(Nearby) nature and human health

Guest lecture University of Sao Paulo

Sjerp de Vries, 16 November 2023

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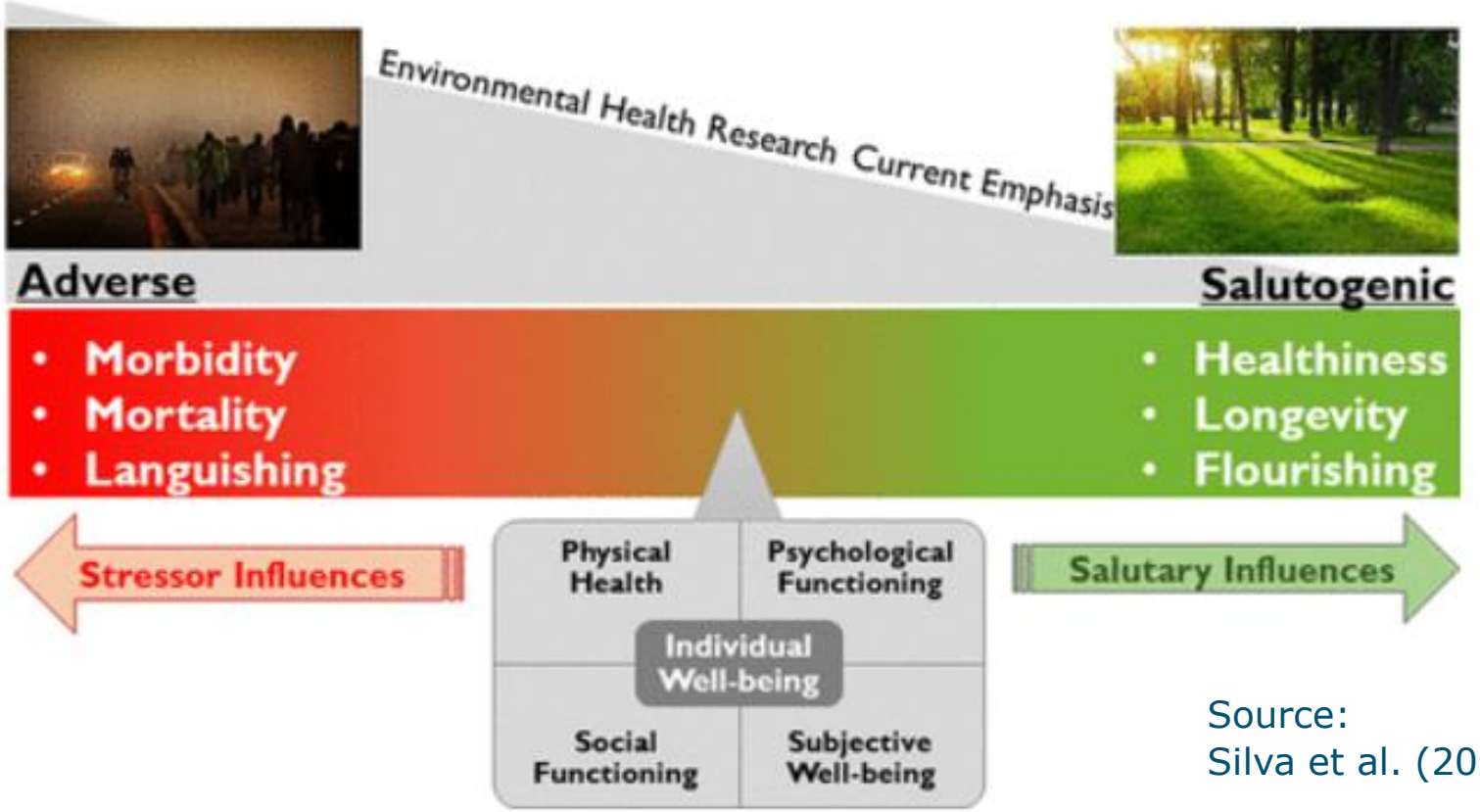
Outline of lecture

- Background/context
- Observed associations between nature and human health
- General models on pathways linking nature & health
- Zooming in on specific pathways
- Relative strength of pathways
- Importance of type of nature and its characteristics
- Conclusions

Background/context

Health domain: trend in environmental epidemiology



Source:
Silva et al. (2018)

Nature & biodiversity domain: ecosystem services

- Ecosystem services (definition):
  - "the contributions that ecosystems (i.e., living systems) make to **human well-being.**" (Haines-Young & Potschin, 2018)

- Three main categories of services (CICES 5.1):
  - a) the **provisioning** of material and energy needs
  - b) **regulation** and maintenance of the environment for humans
  - c) **cultural** services: the non-material characteristics of ecosystems that affect physical and mental states of people

Source: PBL, WUR, CICES 2014

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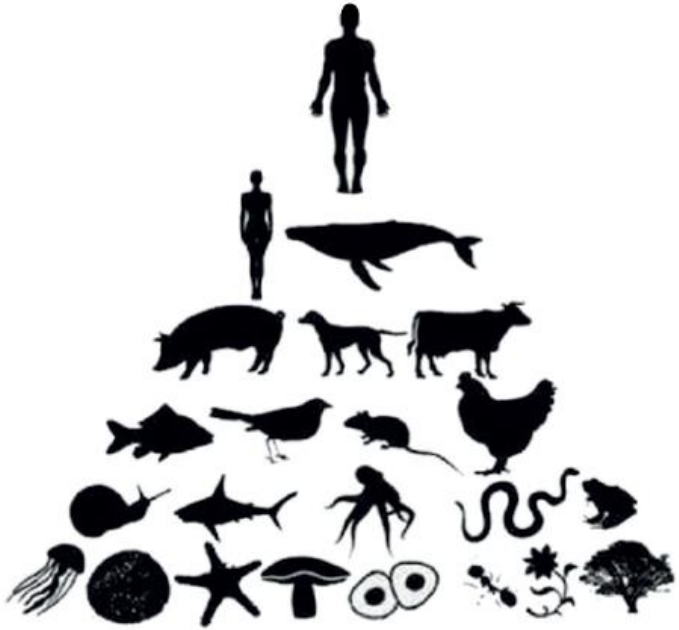
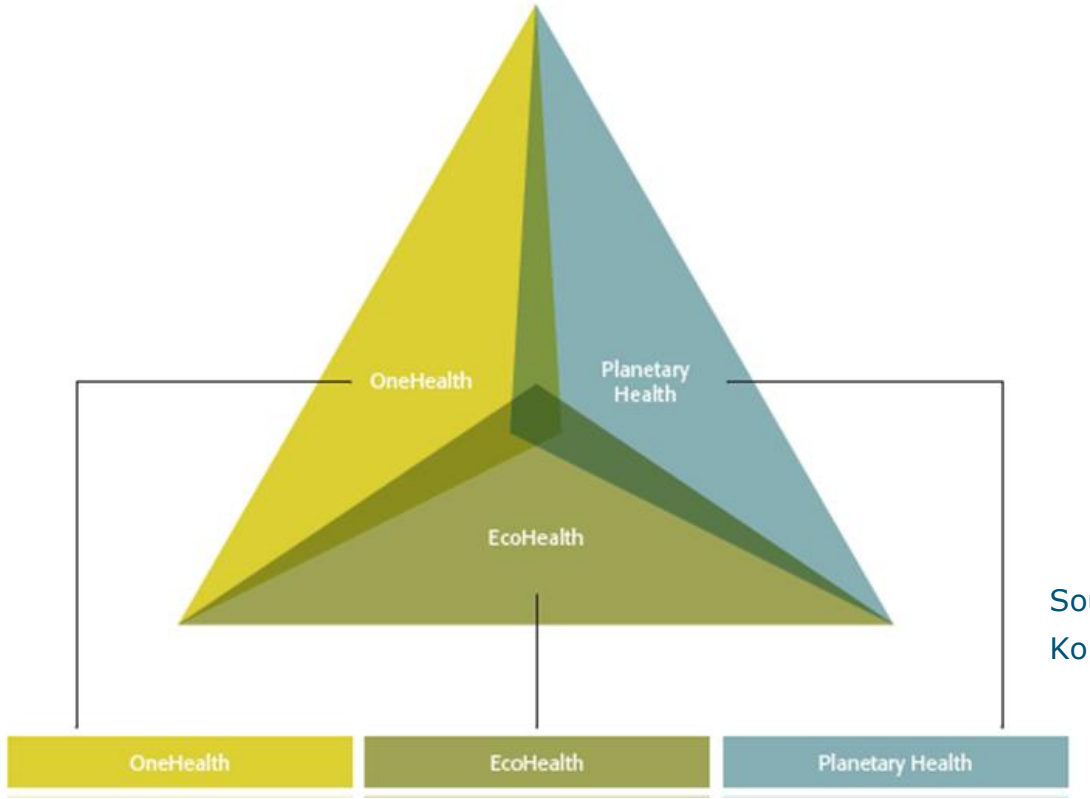
New frameworks, linking environment and human health

Anthropocentric versus ecocentric worldview



Source: Ehrnström-Fuentes, 2016

Illustration of how this assessment builds upon the convergence of three systems approaches: One Health, Planetary Health and EcoHealth – each with roots in different backgrounds, but with increased convergence in the science-policy-practice space

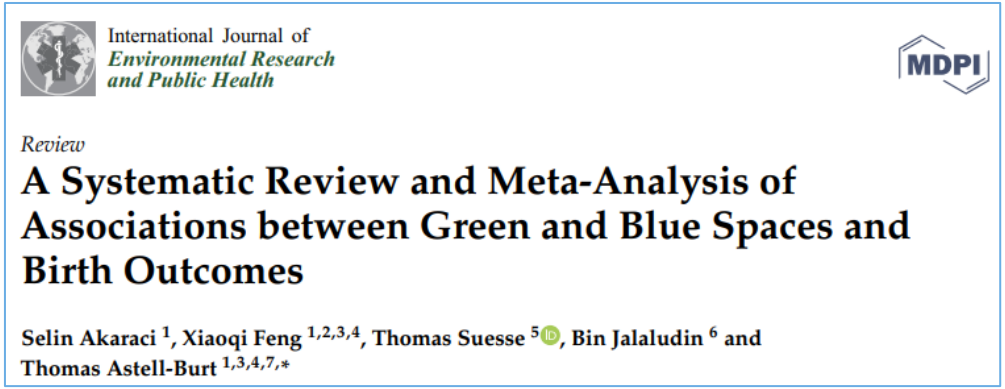


Source:
Konijnedijk et al. (2023)

Question 1:
Is having a green/natural residential environment healthy?

Association between nearby nature and health 1

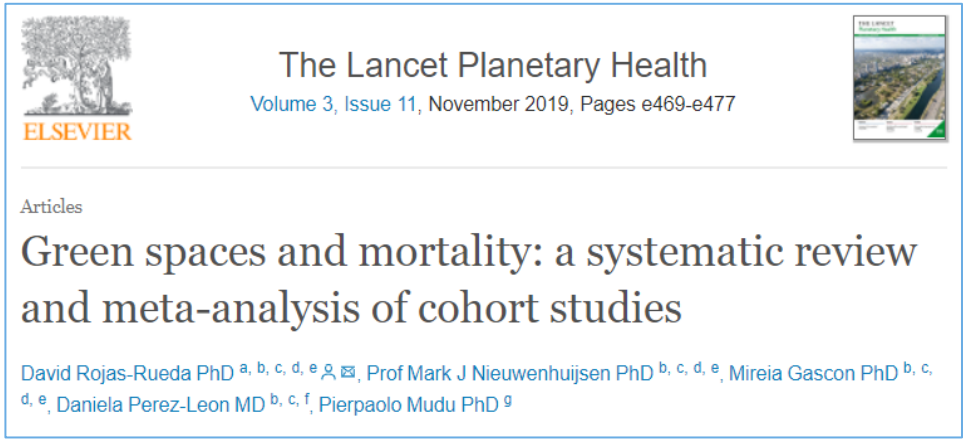
- Already starts at birth:



- Systematic review by Akaraci et al. (2020):
  - Greener residential surroundings of mother are associated with higher birth weight of babies
  - And lower probability of baby being small for gestational age

Association between nearby nature and health 2

- And continues till death:



ELSEVIER

The Lancet Planetary Health

Volume 3, Issue 11, November 2019, Pages e469-e477

Articles

Green spaces and mortality: a systematic review and meta-analysis of cohort studies

David Rojas-Rueda PhD [a, b, c, d, e], Prof Mark J Nieuwenhuijsen PhD [b, c, d, e], Mireia Gascon PhD [b, c, d, e], Daniela Perez-Leon MD [b, c, f], Pierpaolo Mudu PhD [g]

- Systematic review by Rojas-Rueda (2019):
  - In a greener residential environmental is the risk of premature death smaller

Associations between nearby nature and health 3

And between birth and death beneficial associations for, among others:

- Social-emotional development of children (Vanaken & Danckaerts, 2018)
- Being overweight by children (Fyfe-Johnson et al., 2021)
- Being overweight by adults (Luo et al., 2020)
- Diabetes (De la Fuente et al., 2020)
- Mental health and well-being (Li et al., 2021)
- Cardiovascular disorders (Yuan et al., 2021)

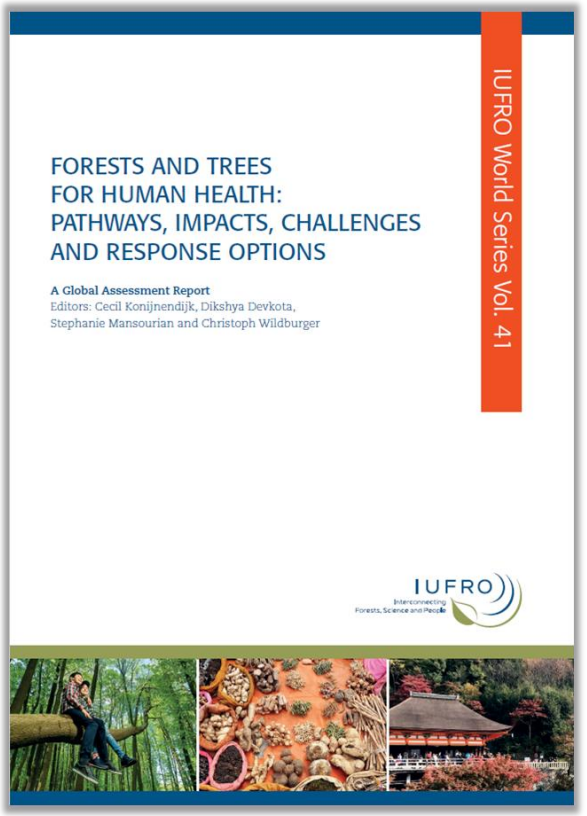
Associations between nearby nature and health 4

- Chapter 3: written on evidence base by 25 experts from all over the world, organized by life stage and type of disorder ->

Table 3.3

Expert assessment (by authors) of the strength of the evidence for forests, trees and other types of green space being associated with different health outcomes among the elderly

ELDERLY: STRENGTH OF THE EVIDENCE			
Cognitive decline and dementia	Physical functioning and frailty	Mental health and wellbeing	Longevity and mortality
++	+/0	++	++



The issue of causality of observed associations

- Thus, nearby nature is beneficially associated with many health outcomes.
- But are the observed associations causal in nature, with nearby nature being the driving force?
    - will greening residential environments help?
- The possibility of reversed causality
    - A poor health status might lead people to move to a less green (more urban) residential environment

Examples of other study designs (than cross-sectional)

- Moving to a green environment (Alcock et al., 2014)
  - Higher mental well-being
- Monozygotic twins later in life (Cohen-Cline et al., 2015)
  - Fewer depressive symptoms
- Greening of vacant lots (Branas et al., 2011)
  - Lower stress levels & more physical activity

However, such studies, allowing for more firm conclusions regarding causality, are relatively scarce.

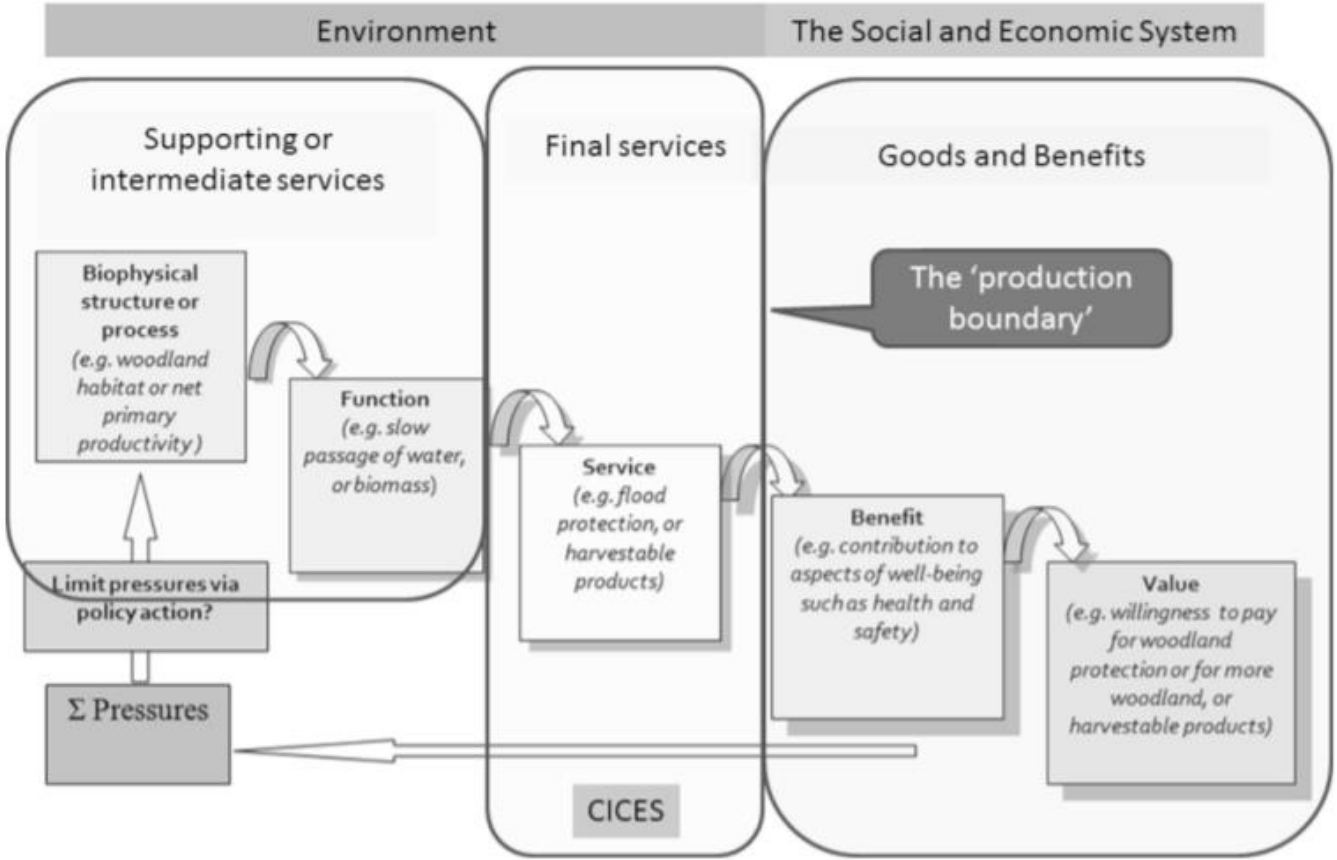
Question 2:
Why would having a green residential environment be healthy?

Generic models with regard to pathways

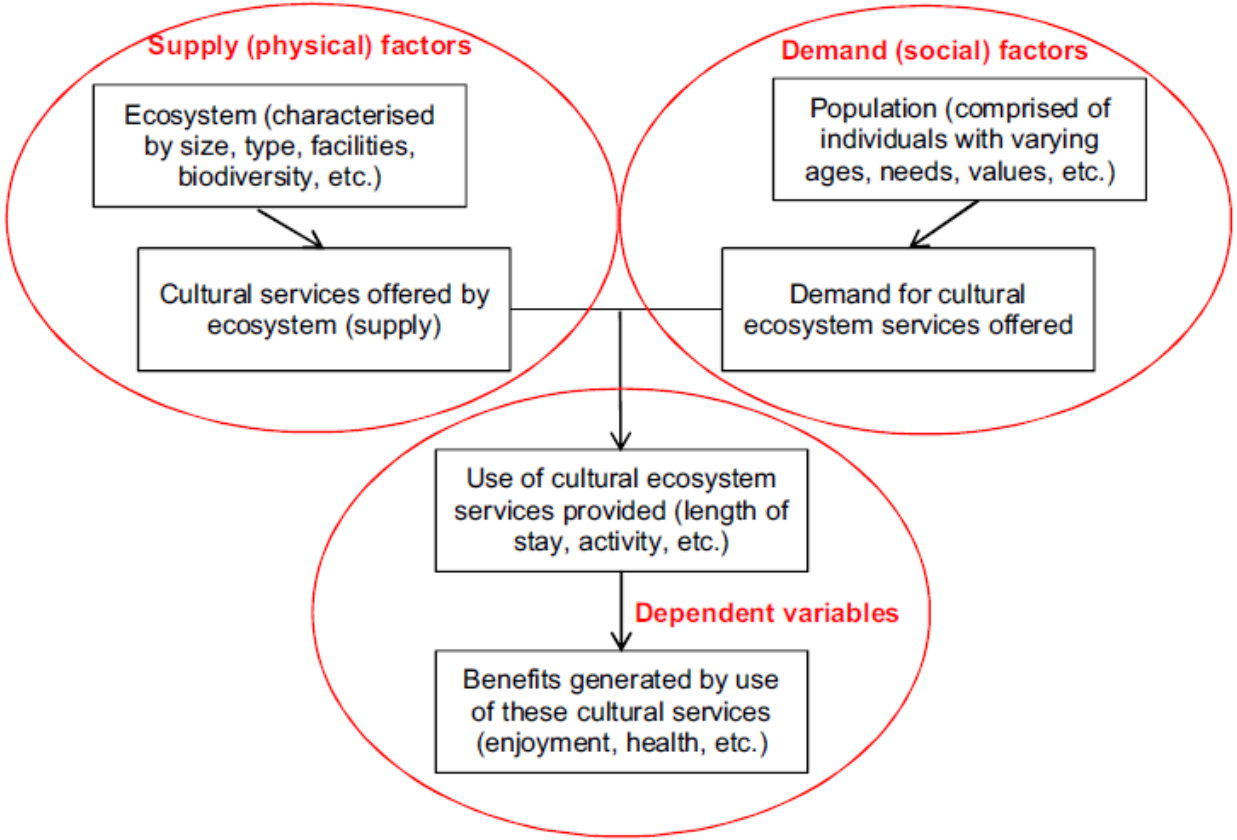
- Ecosystem services
  - Cascade model (Potschin & Haines-Young, 2016)
  - Confluence model (Hegetschweiler et al., 2017)

- Nature and health
  - Markevych et al. (2017)
  - Natural E4HIA framework (De Vries, 2022)

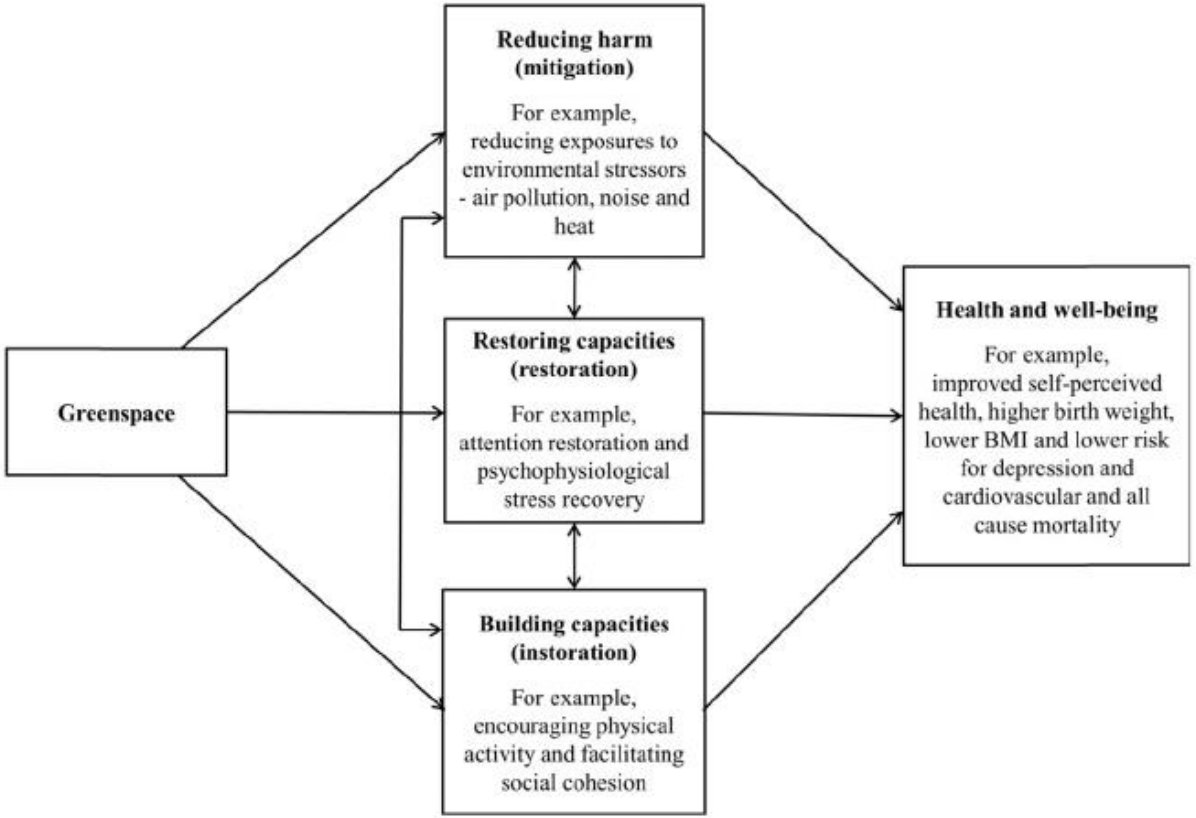
Generic Model 1: Cascade model (Potschin & Haines-Young, 2016)



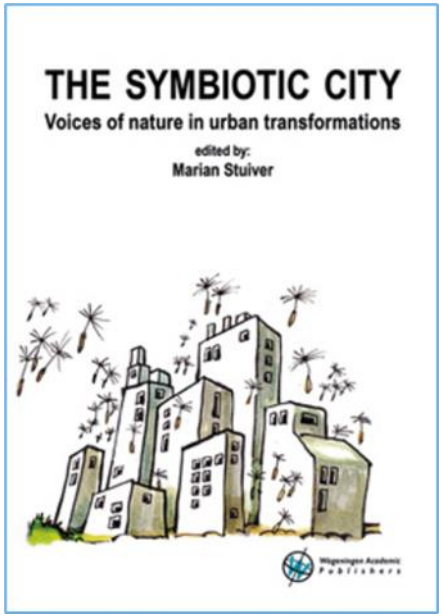
Generic Model 2: Confluence model (Hegetschweiler et al., 2017)

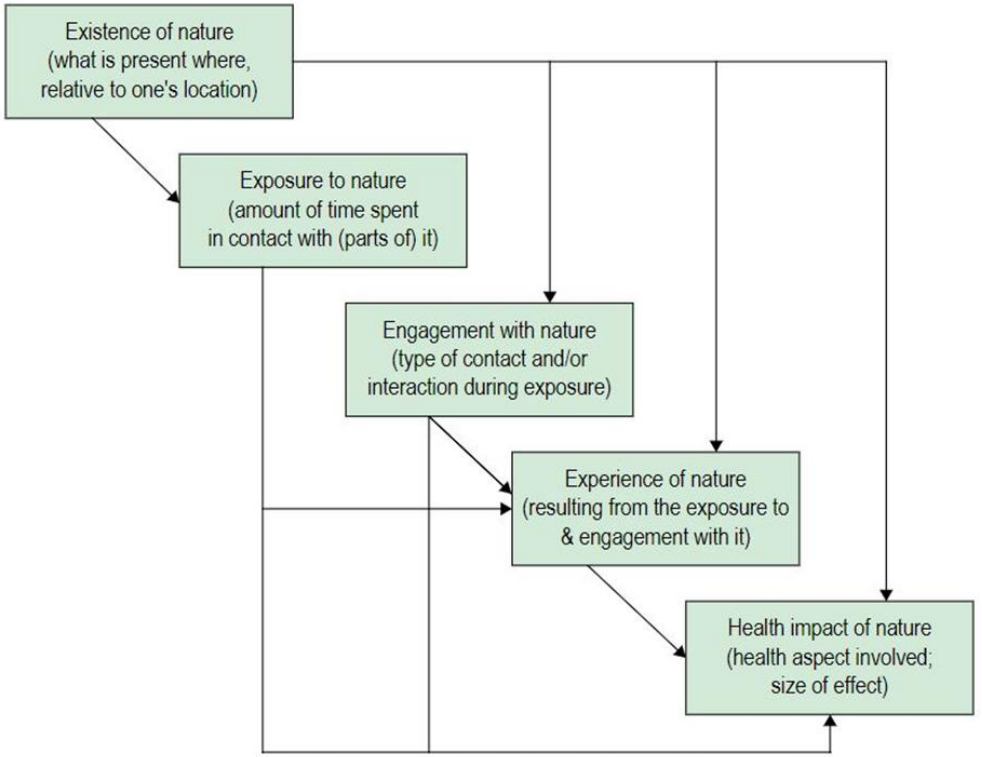


Generic Model 3: Markevych et al. (2017)



Generic Model 4: Natural Environment For Health Impact Assessment (E4HIA) framework (de Vries, 2022)





Why is nearby nature healthy?

Specific pathways

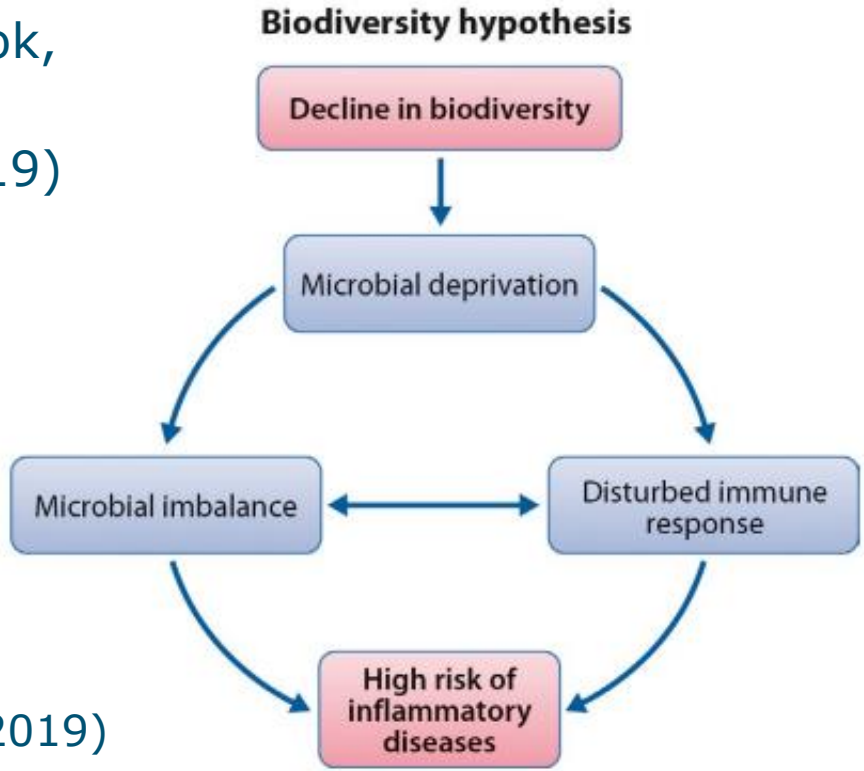
Focus on pathways requiring nearness

- Provisioning services
  - Providing microbes that improve our immune system functioning
- Regulating services
  - Improving air quality, esp. with regard to fine dust
  - Reducing heat stress, esp. needed in cities
- Cultural services
  - Reducing stress, restoring attention, improving mood
  - Inviting physical activity
  - Facilitating social contacts and social cohesion

Providing contact with useful microbes

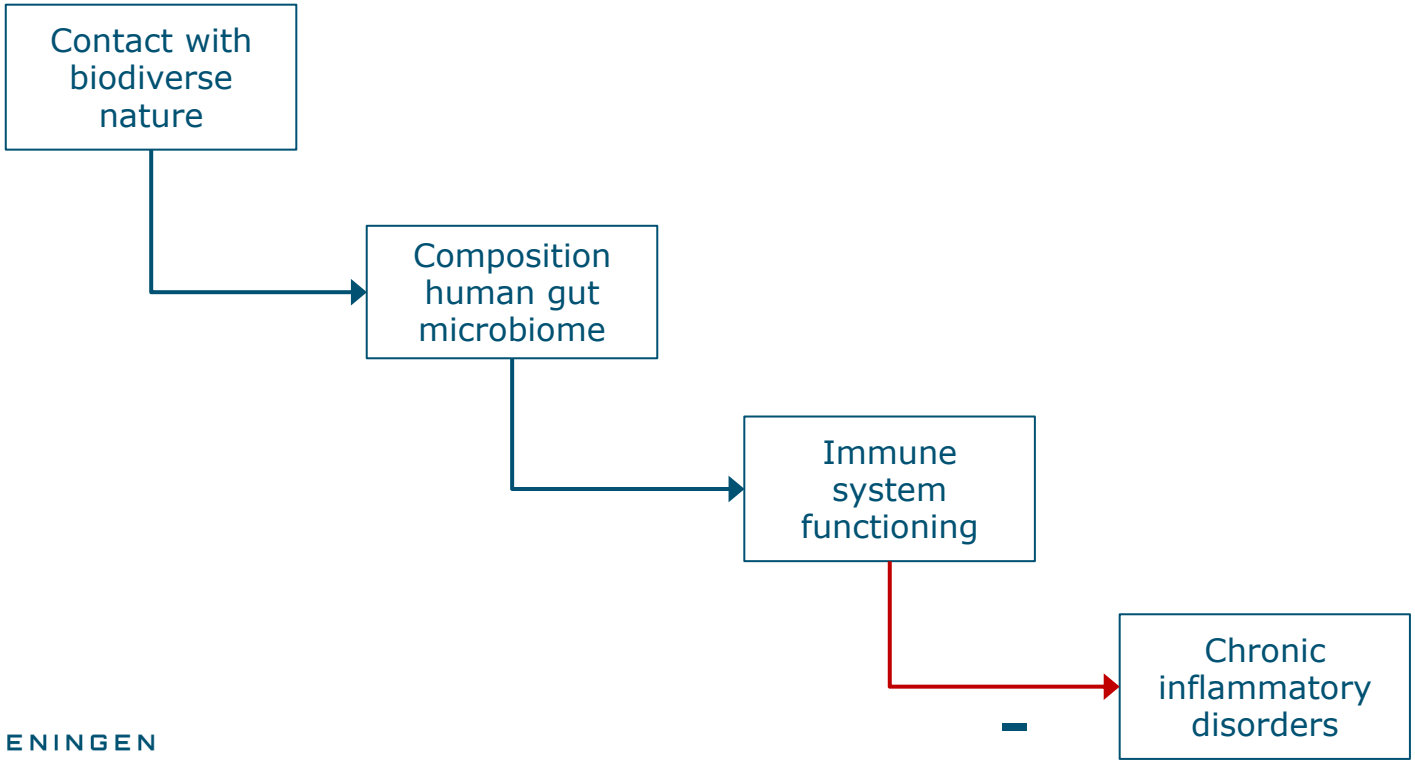
Providing useful microbes

- Know as ‘Old friends’ (Rook, 2013) and/or Biodiversity hypothesis (Haahtela, 2019)



Source: Haahtela (2019)

Providing useful microbes 2: how does it (supposedly) work?



Providing useful microbes 3: what does it (supposedly) require?

- Coming into contact with microbial biodiversity
  - Being on a farm
  - Pet animals (dogs)
  - Gardening?
  - Eating dirt (as a child)?
- Contact should be with *beneficial* microbes
- Q: will a walk in the park do the trick (airborne microbes)?

Providing useful microbes 4:
for whom is it (likely to be) especially important?

- Young children: development of immune system

Improving air quality

Improving air quality: how does it work?

- Inhaling fine dust is unhealthy
    - Some types more than others (e.g. soot)
- Trapping of fine dust (particulate matter) by vegetation
    - Sizes: 10, 2.5, 1.0 micrometers (smaller is worse)
- Vegetation ‘catches’ fine dust.

Improving air quality: what does it require?

- Polluted air should move *through* the leaves
  - Dense forest is not optimal
- Type of vegetation important
  - Trees more effective than grass
  - Type of leaves: coniferous trees more effective
- Warning: if the vegetation blocks the airflow, this may result in the air remaining more pollluted, despite part of the fine dust being ‘caught’

Improving air quality: for whom is it likely to be especially important?

- People with pre-existing respiratory problems, such as asthma
- More in general, children, pregnant women, older adults

Improving air quality: how effective is vegetation?

- Effect of vegetation on air quality seems limited:

  Netherlands Institute for Public Health and the Environment (RIVM): urban vegetation cannot significantly improve the air quality in a city and may even have a negative effect (PM10, NO2) (Wesseling et al., 2011).

Heat stress reduction

Reducing heat stress: how does it work?

- High temperatures waves cause premature mortality
    - Temperatures rise quicker in cities: urban heat island (UHI)
- Urban green space can help to reduce the UHI effect, and thereby premature mortality; with especially trees being effective (also offer shade)
- This mechanism is mainly important during summers/heat waves
    - For certain causes of death: cardiovascular, respiratory
    - In warmer regions and when houses are poorly isolated
- In terms of mortality, it mainly affects the very old (say 80+)

ISGlobal

Over 4% of summer mortality in European cities is attributable to urban heat islands

30%

Increasing **tree cover** in cities to **30%**

can reduce the **temperature** of urban environments by up to **1.3 °C**

and **prevent 1/3 of premature deaths** attributable to urban heat islands in summer

Source: Iungman T., et al., The Lancet, 2023.

Reducing (chronic) mental stress

Stress reduction: how does it work?

- Stress Reduction Theory (SRT)
  - Strongly psycho-evolutionary based
  - Just looking at nature results in an immediate response, also physiological

- Attention Restoration Theory (ART)
  - More also cognitively mediated
  - Being in nature helps to restore attention (ability to concentrate) more quickly

Ulrich (1984): View from hospital window

- Health aspect

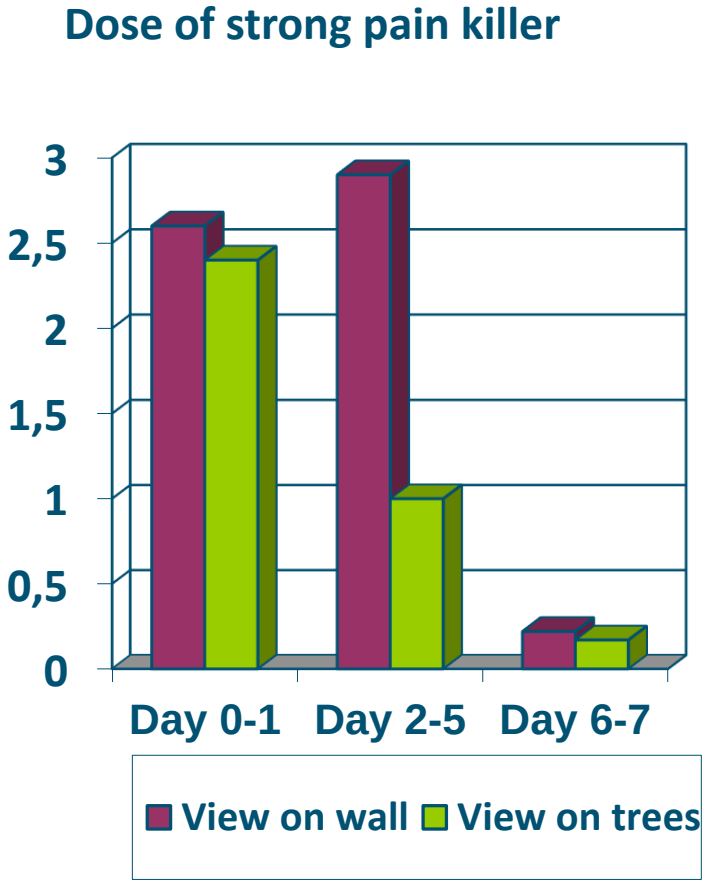
  Recovery after gall bladder surgery: use of pain killers, length of stay

- Environments aspect

  View from hospital room: brick wall versus trees

- Results

  Quicker recovery when window view on trees



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Stress reduction: what does it require?

- Spatial structure
  - SRT: maximize contact with nature/natural elements
  - ART: provide green oases
- Quality of experience
  - SRT: nature should be non-threatening
  - ART: offer peaceful, quiet environments, to provide relaxing, restorative experiences
- NB: both theories may be valid
  - But space is costly, especially in an urban context

Stress reduction: what does it require?

- Which type of nature is most helpful in reducing stress?
  - Is a high level of biodiversity mentally restorative?

Source: https://www.youtube.com/watch?v=tUn8BFUEceM

Inviting physical activity

Inviting physical activity: how does it work?

- Being physically active is good for your health
  - Many people are not active enough/are overweight
  - (Nowadays also: being sedentary is bad for your health)

- Nowadays, people have to be seduced to be physically active
  - Green areas provide space for activity
  - Moreover, green areas are generally considered attractive spaces

Inviting physical activity: what is required?

- Depends on type of activity. Two broad categories may be distinguished:
  - Active transport (going to a destination on foot or by bicycle)
    - Making routes to destinations more attractive
      - Walkability (and cyclability)
  - Outdoor recreational activity
    - Providing attractive areas (or recreational routes), including necessary facilities

Remme et al. (2021):

PERSPECTIVE

An ecosystem service perspective on urban nature, physical activity, and health

Roy P. Remme[a,b,1], Howard Frumkin[c], Anne D. Guerry[a,d], Abby C. King[e,f], Lisa Mandle[a], Chethan Sarabu[g], Gregory N. Bratman[d], Billie Giles-Corti[h], Perrine Hamel[a,i], Baolong Han[j], Jennifer L. Hicks[k], Peter James[l,m], Joshua J. Lawler[d], Therese Lindahl[n,o], Hongxiao Liu[p], Yi Lu[q], Bram Oosterbroek[r], Bibek Paudel[s], James F. Sallis[t,u], Jasper Schipperijn[v], Rok Sosič[w], Sjerp de Vries[x], Benedict W. Wheeler[y], Spencer A. Wood[d], Tong Wu[j], and Gretchen C. Daily[a,z]

- "We note that PA in nature may make up a small proportion of an individual's total PA, but could be highly important for PA and health at the population scale, if improvements in urban nature target groups with poor access to nature, high risk for chronic diseases, or low PA."

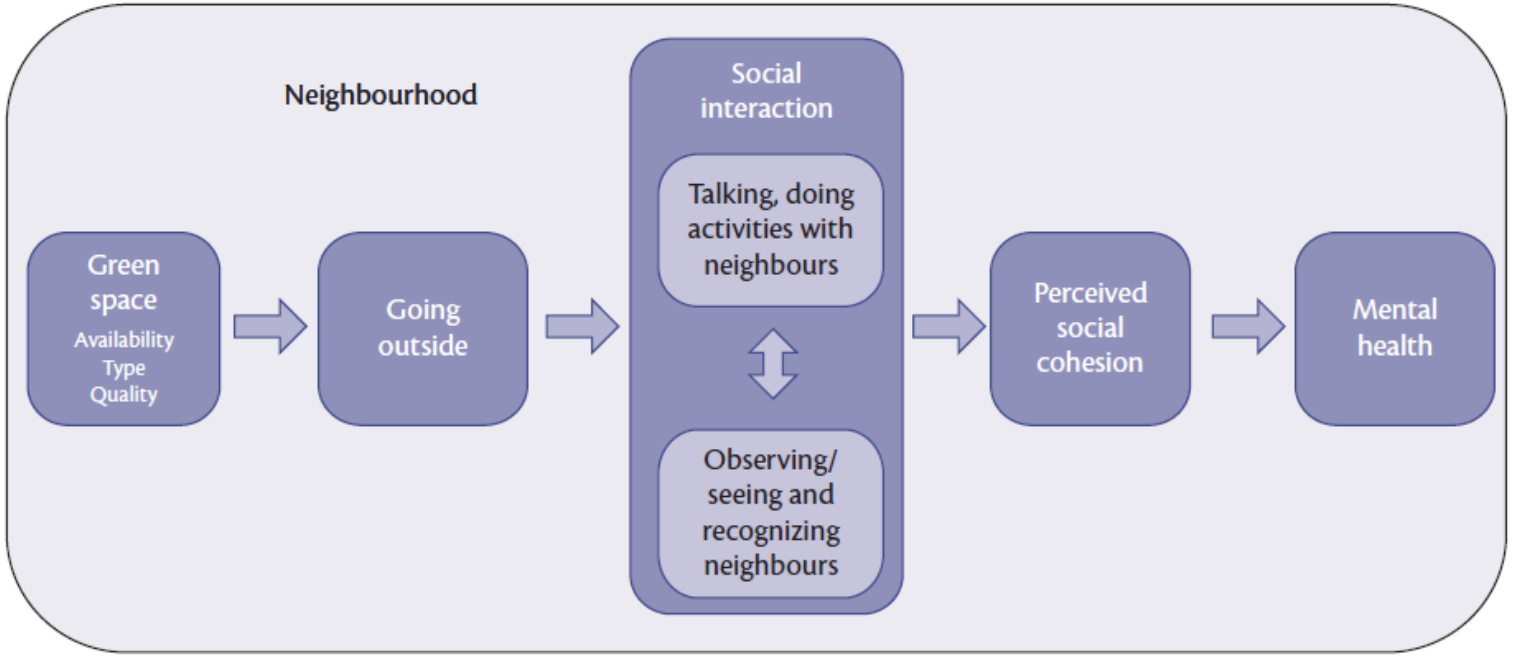
Facilitating social contacts and social cohesion

(within the neighourhood)

Facilitating social cohesion: how does it work?

- Social contacts and social cohesion in the neighbourhood have been shown to be beneficial for one's (mental) health
- Nearby nature may facilitate neighbours meeting each other in common or public areas
    - Attractive outdoor environment may seduce people to go outside
    - Neighbours meet each other in a positive setting and recognize each other as fellow neighbourhood members ('meet & greet')
    - Social cohesion also associated with level of informal social control and (feelings) of social safety

Facilitating social contacts and social cohesion: how is it (supposed) to work?



Source: Elands et al. (2019)

Facilitating social cohesion: what does it require?

- Streets
    - Making streets attractive to walk through (for pleasure)
- Green areas
    - Meeting *neighbourhood* members: *small service area* → small neighbourhood parks rather than a large city park
    - More time outdoors → higher probability of meeting neighbours. Especially facilitate stationary or 'slow' activities
    - Contacts should be positive → avoid conflicting types of use (an area can be too multifunctional)

For whom is it (likely to be) especially important?

- People with a low mobility
    - Young children, elderly
    - Home-makers?
- People that feel insecure (physically or psychologically)
    - Fear of falling, as well as fear of crime
- People with few relatives or good friends within the neighbourhood
    - In danger of feeling lonely/socially isolated

Classic example: Facilitating social cohesion (Kuo et al., 1998)

- Social housing in Chicago: Robert Taylor Homes
  - Identical social housing buildings, originally all with grass and some trees in their common space, in some cases now paved
  - Some appartment building no longer have any greenery
  - Assignment to appartments decided by city hall (random)

Facilitating social cohesion: Kuo et al (1998) cont'd

- Tenants living in appartment buildings with still some greenery used the common space more than those living in appartment buildings without any greenery
- The use of the common space around the building was positively associated with one's social connections with fellow tenants.
- The greennness of the common space and its use were also associated with feelings of safety

Question 3:

What is the relative strength of the different pathways?

Relative strenght of pathways: de Vries et al. (2013)

- Amount of streetscape greenery, rated by observers on a 5-point scale

- Quality rated on:
  - variation
  - maintenance
  - orderly arrangement
  - absence of litter

  plus general impression

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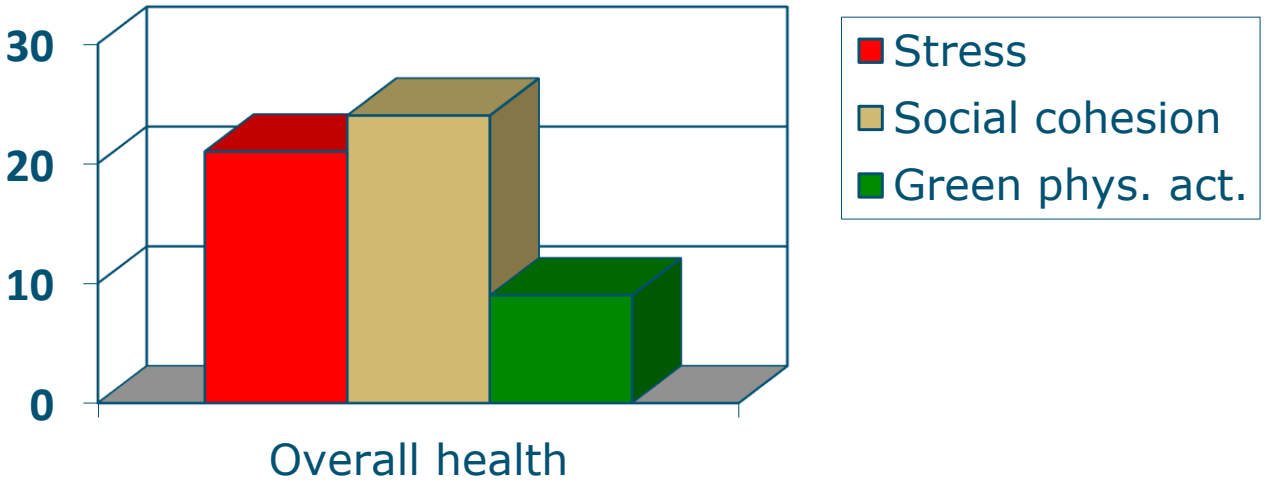
Relation streetscape greenery and health

	Self-rated general health	Health-related complaints	Mental health (scale: GHQ)
Amount of greenery	**	**	**
Quality of greenery	***	**	***

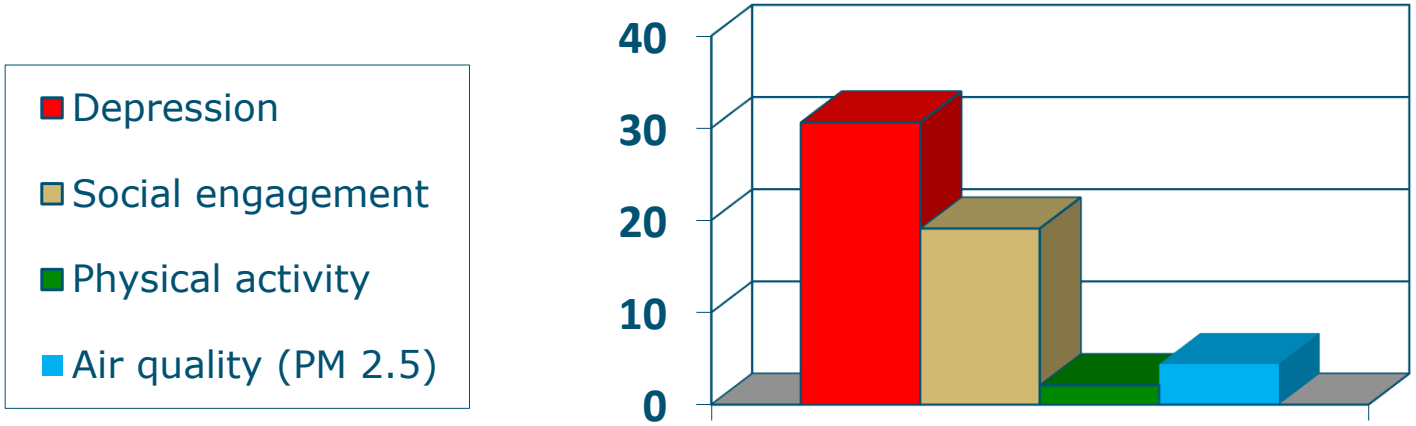
Relative strength of pathways (2)

- De Vries et al. (SSM, 2013): amount of streetscape greenery in the neighbourhood and self-reported general health
    - Percentage of association explained by mediator

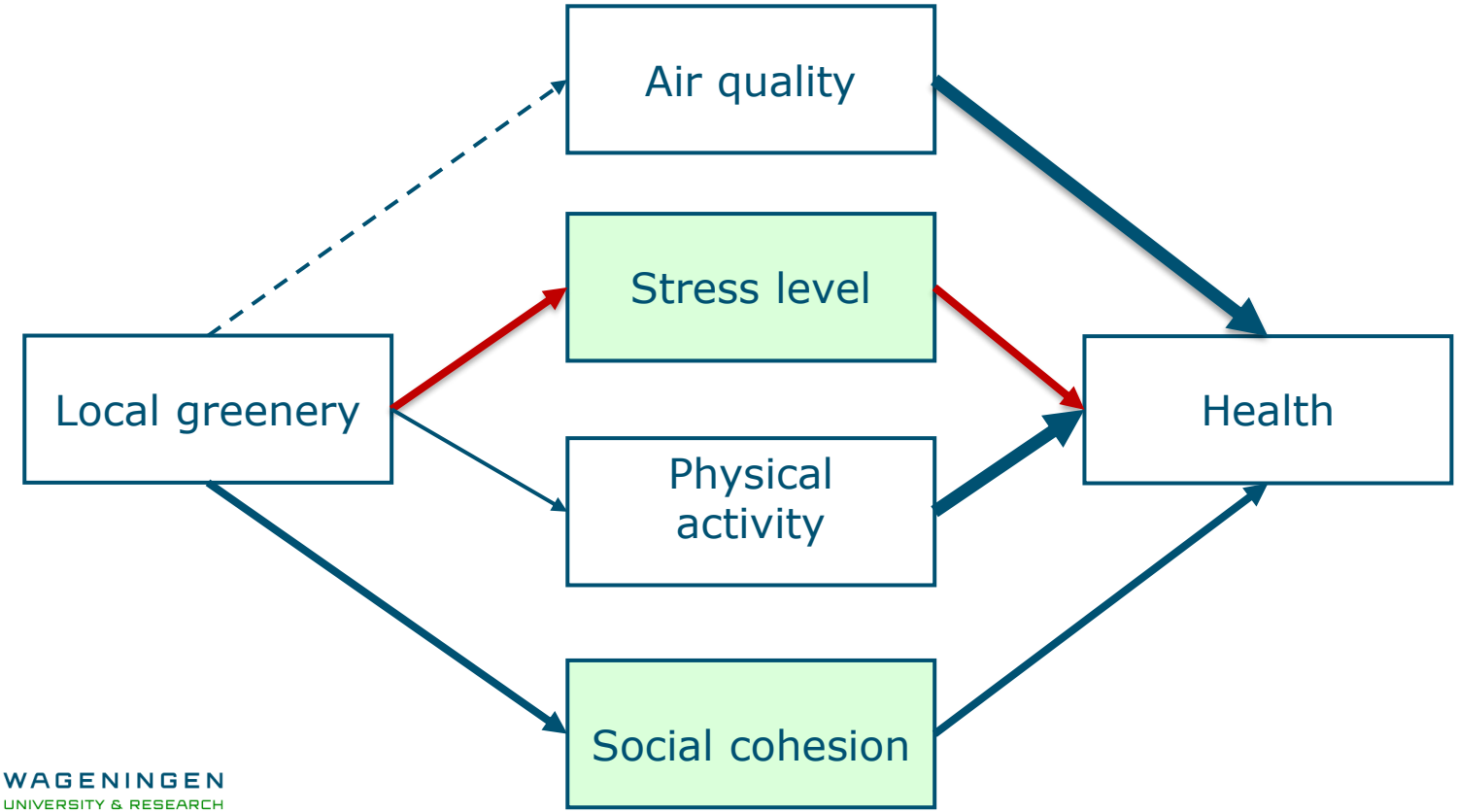


James et al. (2016): residential greenness and mortality

- Result 1: 12% lower mortality among people living in the 20% most green environments compared to those living in the 20% least green environments
- Result 2: percentage of that association explained per mediator:



Which mechanism is how important? Summary

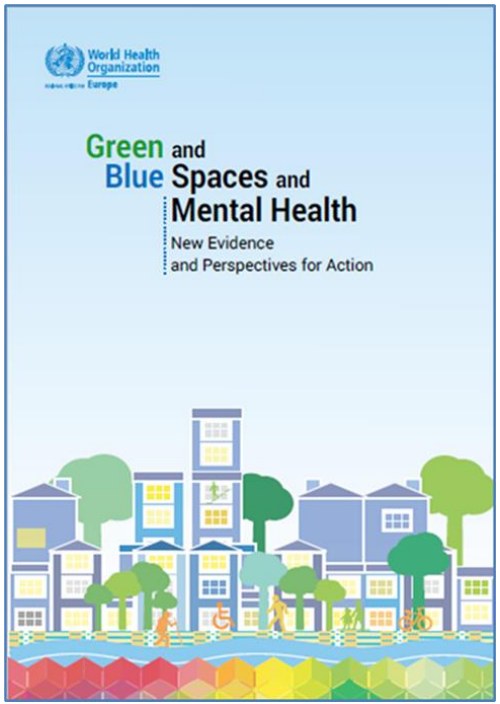


Question 4:

Which type of nature, with which characteristics, is most beneficial?

Types of green and blue space and mental health

- Systematic evidence mapping by Expert Working Group



PEOPLE AND NATURE
BRITISH ECOLOGICAL SOCIETY

REVIEW AND SYNTHESIS | Open Access

How do different types and characteristics of green space impact mental health? A scoping review

F. Beute, M. R. Marselle, A. Olszewska-Guizzo, M. B. Andreucci, A. Lammel, Z. G. Davies, J. Glanville, H. Keune, L. O'Brien, R. Remmen, A. Russo, S. de Vries

First published: 07 September 2023 | https://doi.org/10.1002/pan3.10529

Momentary happiness and type of environment

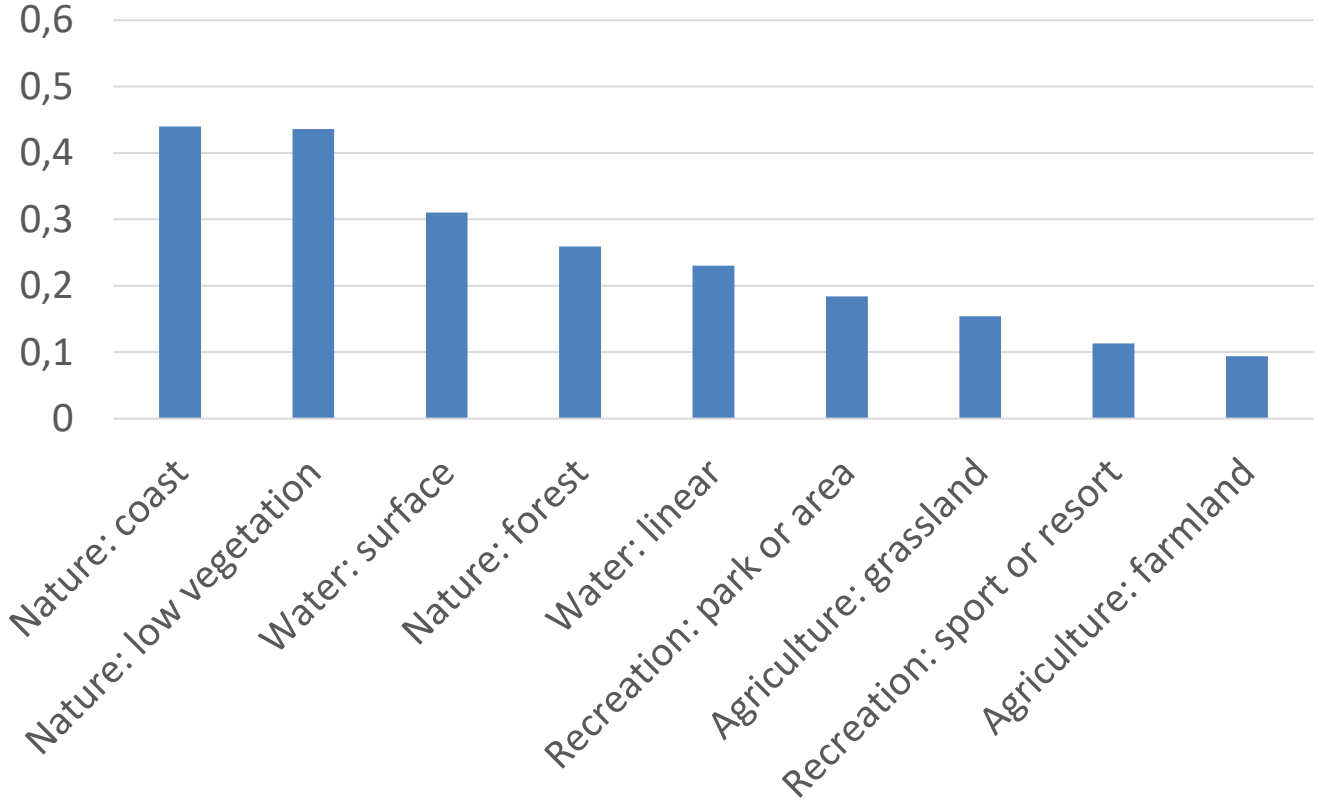
Research question: that what extent is your happiness influenced by the type of (natural) environment that you are in?

Ecological Momentary Assessment (EMA)/experience sampling: how happy do you feel at the moment (with location known thanks to GPS of smartphone)

- HappyHier app especially developed for the study
  - to oversample natural environments
- Recruitment of participants by self enrollment
  - over 4,000 people filling in at least 1 EMA
  - with a total of about 100,000 EMAs

Results:

Increase in momentary happiness by type of environment compared with a built-up environment, when outdoors



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Importance of **nearness** during COVID-19

Purposeful visits vs. casual encounters

- During a visit to e.g. an urban park, you are more immersed in the natural world. However, for many people this may occur less than once a week.
- Casual encounters can happen frequently, multiple times a day, for many people.
- Both may work, but what works better in the long run?

Some conclusions

- Nature, especially nearby nature, is beneficially associated with a broad range of health outcomes
- The pathway is not always clear, but there are several plausible candidates, to some extent supported by empirical evidence
    - related to heat stress, mental stress, social cohesion, and perhaps gut microbiome
- Which type of nature works best is not very clear, but nearness is important
    - amount of exposure is perhaps more important than high quality exposure, however defined

Thanks for your attention!

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