

### Circadian timekeeping: from basic clock function to implications for health

Lucassen, Eliane Alinda

### Citation

Lucassen, E. A. (2016, March 31). *Circadian timekeeping: from basic clock function to implications for health*. Retrieved from https://hdl.handle.net/1887/38651

Version: Corrected Publisher's Version

License: License agreement concerning inclusion of doctoral thesis in the

Institutional Repository of the University of Leiden

Downloaded from: <a href="https://hdl.handle.net/1887/38651">https://hdl.handle.net/1887/38651</a>

Note: To cite this publication please use the final published version (if applicable).

### Cover Page



### Universiteit Leiden



The handle <a href="http://hdl.handle.net/1887/38651">http://hdl.handle.net/1887/38651</a> holds various files of this Leiden University dissertation

Author: Lucassen, Eliane Alinda

Title: Circadian timekeeping: from basic clock function to implications for health

**Issue Date:** 2016-03-31

# Circadian timekeeping: from basic clock function to implications for health

### Eliane Alinda Lucassen

Circadian timekeeping: from basic clock function to implications for health

**ISBN:** 978-94-6233-213-3

**Cover photograph:** handheld time machine, by Don Urban

Cover & Lay-out: Gildeprint Printed by: Gildeprint

### © Eliane A. Lucassen

All rights reserved. No part of this thesis may be reproduced or transmitted in any form or by any means, without written permission of the author.

## Circadian timekeeping: from basic clock function to implications for health

### Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden
op gezag van de Rector Magnificus prof.mr. C.J.J.M. Stolker,
volgens besluit van het College voor Promoties
te verdedigen op 31 maart
klokke 16:15

door

Eliane Alinda Lucassen

geboren te Leiden in 1986

#### **Promotor**

Prof. dr. J.H. Meijer

### Copromotor

Prof. dr. A. Kalsbeek (Amsterdam Medical Center)

#### Promotiecommissie

dr. A.M. Aartsma-Rus

Prof. dr. E. van Cauter (University of Chicago)

Prof. dr. A.J.W. van der Does

Prof. dr. G.T. van der Horst (Erasmus Medical Center)

The research presented in this thesis was performed at Leiden University Medical Center (LUMC) and at the National Institutes of Health (NIH). This work was supported by the Netherlands Organization for Scientific Research grant TOPGO.L.10.035 (to J.H. Meijer) and E.A. Lucassen received a MD PhD scholarschip from the LUMC, and Fulbright, Leiden University Fund (LUF) and VSBfonds scholarschips.



Printing of this thesis was kindly supported by Avantes, Alzheimer Nederland, Novo Nordisk and Kenniscentrum Koffie en Gezondheid. Financial support by the Dutch Heart Foundation for the publication of this thesis is gratefully acknowledged.

### **Table of contents**

Chapter 1	General Introduction	7					
Chapter 2 Chapter 3	Interacting epidemics? Sleep curtailment, insulin resistance, and obesity The hypothalamic-pituitary-adrenal axis, obesity, and chronic stress exposure: sleep and the HPA axis in obesity.						
PART I - The basic functioning of the circadian pacemaker							
Chapter 4	Role of vasoactive intestinal peptide in seasonal encoding by the suprachiasmatic nucleus clock.	87					
Chapter 5	Caffeine increases light responsiveness of the circadian pacemaker.	107					
Chapter 6	Amplitude of the SCN clock enhanced by the behavioral rhythm.						
PART II - Health outcomes of altered circadian rhythms							
Chapter 7	The suprachiasmatic nucleus controls energy metabolism and insulin sensitivity.	145					
Chapter 8	Environmental 24-hour cycles are essential for health.	165					
Chapter 9	Evening chronotype is associated with changes in eating behavior, more sleep apnea, and increased stress hormones in short sleeping obese individuals.						
PART III – Health outcomes of insufficient sleep							
Chapter 10	Sleep extension improves neurocognitive functions in chronically sleep- deprived obese individuals.						
Chapter 11	The association between sleep parameters, osteopenia and sarcopenia in middle-aged men and women: the NEO study.						
Chapter 12	General Discussion	257					
Summary		289					
Nederlandse samenvatting							
Curriculum Vitae							
Dankwoord							
Dankwoord List of publications							
•							