# Shift Work and Cancer

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Institució CERCA Centres de Recerca de Catalunya

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"la Caixa" Foundation

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Chagas, Parasitic and Imported Diseases

Climate and Health

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Non-communicable Diseases and Environment

Childhood & Environment

Viral and Bacterial Infections

Malaria

Radiation

Maternal, Child and Reproductive Health

# Outline

- Night shift work
- Mistimed eating and sleep patterns
- Sleep
- Light at night
- OMEGA-NET
- EPHOR

# Incidence of breast cancer in Norwegian female radio and telegraph operators

Tore Tynes, Merete Hannevik, Aage Andersen, Arnt Inge Vistnes, and Tor Haldorsen

- Cohort of 2,619 female radio and telegraph operators at sea, certified from 1920–1980
- Shift work categories (0,1,2,3) classified for each ship
- Potential exposure to light at night, radiofrequency fields, extremely low frequency fields
- Linkage to Cancer Registry 1961–1991

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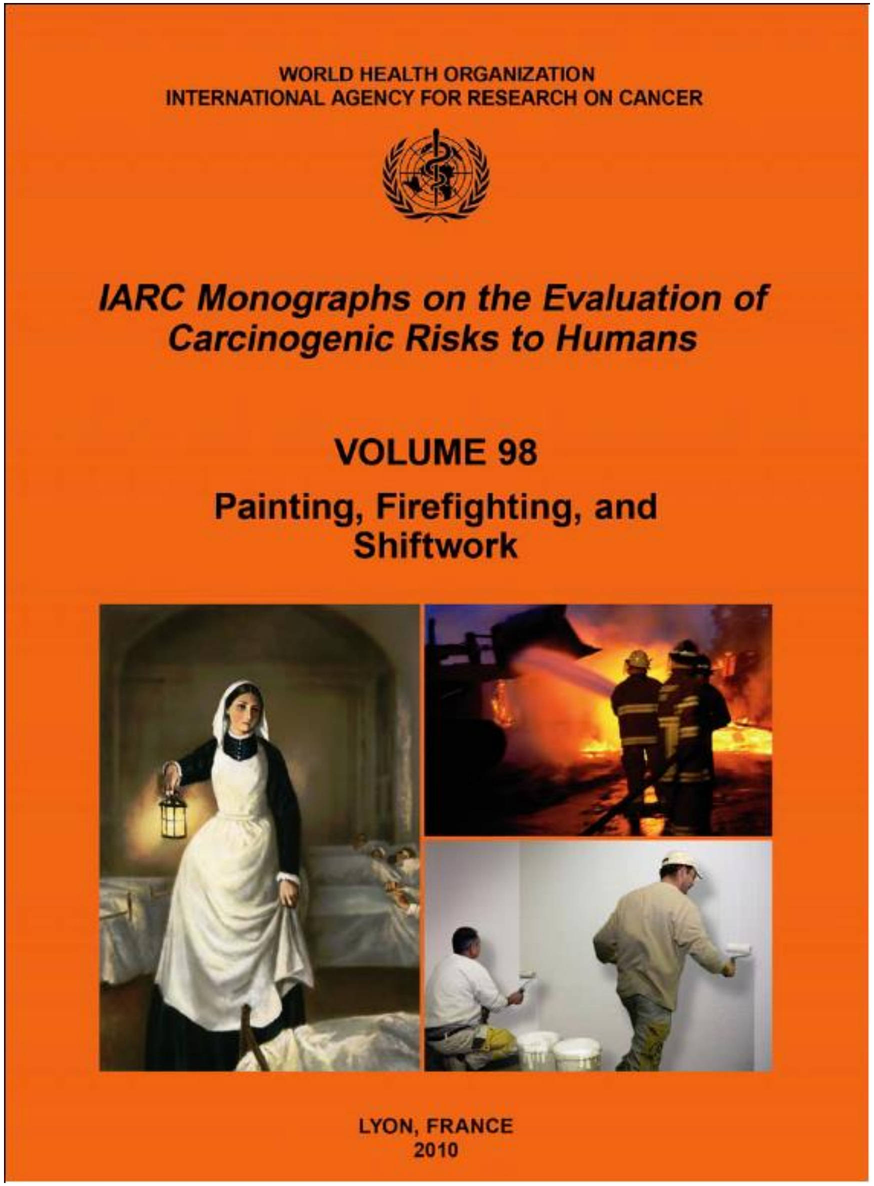
| Exposure categories | No. of cases/deaths | OR or RR (extreme group versus referent) | Adjustment for potential confounders |
|---|---|---|---|
| *Shiftwork in women age < 50* | | | Age, duration of employment, parity, and age at first birth |
| None | 12 | 1.0 (ref) | |
| <3.1 yrs. | 5 | 0.3 (0.1–1.2) | |
| >3.1 yrs | 12 | 0.9 (0.3–2.9) | |
| *P* for trend | | 0.97 | |
| *Aged 50+* | | | |
| None | 3 | 1.0 (ref) | |
| <3.1 yrs. | 6 | 3.2 (0.6–17.3) | |
| >3.1 yrs | 12 | 4.3 (0.7–26.0) | |
| *P* for trend | | 0.13 | |

- Future epidemiological studies should address the possible relationship between chrolonogical disturbances and breast cancer
- Environmental factors, such as shift work in combination with light at night or EMF, are of particular interest

IARC (2007); Tynes et al. (1996)




Shiftwork that involves circadian disruption is **probably** carcinogenic to humans (**Group 2A**)

**Sufficient evidence** in experimental animals for the carcinogenicity of light during the daily dark period (biological night)

**Limited evidence** in humans for the carcinogenicity of shift-work that involves night work (breast cancer)

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# Animal Carcinogenicity Data

- Major patterns of light–dark environments that have an impact on cancer development and/or growth:
  - constant light exposure (two + of three studies, five + of six initiation–promotion studies, five + of five tumour growth studies)
  - dim light during darkness (five + of five studies)
  - experimental chronic jet lag (two + of two studies)
  - circadian timing of carcinogens (four + of four studies)
  - no association in light pulse during the dark period (two of two studies), and constant darkness (two of two studies)

# Human Carcinogenicity Data

- Evidence for an association with breast cancer consistent in studies designed to address this question (six + of eight studies, particularly in long-term night shiftworkers)
- Studies of cabin crews provided additional support
- Questions remaining:
  - Limited number of studies
  - Most focused on a single profession, i.e. nurses
  - Some potential for confounding by unknown risk factors
  - Inconsistent and inaccurate exposure assessments of shiftwork
  - Potential detection bias among female cabin crew, potential confounding by reproductive factors and cosmic radiation
  - Few studies at other cancer sites

# Considerations of circadian impact for defining 'shift work' in cancer studies: IARC Working Group Report

Richard G Stevens,[1] Johnni Hansen,[2] Giovanni Costa,[3] Erhard Haus,[4] Timo Kauppinen,[5] Kristan J Aronson,[6] Gemma Castaño-Vinyals,[7] Scott Davis,[8] Monique H W Frings-Dresen,[9] Lin Fritschi,[10] Manolis Kogevinas,[11] Kazutaka Kogi,[12] Jenny-Anne Lie,[13] Arne Lowden,[14] Beata Peplonska,[15] Beate Pesch,[16] Eero Pukkala,[17] Eva Schernhammer,[18] Ruth C Travis,[19] Roel Vermeulen,[20] Tongzhang Zheng,[21] Vincent Cogliano,[22] Kurt Straif[22]

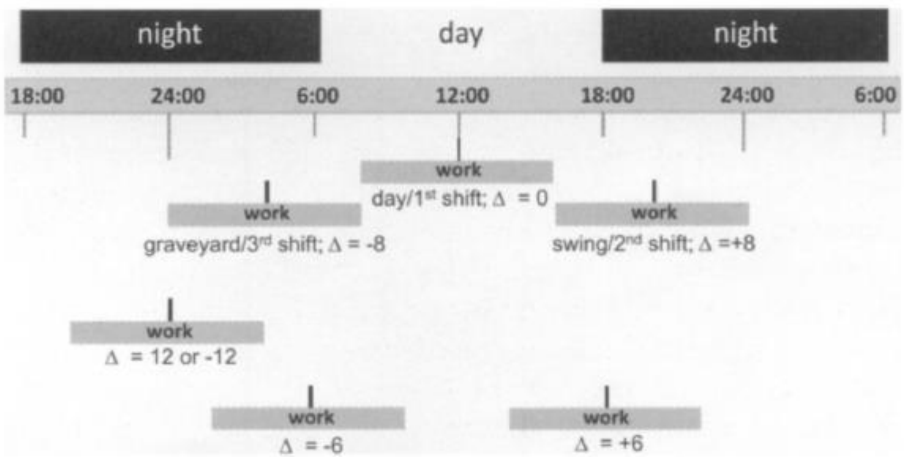


**Figure 1** Displacement of various shifts from solar noon; Δ=(midpoint work shift minus noon).

**Table 3** Domains for capture in epidemiological studies.

| Domain | Variable | Circadian impact |
|---|---|---|
| Working time | Work hours/week | |
| Night work (non-day shift work) | At least 3 h of work between midnight and 05:00 | Required to estimate phase shift and sleep perturbation |
| Duration | Years employed in non-day shift work | Duration of non-day shift work |
| Intensity | No of non-day shifts per month/year | Recovery time off between work periods |
| Cumulative exposure | Duration times intensity over the work history | Dose (burden) of non-day shift work |
| Permanent night shift (not rotating) | No of consecutive days of night work, followed by number of days off | Permanent night work is less disruptive only if phase shift is maintained also on days off |
| Rotating type | Continuous (365 days/year) or discontinuous (interruption on weekend) | Different rotating shift schedules have a different impact on phase shift and adjustment |
| Direction of rotation | Forward (morning→afternoon/evening→night) backward (afternoon/evening→morning→night) | Forward rotating shift schedules are less disruptive than backward ones |
| Rate of rotation | Daily change, 2–3–4 day change, weekly, fortnightly change, etc | Rate of rotating shift schedules (fewer nights in a row) may have different impact on circadian disruption |
| Morning shift | No of consecutive days of early morning shift (before 06:00) | The earlier the morning shift starts, the more disruptive it is |
| Start and end time of shifts | Defines displacement from solar day and duration of the working hours | May be relevant for phase shift, sleep deficit, and fatigue |
| Rest periods after shift | No of rest-days after night shifts | The shorter the rest period between shifts, the shorter the sleep and recovery |
| Jetlag | No of time zones crossed; eastward versus westward | Given the low prevalence in the general population, this is probably only needed in cohort studies of frequent trans-meridian travellers (eg, air crews), whereas jetlag studies should also include questions on shift work, since these often go hand in hand |
| Sleep | Sleep duration in relation to type of shift; naps; sleep quality; sleepiness; sleeping problems (circadian disruption); possibility to sleep on duty (night shifts) | Sleep/wake cycle and timing of sleep are important in phase shift and resetting, but they may also act as independent risk factors |
| Light at night | During sleep period, during night shift, at leisure time | Both timing and intensity are important on circadian phase shift |
| Characteristics of the individual | Diurnal type (morning person, evening person, neither) | It influences differently adjustment and tolerance to night and morning shifts |

# Night Shift Work

**18-25%** of the population works on shift-schedules including night
**(♂ : 21.9% , ♀: 10.7%)**

**7% works permanently at night**


4th EU Survey on Working Conditions (2005)

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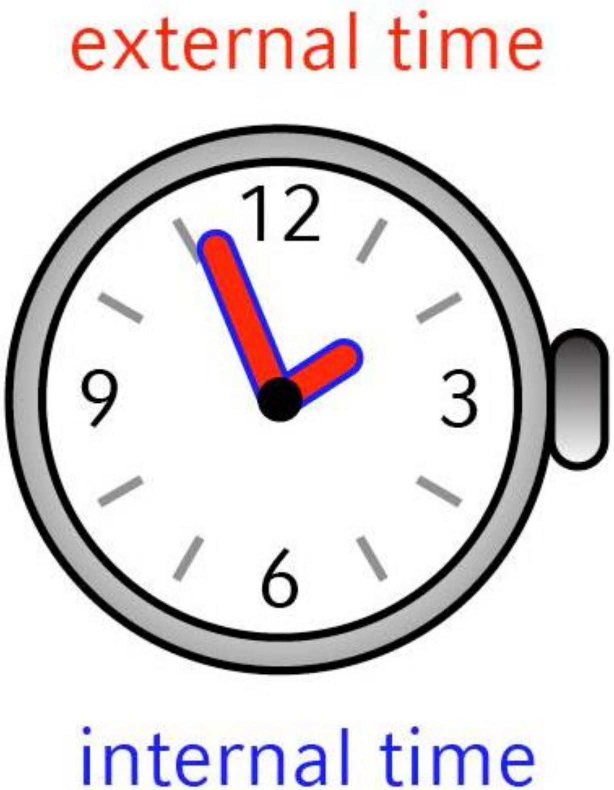
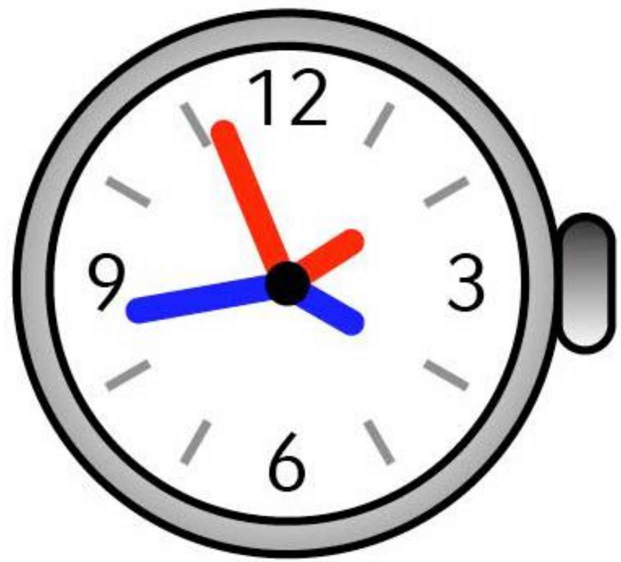
# Circadian Misalignment




Shift work
Travel jetlag
Social jetlag

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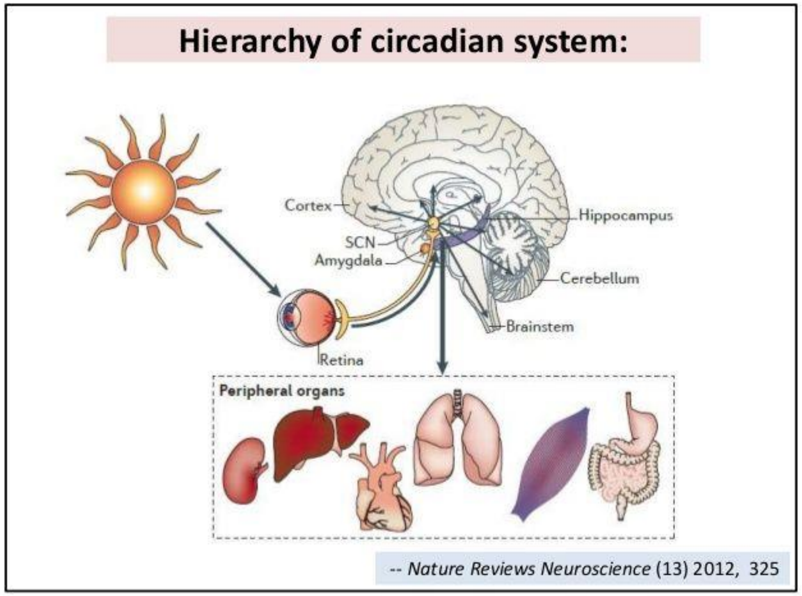
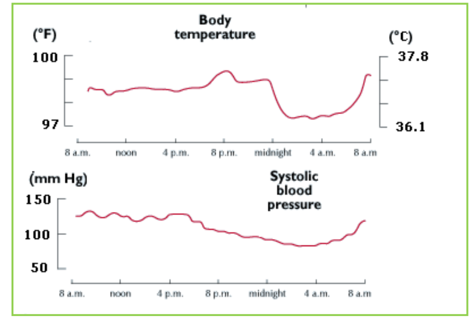
# Circadian Rhythms



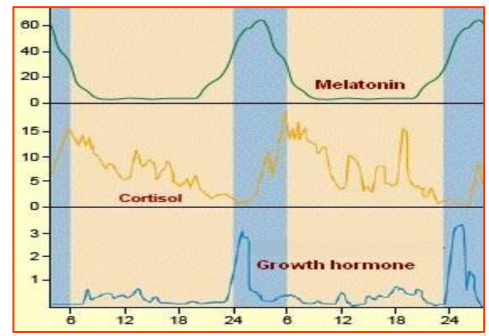


**About 30% of genes have been shown to follow a circadian expression pattern**

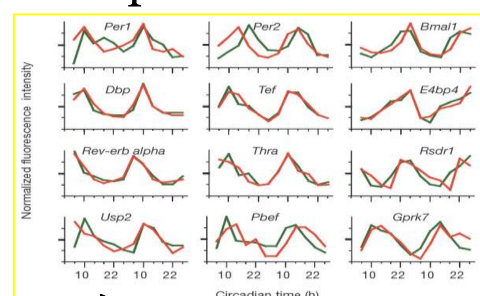
Autonomous processes




Hormone excretion




Gene expression




Bass et al. (2012); Kai-Florian Storch et al. (2002); Maury et al. (2010)

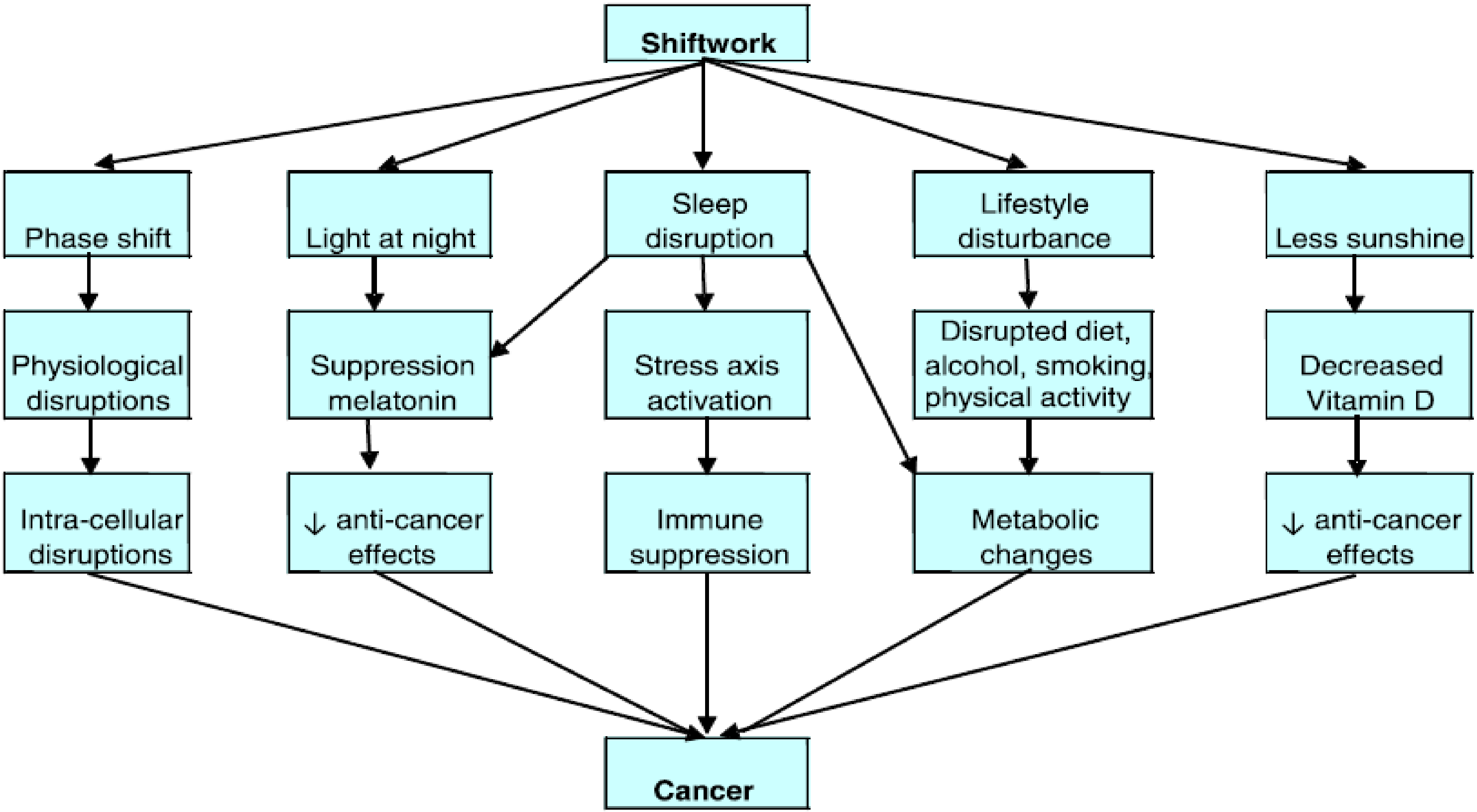
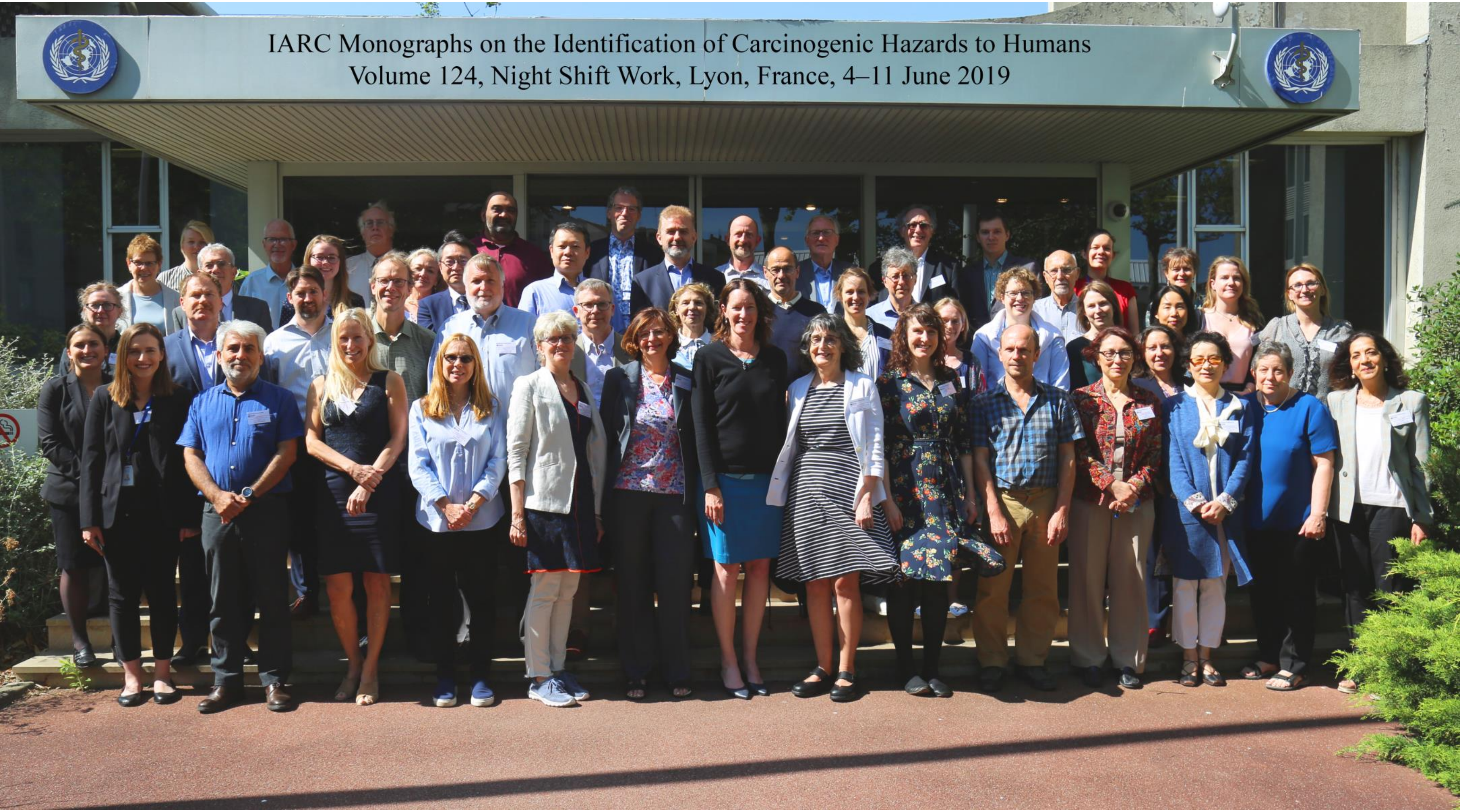



Fig. 1. Theoretical framework of possible mechanisms by which shiftwork might cause breast cancer.




27 scientists from 16 countries

## Carcinogenicity of night shift work

In June, 2019, a Working Group of 27 scientists from 16 countries met at the International Agency for Research on Cancer (IARC) in Lyon, France, to finalise their evaluation of the carcinogenicity of night shift work. This assessment will be published in volume 124 of the IARC Monographs.[1]

Night shift work involves work, including transmeridian air travel, during the regular sleeping hours of the general population. The misalignment or disruption of circadian rhythms of normal physiology is the most pronounced effect of night shift work.

Night shift work is essential for guaranteeing round-the-clock production and activities. It is commonly found in health care, manufacturing, transport, retail, and services sectors. About 1 in 5 workers worldwide are engaged in night shift work; however, definitions, quality, and extent of data vary globally. Regulatory approaches for night shift work and their degree of implementation also differ across regions and employment sectors.

In 2007, shift work involving circadian disruption was classified as "probably carcinogenic to humans" (Group 2A), on the basis of sufficient evidence in experimental animals and limited evidence of breast cancer in humans. In this updated evaluation, the Working Group chose the name "night shift work" to better describe the exposure circumstances and to reflect the main evidence base for the human cancer studies. The re-evaluation was motivated by the large number of new, high-quality epidemiologic studies including additional cancer sites. However, the Working Group noted the considerable variability in the detail and quality of exposure information on night shift work reported in these studies. Exposure information was more detailed in case-control studies, including in those nested within cohorts, than in cohort studies. A number of occupational, individual, lifestyle, and environmental factors might mediate, confound, or moderate potential cancer risk in night shift workers.

The Working Group concluded there was limited evidence that night shift work causes breast, prostate, and colorectal cancer. This evaluation was based on comprehensive searches of the literature, screening of the studies using established inclusion criteria, and evaluation of study quality, including a standardised review of exposure assessment. Greater weight was given to the most informative human cancer studies based on methodologic considerations, including study size, potential selection bias, night work assessment quality (most notably, potential for misclassification), and control for potential confounding factors. The largest number of informative studies examined breast cancer, several examined prostate and colorectal cancer, while fewer were done on other cancers.

Most cohort studies, including large cohorts within the general population[2] and among air crew, did not find a positive association with ever versus never working night shifts or by increasing duration of night shift work. The Nurses' Health Study II, a large cohort study that evaluated breast cancer risk across a broad age range, found an elevated risk of breast cancer in long-duration night workers,[3] which was also seen in a Swedish cohort study. The strongest evidence regarding an association of night shift work and breast cancer is provided by cohort-based nested case-control studies and population-based case-control studies. The largest case-control study,[4] including more than 6000 breast cancer cases and corresponding controls from five countries, incorporated an extensive exposure assessment protocol and evaluated detailed exposure metrics on both duration and intensity of exposure (eg, number of night shifts per week). This study provided evidence for positive associations between night shift work and breast cancer risk, particularly among premenopausal women. The associations were strongest for high-intensity, long-duration night shift work. The variation in findings between studies could be attributed to differences in exposure assessment quality or the inclusion of mainly older post-employment women in some cohort studies, such that they might not be able to determine an effect in younger women. A small minority viewpoint was that evidence for breast cancer was inadequate, with studies of sufficient quality available in humans but with inconsistent results. Overall, the Working Group concluded that a positive association has been observed regarding night shift work and breast cancer; however, given the variability in findings between studies, bias could not be excluded as an explanation with reasonable confidence.

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**Declaration of interests**
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**Night shiftwork** is **probably** carcinogenic to humans (**Group 2A**)

**Sufficient evidence** of cancer in experimental animals

**Limited evidence** of cancer in humans (breast cancer, prostate cancer, colorectal cancer)

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European Journal of Epidemiology (2018) 33:369–379
https://doi.org/10.1007/s10654-018-0368-x

META-ANALYSIS

# Night shift work and breast cancer: a pooled analysis of population-based case–control studies with complete work history

Emilie Cordina-Duverger[1] · Florence Menegaux[1] · Alexandru Popa[1] · Sylvia Rabstein[2] · Volker Harth[3] · Beate Pesch[2] · Thomas Brüning[2] · Lin Fritschi[4] · Deborah C. Glass[5] · Jane S. Heyworth[6] · Thomas C. Erren[7] · Gemma Castaño-Vinyals[8,9,10,11] · Kyriaki Papantoniou[8,10,11,12] · Ana Espinosa[8,9,10,11] · Manolis Kogevinas[8,9,10,11] · Anne Grundy[13,14] · John J. Spinelli[15,16] · Kristan J. Aronson[17] · Pascal Guénel[1]

Largest case-control study, >6,000 cases from 5 countries

**Table 4** Odds ratios for breast cancer combining night work intensity with night work duration, length of shifts and time since last night shift, based on four studies with information on number of nights per week (Canada, France, Germany and Spain)[a]

| | All women | | | | Premenopausal women | | | | Postmenopausal women | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cases | Controls | OR | 95% CI | Cases | Controls | OR | 95% CI | Cases | Controls | OR | 95% CI |
| *Intensity × duration of night work* | | | | | | | | | | | | |
| Never worked at night | 4373 | 4634 | 1 | Ref. | 1393 | 1437 | 1 | Ref. | 2979 | 3196 | 1 | Ref. |
| < 3 nights/week and < 10 years | 201 | 218 | 0.99 | [0.81–1.21] | 106 | 99 | 1.19 | [0.89–1.60] | 95 | 119 | 0.84 | [0.63–1.11] |
| < 3 nights/week and ≥ 10 years | 175 | 180 | 0.99 | [0.79–1.23] | 64 | 72 | 1.01 | [0.71–1.45] | 111 | 108 | 0.98 | [0.74–1.30] |
| ≥ 3 nights/week and < 10 years | 92 | 80 | 1.23 | [0.90–1.67] | 52 | 34 | 1.66 | [1.05–2.60] | 40 | 46 | 0.88 | [0.57–1.37] |
| ≥ 3 nights/week and ≥ 10 years | 40 | 32 | 1.34 | [0.83–2.15] | 16 | 7 | 2.55 | [1.03–6.30] | 24 | 25 | 1.00 | [0.56–1.77] |

OXFORD

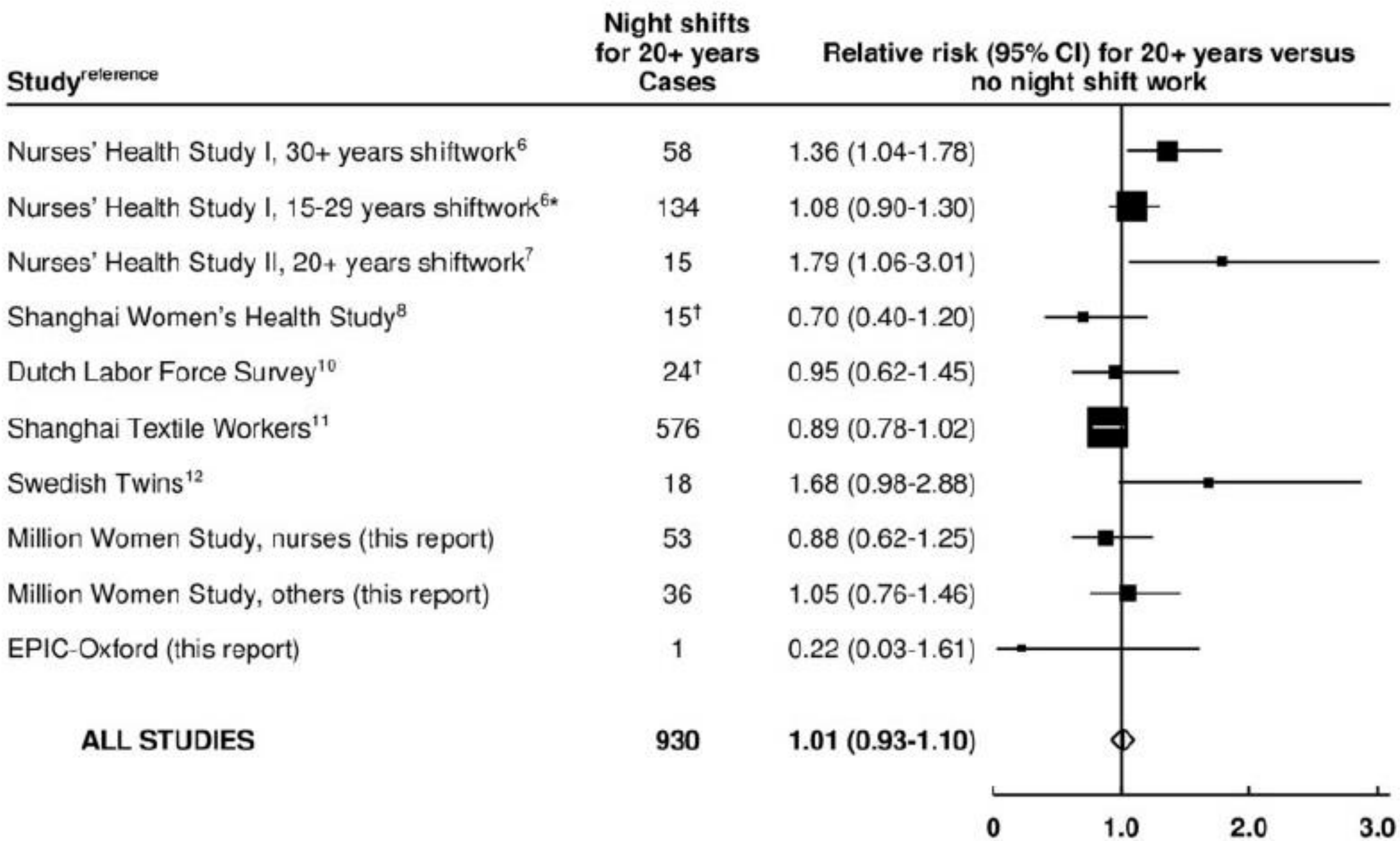
*JNCI J Natl Cancer Inst* (2016) 108(12): djw169

doi: 10.1093/jnci/djw169
First published online October 7, 2016
Article

ARTICLE

# Night Shift Work and Breast Cancer Incidence: Three Prospective Studies and Meta-analysis of Published Studies

Ruth C. Travis, Angela Balkwill, Georgina K. Fensom, Paul N. Appleby, Gillian K. Reeves, Xiao-Si Wang, Andrew W. Roddam, Toral Gathani, Richard Peto, Jane Green, Timothy J. Key, Valerie Beral



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**Limited evidence** of cancer humans:

Breast cancer
- Inconsistent findings
- Differences in exposure assessment quality
- Inclusion of mainly post-menopausal women in cohort studies

Prostate and colorectal cancer
- Few studies
- Inconsistent findings

Mechanistic evidence **limited** in exposed humans

# Hormonit Study

- Objective: To evaluate the effects of circadian disruption due to night shift work on the production and timing of sex steroid hormones, the transcriptional pattern and genetic variates in candidate genes and systemic adaptation to night shift work

- To provide evidence on molecular and hormonal mechanisms to explain the increase of cancer in night shift workers

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# Within Subjects Study on Shift Work

# (Barcelona - Major Car Factory)

- 50 male rotating workers, sampled twice (all workers are rotating so we are comparing each worker to himself)
  - end of 3 weeks night shift,
  - end of 3 weeks day shift
- Blood samples before and after work, 4 samples per person, total approx. 200 samples: immune response and RNAseq
- All urine voids 24 hr (approx. 750 samples): melatonin, steroid hormones and metabolites


Personal light measurements (HOBO), actigraph, ELF-EMF (EMDEX-II), questionnaires, chronotype, diaries (sleepiness)

HORMONIT - Sleep

Slide with results of sleep shown.

# Melatonin at end of 3 weeks night shift and end of 3 weeks day shift. Cosinor model

Slide with results of melatonin shown.

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# Steroid hormones (51 hormones/metabolites) in night vs day shift (same worker comparison) in 50 workers. Difference in peak levels (acrophase).

Slide with results of steroid hormones shown.

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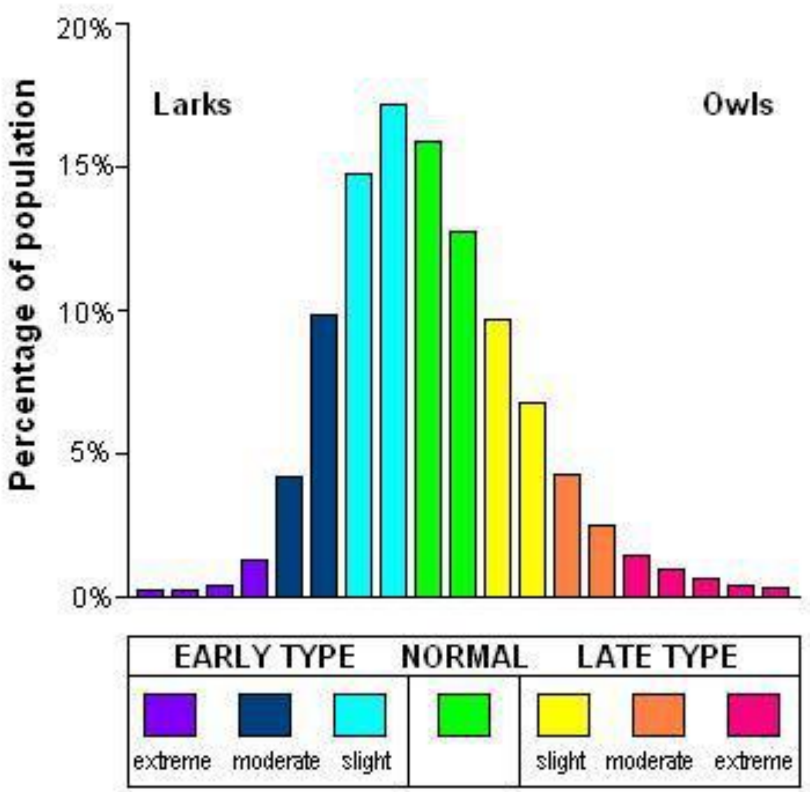
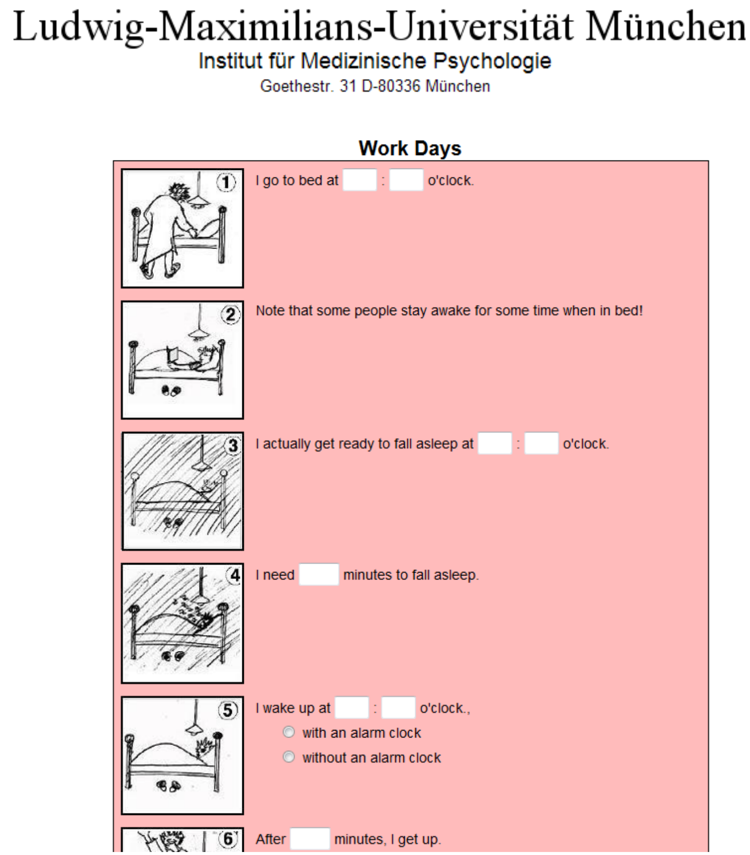



Individual chronotype is a human attribute with genetic basis that reflects the circadian phase of entrainment



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**Work Days**

1. I go to bed at ___ : ___ o'clock.
2. Note that some people stay awake for some time when in bed!
3. I actually get ready to fall asleep at ___ : ___ o'clock.
4. I need ___ minutes to fall asleep.
5. I wake up at ___ : ___ o'clock.,
   - with an alarm clock
   - without an alarm clock
6. After ___ minutes, I get up.

https://www.bioinfo.mpg.de/mctq/core_work_life/core/core.jsp?language=eng

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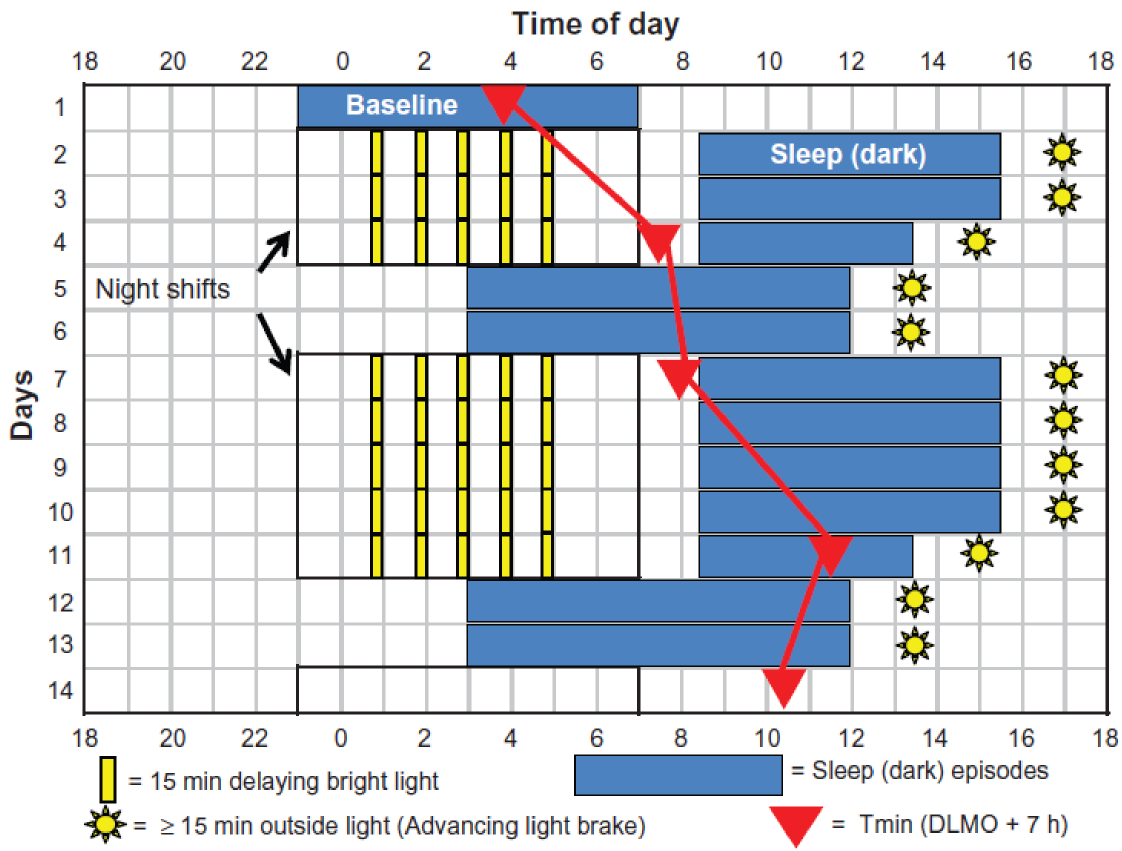
# Sleep-and-light schedule for night-shift work to align circadian rhythms with the sleep schedule enough to move the temperature minimum (Tmin red triangles) to within sleep




Smith & Eastman (2012)

# Other Recommendations

- Rapidly rotating shifts including both night and day shifts
  - very common but should be avoided
  - very difficult to reduce circadian misalignment
  - associated with various performance, safety, and health problems
- Slowly rotating three-shift system in the delaying direction (eg, 2 weeks days, 2 weeks evenings, 2 weeks nights, …)
  - circadian misalignment could be practically eliminated

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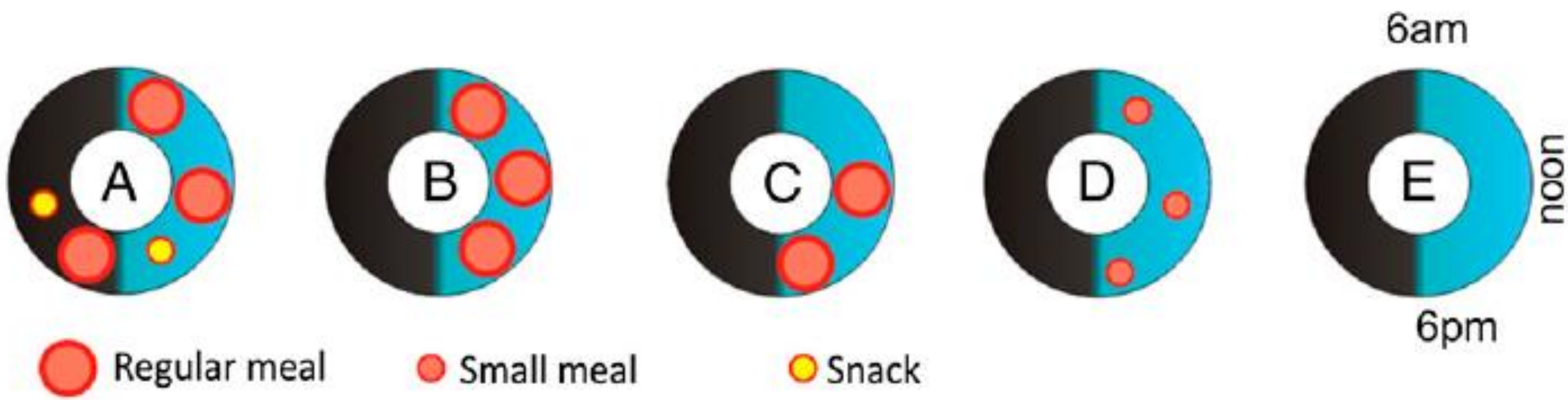
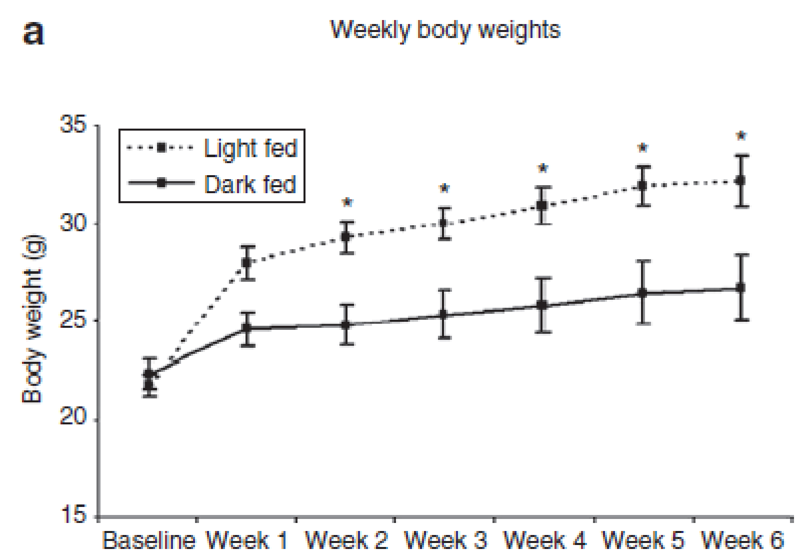
Smith & Eastman (2012)

# Patterns of Daily Food Consumption

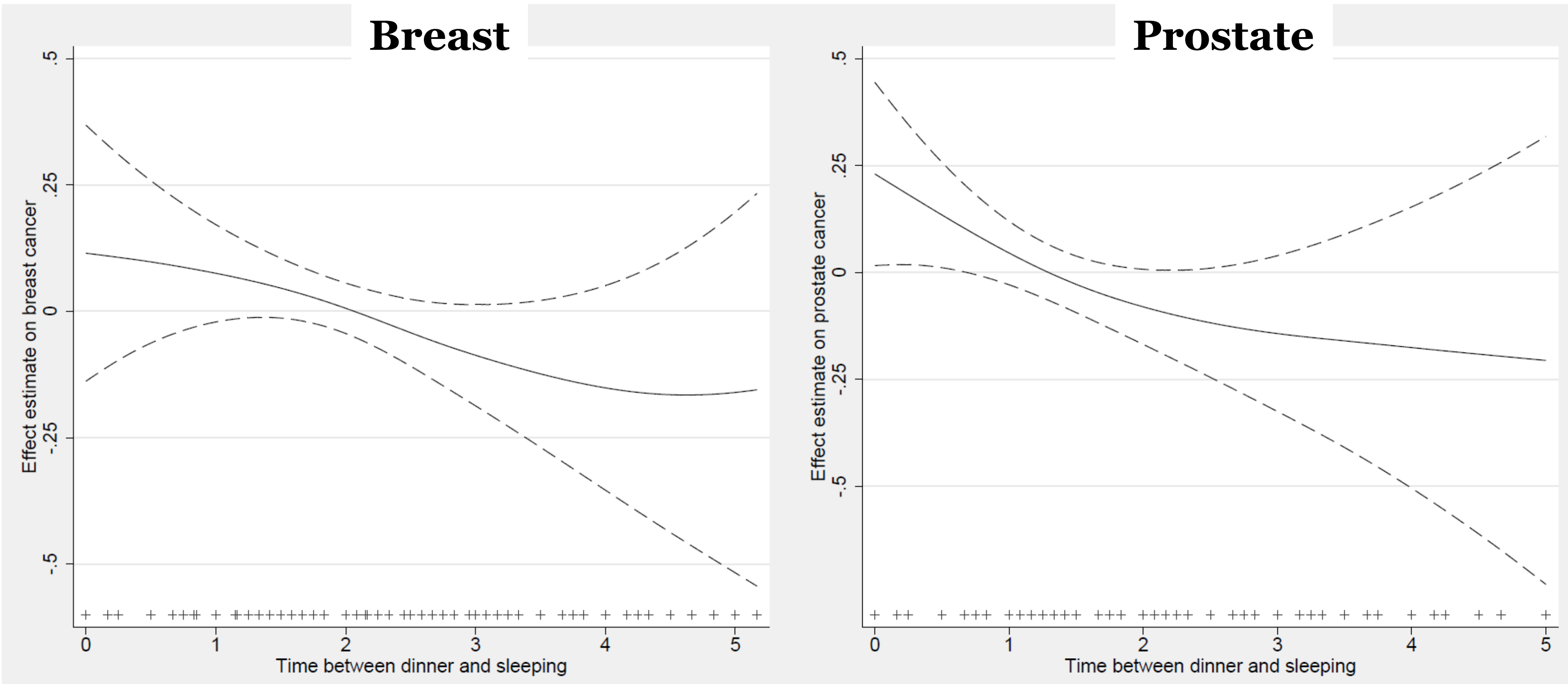



A. 3 meals and snacks
B. 3 meals consumed during the day
C. 2 meals no breakfast
D. 3 small meals
E. Complete fast




Mattson et al. (2014), Abele et al. (2009)

# Effect of mistimed eating on breast and prostate cancer risk. Association with time between dinner (last main meal) and sleep. MCC-Spain.




Kogevinas et al. (2018)

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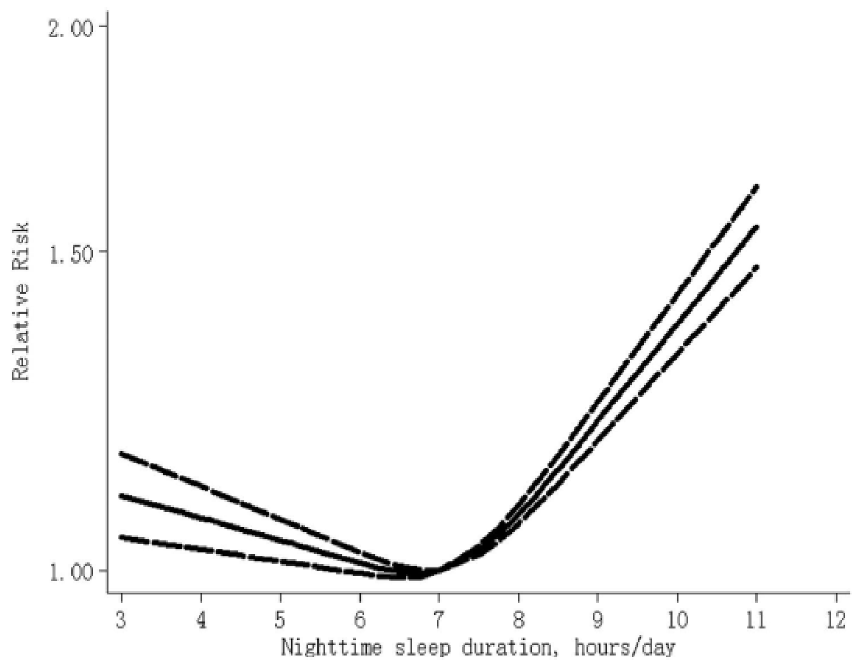
# Sleep and Cancer – Epidemiological Studies

OPEN

**Nighttime sleep duration, 24-hour sleep duration and risk of all-cause mortality among adults: a meta-analysis of prospective cohort studies**

Received: 13 October 2015
Accepted: 25 January 2016
Published: 22 February 2016

Xiaoli Shen*, Yili Wu* & Dongfeng Zhang




- Twelve studies on sleep and breast cancer - Mixed results
- Six studies on sleep and prostate cancer - Mixed results

- Limitations:
  - Exposure assessment (limited information on sleep, usually a single question on duration)
  - Lack of information on sleep medication use

Samuelsson et al. (2018); Wendeu-Foyet et al. (2017)

Sleep Medicine Reviews 27 (2016) 43–55

Contents lists available at ScienceDirect

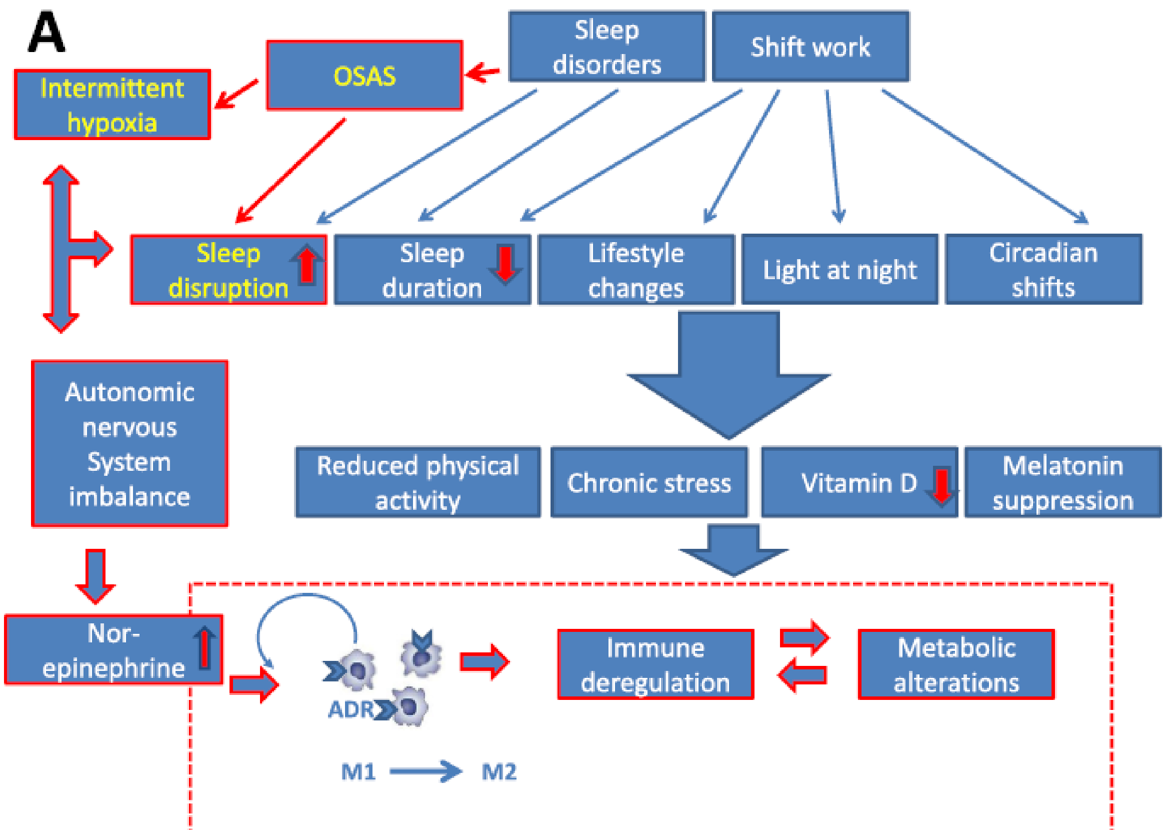
Sleep Medicine Reviews

journal homepage: www.elsevier.com/locate/smrv

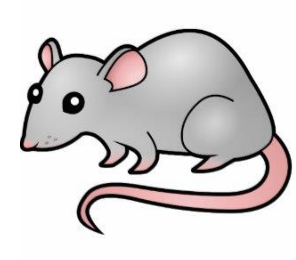
FOCUS REVIEW

# Obstructive sleep apnea and cancer: Epidemiologic links and theoretical biological constructs

David Gozal [a,*], Ramon Farré [b,c], F. Javier Nieto [d]




**Fragmented sleep and intermittent hypoxia** may promote changes in multiple signalosomes and transcription factors that can not only **initiate malignant transformation**, but will also alter the tumor microenvironment, disrupt immunosurveillance, and thus hasten **tumor proliferation** and **increase local and metastatic invasion**.



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MULTI-CASO CONTROL - SPAIN


Slide with results of sleep shown.

Detailed sleep questionnaire: Sleep duration, sleep problems, problems to fall asleep, problems to wake up, sleep medication use, changes in sleep patterns, siesta

Turner et al.

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# International Space Station Night Image (https://eol.jsc.nasa.gov) of Barcelona 2013

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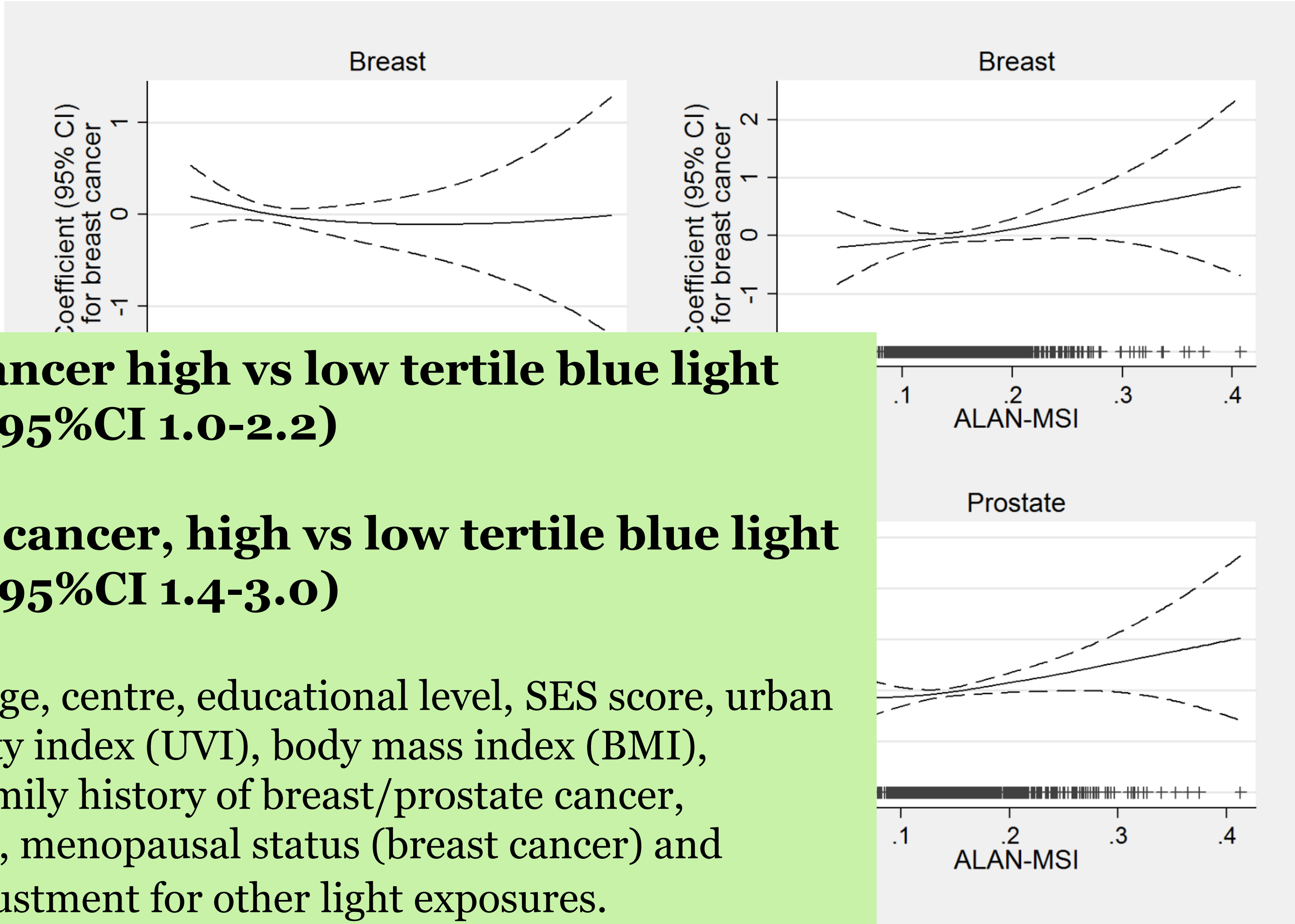
Garcia-Saenz et al. (2018)

## Evaluating the Association between Artificial Light-at-Night Exposure and Breast and Prostate Cancer Risk in Spain (MCC-Spain Study)




**Breast cancer high vs low tertile blue light OR=1.5 (95%CI 1.0-2.2)**

**Prostate cancer, high vs low tertile blue light OR=2.1 (95%CI 1.4-3.0)**

Adjusted: age, centre, educational level, SES score, urban vulnerability index (UVI), body mass index (BMI), tobacco, family history of breast/prostate cancer, chronotype, menopausal status (breast cancer) and mutual adjustment for other light exposures.

Garcia-Saenz et al. (2018)

# Network on the Coordination and Harmonisation of European Occupational Cohorts (OMEGA-NET)

- Goal: To create a **network** to optimize the coordination and use of occupational, industrial, and population **cohorts** at the European level to inform evidence-based interventions and policy
- Timeframe: October 2017-October 2021
- Funding: EU Framework Programme Horizon 2020 European Cooperation in Science and Technology (COST Action)
- Budget: 520,000+€ for networking tools

OMEGA-NET

EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

# OMEGA-NET Countries


- >150 participants from 37 countries
- 32 COST countries and COST cooperating states
- Near Neighbour Countries (NNC)
  - Belarus, Morocco, the Palestinian Authority
- International Partner Countries (IPC)
  - Australia, the United States
- International Organisations
  - the International Agency for Research on Cancer (IARC)

OMEGA-NET

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**Dr Michelle Turner**
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**Dr Gemma Castaño**
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Working Group 3 Vice Leader

**Prof Neil Pearce**
Working Group 4 Vice Leader

**Dr Raquel Lucas**
STSM Coordinator

ITC Conference Grant Coordinator

Scientific Officer

Administration Oficer

# Working Groups

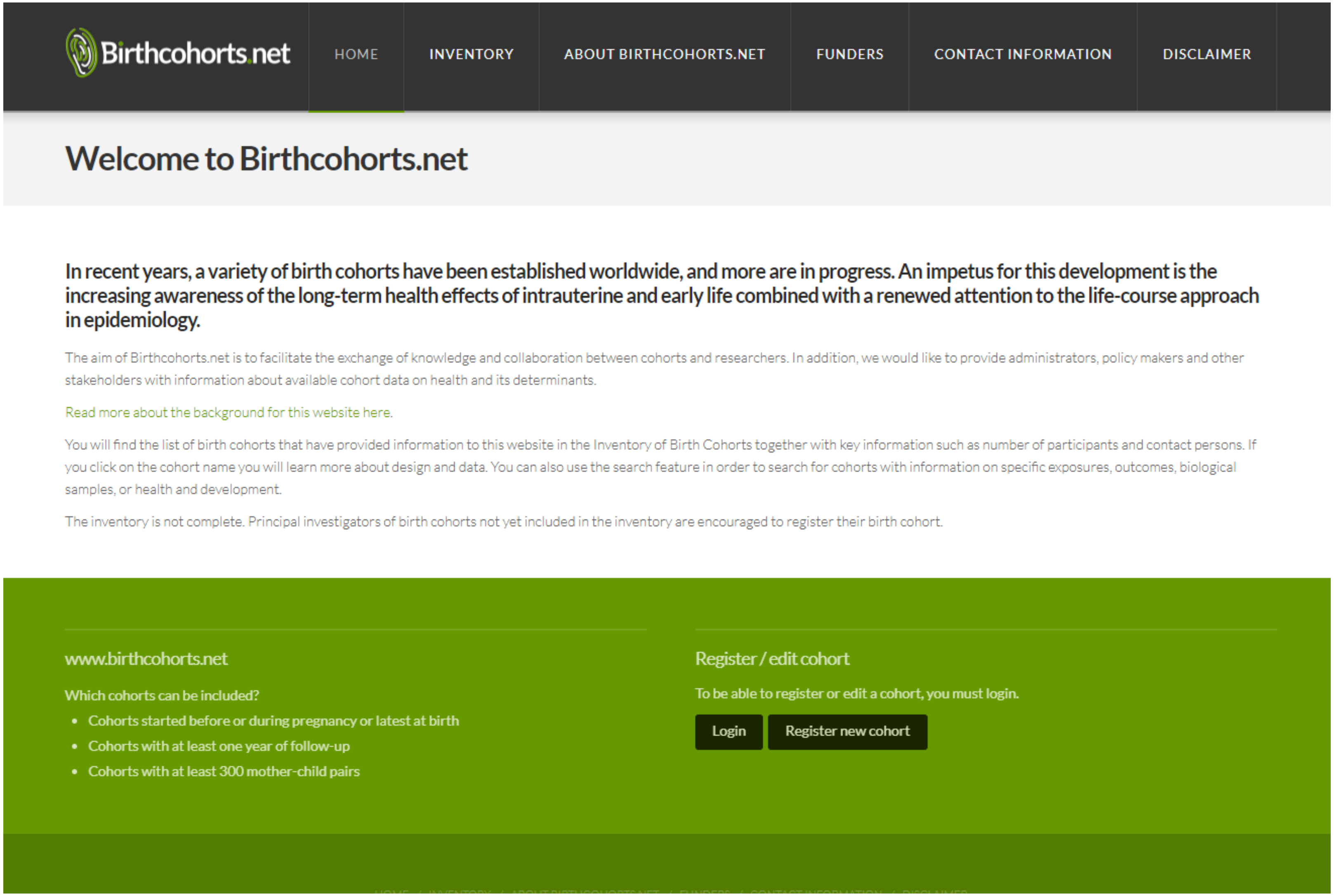
- WG1. Inventory of Occupational Cohorts

- WG2. Harmonisation of Existing Occupational Exposure and Outcome Information

- WG3. Standardised Protocols for New Occupational Data Collection

  - Task 3.1 Healthy ageing and work participation
  - **Task 3.2 Working hours**
  - Task 3.3 Employment patterns in the young including young employed mothers
  - Task 3.4 Occupational skin diseases
  - Task 3.5 Work-related psychosocial determinants on mental health
  - Task 3.6 Precarious work

- WG4. Science Communications, Dissemination and Training



Birthcohorts.net

HOME | INVENTORY | ABOUT BIRTHCOHORTS.NET | FUNDERS | CONTACT INFORMATION | DISCLAIMER

# Welcome to Birthcohorts.net

**In recent years, a variety of birth cohorts have been established worldwide, and more are in progress. An impetus for this development is the increasing awareness of the long-term health effects of intrauterine and early life combined with a renewed attention to the life-course approach in epidemiology.**

The aim of Birthcohorts.net is to facilitate the exchange of knowledge and collaboration between cohorts and researchers. In addition, we would like to provide administrators, policy makers and other stakeholders with information about available cohort data on health and its determinants.

Read more about the background for this website here.

You will find the list of birth cohorts that have provided information to this website in the Inventory of Birth Cohorts together with key information such as number of participants and contact persons. If you click on the cohort name you will learn more about design and data. You can also use the search feature in order to search for cohorts with information on specific exposures, outcomes, biological samples, or health and development.

The inventory is not complete. Principal investigators of birth cohorts not yet included in the inventory are encouraged to register their birth cohort.

## www.birthcohorts.net

Which cohorts can be included?

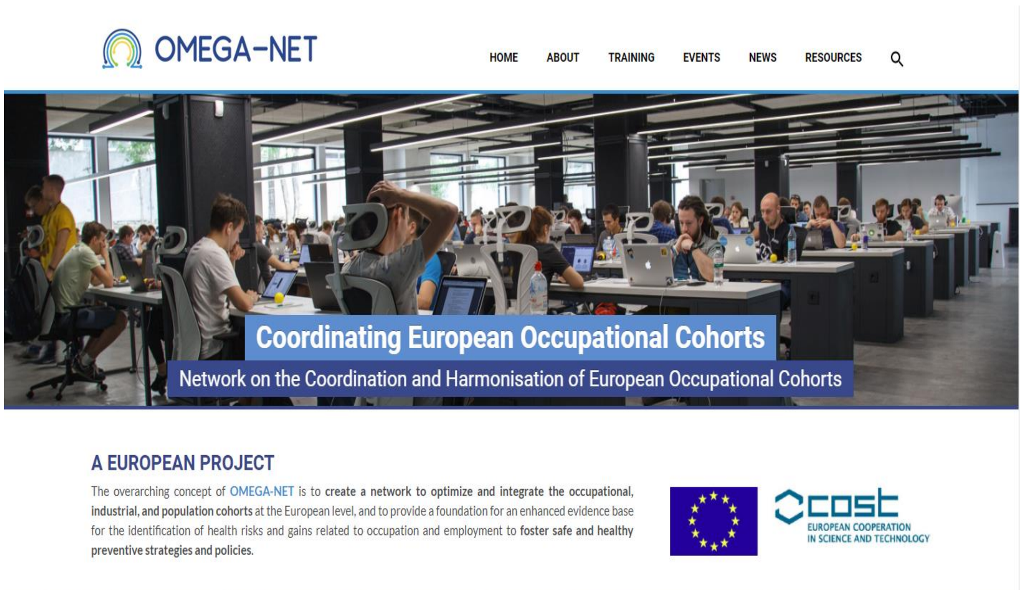
- Cohorts started before or during pregnancy or latest at birth
- Cohorts with at least one year of follow-up
- Cohorts with at least 300 mother-child pairs

## Register / edit cohort

To be able to register or edit a cohort, you must login.

Login | Register new cohort

www.omeganetcohorts.eu

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EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

# Exposome Project for Health and Occupational Research (EPHOR)

- Goal: To **develop** the **working-life exposome**, defined as all **occupational** and related **non-occupational** exposure factors, to lay the groundwork for evidence-based and cost-effective preventive actions to improve working life health and reduce the burden of NCDs
- Timeframe: 2020-2024
- Funding: Horizon 2020 SC1-BHC-28-2019: The Human Exposome Project: a toolbox for assessing and addressing the impact of environment on health
- Budget: €11,981,860

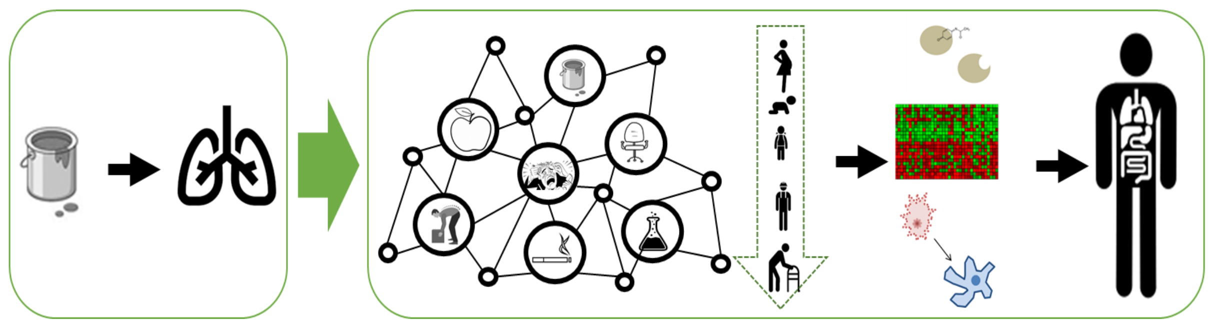

*Figure 1.1.1: Taking an exposome approach to the working life: a fundamental shift from studying one occupational exposure in relation to one defined health effect, to mapping the complex picture of several interrelated exposures in relation to inherent biological pathways, key body functions and health, identifying also vulnerable individuals, groups or life stages.*

# EPHOR: Work Packages

**Method development: exposome and data analyses**

**WP1**: New technologies for external exposome and health
**WP2**: Standardized assessment of multiple exposures in large populations
**WP3**: Internal exposure and effect assessment using biomonitoring, omics and minimally invasive biomarker development
**WP4**: Working life exposome data management and analytics platform

**Project outcomes**

**WP9**: Working life exposome toolbox
**WP10**: Dissemination & exploitation

**Method application/data generation**

**WP5**: EPHOR Mega Cohort
**WP6**: Working life exposome, lung function, and obstructive lung disease among men and women
**WP7**: Exposome studies on shift work and health

**Method development: impact assessment**

**WP8**: Impact assessment of the working life exposome

# Conclusions

- Circadian disruption and night shift work associated with acute and chronic health effects including cancer
- Few recommendations for better adaptation to circadian disruption due to night shift work are based on solid evidence
  - Importance of evaluating circadian rhythms in studies on diet and cancer (and developing recommendations for prevention not only focusing on type and quantity of food intake)
  - Importance of blue-light spectrum which has rapidly increased both in public and private places (massive use of LED, tablets, smartphones)

Visit epicoh2020.org
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Montréal, Canada
28th International Symposium on Epidemiology in Occupational Health
EPICOH 2020
SAVE THE DATE
August 31st – September 3rd 2020
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# Acknowledgements


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# Thank you!

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