

Aircraft noise exposure and saliva cortisol in a pooled-analysis from seven European countries

Clémence BAUDIN¹, Marie LEFÈVRE¹, Jenny SELANDER², Patricia CHAMPELOVIER³, Jacques LAMBERT⁴, Bernard LAUMON⁵, Anne-Sophie EVRARD¹

¹ Univ Lyon, Université Claude Bernard Lyon1, IFSTTAR, UMRESTTE, UMR T_9405, Bron, France

² Institute of Environmental Medicine, Karolinska Institute, Stockholm, Sweden

³ IFSTTAR, Planning, Mobilities and Environment Department, Transport and Environment Laboratory, Bron, France

⁴ IFSTTAR, Currently retired

⁵ IFSTTAR, Transport, Health and Safety Department, Bron, France

ERSA Congress – 30th August 2019



Scientific context

Air traffic is the **2nd most important** source of transport-related noise
(after road traffic)



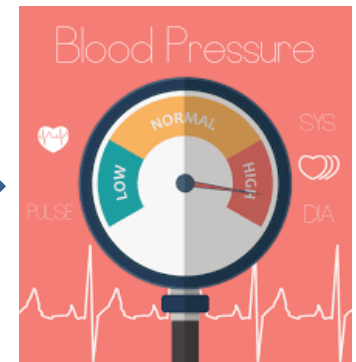
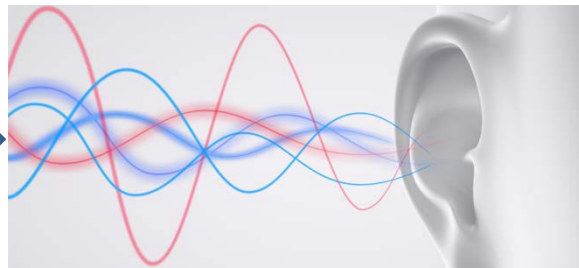
<https://to70.com/aircraft-noise-exposure-around-european-airports/>

Scientific context

→ Literature : Aircraft noise exposure associated to adverse health outcomes

- ✓ Hypertension (*van Kempen et al. 2002*)
- ✓ Ischemic heart disease (*Floud et al. 2013*)
- ✓ Stroke (*Weihofen et al. 2019*)
- ✓ Depressive symptoms (*Seidler et al. 2016*)
- ✓ Anxiety (*Hardoy et al. 2008*)
- ✓ Obesity (*Eriksson et al. 2014*)
- ✓ Diabetes (*Eze et al. 2017*)
- ✓ Adverse birth outcomes (*Knipschild et al. 1981*)

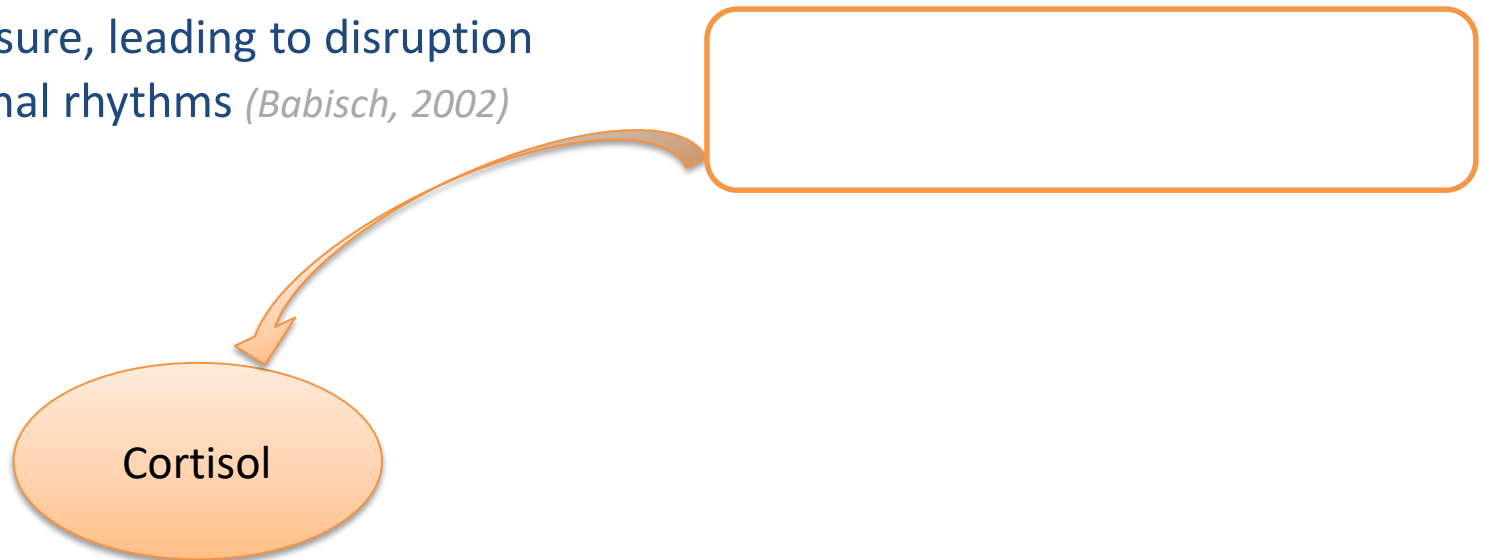
→ Question...



Scientific context

Proposed biological mechanism:

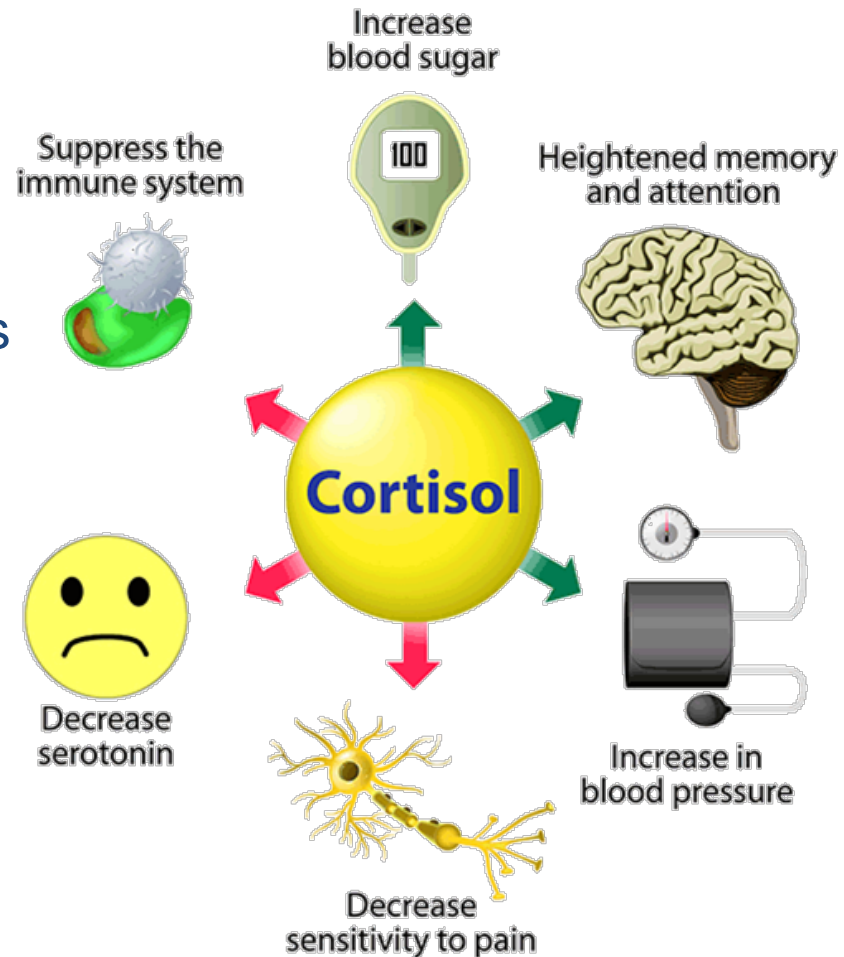
Release of stress hormones with noise exposure, leading to disruption of hormonal rhythms (*Babisch, 2002*)



Scientific context

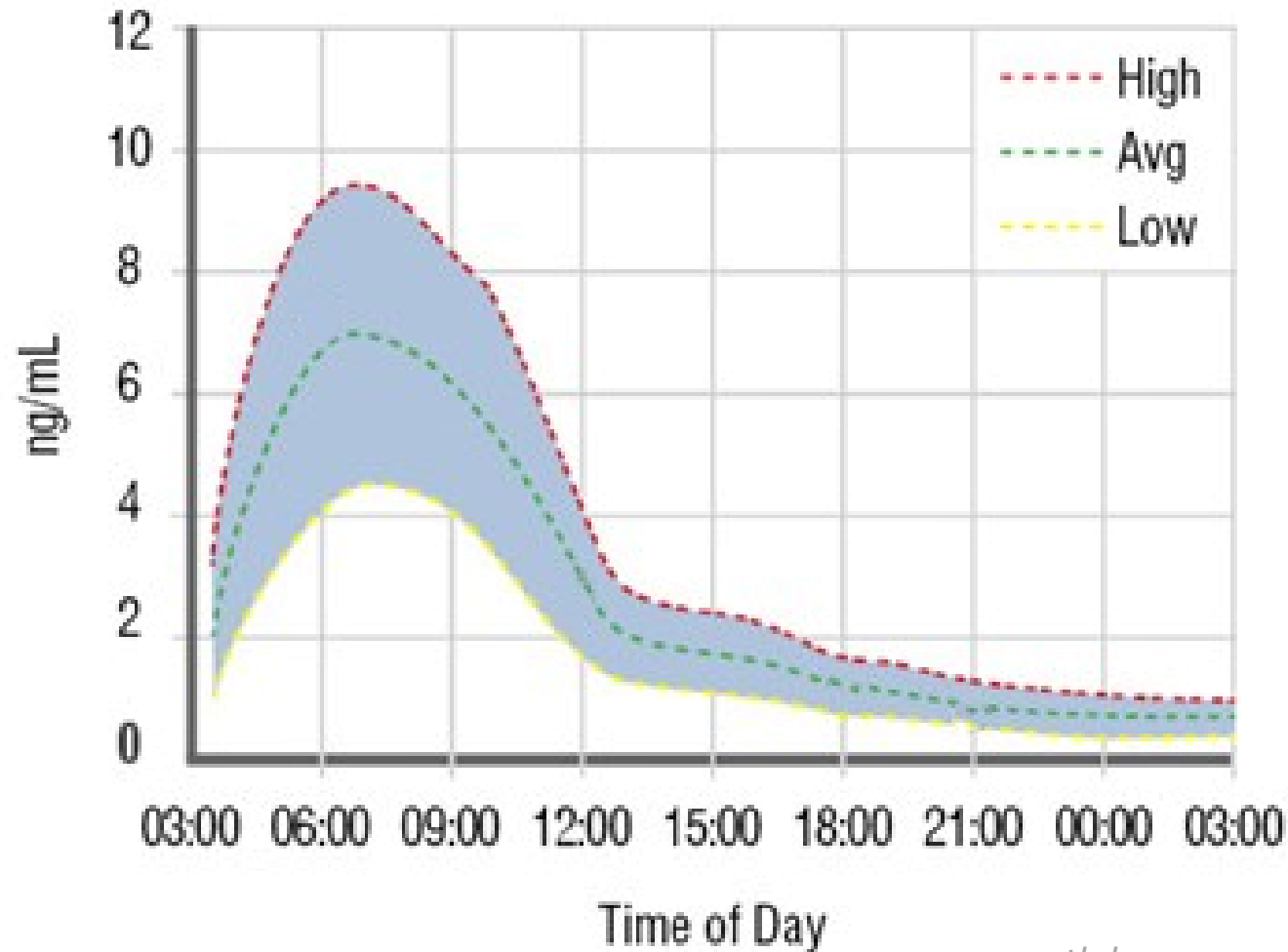
What's Cortisol?

- ✓ Stress marker
- ✓ Hormone secreted by the adrenal glands
- ✓ Essential to the body's metabolic process
- ✓ Modification of cortisol secretion is harmful for health
- ✓ Four sampling methods: urine, blood, hair or saliva



Scientific context

DIURNAL CORTISOL – NORMAL



Scientific context

Selander et al. (2009)

« *Saliva Cortisol and Exposure to Aircraft Noise in Six European Countries* »

$\beta = 6.07 \text{ nmol.L}^{-1}$ (95%CI 2.32-9.81)

in women exposed to aircraft noise

$L_{Aeq,24h} > 60\text{dB}$ vs $L_{Aeq,24h} \leq 50\text{dB}$

→ Corresponding to an increase of 34%

**Morning saliva
cortisol level**

**Evening saliva
cortisol level**

No change with noise exposure

General objective

**DOES AIRCRAFT NOISE EXPOSURE
HAVE AN EFFECT ON STRESS HORMONES CONCENTRATION
IN PEOPLE LIVING IN THE VICINITY OF AIRPORTS?**



NO PROBLEM!

Specific objective



**→ POOLED ANALYSES OF THE TWO PREVIOUS STUDIES IN
ORDER TO DISENTANGLE CONCLUSIONS ABOUT THE EFFECTS
OF AIRCRAFT NOISE EXPOSURE
ON SALIVA CORTISOL LEVELS IN EUROPE**

Material and Methods

Study population

HYENA

- 7 European airports
- 439 participants included between 2004 and 2006
- Aged 45 to 70 years old

DEBATS

- 3 French airports
- 954 participants included in 2013
- Aged 18 and over



Material and Methods

Exposure: Aircraft noise level

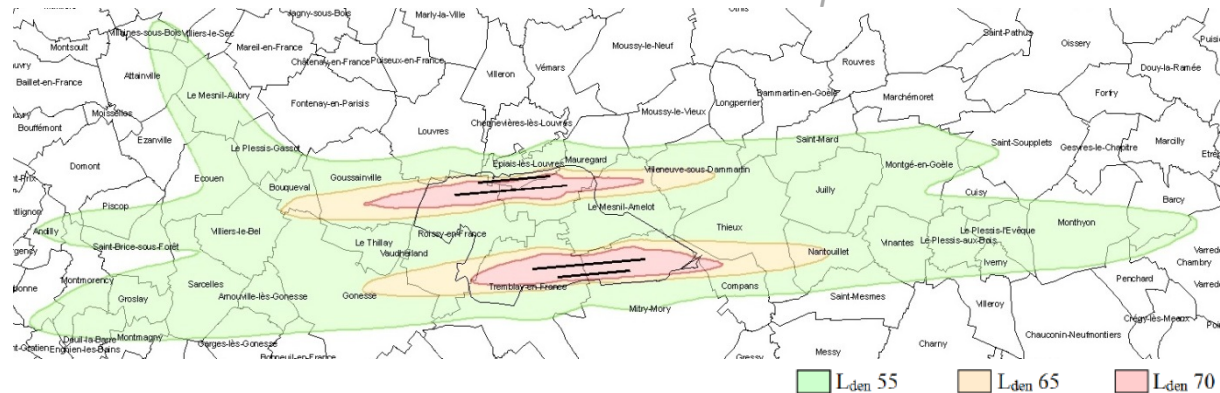
- From noise calculations
 - Using the INM model (Integrated Noise Model) and the Ancon model
- For each place of residence by geolocalization
 - with the (x ; y) coordinates

- 4 average noise metrics



Noise contours for Paris-Charles de Gaulle airport

Source : Paris Airports

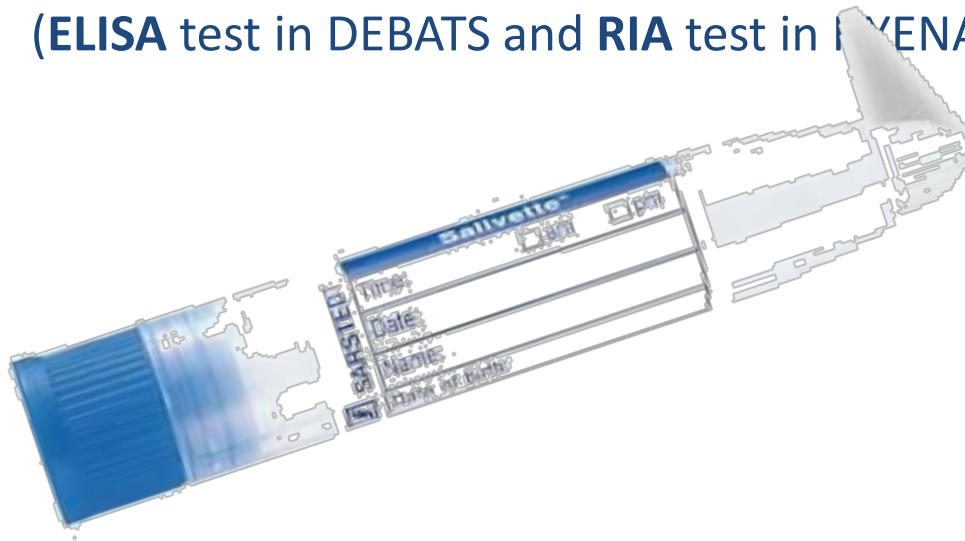


Material and Methods

Outcome : Saliva cortisol level

- ✓ Saliva test tubes kit (Salivette[®], Sarstedt) + instructions
- ✓ Samplings: **morning** (upon awakening) + **evening** (just before going to bed)
- ✓ Mandatory **date and time** information for each sample
- ✓ Saliva tubes sent to laboratory for analysis

(ELISA test in DEBATS and RIA test in YVENA)



Material and Methods

Statistical analyses

✓ Cortisol outcomes:

- Morning concentration = C_1
- Evening concentration = C_2
- Relative variation between both samples = $[(C_1 - C_2)/C_1] / \text{time between samplings}$

✓ Log-transformations



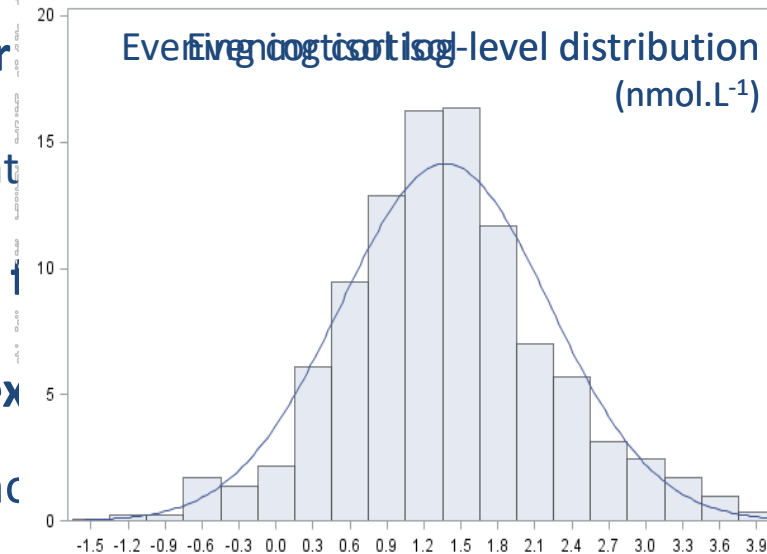
✓ Multivariate linear

✓ Confounders: count

✓ Analyses (*a priori*) i

✓ Results given for ex

dB(A) increase in nc



Noise + confounders + ϵ

activity, education level

alue in cortisol for a 10-

Results: Participants

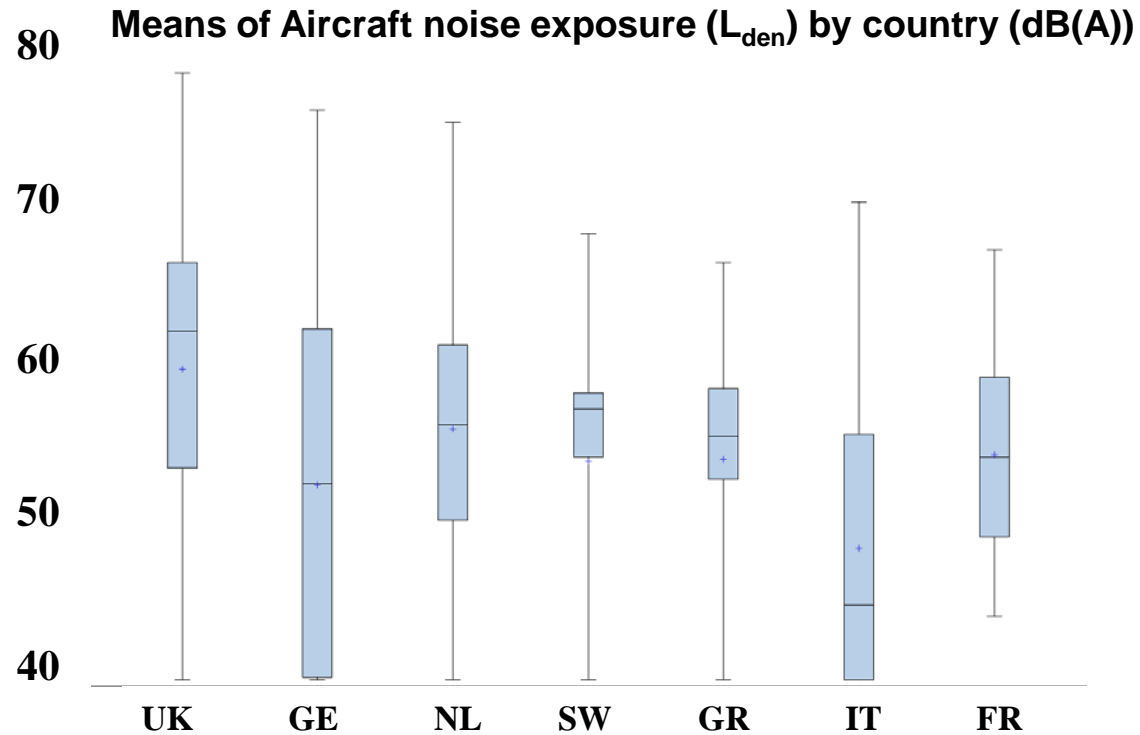
HYENA study

N=4,861

DEBATS study

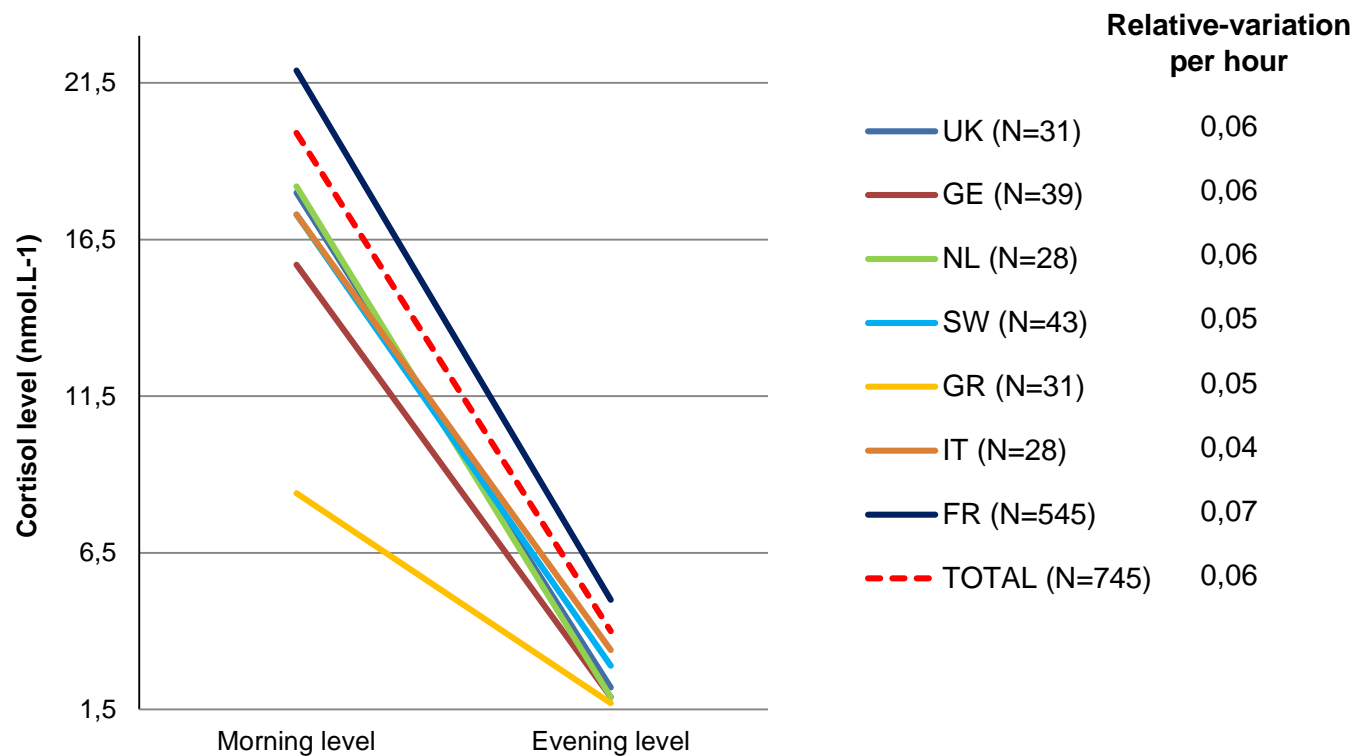
N=1,244

Results: Exposure description



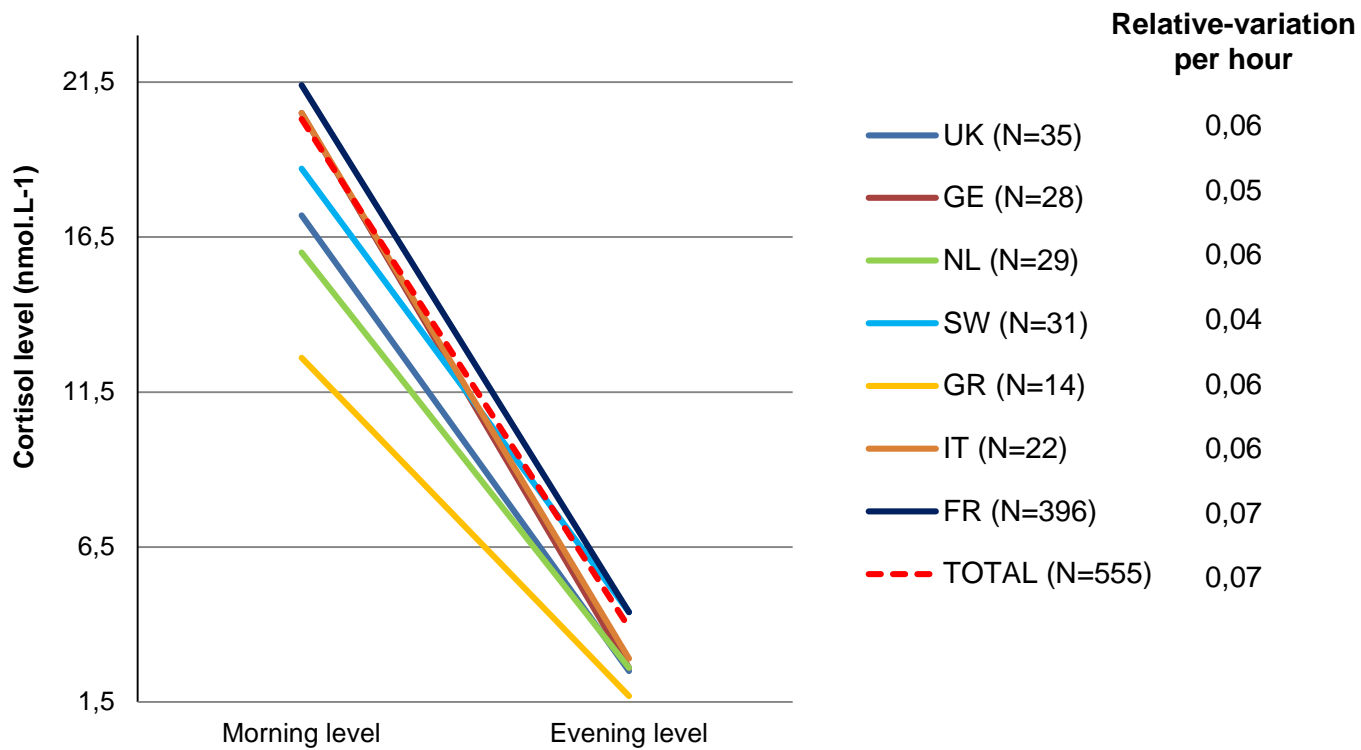
Results: Cortisol levels description

Geometric means of cortisol outcomes in females



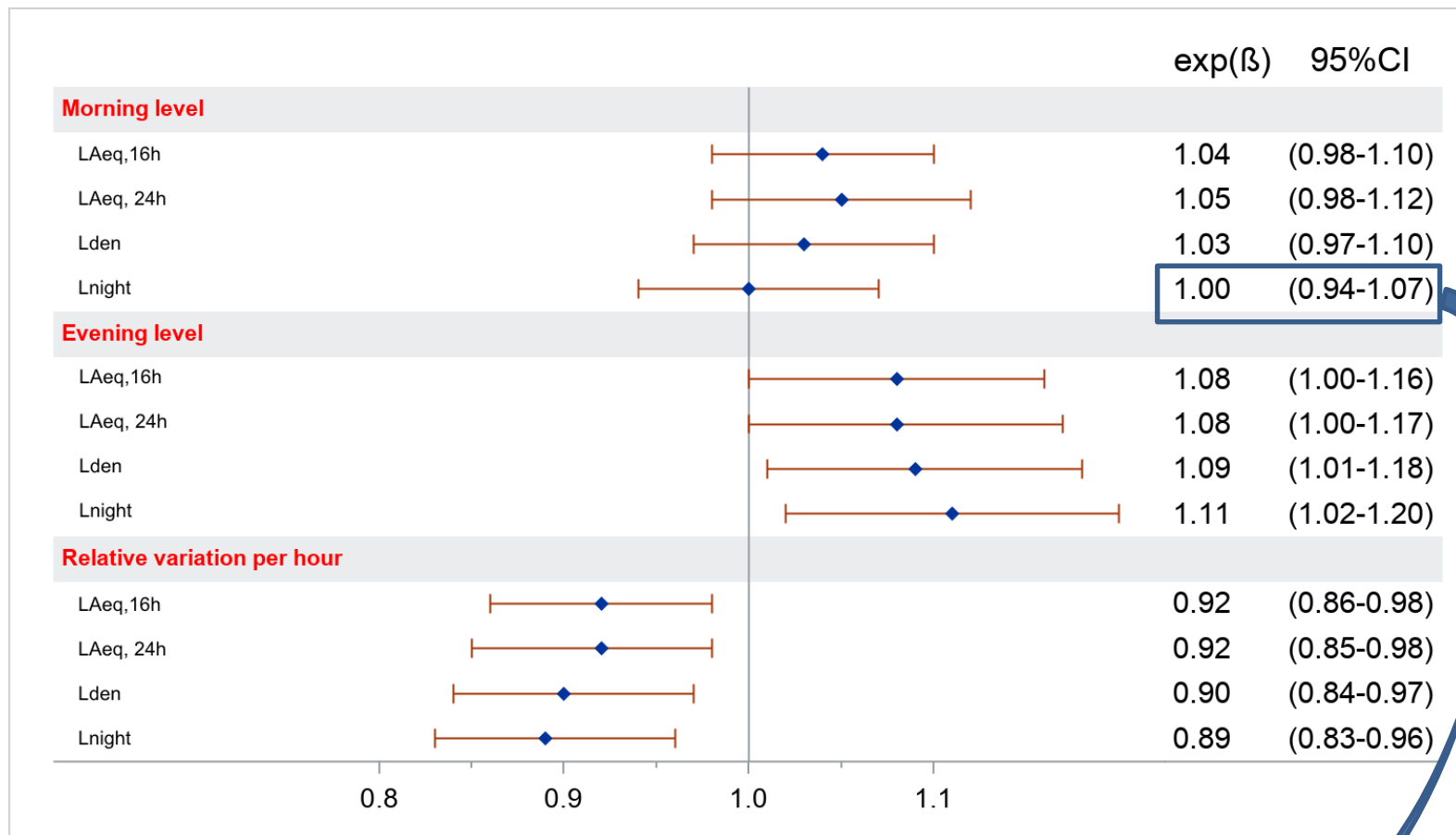
Results: Cortisol levels description

Geometric means of cortisol outcomes in males



Results: Analyses

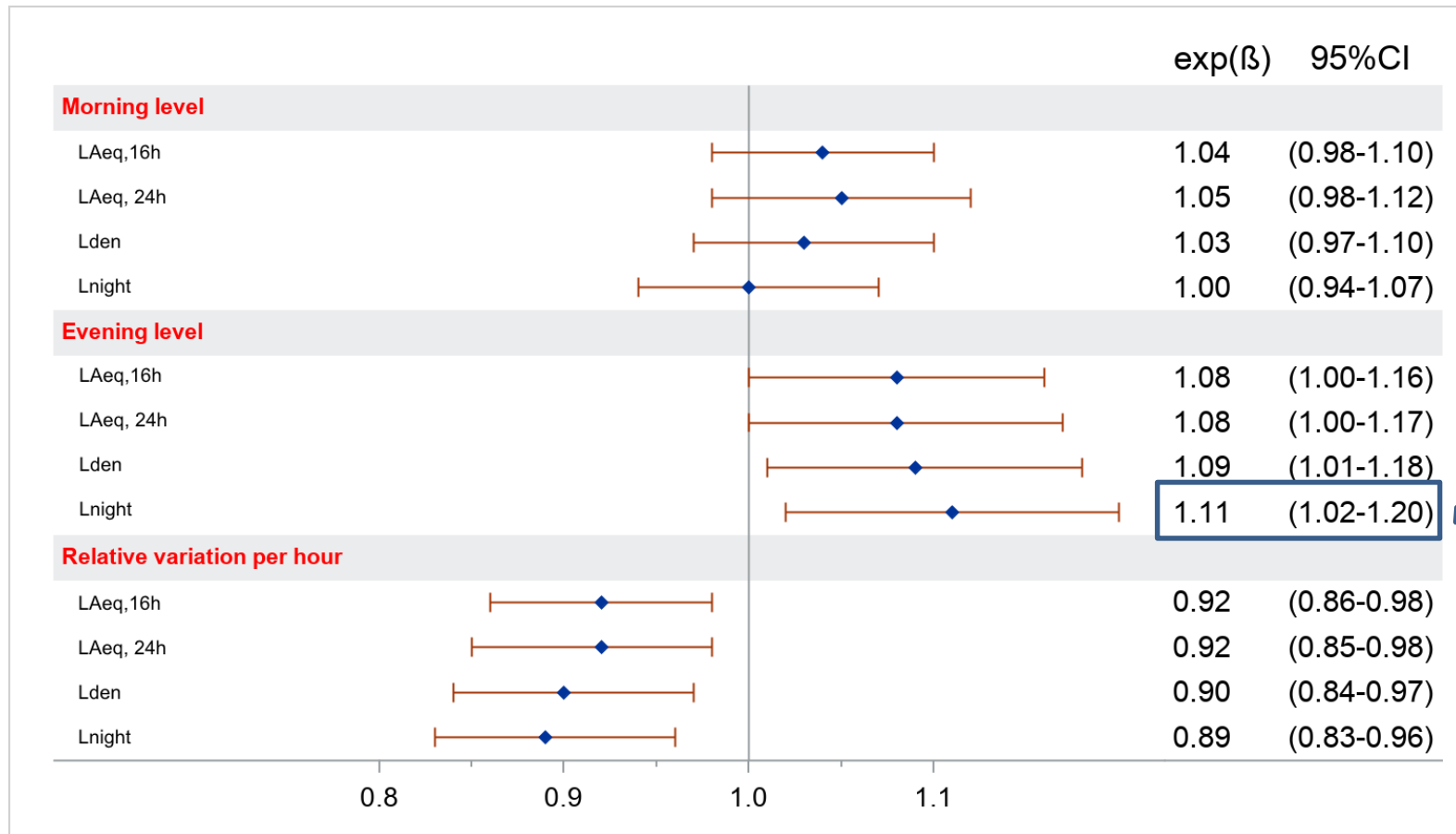
In women



In women, there is no association between aircraft noise exposure at night and the morning cortisol level

Results: Analyses

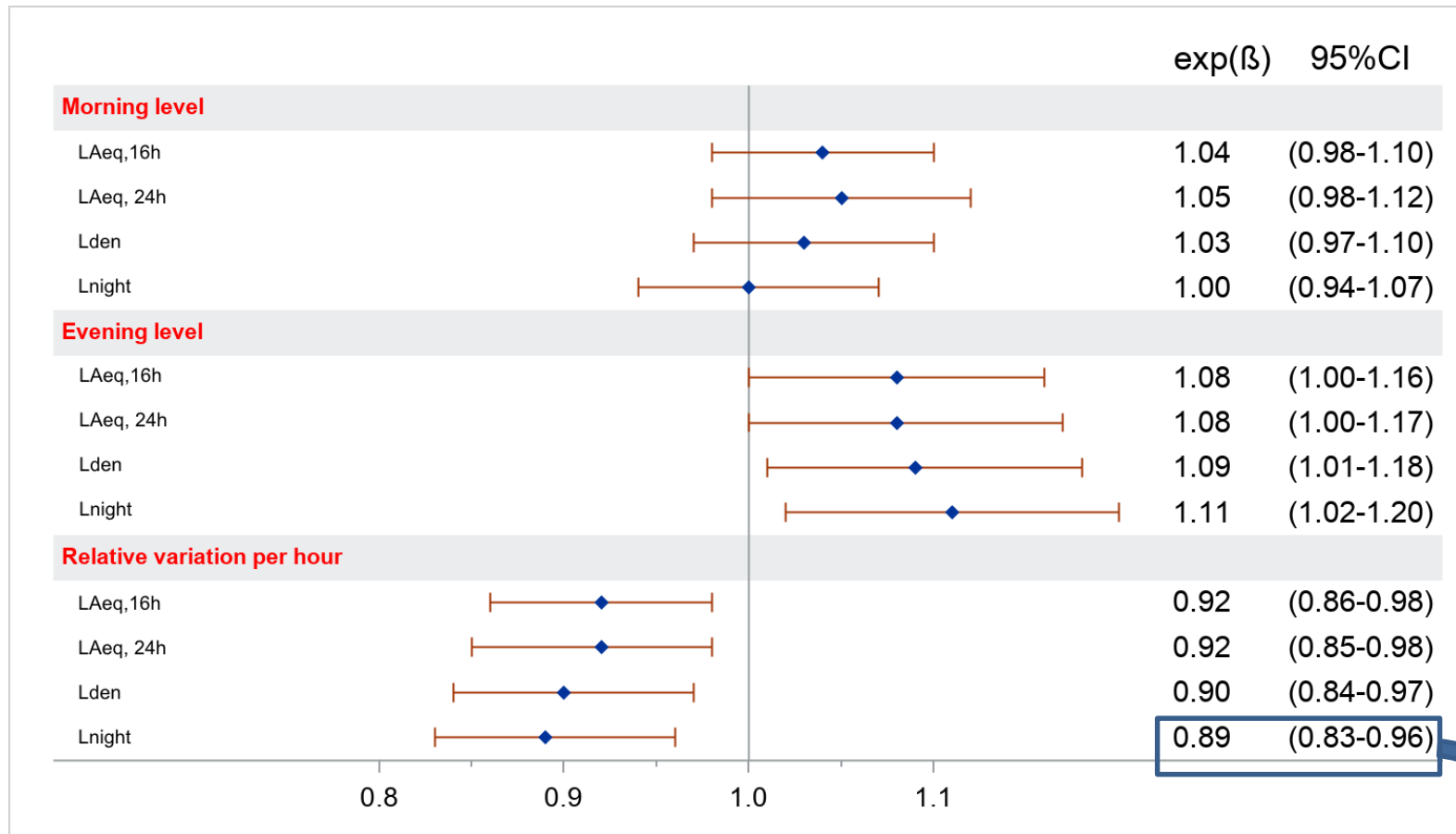
In women



In women, a 10 dB(A)-increase in aircraft noise exposure at night is significantly associated with an average of 11%-increase in evening cortisol level

Results: Analyses

In women

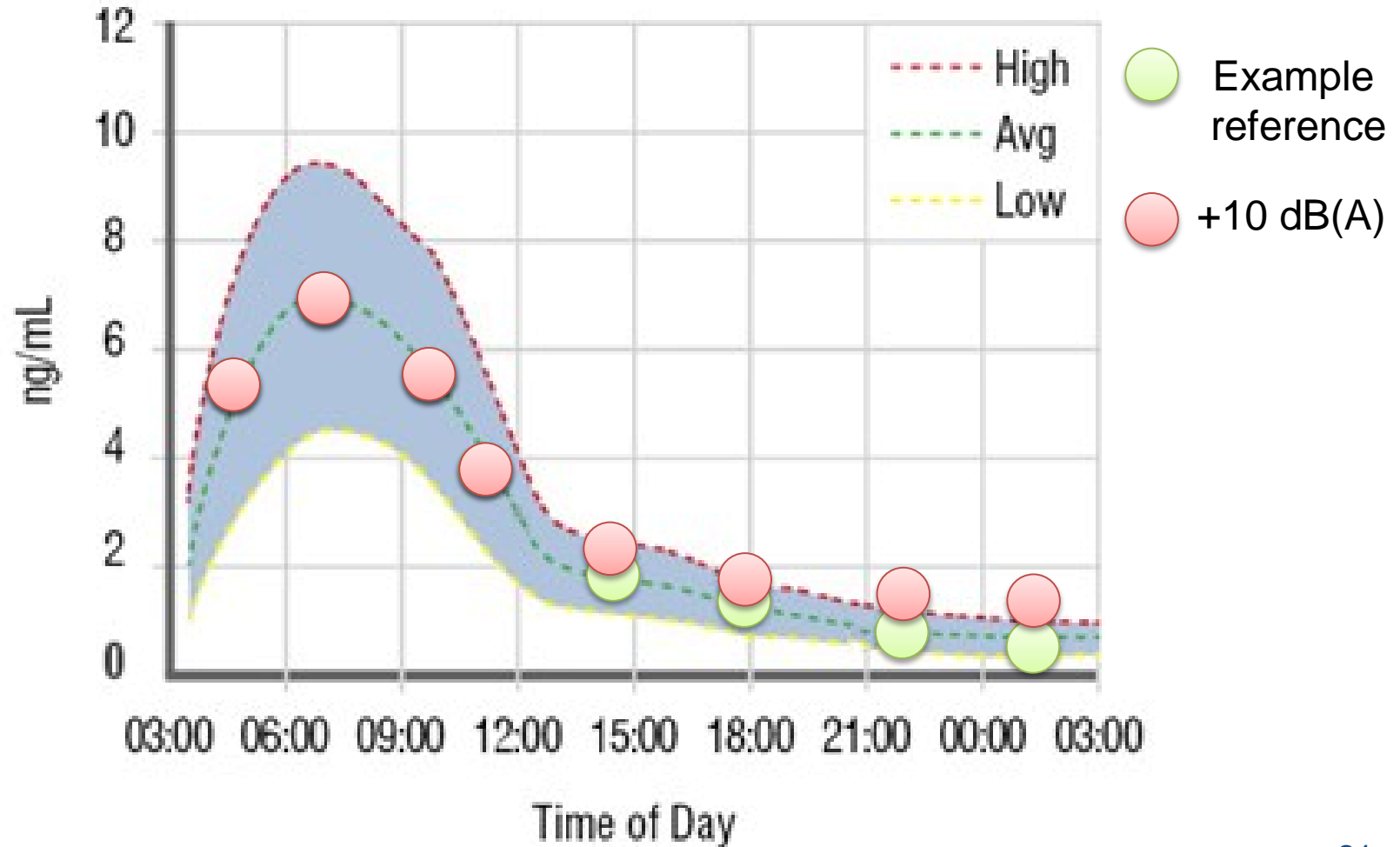


In women, a 10 dB(A)-increase in aircraft noise exposure at night is significantly associated with an average of 11%-decrease of the relative variation per hour

Results: Analyses

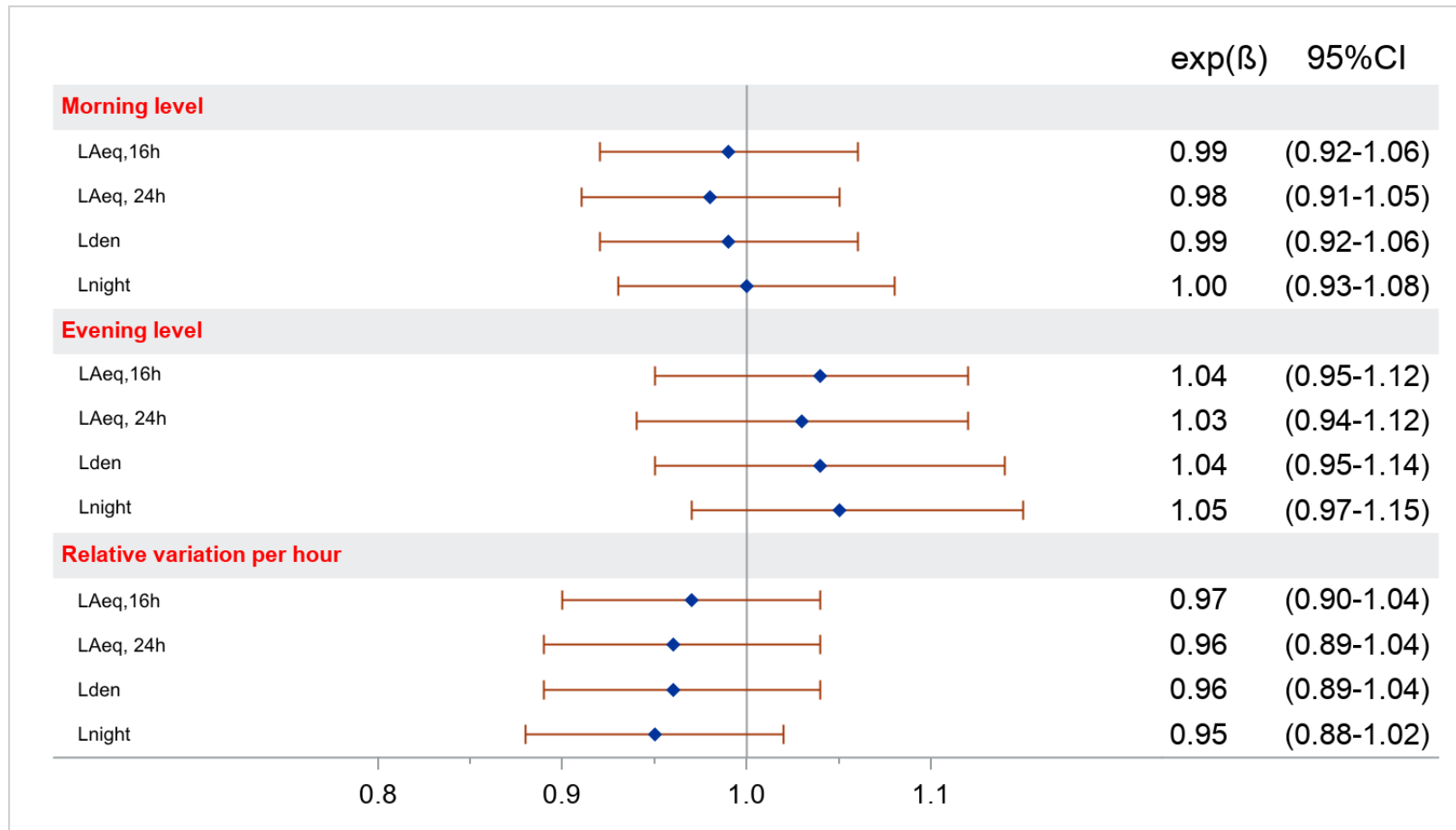
In women

DIURNAL CORTISOL – NORMAL ~ Illustration



Results: Analyses

In men



Discussion

▪ Limits

- ✓ Noise exposure calculation:
 - Average noise metrics over the day/night/24h... → Event indicators ?
 - Exposure in front of buildings... ?
 - No information about the time budget of participants

▪ Strengths

- ✓ Saliva Cortisol is a reliable measure
- ✓ Statistical analyses with a good statistical power
- ✓ Relative variation per hour: new approach which allows for potential measurement differences between HYENA and DEBATS
- ✓ Results remain stable during sensitivity analyses

Conclusion

- Confirmation of an **increase** in cortisol level in the **evening**
- Leading to a **flattening of the cortisol rhythm**
(= **Decrease** in **relative variation** per hour)
- Associations observed **in women only**
- **No substantial difference** in noise association between countries

Many thanks

to all the protagonists

- *DEBATS team : Anne-Sophie EVRARD, Patricia CHAMPELOVIER, Jacques LAMBERT, Bernard LAUMON, Marie LEFÈVRE, Marie-Christine CARLIER*
- *HYENA consortium : Anna HANSELL, Jenny SELANDER, Töres THEORELL*
- *Collaborators and funders*

... and all participants and their interviewers

