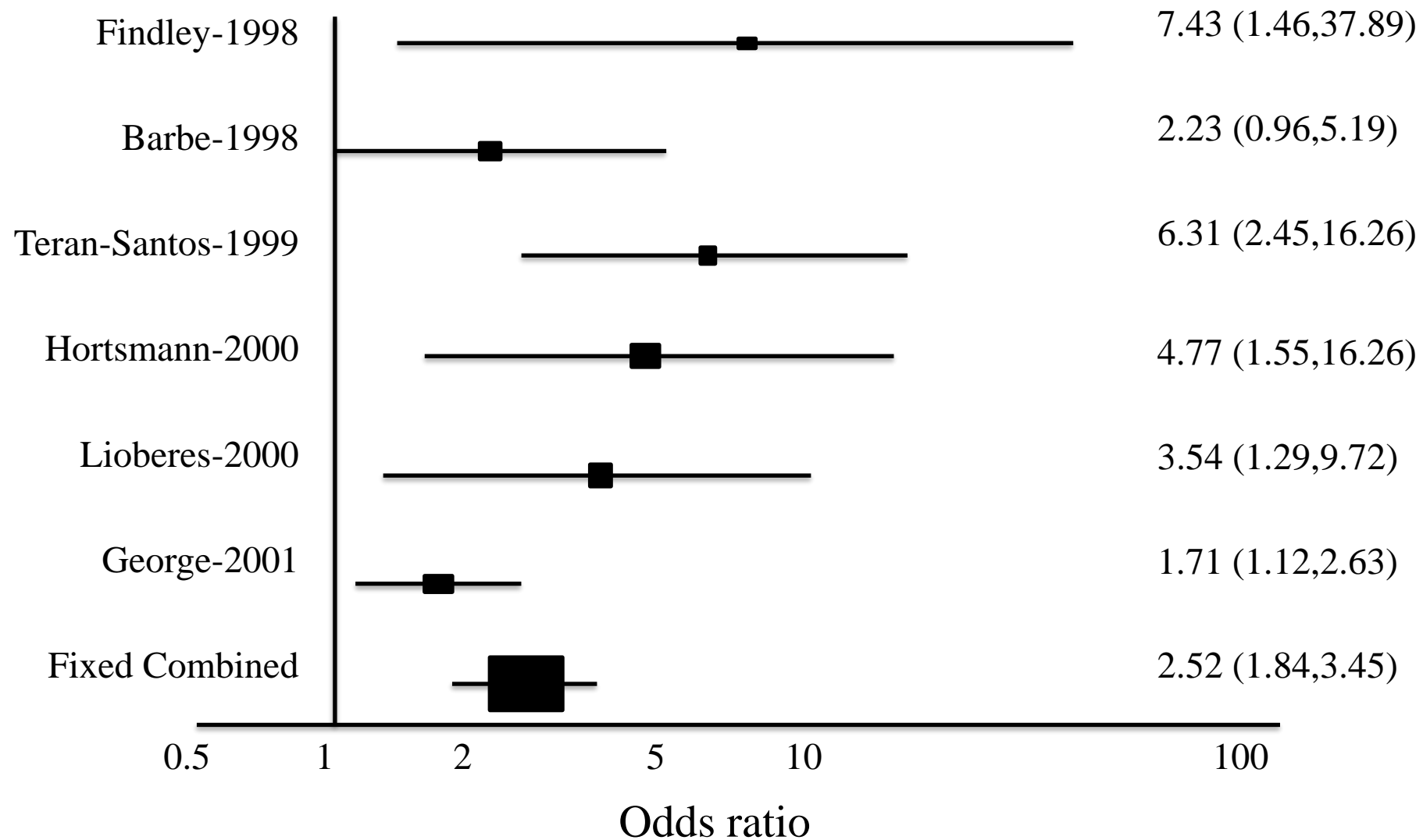
OSAS



Upper respiratory obstruction and disruption of airflow

- Frequent oxygen deficiency
 - Awakening occurs in order to open the airway, resulting in fragmented sleep.
- As a result, sleep quality is deteriorated and next day drowsiness is increased.

An average threefold increase in accidents due to OSA



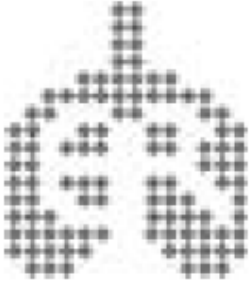
Development and dissemination of OSA screening services

- ❖ Development and dissemination of a system that can examine OSAS patients easily and efficiently
- ❖ Inspection system
 - Development of a flow sensor which captures the flow of breath by placing a sensor between mouth and nose overnight; the number of apneas or hypopneas are recorded while sleeping at home.



Development of automatic detection system

Eur Respir J 2007; 29: 728–736
DOI: 10.1183/09031936.00091206
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Automatic detection of sleep-disordered breathing from a single-channel airflow record

H. Nakano*, T. Tanigawa[#], T. Furukawa* and S. Nishima*

Validation study

Eur Respir J 2008; 32: 1060–1067
DOI: 10.1183/09031936.00130907
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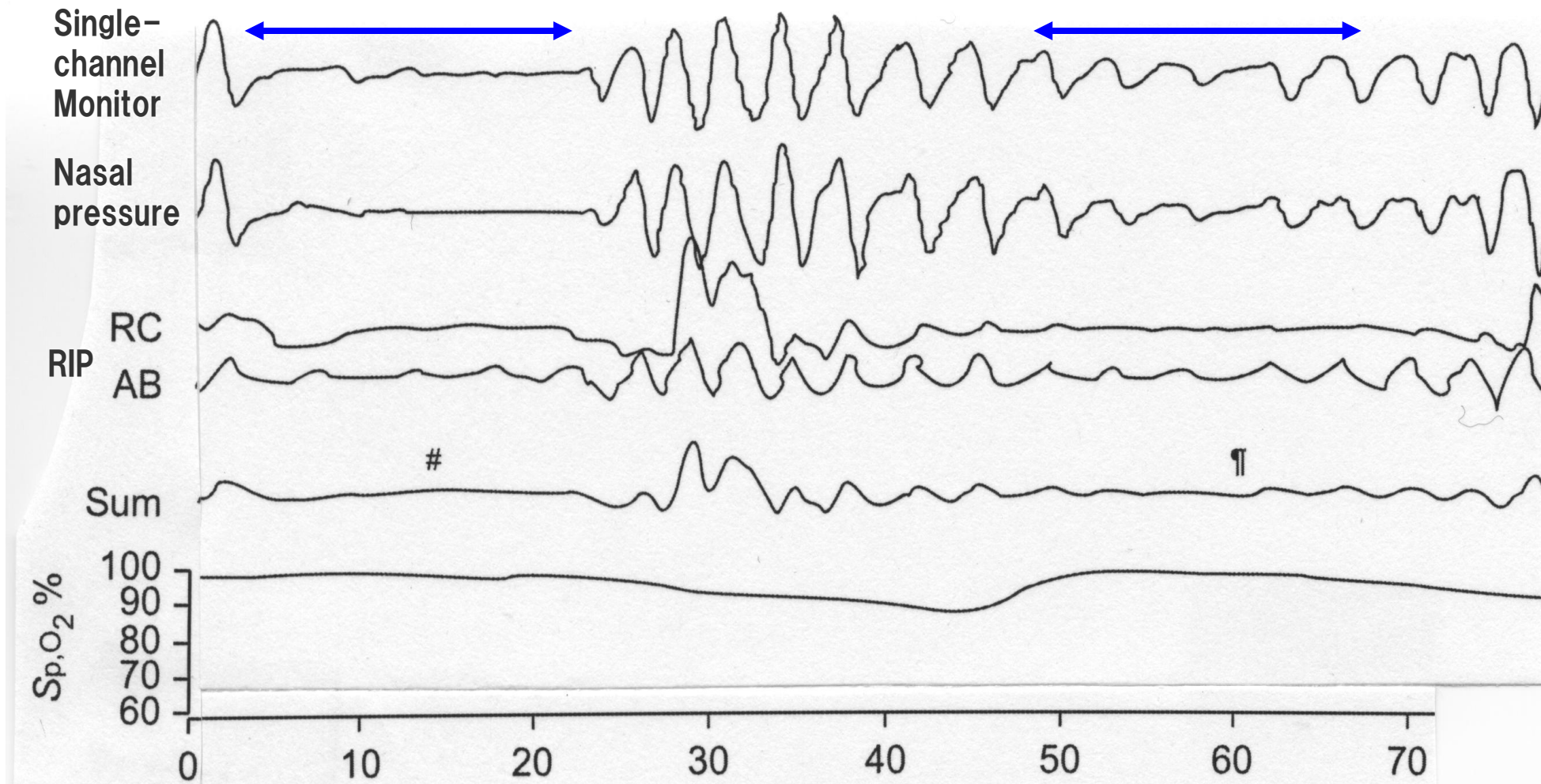


Validation of a single-channel airflow monitor for screening of sleep-disordered breathing

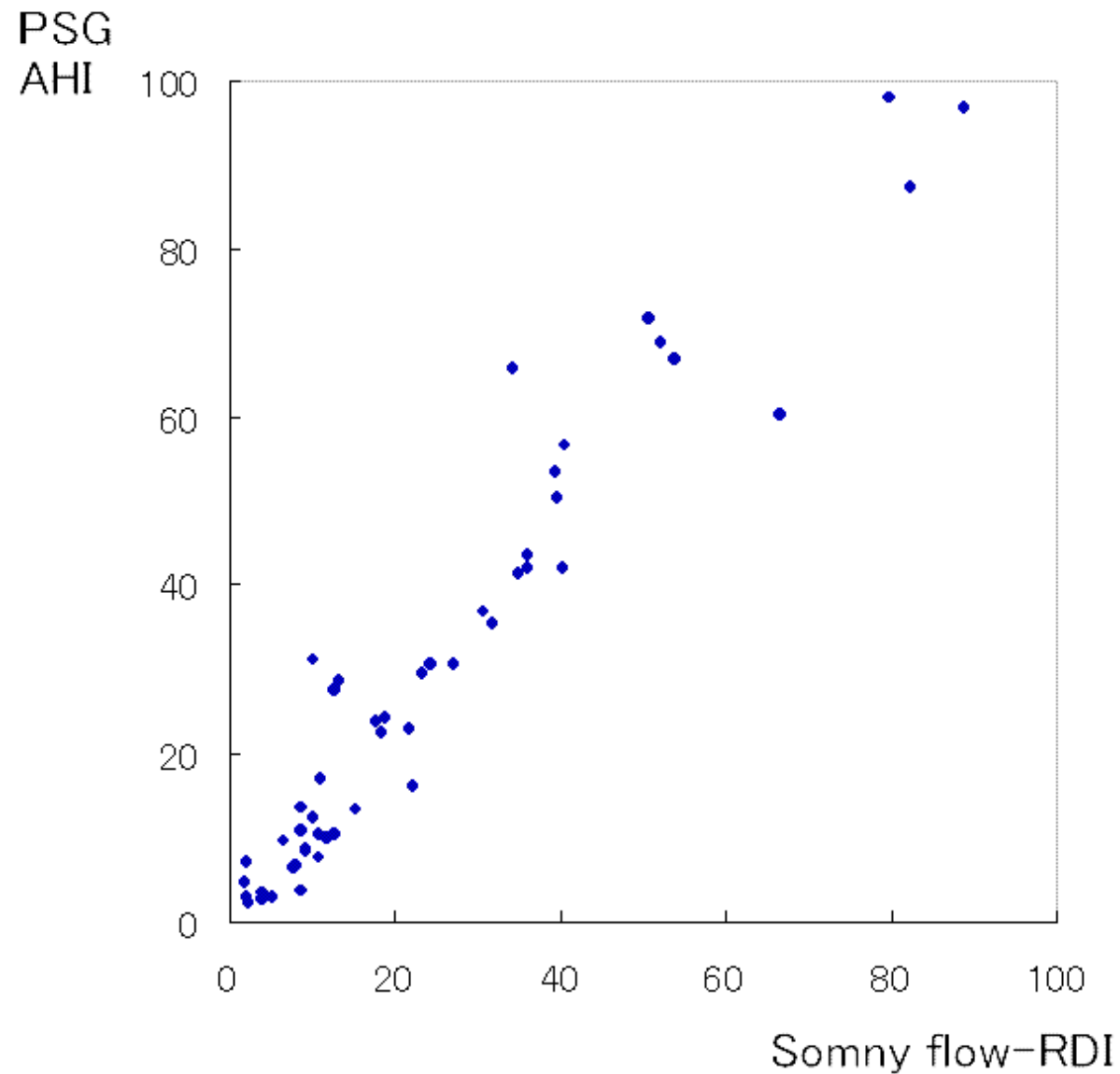
H. Nakano*, **T. Tanigawa[#]**, **Y. Ohnishi[¶]**, **H. Uemori***, **K. Senzaki[¶]**,
T. Furukawa* and **S. Nishima***

Apnea

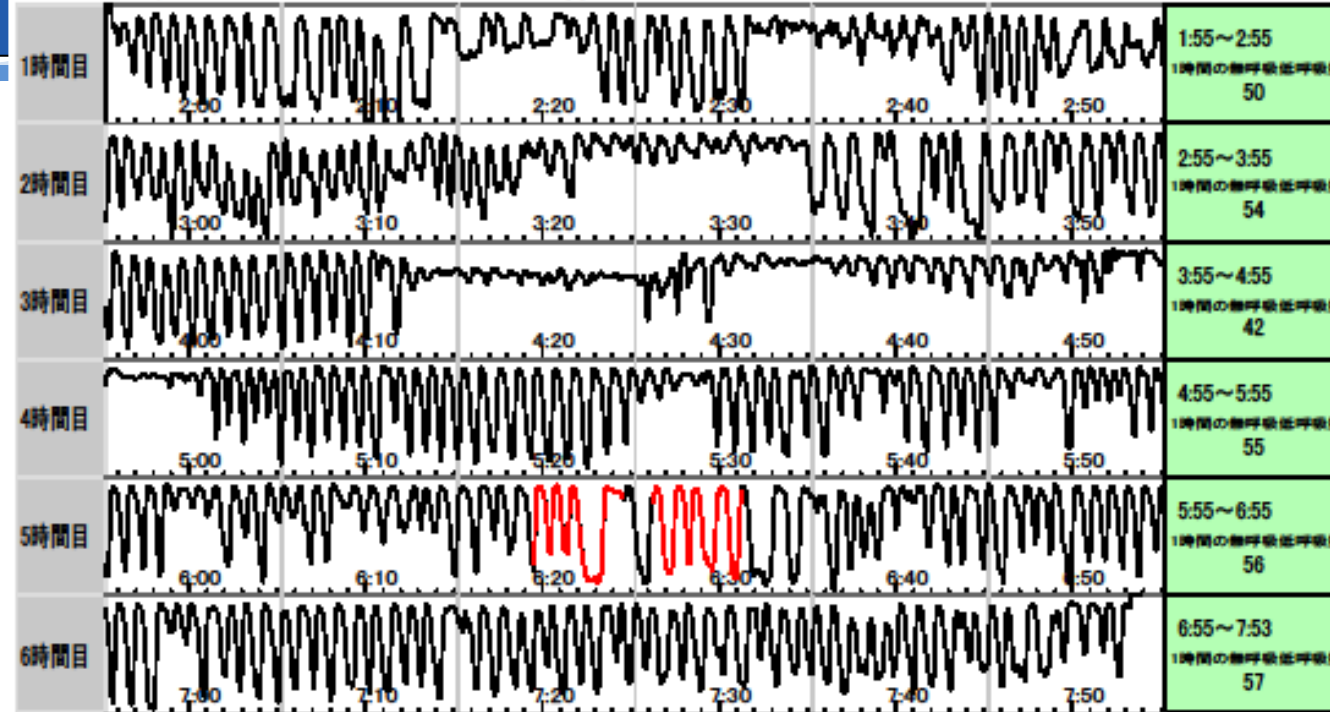
Hypopnea



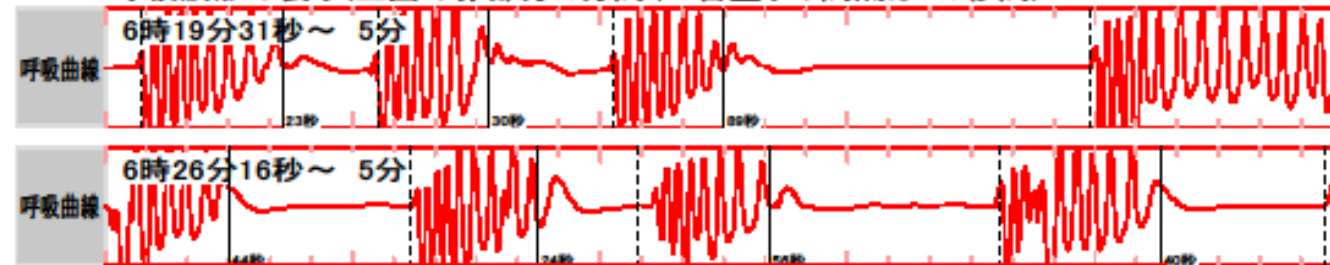
Validity of flow sensor method



呼吸パワートレンドグラフ:1段1時間



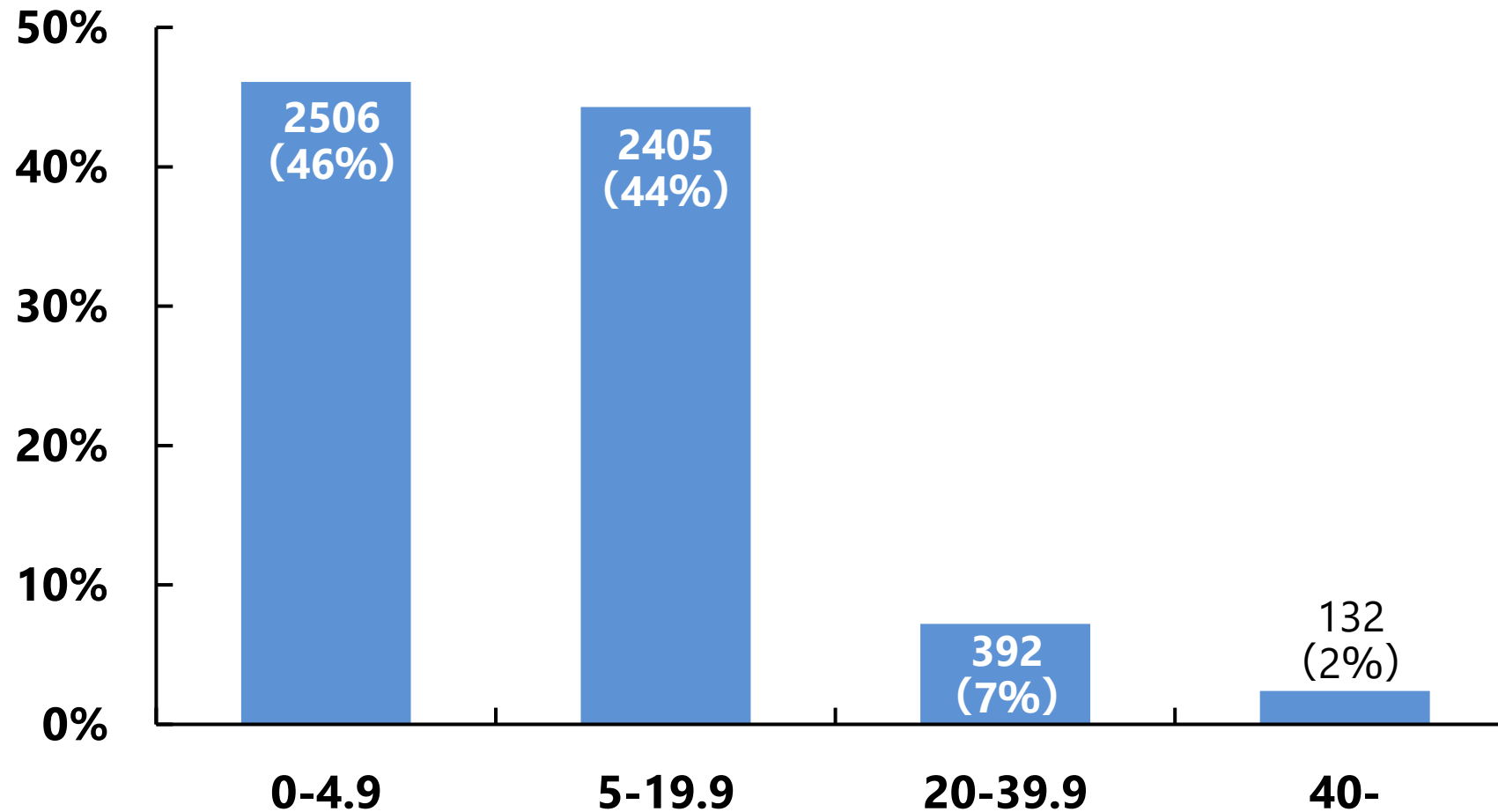
呼吸波形の表示(上図の赤部分 5分間:1目盛りの間隔は10秒間)



無呼吸指数	43.7/時間
平均持続時間	30.9秒
総無呼吸低呼吸指数	52.5/時間

Prevalance of OSA among All-Japan Trucking Association member drivers

❖ 5,435 men aged 20-65, by severity



RDI: Apnea-hypopnea index, number: number of people

Is OSA screening using self-reported sleepiness recommended?

Comments on driving by people with OSA

❖ 2004 Ministry of Health, Labor and Welfare commissioned research

- **Survey on the effects of sleep apnea on occupational safety**

Case 1

I had already arrived at my destination but **had no recollection** of driving there. While driving on the highway, **I hadn't realized** that I crashed into the highway exit until it had already happened. Other than that, I tend to often nick the barriers.

Case 2

I often fall asleep while driving and have had five rear-end collisions in the last 10 years.

Case 3

While in traffic, **I suddenly realized** that the car in front of me had already moved. After that, traffic ahead continued to stop and go, however, despite me stepping on the brake, I ended up rear-ending the car in front of me. **I don't remember exactly** what happened. I felt like I had forcefully pressed on the brake, however, I still rear-ended the car.

Case 4

While driving my motorcycle, I fell asleep and **didn't notice** that I had rear-ended a car in front of me until it had already happened.

Case 5

While driving about 12 times this past year I have dozed off, **not realizing** that I had rear-ended cars in front of me who were waiting at the traffic light until I had rear-ended them.

Daytime sleepiness (ESS Questionnaire)

In the following situations, excluding being just tired, how often do you fall asleep?

Please select an applicable score.

0 **Never** have I felt drowsy (or fell asleep) 1 I have **sometimes** felt drowsy (or fell sleep)
2 I have **often** felt drowsy (or fell asleep) 3 I **always** feel drowsy (or fall asleep)

(1) When I'm sitting and reading something	0	1	2	3
(2) While I'm watching TV	0	1	2	3
(3) When other people are here with me in public spaces and are not moving but just sitting (at a meeting, in a theater, etc.)	0	1	2	3
(4) When someone is driving me, and we don't have a break for about an hour	0	1	2	3
(5) When I take a break in the afternoon, I lay down	0	1	2	3
(6) When I'm sitting and talking with people	0	1	2	3
(7) After lunch (with no alcohol), when I'm just sitting quietly by myself	0	1	2	3
(8) In a car, while stopped in traffic	0	1	2	3

Relationship between sleepiness and the prevalence of OSA

- ❖ Judging by ESS scores alone, there is a risk of overlooking 76% of those who have severe OSA

		Sleep Apnea				Total
		Normal (RDI <5)	Mild (RDI 5-<20)	Moderate (RDI 20<40)	Severe (RDI ≥40)	
Weak ↑ Sleepiness ↓ Strong	ESS 0-5	1,457 (47%)	1,391 (45%)	201 (7%)	46 (1%)	3,095 (100%)
	ESS 6-10	774 (46%)	725 (43%)	138 (8%)	52 (3%)	1,689 (100%)
	ESS 11-15	142 (39%)	170 (46%)	34 (9%)	23 (6%)	369 (100%)
	ESS 16-20	37 (39%)	44 (47%)	5 (5%)	8 (9%)	94 (100%)
Total		2,410 (46%)	2,330 (44%)	378 (7%)	129 (3%)	5,247 (100%)

Source: Takeshi Tanikawa, Hiroyasu Iso: "Construction of a traffic accident prevention system by screening for sleep apnea disorders of professional drivers" 2006 Grant-in-Aid for Scientific Research (Ministry of Education, Culture, Sports, Science and Technology) Report

Be careful about NOSSA ! !

❖ **NOSSA : non sleepy sleep apnea**
⇒ **sleep apnea without subjective drowsiness**

【Subjective symptoms】

- Chronic fatigue
- Depression
- Loss of concentration
- Decreased memory
- Irritability
- Headache when waking up
- Nocturia
- ED
- Two or more rear-end collisions
- Frequent traffic accidents/Industrial accidents



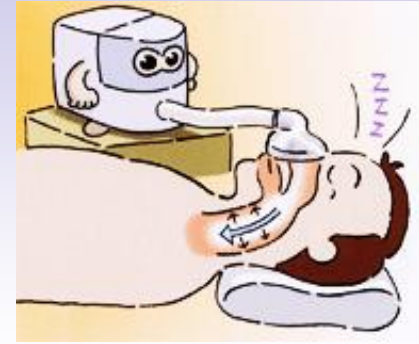
Established OSA treatment

Weight loss, smoking cessation, sobriety, losing weight due to sleeping pills



Lifestyle improvement

Continuous Positive Airway Pressure



nCPAP nasal continuous positive airway pressure

Treatment is symptom dependent

Oral device

PMA(Prosthetic mandibular advancement) and Tongue retaining device (TRD)

一体型

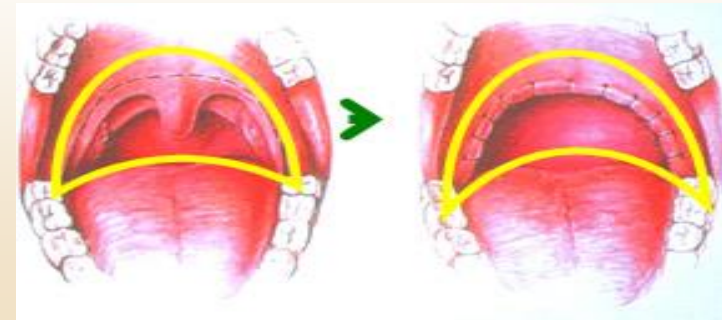


分離型



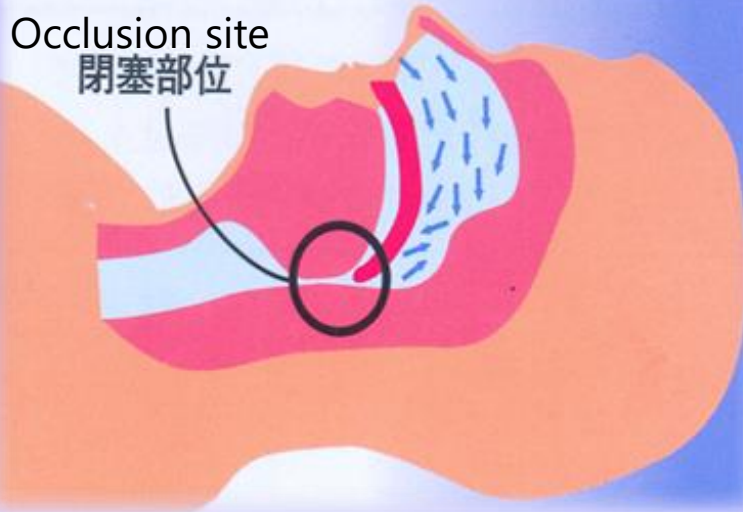
Surgical operation

Uvulopalatopharyngoplasty (UPPP) and laser assisted uvula palatoplasty (LAUP)



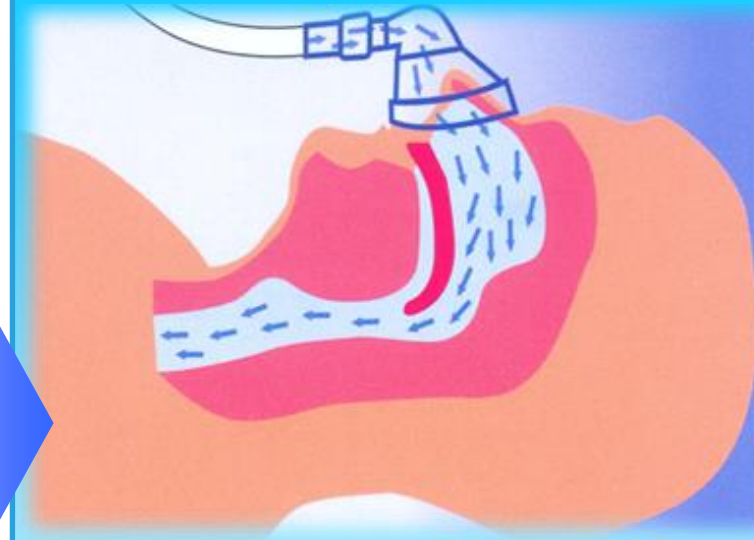
Principle of CPAP

Obstructive sleep apnea syndrome



Obstructive sleep apnea syndrome causes airway obstruction due to blockage of the soft palate and tongue base, resulting in apnea.

CPAP treatment



nCPAP, through a nasal mask, sends constant positive air pressure to widen the upper airway and assist patency of the upper airway.

Effect of CPAP treatment

- ❖ Apnea, hypopnea, snoring disappearance
- ❖ Improved sleep quality
- ❖ Disappearance of daytime sleepiness
- ❖ Increased daytime activity
- ❖ Reduction of nocturnal urine
- ❖ Improved high blood pressure
- ❖ Improved cardiac function
- ❖ Improved QOL
- ❖ **Decrease in traffic accident rates**

Effect of OSA measures

Early detection of OSA contributed to safety

- ❖ Personal Data
 - Fixed route bus driver (7 years of experience)
 - 31 years old, male
 - Height 167 cm, weight 79.5 kg, BMI 28.5
- ❖ Before starting treatment
 - **I felt strong drowsiness during the day**
 - **I was worried about continuing my career due to this issue**
- ❖ About the examination consultation
 - I felt drowsy during the day, so I wasn't hesitant to undergo examination.

After treatment

❖ Method of treatment

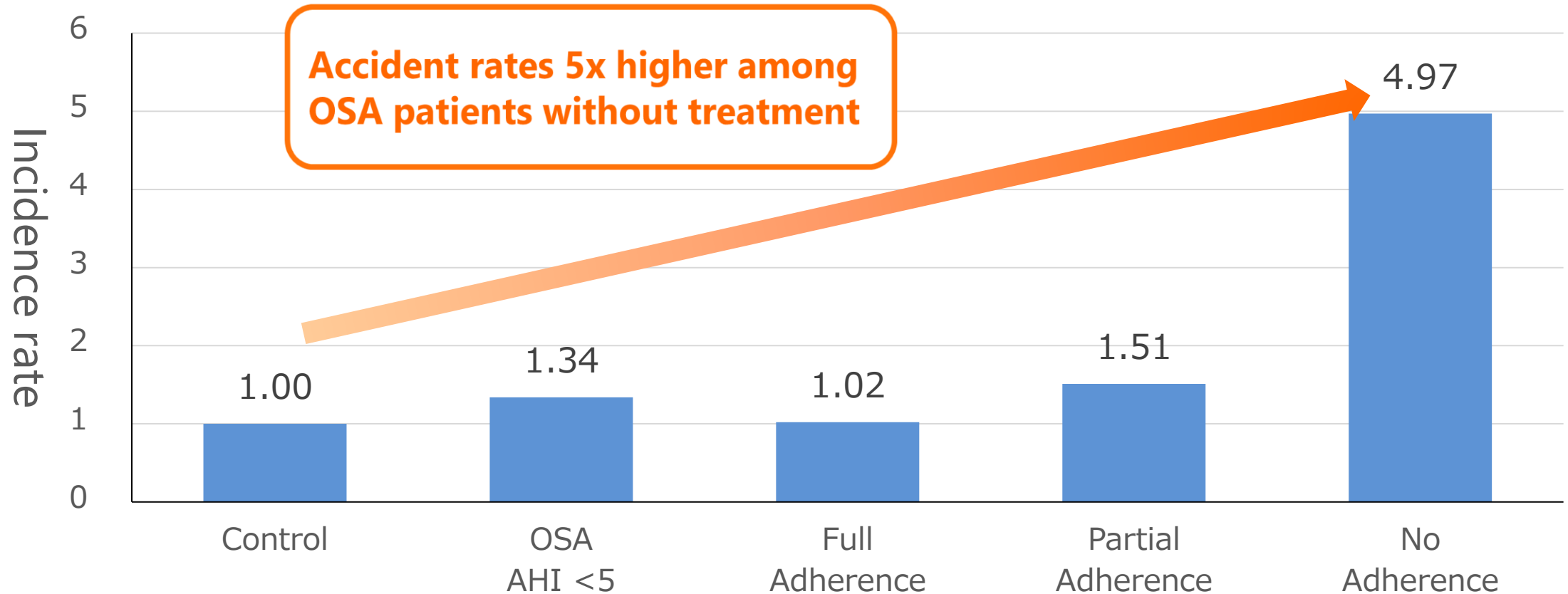
- It took a week or two to get used to wearing the device, but now it's no longer an issue.
- It's not too noisy and it does not bother who sleep near me.

❖ Changes after treatment

- **I slept well and no longer felt drowsy during the day.**
- **I've had increased concentration and less stress and irritability.**

Accident rates increased fivefold among those without treatment

- ❖ Target: 3,732 drivers of the same level of work quantity and quality



Effect of OSA screening follow-up measures

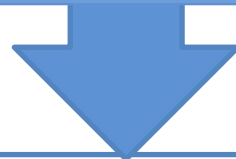
Drowsiness and poor concentration improvement in subjects with OSA

Decrease in accident rate (expected to decrease by 5-17%)



Reduced health risk for people with OSA

Prevention of hypertension, diabetes, myocardial infarction, arrhythmia, and stroke



Lower medical costs

Coming soon!!



❖ Chinese and Thai version movies are available!

Let's collaborate together!

Dr. Apiwat Ratanawaraha (Chulalongkorn University)

Dr. Passakon Prathombutr (Ministry of Digital Economy and Society)

Dr. Agachai Sumalee (Chulalongkorn University)

Dr. Yossapong Laonual (King Mongkut's University of Technology Thonburi)

Dr. Sittha Jaensirisak (Ubonratchathani University)

In 2022, we will conduct a study funded by the IATSS to examine the usefulness of our movies on sleep apnea and visual field disorder.

Let's collaborate together to prevent sleep apnea-related accidents in Thailand!

1906



2020



Thank you for your attention

