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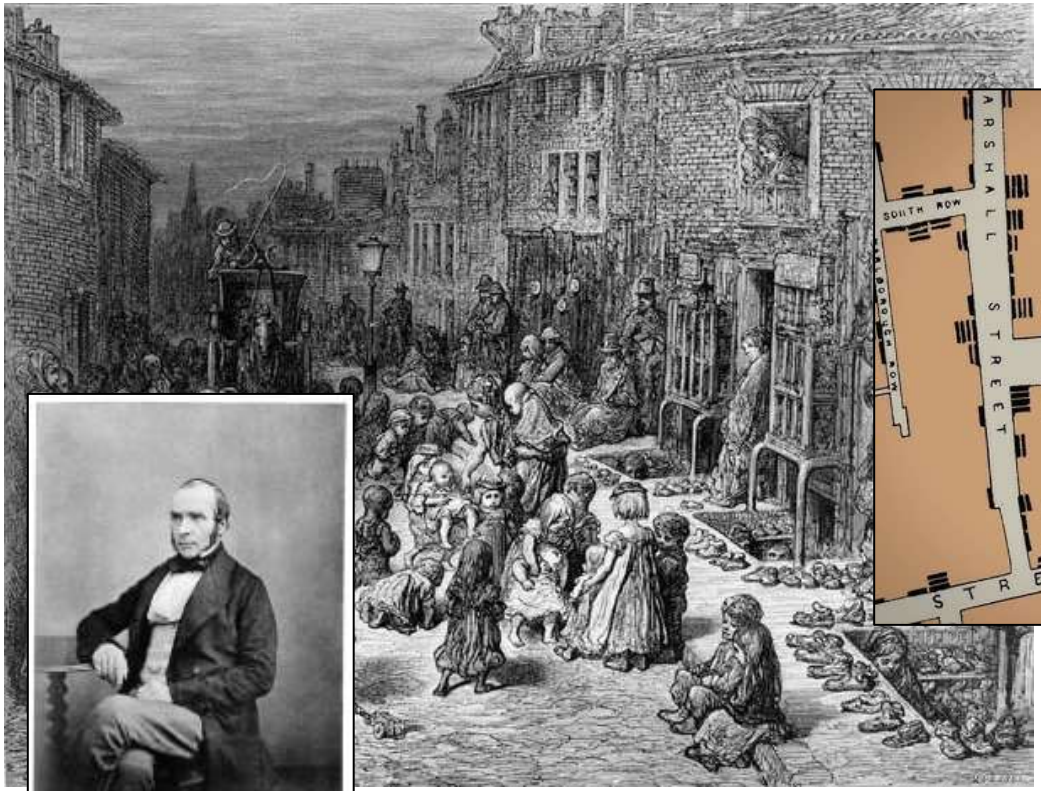
UNIL | Université de Lausanne
Faculté de biologie
et de médecine

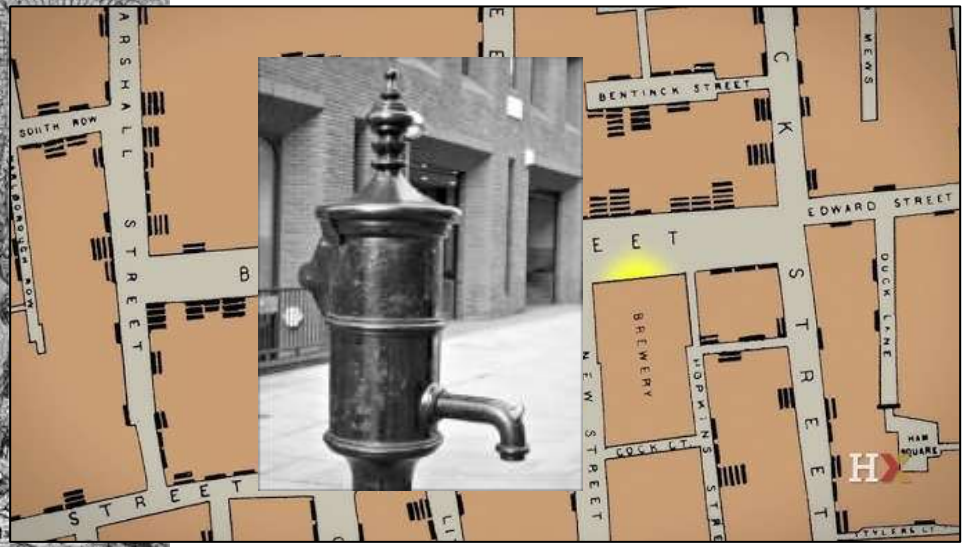
Le rôle et bienfaits de la nature pour la santé et le bien-être de la population

Prof Nicolas Senn, Université de Lausanne, Unisanté

EPFL, 2 mai 2025

La santé en ville... En 1854 le Choléra





Quizz

Quelle part de notre santé est due à notre système de santé?

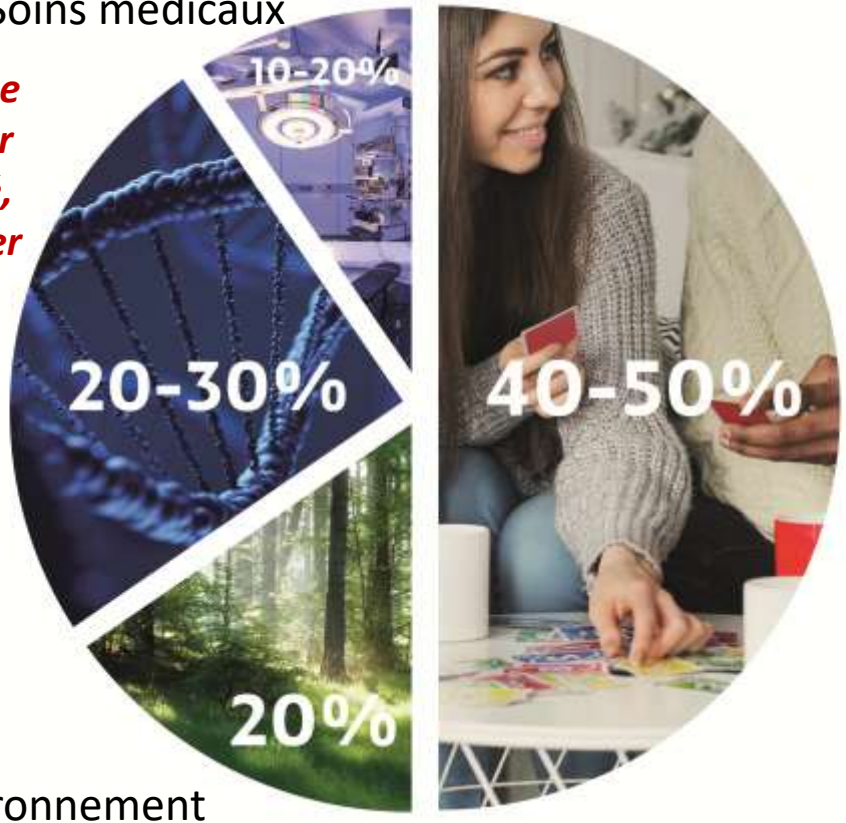
5% - 15% - 30% - 50%

Ce qui fait notre santé

Soins médicaux

Les soins médicaux ne contribuent que pour 10 à 20% de la santé, mais coûtent très cher

Héritage génétique



Culture - Education

Environnement

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Ref: adapté de Kiefer et Balavoine, 2019

Les liens (complexes) entre santé et environnement


a
b
c
d
e
f

De multiples concepts pour caractériser la relation de l'humain à la nature

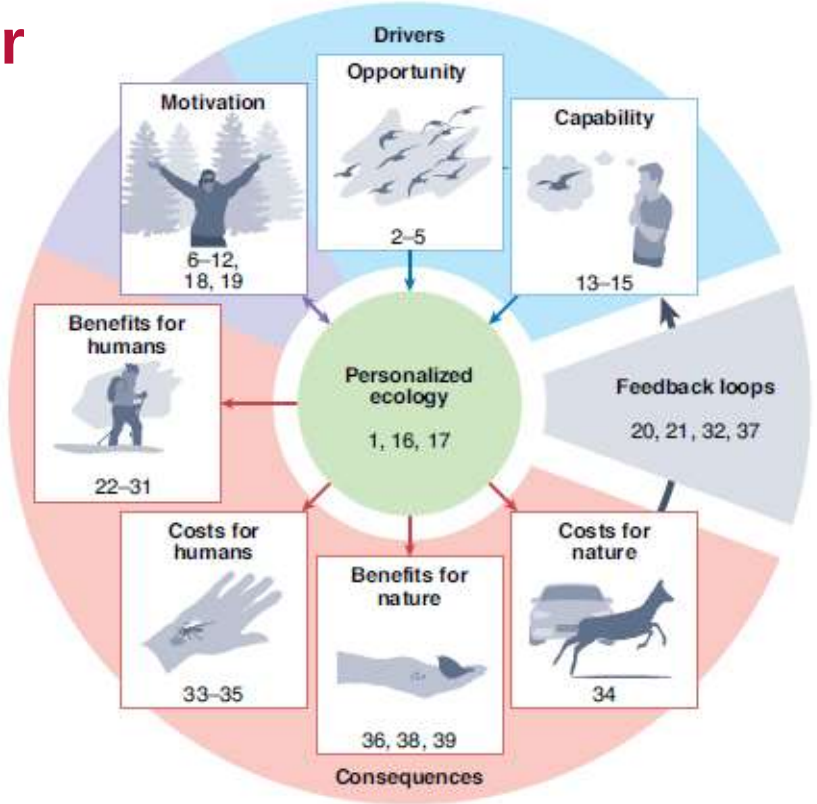


Fig. 2 | A unified conceptual framework for understanding the dynamics of direct human–nature interactions. This consists of four

Ref: Soga et Gaston, 2023

Table 1 | Concepts and theories concerning direct human–nature interactions

ID	Concept/theory	Definition	Related discipline	Key reference(s)	Related component
1	Personalized ecology	The set of direct sensory interactions that an individual person has with nature	Ecology	1	Personalized ecology
2	Luxury effect	Higher number of species and abundance in the areas where wealthier groups of people live and those that they use	Ecology	3	Drivers (opportunity)
3	Poverty effect	Higher number of species and abundance in the areas where poorer groups of people live and those that they use	Ecology	24	Drivers (opportunity)
4	Nature scarcity	Progressive decline in people's opportunities to experience interactions with nature	Conservation science	25	Drivers (opportunity)
5	Shifting baselines	Long-term changes to an environment go unrecognized because they are perceived as natural shifts with succeeding generations of scientists and other observers	Conservation science	26,27	Drivers (opportunity)
6	Nature relatedness	Subjective sense of connection people have with the natural world	Psychology	15	Drivers (motivation)
7	Biophilia hypothesis	People are innately attracted to animals and other living things	Evolutionary psychology	28	Drivers (motivation)
8	Savannah hypothesis	Humans prefer open, savannah-like landscapes as they would have favoured the survival of our early ancestors	Evolutionary psychology	29	Drivers (motivation)
9	Biophobia	A partly genetic predisposition to retain feelings of strong negative responses to certain natural stimuli that have been threats during human evolution	Evolutionary psychology	30	Drivers (motivation)
10	Nature apathy	Progressive decline in people's interest in nature	Psychology	33	Drivers (motivation)
11	Videophilia hypothesis	Younger generations are losing inclination to engage with nature, largely due to a shift in preferences for electronic entertainment	Leisure	32	Drivers (motivation)
12	Urbanization-disgust hypothesis	Living in urban areas increases the intensity of feelings of disgust towards animals	Evolutionary psychology	31	Drivers (motivation)
13	People–biodiversity paradox	Although people tend to prefer biodiverse environments, and obtain greater well-being benefits from these, they generally have limited ability to accurately perceive the biodiversity surrounding them	Conservation science	36	Drivers (capability)
14	Nature blindness	Tendency of people not to see or notice certain groups of animals and plants in their environment	Conservation science	37	Drivers (capability)
15	Nature ignorance	Progressive decline in the average level of natural-history knowledge among the general public	Education	38	Drivers (capability)
16	Extinction of experience	Progressive loss of daily interactions between people and nature	Conservation science	5,40	Personalized ecology
17	Expansion of experience	Progressive increase in some kinds of interaction of people with nature	Public health	18,19	Personalized ecology
18	Early nature experience hypothesis	Direct nature experiences during childhood promote pro-environmental attitudes and behaviour	Psychology	41	Consequences (attitudes towards nature)
19	Nature and happiness hypothesis	Increased emotional connection to nature promotes psychological health	Psychology	43	Consequences (attitudes towards nature)
20	Nature inheritance hypothesis	Resemblance in beliefs and attitudes towards nature between parents and their children	Psychology	34,39	Feedback loops
21	Nature demand hypothesis	People who have more positive attitudes towards nature are more likely to seek opportunities, and develop capabilities, that allow them to interact with nature	Psychology	45	Feedback loops

Continued

Table 1 | Concepts and theories concerning direct human–nature interactions (Continued)

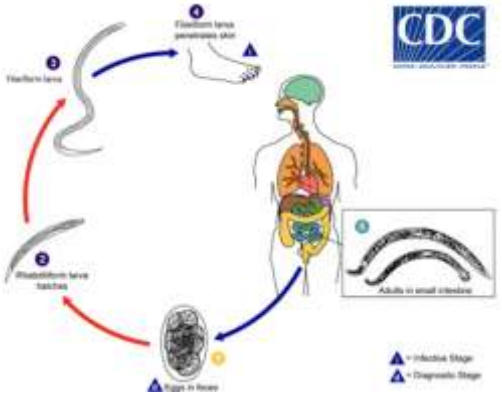
ID	Concept/theory	Definition	Related discipline	Key reference(s)	Related component
22	Cultural ecosystem services	Non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences	Conservation science	9	Consequences (benefits for humans)
23	Green exercise hypothesis	Physical activity in natural settings provides greater health and well-being benefits than equivalent exertion in indoor settings	Public health	46	Consequences (benefits for humans)
24	Hygiene hypothesis	Early childhood exposure to particular microorganisms protects against allergic diseases by contributing to the development of the immune system	Immunology	47	Consequences (benefits for humans)
25	Old-friends hypothesis	Humans co-evolved with pathogens and other microorganisms to the point that exposure to these symbionts is used in the development and regulation of immune systems	Immunology	12	Consequences (benefits for humans)
26	Biodiversity hypothesis	Contact with natural environments and biodiversity (especially microorganisms) enriches the human microbiome, promotes immune balance and protects from allergy and inflammatory disorders	Immunology	11	Consequences (benefits for humans)
27	Microbiome rewilding hypothesis	Restoring biodiverse habitats can rewild the environmental microbiome to a state that enhances primary prevention of human disease	Immunology	48	Consequences (benefits for humans)
28	Stress reduction theory	Nature has a stress-reducing and restorative influence on people	Psychology	49	Consequences (benefits for humans)
29	Attention restoration theory	People can concentrate better after experiencing nature	Psychology	50	Consequences (benefits for humans)
30	Biodiversity–well-being hypothesis	Natural environments with higher biodiversity provide greater psychological benefits to humans	Conservation science	51	Consequences (benefits for humans)
31	Nature and social cohesion hypothesis	Nature interactions promote social interaction within neighbourhoods, which in turn contributes to increased social cohesion	Public health	6	Consequences (benefits for humans)
32	Nature-based health intervention	Any programme, activity or strategy that aims to engage people in nature-based experiences with the specific goal of achieving improved health and well-being	Public health	17	Feedback loops
33	Nature-deficit disorder	People, especially children, are spending less time outdoors, resulting in a wide range of health and developmental problems	Public health	53	Consequences (costs for humans)
34	Human–wildlife conflict	Any interaction between humans and wildlife with negative consequences for both parties	Conservation science	55	Consequences (costs for humans; costs for nature)
35	Ecosystem disservices	Ecosystem-generated functions, processes and attributes that result in negative consequences for people	Conservation science	56	Consequences (costs for humans)
36	Human shield effect	Prey species use humans as a shield from natural predation	Ecology	57	Consequences (benefits for nature)
37	Human–wildlife feedback	Direct human interactions with nature alter the behaviour, abundance and distribution of wildlife, which can in turn either increase or decrease the frequency and intensity of these interactions	Ecology	21	Feedback loops
38	Nature benefit hypothesis	Nature benefits, through increased support for conservation policies and action, when people increase their level of direct interactions with nature	Conservation science	58	Consequences (benefits for nature)
39	Nature and sustainability hypothesis	Exposure to nature reduces impulsive and selfish decision-making in humans, which may promote environmentally sustainable behaviour and decision-making	Psychology	59,60	Consequences (benefits for nature)

Each concept is defined briefly, the discipline with which it is closely related is listed and one or more key references are provided. For each of the concepts and theories, we also provide the major component of our conceptual framework with which it is most closely related (Fig. 2).

Parmi les nombreux concepts...

- Biophilie
- Écologie personnalisée
- Hypothèse des vieux amis
- Syndrome de déficit de nature
- Théorie de la restauration de l'attention
- Hypothèse du réensemencement du microbiome
- Interventions basées sur la nature
- ….

Ex: ankylostome



Effet sur la mortalité de l'exposition à la végétation

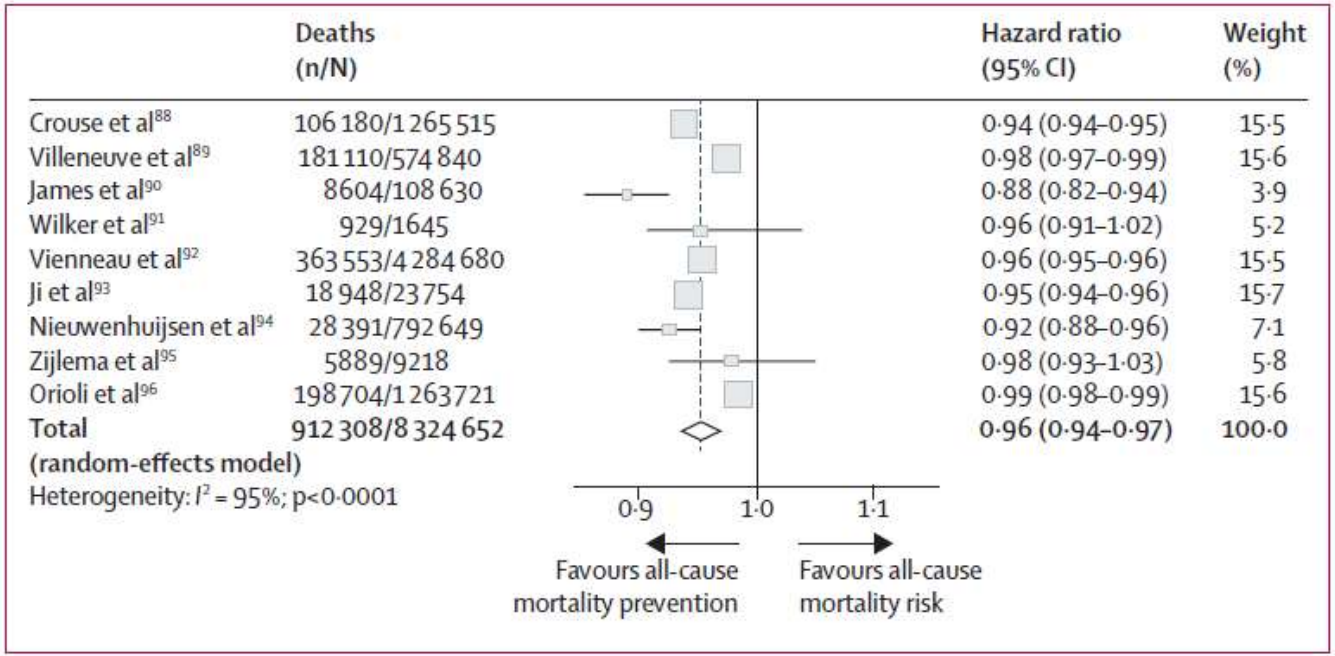


Figure 2: **Meta-analysis of the association between greenness and all-cause mortality for each 0·1 increment of normalised difference vegetation index in less than 500 m from the participant's residence**

The size of the square for each estimated hazard ratio in the plot is proportional to the weight of the study, which indicates its relative impact on the calculations of the common effect. Some 95% CI lines are not visible because the data have narrow CIs.

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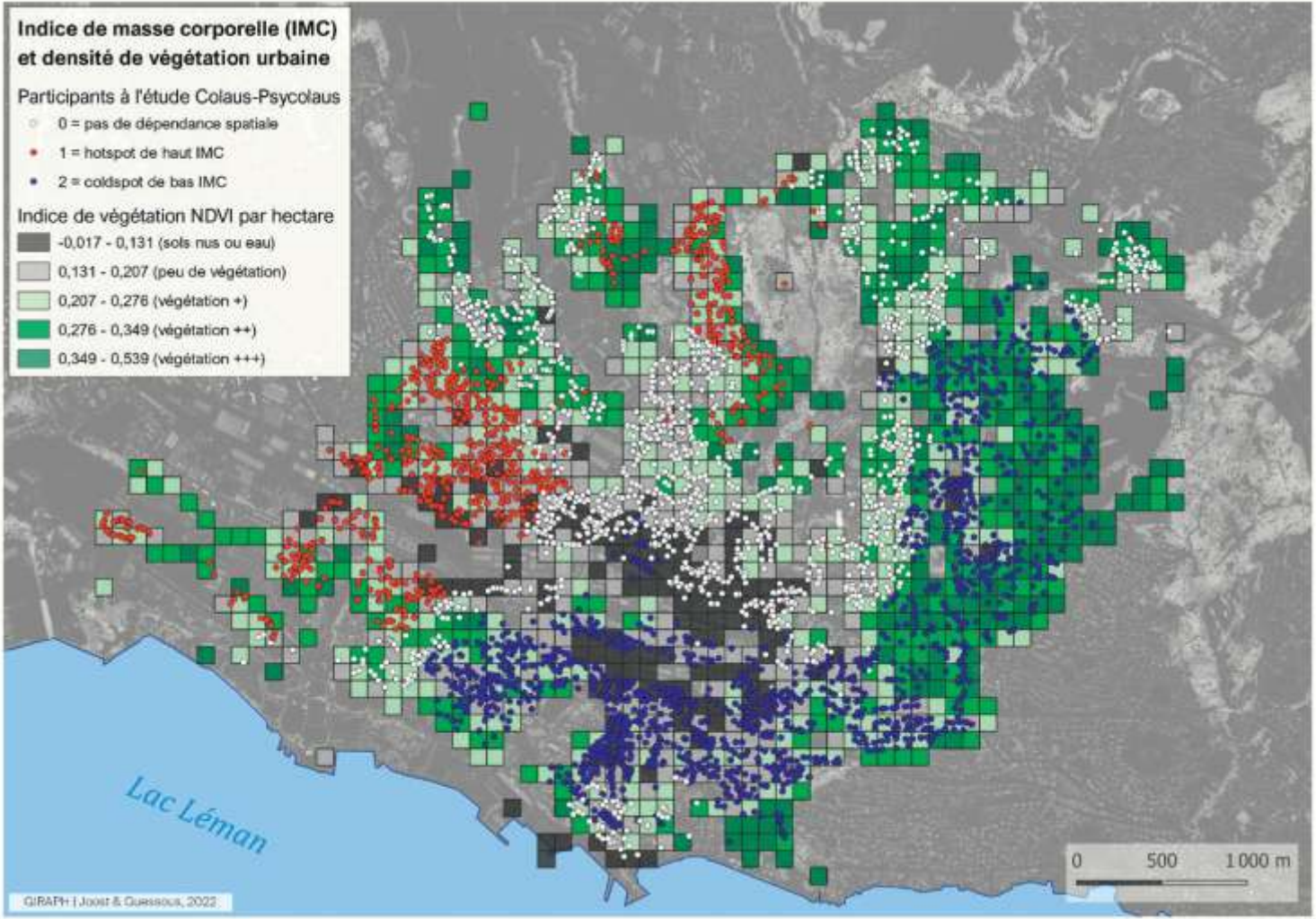
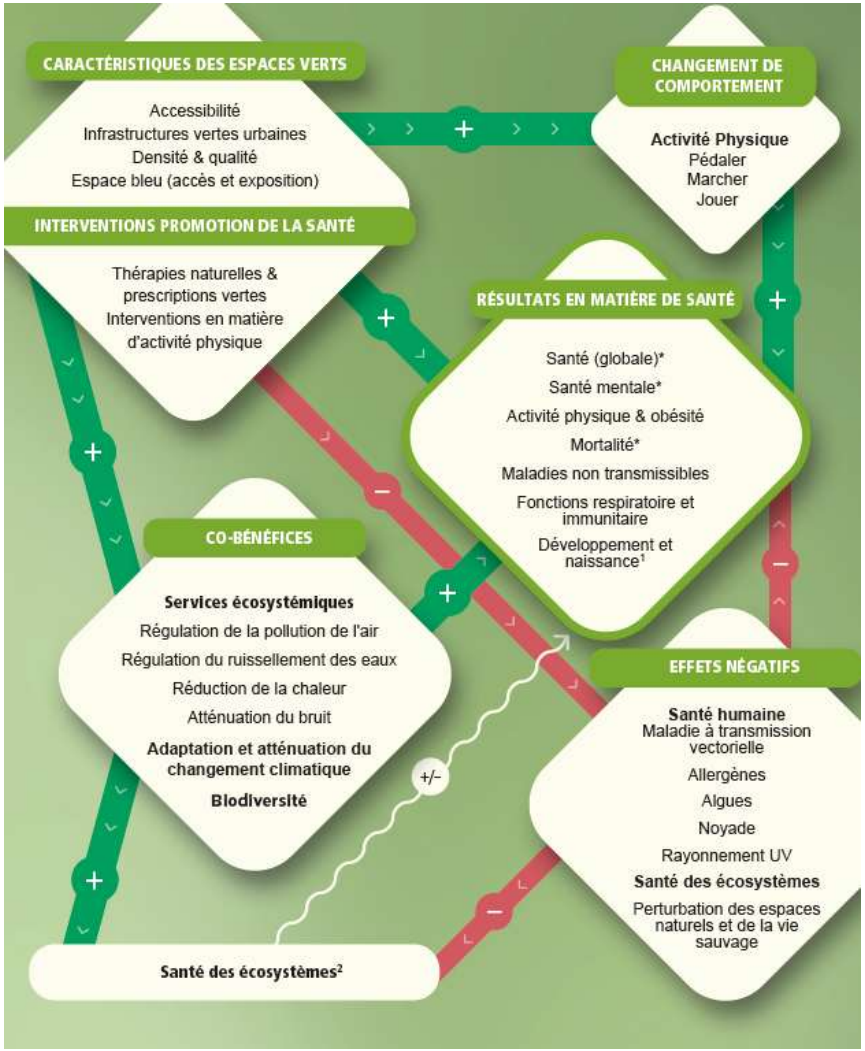
La santé en ville



Chapitre 18 Géomédecine environnementale pour la mise en relation des données de santé avec les caractéristiques des lieux de résidence - *Stéphane Joost et al.*

la santé en ville (1): Espaces verts



Ref: Banwell et al, Public Health Rev, in press

TABLE 2 | Greenspace interventions identified across articles included in the review (Switzerland, 2024).

Intervention type	Corresponding studies
Greenspace	
Land openly accessible to the public that are designed to provide a natural environment for community members and access to spaces for recreation uses	
Access or proximity to greenspace, greenness	(6,14–52)
Degree to which individuals, communities, or environments are connected to and surrounded by greenspaces and vegetation, common proxy measures include the NDVI	
Parks and community gardens	(53–60)
Park: public garden or area of land for recreation Community gardens: small plots of land integrated in urban neighborhoods managed collaboratively by residents	
Urban greenspace or infrastructure	(5–8,10,18,21,56,61–72)
Vegetated land that surrounds or separates areas of concentrated residential or commercial activity	
Density, diversity and quality of greenspace	(7,8,51,61,62,68,73–84)
Includes the density and diversity of biotic integrity (such as species richness and heterogeneity, and habitat heterogeneity), or pleasing aesthetic aspects of greenspaces, such as depth and lushness	
Playground	(14,32,85–87)
Public space designed for engagement of children in play, recreation and physical activity	
Blue space	
Visible surface waters in public space, including streams, lakes, rivers, waterfalls, etc.	
Access or exposure to blue space	(23,35,51,88–92)
Green and blue space	
Exposure to green and blue space	(10,20,21,32,35,62,88,93–96)
Nature-based interventions	
Physical activity and exercise interventions	(97–110)
Health interventions focused on promoting physical activity in greenspaces	
Walkability and cycling routes	(111–113)
Walkability: ease and convenience with which people can walk within a particular environment	
Nature-based therapy (green care)	(22,97,114–123)
Also known as green prescription or nature prescription which refers to a recommendation from a health or social professional for a patient to spend a fixed amount of time in a natural setting	
Contact with nature	(7,8,18,124–126)
Direct and intentional engagement or interaction between individuals and the natural environment	
Confounding factors	
Income and socioeconomic status	(7,8,24,61,113,127)
Gender	(8,128,129)
Ethnicity	(127,130)

Un grand nombre d'interventions différentes étudiées

Espaces verts urbains et mortalité

- Selon l'OMS: les espaces verts (min 0.5 hectares) devraient être à accessible à moins 300m de distance linéaire du lieu de résidence.
- Une étude estime à 43'000 le nombre de décès prématurés/an évitables dans env. 1000 villes européennes si la recommandation de l'OMS était respectée (selon NDVI)

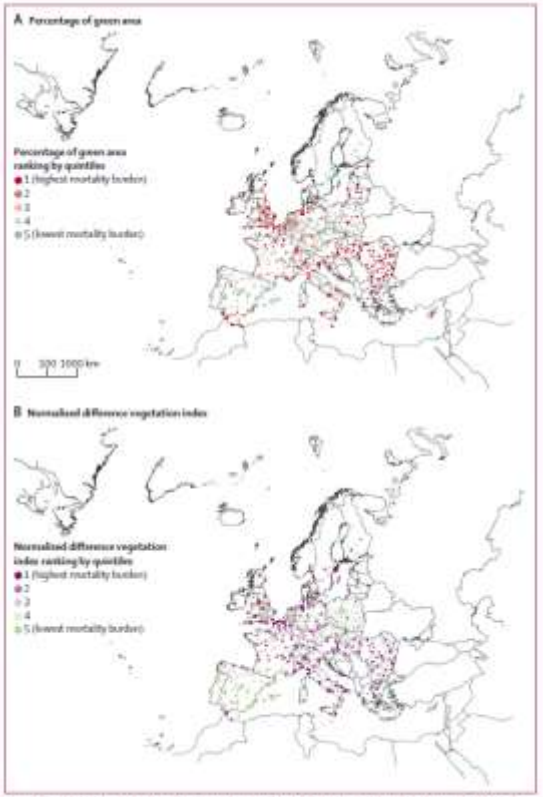


Figure 3: Cities and greater cities ranked from highest (first quintile) to the lowest (fifth quintile) mortality burdens based on the principal component analysis score

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Ref:E. P. Barbozaet al., Lancet Planet Health 2021

	Impact group (quintile)	City ranking	NDVI level (mean)	Target NDVI	Population below target NDVI (%)	Annual preventable deaths (n; 95% CI)	Annual preventable age-standardised mortality rate (deaths per 100 000 inhabitants; 95% CI)	Annual preventable impact on deaths (%; 95% CI)	Years of life lost (per 100 000 inhabitants; 95% CI)
Brussels (Belgium)	1	5	0·47	0·52	78·5	426 (321–632)	54 (41–80)	5·0% (3·8–7·4)	464 (350–688)
Copenhagen (Denmark; greater city)	1	9	0·53	0·55	76·5	437 (329–649)	46 (35–69)	4·0% (3·0–5·9)	462 (348–685)
Budapest (Hungary)	1	12	0·49	0·51	76·6	746 (562–1109)	50 (37–74)	3·5% (2·6–5·2)	450 (339–669)
Paris (France; greater city)	1	17	0·42	0·48	86·4	1918 (1446–2850)	36 (27–53)	4·9% (3·7–7·3)	378 (285–561)
Athens (Greece; greater city)	1	18	0·29	0·32	87·7	1431 (1074–2141)	42 (32–63)	3·5% (2·6–5·2)	485 (364–7269)
Riga (Latvia)	1	28	0·50	0·50	72·4	227 (170–338)	42 (32–63)	2·9% (2·2–4·3)	432 (325–644)
Tallinn (Estonia)	1	61	0·51	0·51	70·8	108 (81–161)	37 (28–55)	2·8% (2·1–4·2)	355 (267–529)
Vienna (Austria)	1	69	0·47	0·49	61·4	464 (349–690)	34 (26–51)	3·0% (2·3–4·5)	322 (242–479)
London (UK; greater city)	1	72	0·52	0·54	76·6	1712 (1288–2550)	33 (25–49)	3·6% (2·7–5·3)	266 (200–397)
Bucharest (Romania)	1	77	0·40	0·44	78·5	470 (353–703)	38 (29–57)	2·7% (2·1–4·1)	301 (226–451)
Amsterdam (Netherlands)	1	108	0·49	0·51	69·5	187 (141–279)	33 (25–49)	3·0% (2·3–4·5)	255 (192–381)
Sofia (Bulgaria)	1	146	0·48	0·48	73·7	247 (185–371)	35 (26–52)	2·2% (1·6–3·2)	269 (202–403
Stockholm (Sweden; greater city)	1	150	0·58	0·54	65·5	329 (248–490)	28 (21–42)	2·9% (2·2–4·3)	237 (179–353)
Rome (Italy)	1	155	0·47	0·44	68·5	649 (488–970)	26 (20–39)	2·6% (2·0–3·9)	287 (215–428)
Berlin (Germany)	1	168	0·53	0·54	65·2	763 (573–1139)	28 (21–42)	2·4% (1·8–3·6)	274 (206–409)
Oslo (Norway)	2	239	0·53	0·53	55·2	405 (79–456)	29 (32–43)	2·4% (1·6–3·4)	198 (149–295)
Zurich (Switzerland; greater city)	2	268	0·56	0·55	60·1	107 (81–160)	22 (17–33)	2·4% (1·8–3·6)	205 (155–306)
Vilnius (Lithuania)	2	269	0·55	0·50	52·4	99 (75–148)	26 (19–38)	1·9% (1·4–2·8)	230 (173–344)
Dublin (Ireland; greater city)	2	282	0·62	0·57	58·8	174 (131–259)	26 (19–38)	2·2% (1·7–3·3)	177 (133–262)
Lisbon (Portugal; greater city)	2	301	0·38	0·35	72·1	355 (266–533)	22 (16–33)	1·9% (1·5–2·9)	234 (176–351)
Bratislava (Slovakia)	2	314	0·51	0·51	61·2	68 (51–102)	26 (19–39)	1·8% (1·4–2·7)	200 (150–299)
Luxembourg (Luxembourg)	3	359	0·52	0·49	50·8	14 (11–21)	21 (16–31)	2·1% (1·6–3·2)	180 (135–269)
Zagreb (Croatia)	3	366	0·60	0·53	52·7	143 (107–214)	23 (18–35)	1·7% (1·3–2·6)	195 (146–292)
Warsaw (Poland)	3	495	0·49	0·47	62·6	271 (203–406)	18 (14–27)	1·5% (1·2–2·3)	187 (140–281)
Valletta (Malta)	3	518	0·24	0·25	75·0	24 (18–37)	19 (14–28)	1·6% (1·2–2·4)	162 (121–244)
Helsinki (Finland; greater city)	4	521	0·52	0·47	55·3	128 (96–191)	17 (13–26)	1·7% (1·3–2·6)	153 (115–228)
Madrid (Spain; greater city)	4	538	0·32	0·32	66·6	620 (465–932)	15 (12–23)	1·7% (1·3–2·5)	156 (117–235)
Ljubljana (Slovenia)	4	561	0·58	0·51	49·0	34 (26–51)	15 (11–23)	1·6% (1·2–2·4)	148 (111–221)
Prague (Czech Republic)	4	562	0·55	0·51	44·1	175 (132–262)	17 (13–26)	1·4% (1·1–2·2)	147 (110–219)
Reykjavik (Iceland)	4	616	0·37	0·38	64·9	20 (15–29)	15 (11–23)	1·6% (1·2–2·4)	120 (90–181)
Lefkosia (Cyprus)	5	835	0·23	0·23	68·2	11 (8–17)	8 (6–12)	0·7% (0·5–1·0)	52 (39–79)

NDVI=normalised difference vegetation index.

Table 2: **Preventable mortality burden due to the increase in normalised difference vegetation index (NDVI) in the 31 European capitals, from highest (top) to lowest (bottom) burden**

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Les caractéristiques morphologiques testées pour la santé

Where and how to invest in greenspace for optimal health benefits: a systematic review of greenspace morphology and human health relationships

Huaqing Wang, Simin Gholami, Wenyan Xu, Amirhossein Samavatekbatan, Ole Sielenes, Louis G Tassinary

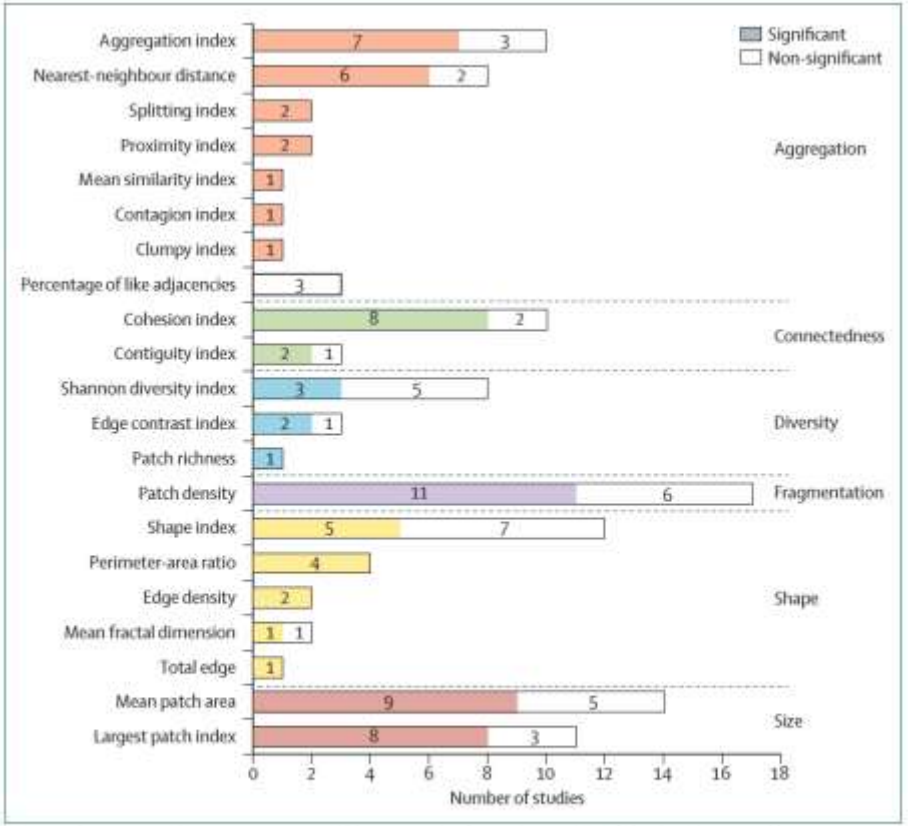

Figure 3: Frequency of greenspace morphology metrics that show statistically significant and non-significant associations with health outcomes

A solid bar represents statistically significant associations, while an uncoloured bar indicates that the metric was examined, but resulted in non-significance.

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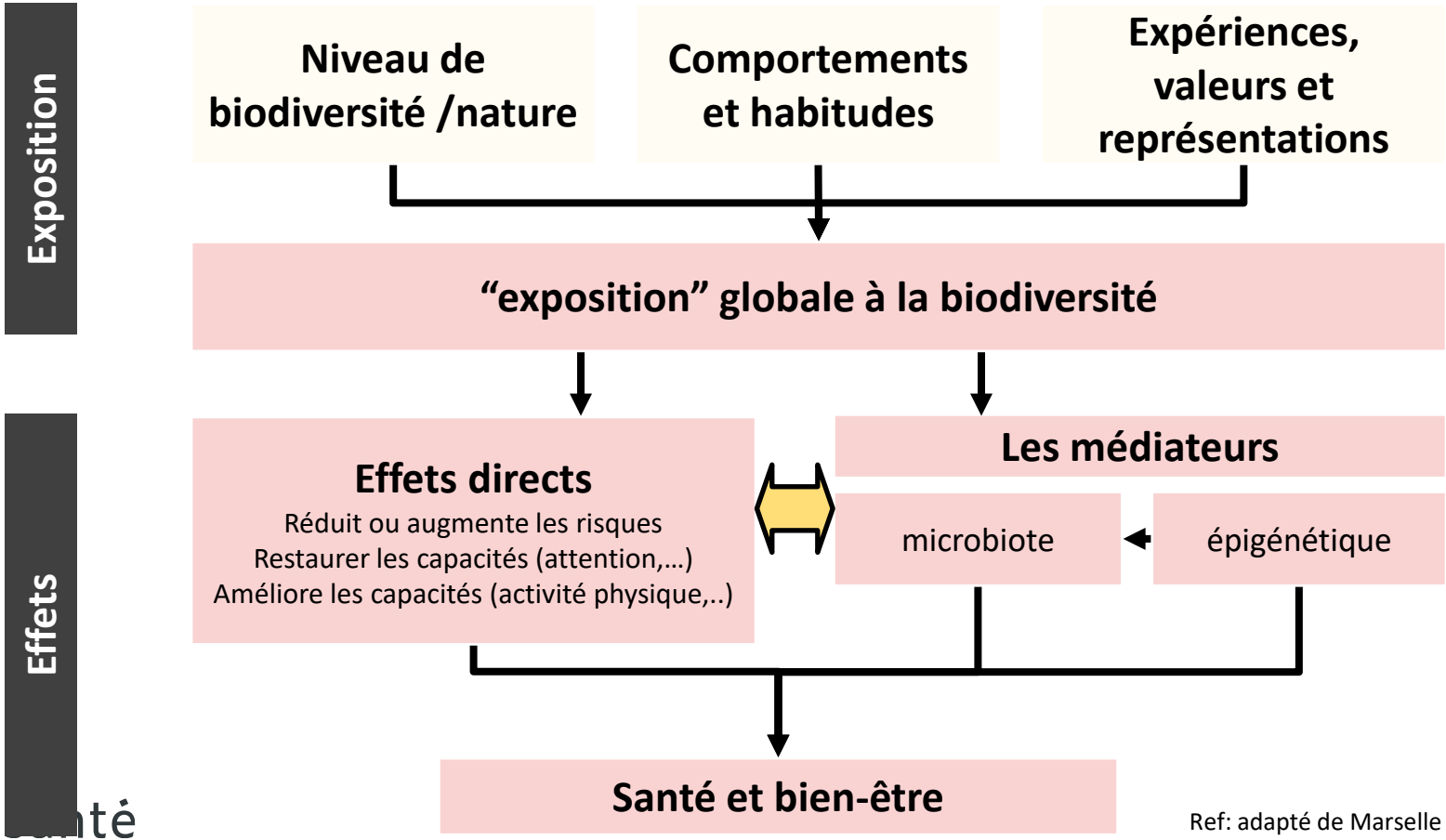
Allergie au bouleau et biodiversité en Carélie

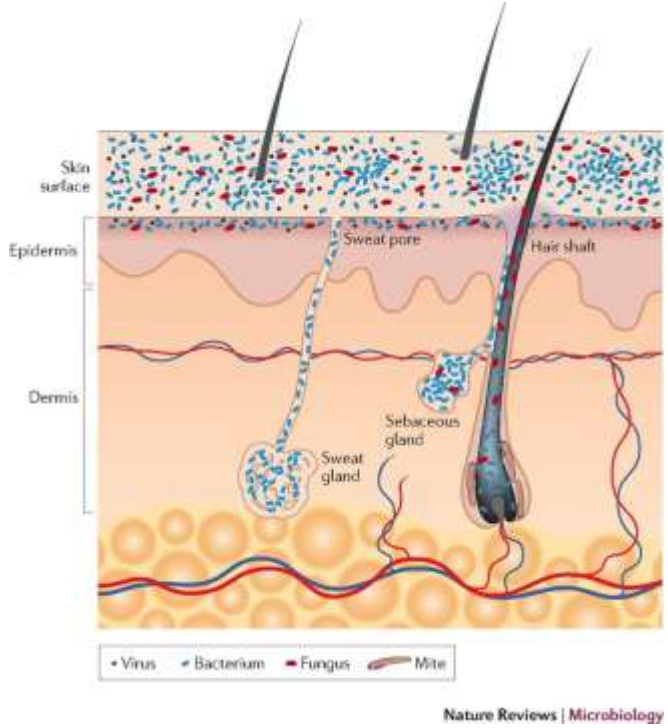
Ref: Haahtela, T. (2019). "A biodiversity hypothesis."

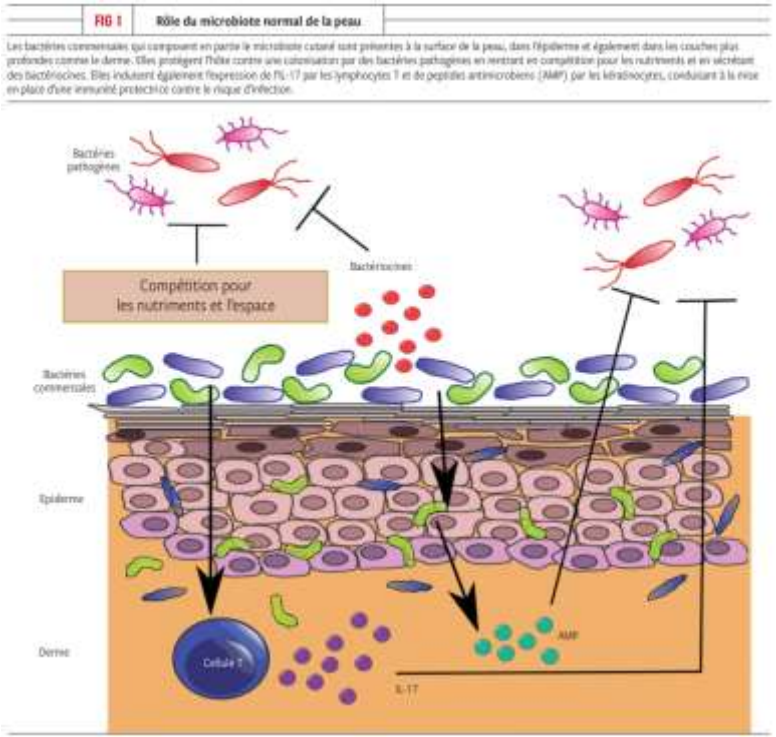
Comment expliquer les liens entre la santé et la biodiversité/nature?



Ref: adapté de Marselle et al. 2021

La qualité de notre microbiote dépend de l'environnement





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Land use types, skin microbiota, inflammation and atopic dermatitis

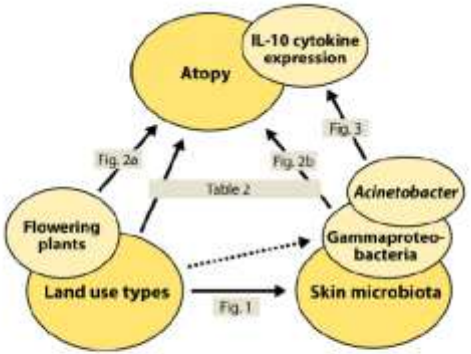
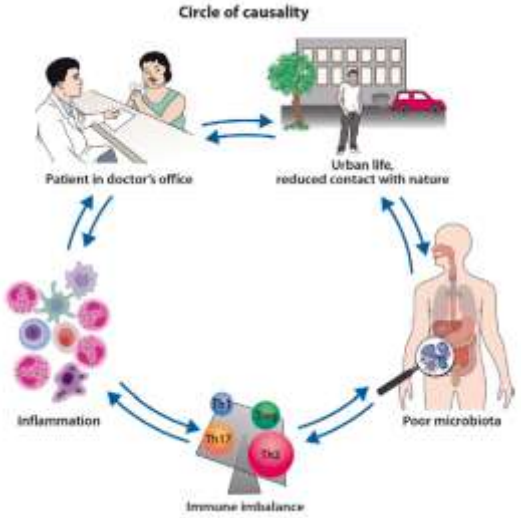


Fig. 4. Summary graph of the associations among environmental biodiversity, skin microbiota, and atopy. The solid arrows refer to the results in Figs. 1–3 and Table 2. The dashed-line arrow indicates a less significant effect of $PC1_{env}$ on the generic diversity of gammaproteobacteria ($t = 1.91$, $P = 0.059$, $n = 95$, with total number of bacterial genera as a covariate as in Fig. 2*B*).

Hanski et al. Proceedings of the National Academy of Sciences **109**(21): 8334



Ref: Haahtela, T. (2019). "A biodiversity hypothesis." **74**(8): 1445-1456

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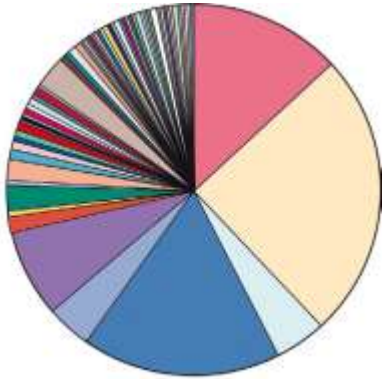
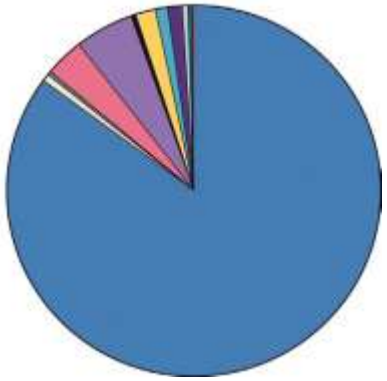
Biodiversité, microbiote et maladies de peau





Ref: Salava, A. and A. Lauerma (2014). "Role of the skin microbiome in atopic dermatitis."

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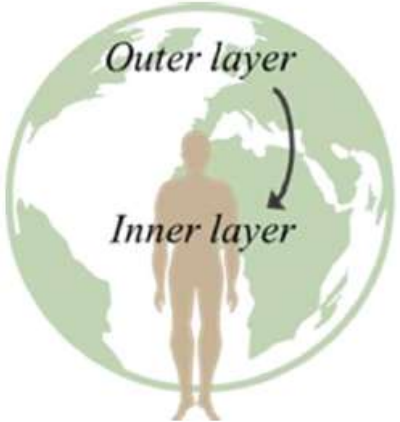
Effet de la biodiversité out/in sur l'asthme et les symptômes respiratoires



Two nested layers of biodiversity

Outer layer dependent on the environment we live in (including air, soil, natural waters, plants, and animals)

→ Exposition plutôt protectrice

Inner layer inhabits the human body [internal (airways, gut) and external microbiota (skin)], dependent on colonization from the outer layer

→ Pas d'influence claire

Figure 1. Layers of biodiversity.[6]

The Role of Biodiversity in the Development of Asthma and Allergic Sensitization: A State-of-the-Science Review

Inês Paciência,[1,2] Needhi Sharma,[3] Timo T. Hugg,[1,2] Aino K. Rantala,[1,2] Behzad Heibati,[1,2] Wael K. Al-Delaimy,[3] Maritta S. Jaakkola,[1,2] and Jouni J.K. Jaakkola[1,2,4]

[1]Center for Environmental and Respiratory Health Research, Population Health, University of Oulu, Oulu, Finland
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Enrichir le sol des places de jeu des garderies pour améliorer le microbiote et l'immunité des enfants?

"intervention daycares" :
Covered part of the gravel with forest floor (100 m2) and sod (200 m2) (study subjects, n = 36). Intervention daycares received segments of forest floor, sod, planters for growing annuals, and peat blocks for climbing and digging.

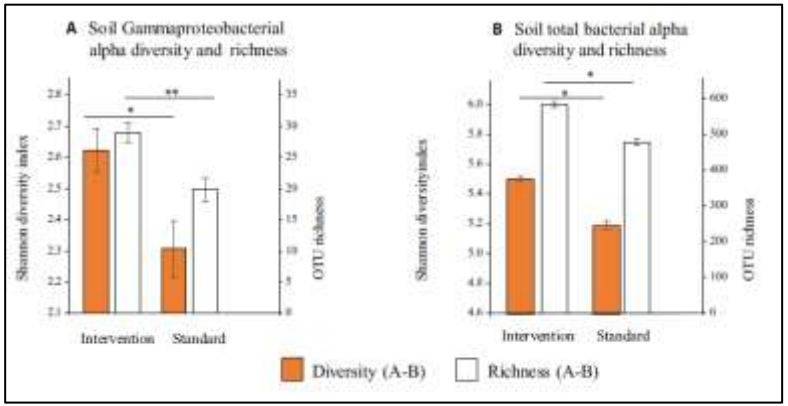
ENVIRONMENTAL STUDIES

Biodiversity intervention enhances immune regulation and health-associated commensal microbiota among daycare children

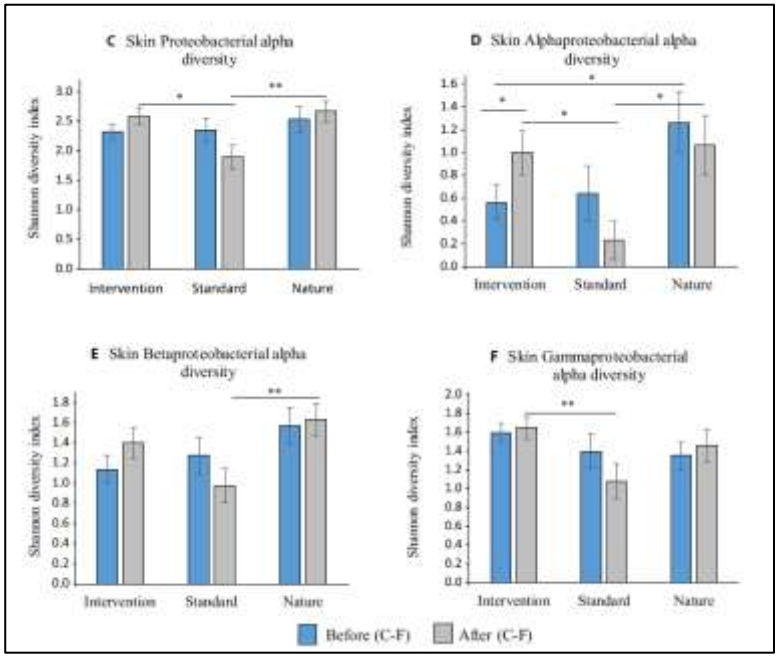
Marja I. Roslund[1], Riikka Puhakka[1], Mira Grönroos[1], Noora Nurminen[2], Sami Oikarinen[2], Ahmad M. Gazali[3*], Ondřej Cinek[4], Lenka Kramná[4], Nathan Siter[5], Heli K. Vari[1], Laura Soininen[1], Anirudra Parajuli[1], Juho Rajaniemi[3], Tuure Kinnunen[3,6], Olli H. Laitinen[2], Heikki Hyöty[2], Aki Sinkkonen[1,7†], ADELE research group[†]

Enrichir le sol des places de jeu des garderies pour améliorer le microbiote et l'immunité des enfants? (suite)

Sol



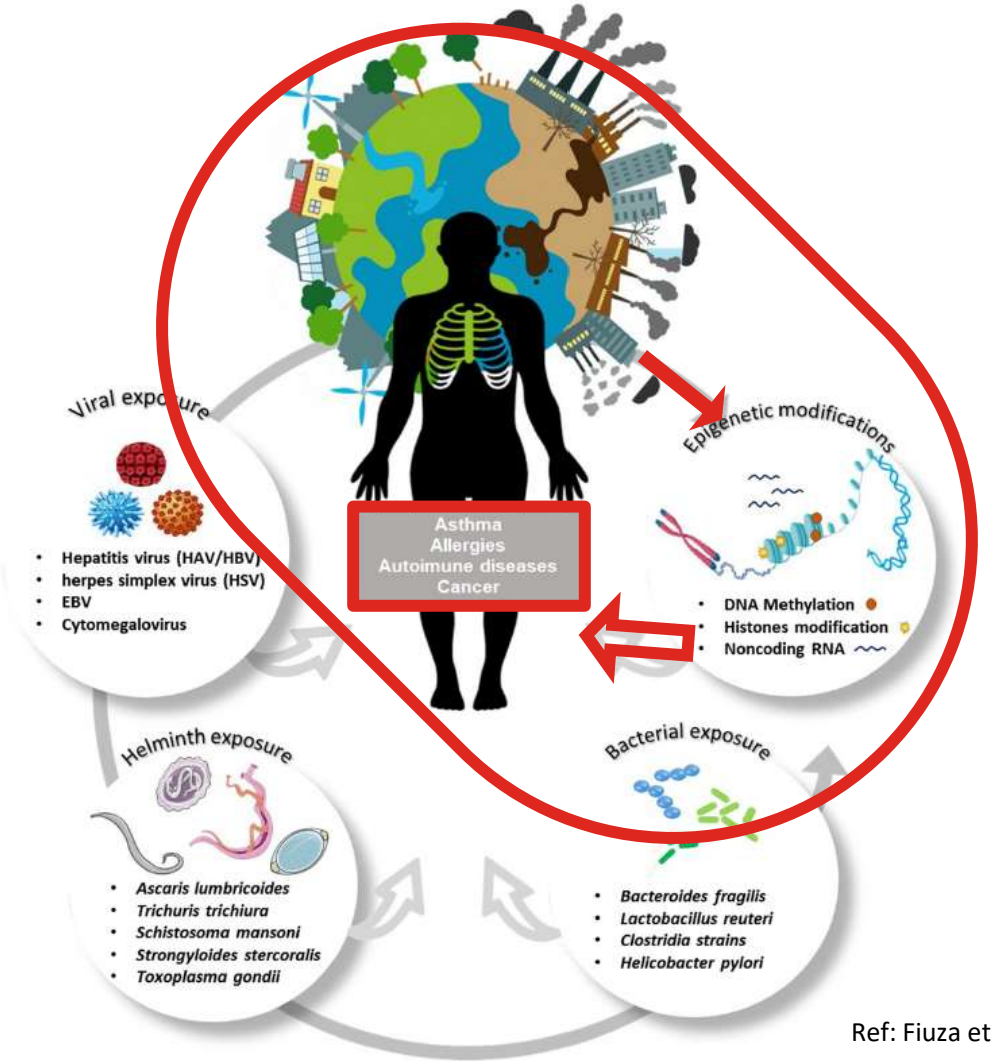
Microbiote cutané



Épigénétique

Modification de l'expression de certains gènes, sans modification de l'ADN lui-même (c'est réversible!)

Va avoir un impact sur le vieillissement (**=horloge biologique**) et l'apparition de certaines maladies



Ref: Fiuza et al. 2021

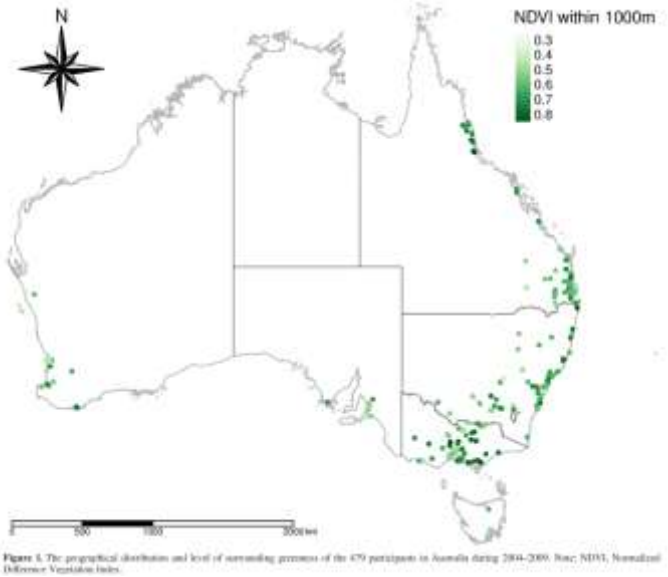


Figure 1. The geographical distribution and level of surrounding greenness of the 479 participants in Australia during 2004–2009. Note: NDVI, Normalized Difference Vegetation Index.

Association between vegetal density and DNA methylation (ageing)

Surrounding Greenness and Biological Aging Based on DNA Methylation: A Twin and Family Study in Australia

RongMei Xu,[1] Shuai Li,[1,2,3] Shanshan Li,[1] Ee Ming Wong,[4,5] Melissa C. Southey,[4,5] John L. Hopper,[1] Michael J. Abramson,[6] and Yuming Guo[1]

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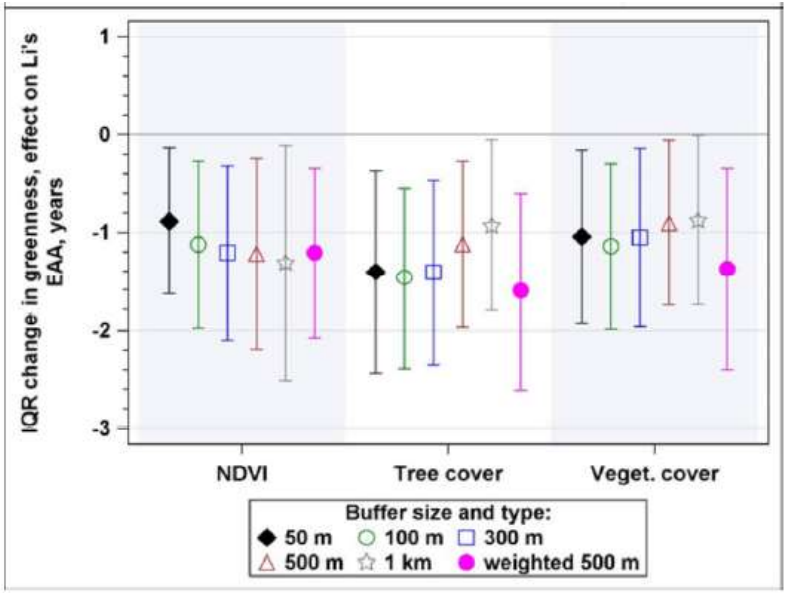
Epigenetic age acceleration and greeness



scientific reports

OPEN

Greater residential greenness is associated with reduced epigenetic aging in adults

Andrey I. Egorov[1], Shannon M. Griffin[1], Jo Kvist[1], Marilaure[1], Jennifer M. Styles[1], Jason Kobylanski[2], Mark S. Murphy[2], Elizabeth Sams[2], Edward D. Hodgens[2] & Timothy J. Wade[1]

Fig. 1. Associaitons between greeness measures and EAA: multiplicative effect estimates with 95% confidence intervals adjusted for race, sex, height, WHR, smoking status, and two-dimensional spline of coordinates.

Inequalities in urban greenness and epigenetic aging: Different associations by race and neighborhood socioeconomic status

+3 authors Authors info & affiliations

SCIENCE ADVANCES

Living within 5 km of a park and the time exposure to greenness (NDVI) is correlated with DNA methylation (epigenetics)

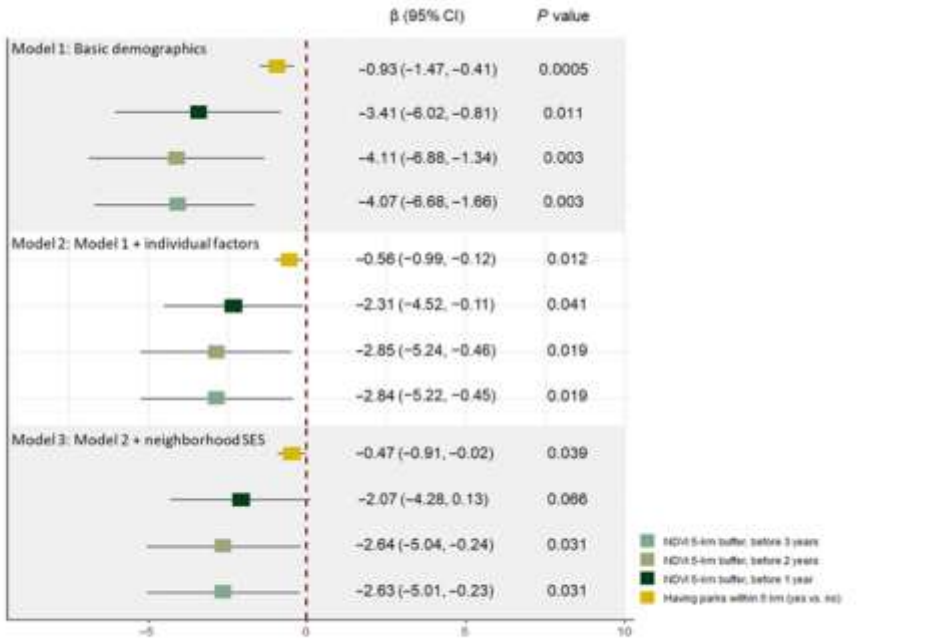


Fig. 1. Association between long-term exposure to surrounding greenness (1985–2006; Y0-Y20) and GrimAA (2005–2006; Y20). Model 1: adjusted for age, sex, race, and study field center; model 2: adjusted for model 1 covariates + individual behavior and SES [education years, smoking, marital status, income, physical activity, and body mass index (BMI)]; model 3: adjusted for model 2 covariates + neighborhood deprivation score.

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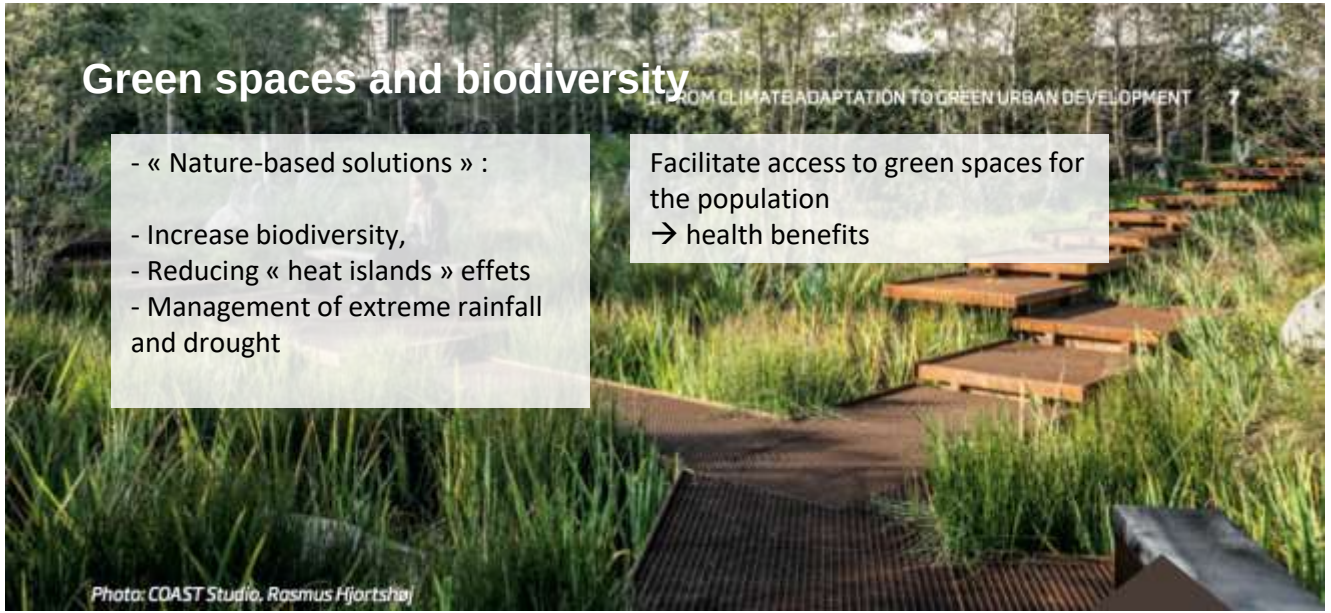
Les interventions

Les approches structurelles



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Avenue de Montoie

LAUSANNE : « stratégie canopée »

50 % increase the canopy of tree leaves in Lausanne by 2040

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Jardins communautaires, approches individuelles

Effects of a community gardening intervention on diet, physical activity, and anthropometry outcomes in the USA (CAPS): an observer-blind, randomised controlled trial

Jill S Litt*, Katherine Alaimo*, Kylie K Harrell, Richard F Hamman, James R Hébert, Thomas G Hurley, Jenn A Leiferman, Kaigang Li, Angel V Villalobos, Eva Corongiu, Jimikaye Beck Courtney, Maya Peyton, Deborah H Glueck

Ref: Biodiversity and Allotments: Gardening in harmony with Nature - apse

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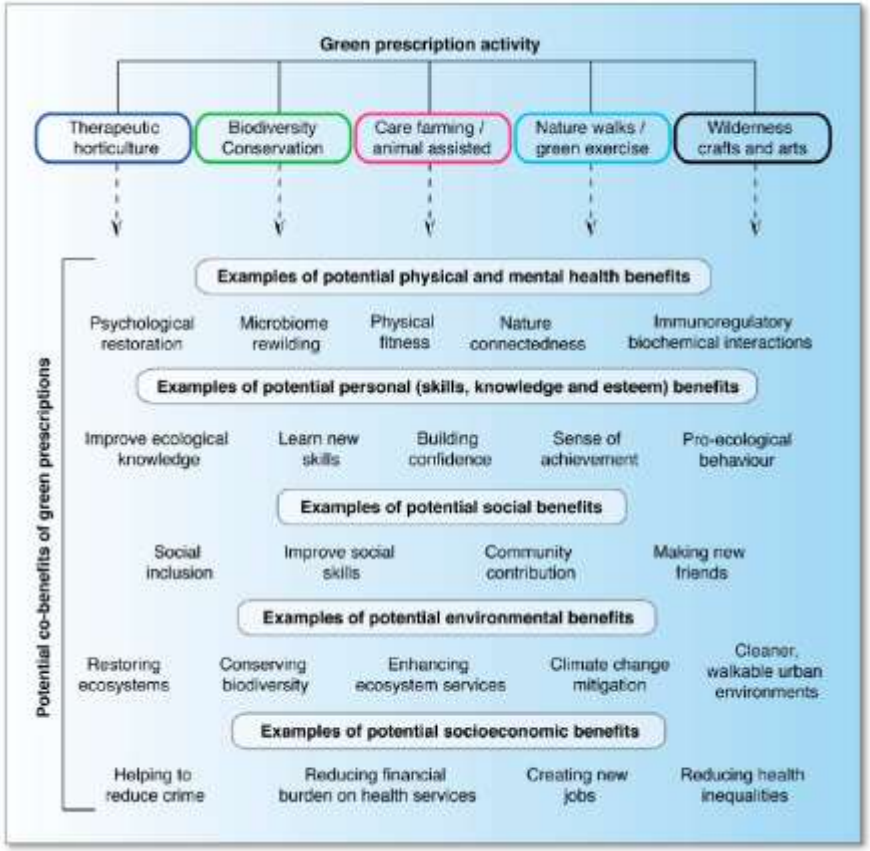
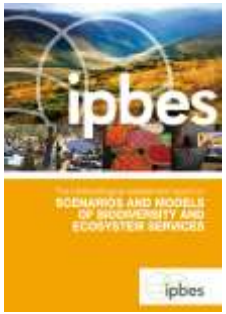
Green prescribing in practice





(Robinson et al, 2019)

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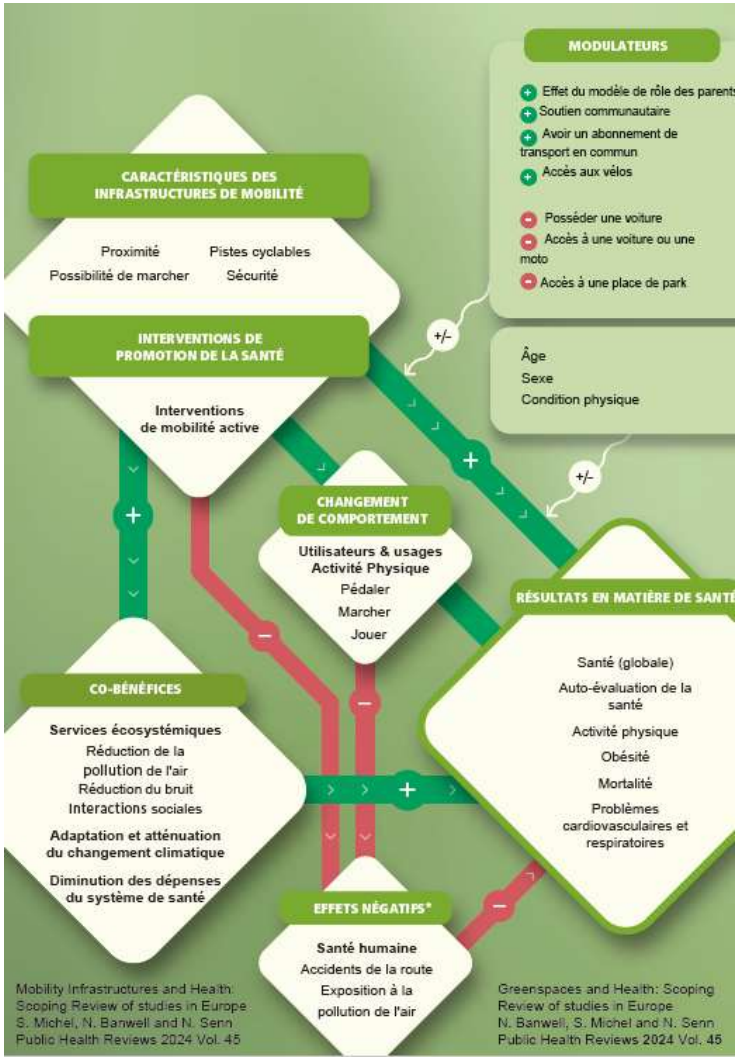
Interventions basées sur la nature

la santé en ville (2): Les infrastructures de mobilité



Ref: Banwell et al, Public Health Rev, in press

TABLE 2 | Identified mobility interventions (Switzerland, 2024).

Intervention type	Corresponding studies
Built environment	
Human-made features and physical infrastructure in which people live, work and carry out recreational activities	
Walking infrastructure	(8–21)
Cycling infrastructure	(22–35)
Walking and cycling infrastructure	(36–46)
Access and proximity	(12, 14, 20, 28, 47–53)
The distance between the current location and target location as well as the ease with which it can be covered	
Play-infrastructure	(40, 52, 54–56)
Includes for example, playgrounds, outdoor areas facilitating children's play, as well as sports facilities	
Car-related infrastructure	(43, 44, 57–60)
Includes for example, car parking, crossroads and busy roads	
Pollution and noise exposure	(51, 61–79)
Exposure to particulate matter less than 2.5 μm and to traffic noise exceeding national guidelines	
Physical activity and active travel	
Travel to school	(47, 80–94)
Commuting to work	(57, 95–112)
Physical activity	(61–64, 113–137)
Confounding factors	
Income and socioeconomic status	(16, 17, 19, 37, 42, 48, 86, 93, 95, 138–140)
Gender	(23, 27, 39, 53, 92)
Ethnicity	(91)

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Ref: Michel et al, Public Health Rev, 2024

Pour une approche intégrée de la santé et de l'urbanisme

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Ref: Mueller et al.Int J Hyg Environ Health (2021) 235:113772

Limites des études actuelles

- Souvent basée sur *Normalized Difference Vegetation Index (NDVI)* plus que biodiversité
- Hétérogénéité des mesures de santé et d'exposition
- Etudes observationnelles /modélisation
- Peu d'étude sur une approche co-bénéfices / intégrées

Conclusion

- Passablement d'étude montrant les liens entre aménagement urbains (espaces verts, infrastructures de mobilité) et la santé
- Une marge importante, même en Suisse, pour améliorer l'accès aux espaces verts de la population dans les villes
- Nécessaire de développer des interventions conjointes de l'urbanisme, l'environnement et la santé (approches co-bénéfices)

«Le monde inquiet dénonce l'invasion des êtres venus d’ailleurs. Étrangers, plantes, animaux, comment osez-vous gagner nos terres ?»

Gilles Clément, *Eloge des vagabondes*

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