

The ORIGIN PROJECT

Understanding the implications of the early environment for children's long-term health and wellbeing

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Sponsored by
The logo for Nature Play WA, featuring the words "Nature Play" in a green, cursive font with a small green leaf icon above the letter 'P', and "WA" in a smaller, blue font below it.

THE ORIGINS PROJECT



W | Originsproject.telethonkids.org.au

A HEALTHY START for a Better Future



Nature Connectedness and Health: The ORIGINS PROJECT

Desiree Silva



The ORIGINS Project is funded by the Paul Ramsay Foundation and the

CONTENT

- Developmental Origins of child and adult diseases
- Microbiome
- Benefits of Nature relatedness
- Play and Grow (Intervention in HongKong)
- The ORIGINS project
- Interventions within the ORIGINS project
- Questions

A global pandemic of chronic NCDs

Increase in chronic diseases of virtually all organ systems

A significant proportion of NCD's are preprogrammed early in life



Susan Prescott 2012

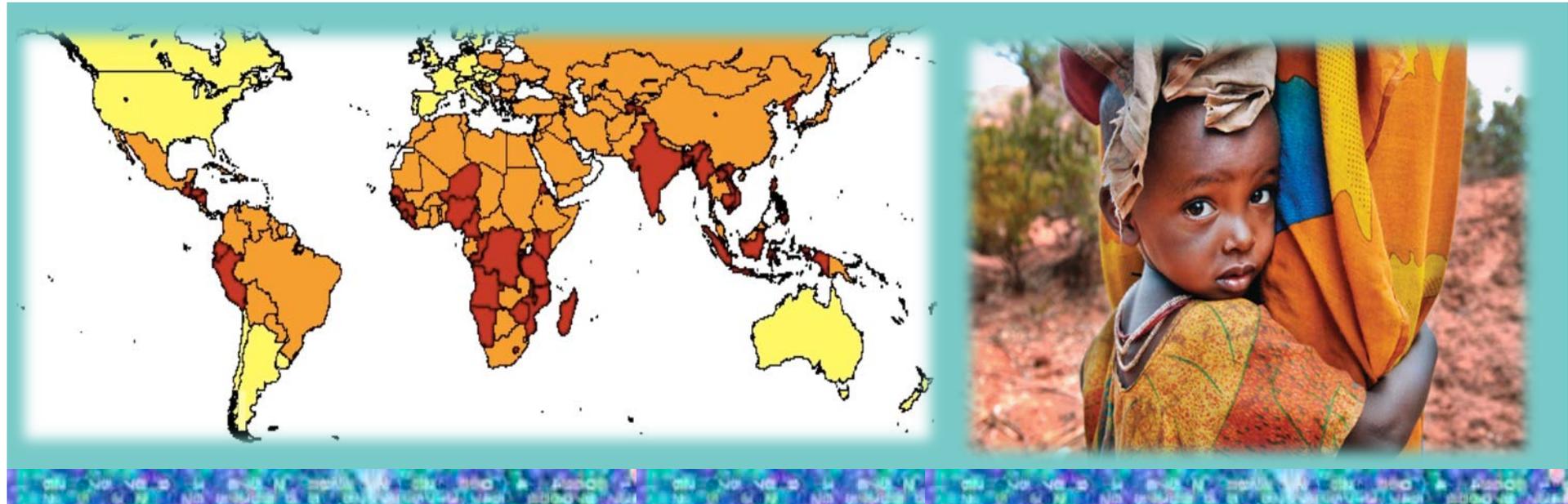
While the world has focused on fighting infectious diseases...

...a pandemic of NCDs has been emerging, almost unnoticed.

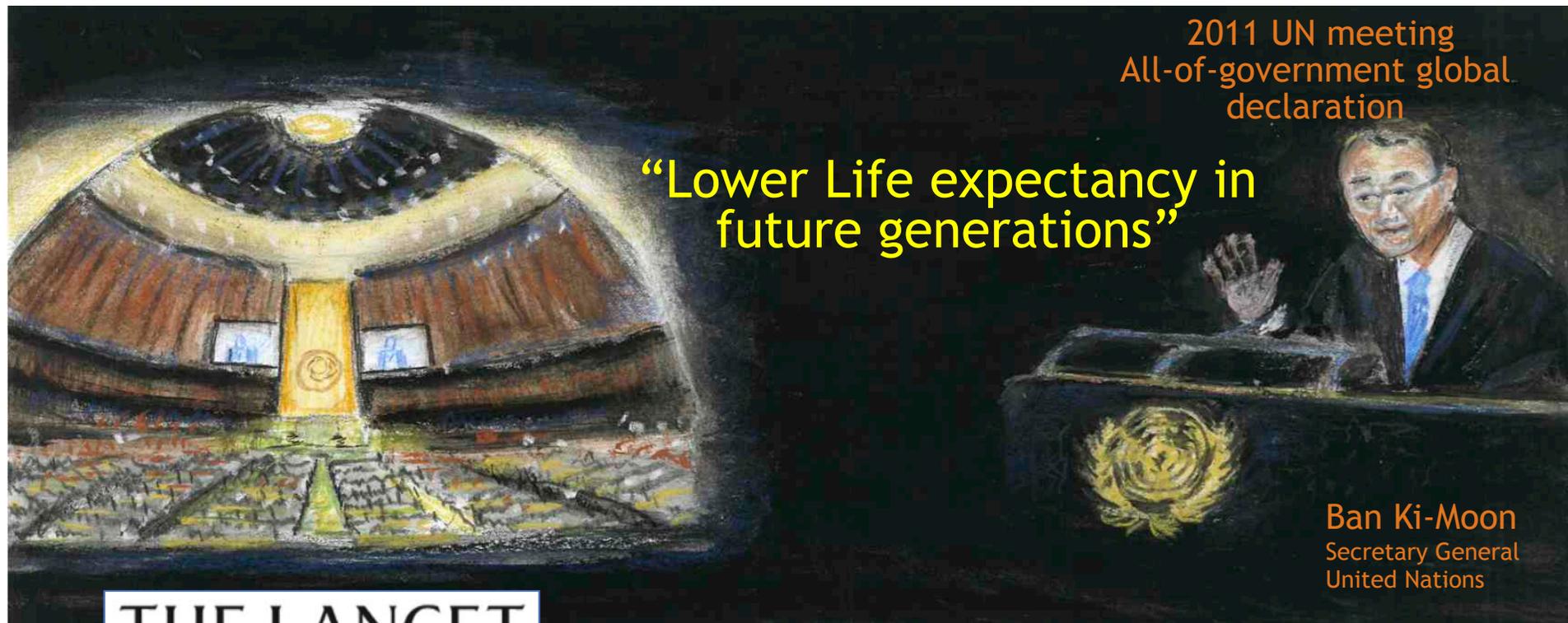
By 2030:

--

52 million deaths/yr from NCDs (surpassing infectious deaths, even in Africa)



NCDs are a global threat to social and economic stability



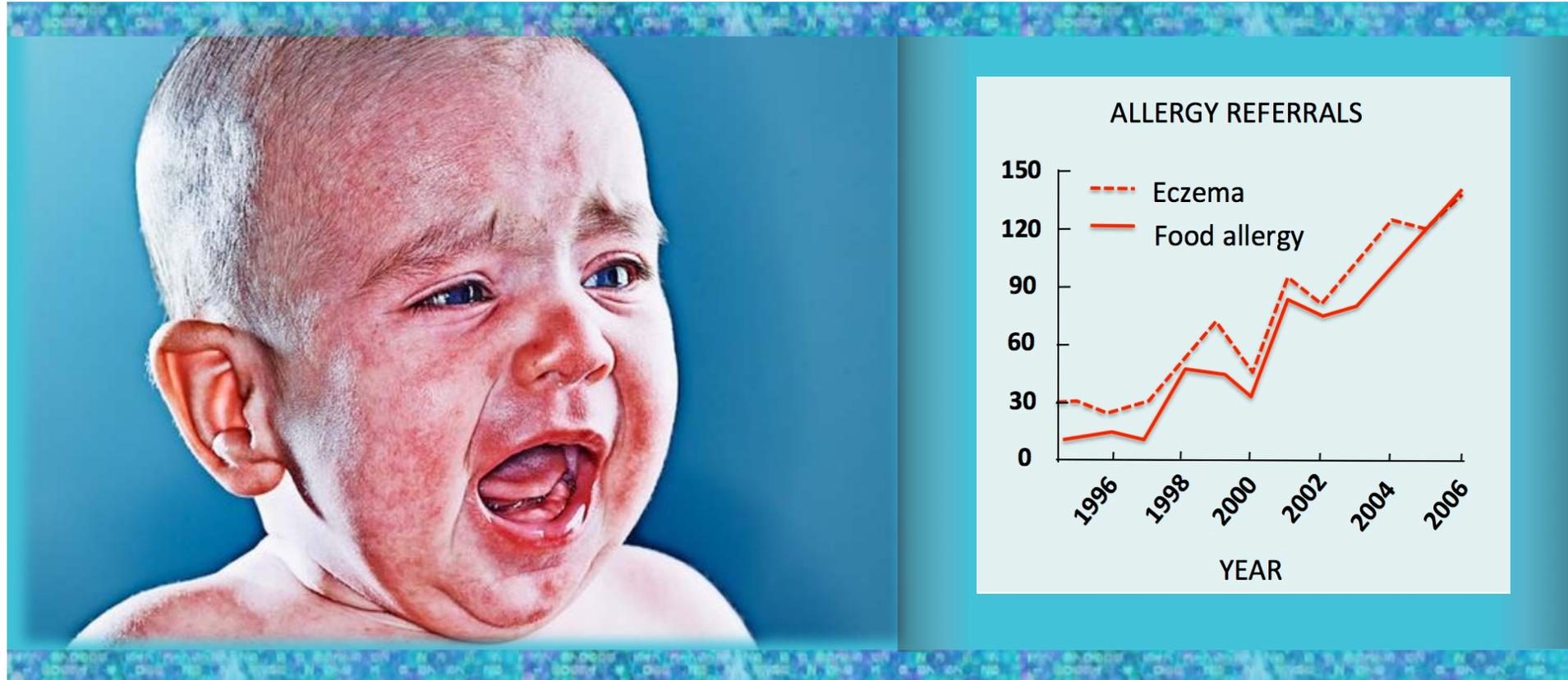
THE LANCET

Most NCDs
are inherently
preventable

- More than 36 million deaths per year
- 9 million in younger people in their prime
- 60% of all global deaths
- 80% in underprivileged developing countries

Increasing burden of eczema and food allergy

Earlier and more severe disease in infancy

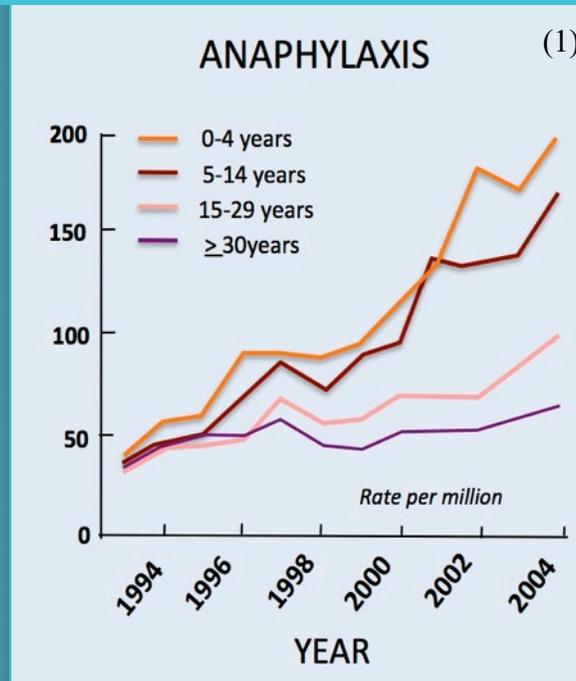


Earlier vulnerability of the immune system to modern environmental changes

1. Mullins, MJA 2007; 186: 618-621.
(Australian data)

Increase in serious food allergies (anaphylaxis)

Greatest increase in preschool children^{1,2}

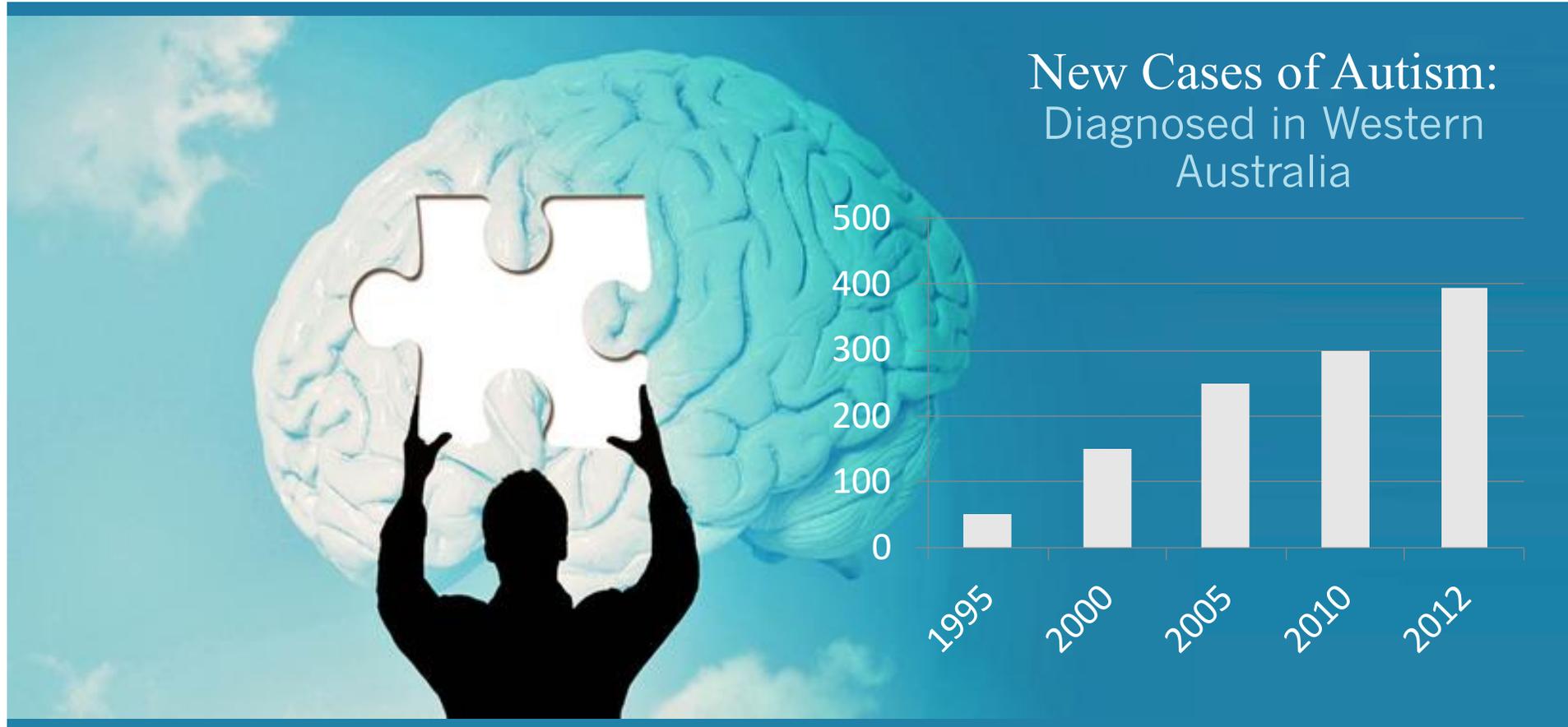


Emergency visits: 5-fold rise in preschoolers over 10 yrs¹

1. Mullins, MJA 2007; 186: 618-621
2. Poulous et al. JACI 2007 120: 878-84 (Australian data)

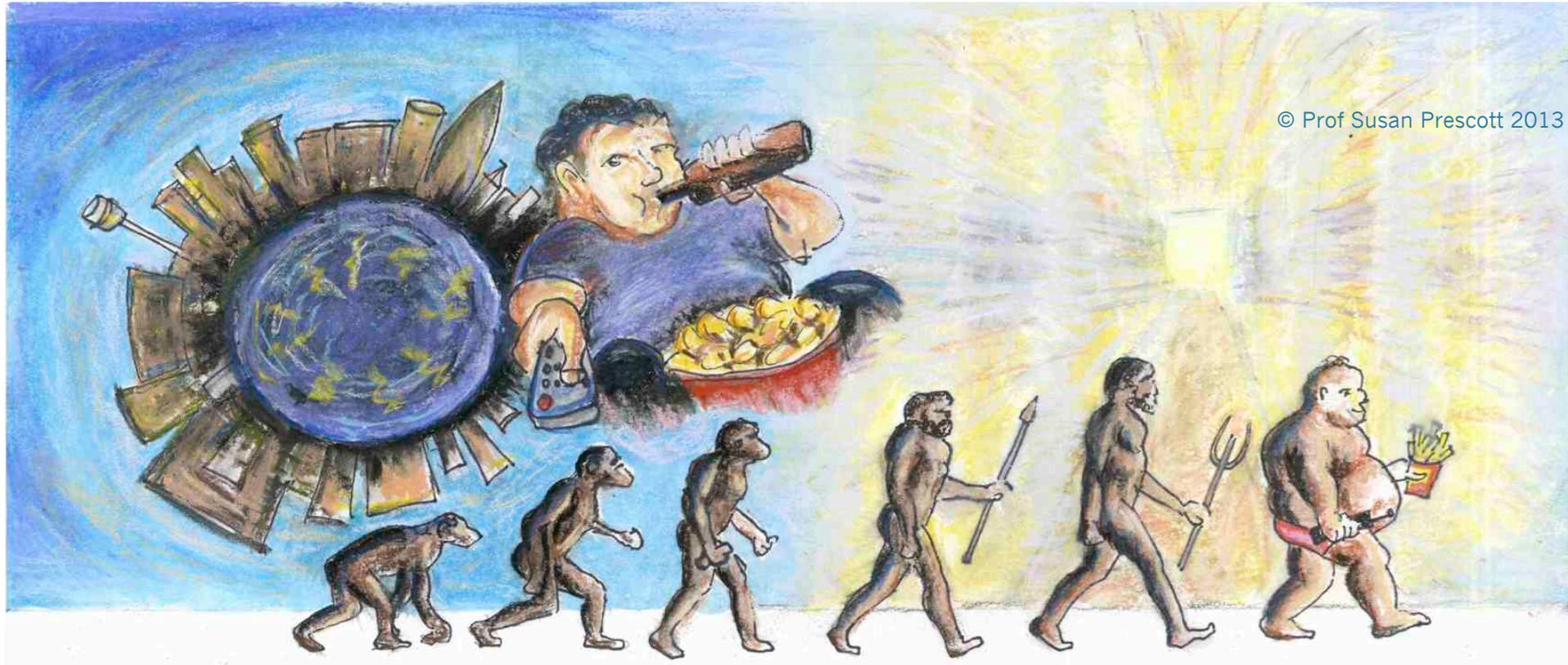
Increasing mental ill-health and developmental disorders:

Almost 1 in 10 children will have long-term MH issues



Early onset and growing burden points to importance of the early environment

The pandemic of NCD is inexorably linked to modern environmental and lifestyle change



These complex changes are **common risk factors** for many NCDs

Obesity in China: Waistlines are Expanding Twice as Fast as GDP

China is experiencing a record high obesity rate: millions are becoming obese each year.



CHINA



In 1986 - no obesity... **>120 Mln**

Obesity among children <6 y of age in South China increased **>5 times** in the last ten years

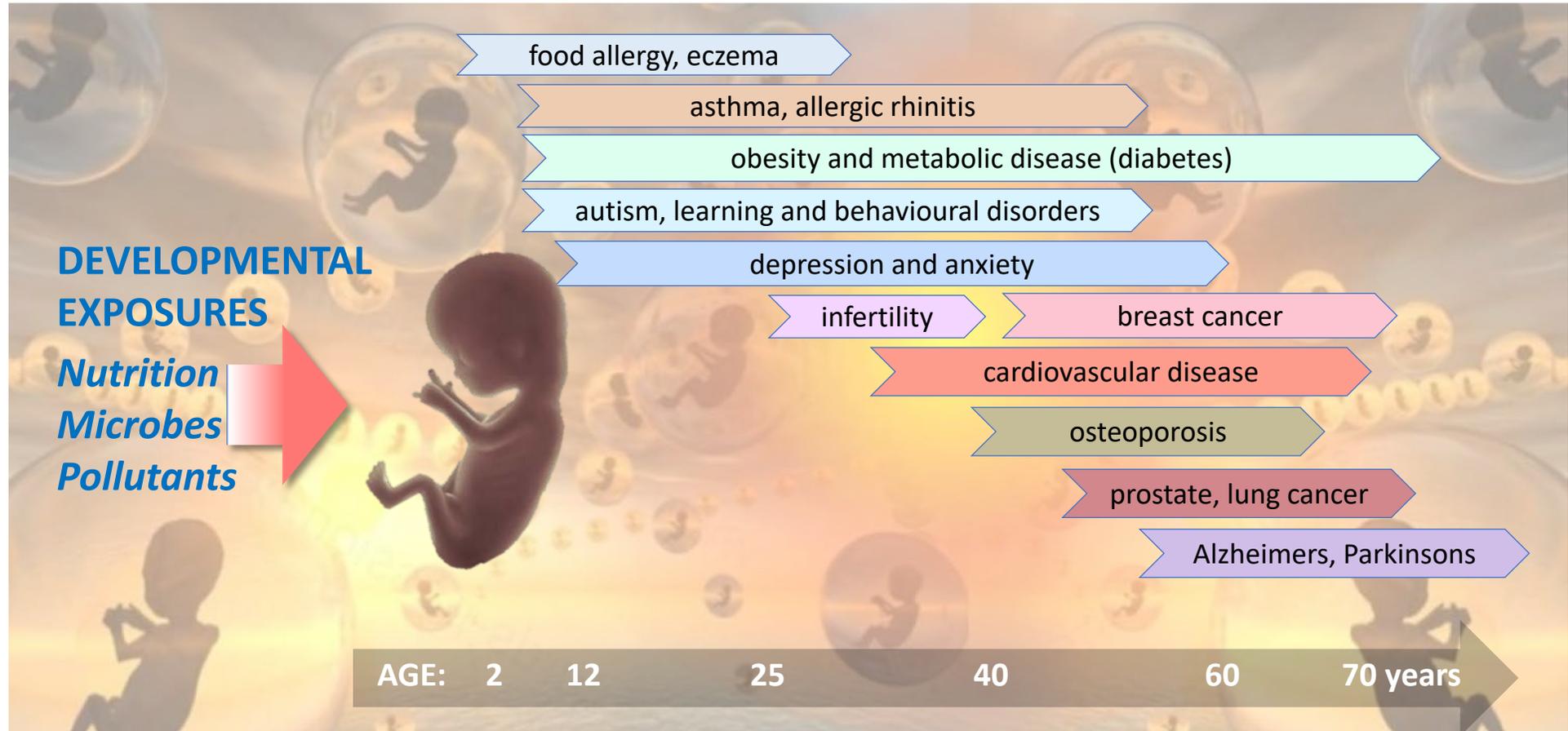
Rapid change in Aboriginal Health



Detrimental effect of an acute change from hunter gatherer to a western culture

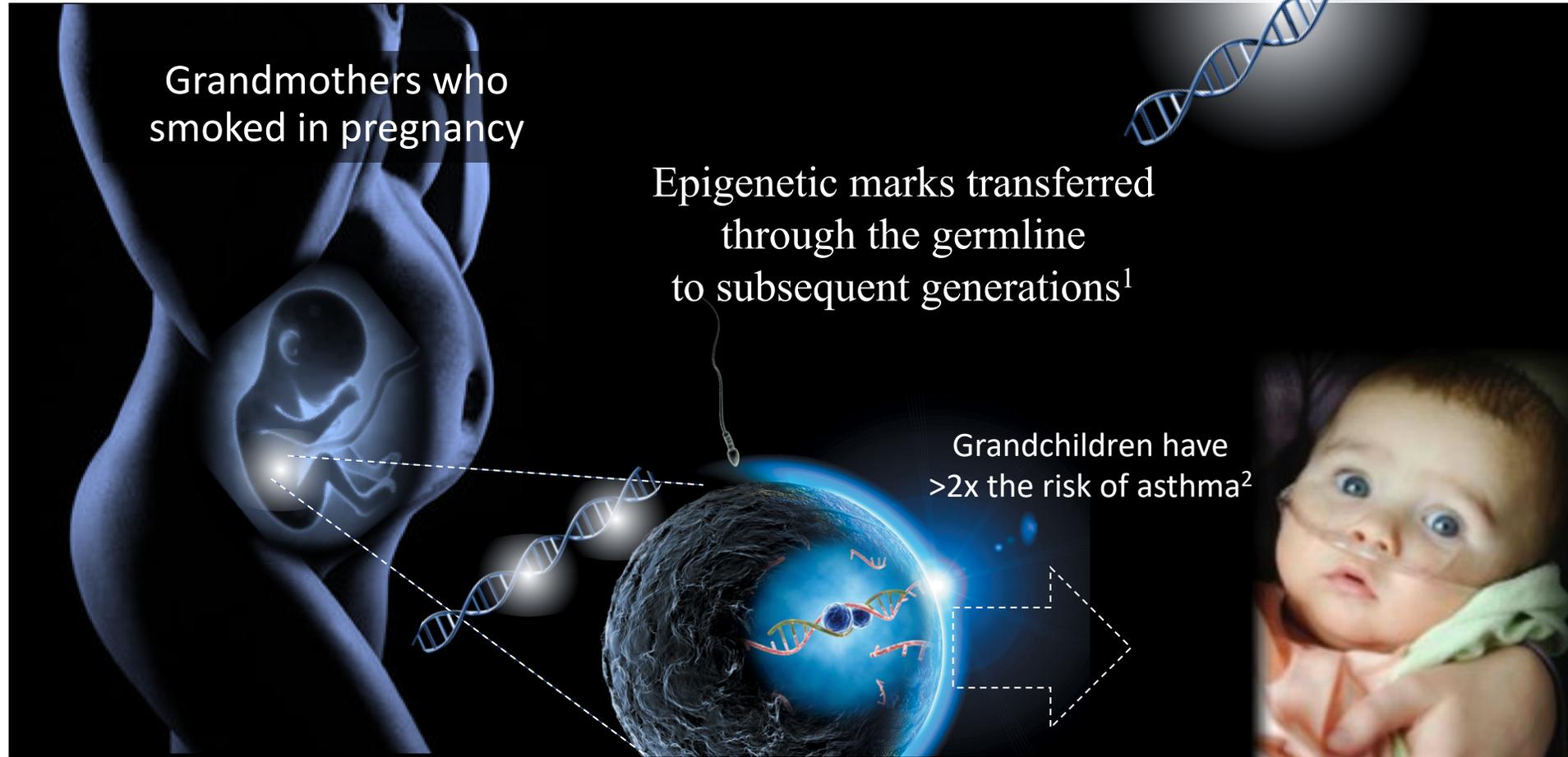
DIALYSIS UNIT DOUBLED EVERY 4 YEARS (Tiwi Island NT)

Examples of diseases that are developmentally programmed



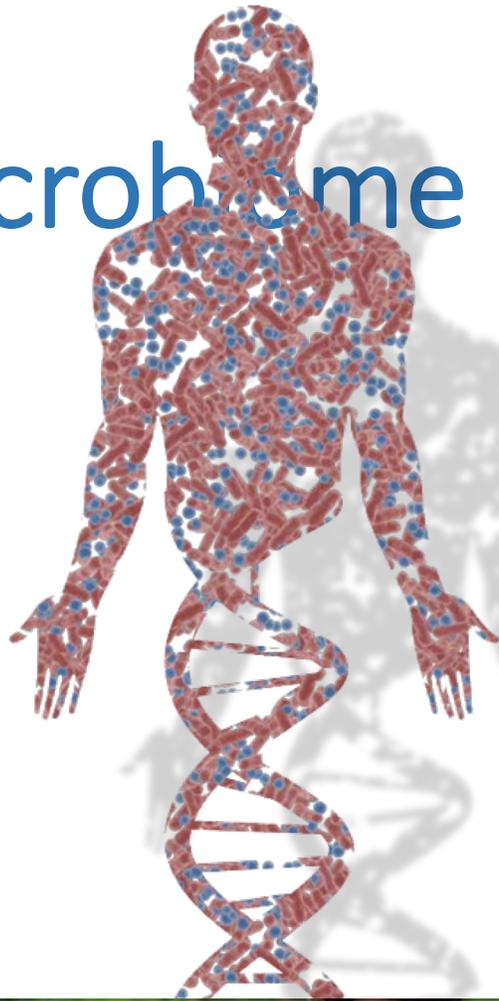
The basis of 'DOHaD' a new health discipline
(Developmental Origins of Health and Disease)

Trans-generational effects of cigarette smoking:



1. Li et al. *Chest*. 2005;127(4):1232-41.
2. Rehan et al.. *BMC Med* 2012; 10:129.

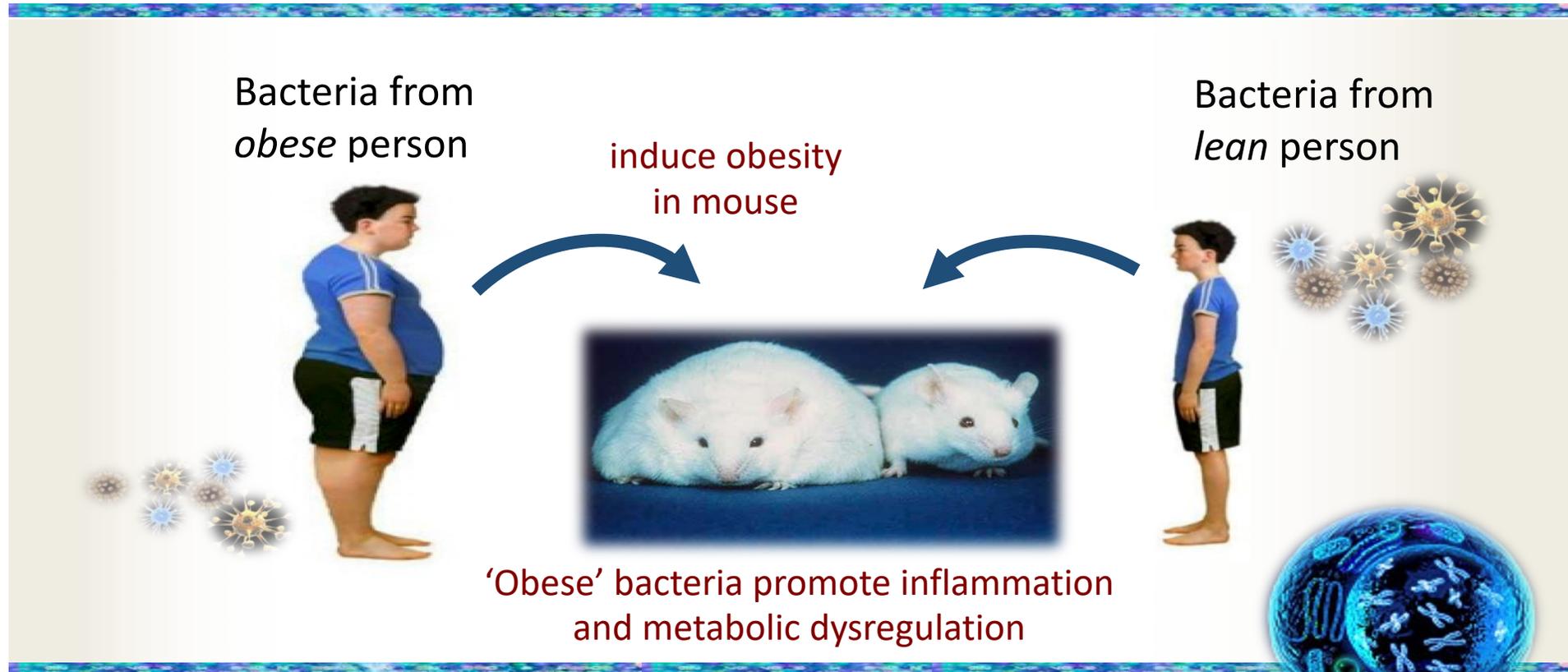
Microbiome



- Genetic make up: We are 10% human and 90% bacteria
- How babies leave mothers sets up their microbiome
- What we eat alters our microbiome
- Antibiotic use alters our microbiome
- Contact with Nature alters our microbiome
- Effects our immune system and brain development

Differences in gut bacteria in obese and lean people

Microbial induced obesity



In animals: changing the gut bacteria changes weight gain, brain and immune development, heart disease and diabetes risk and longevity.

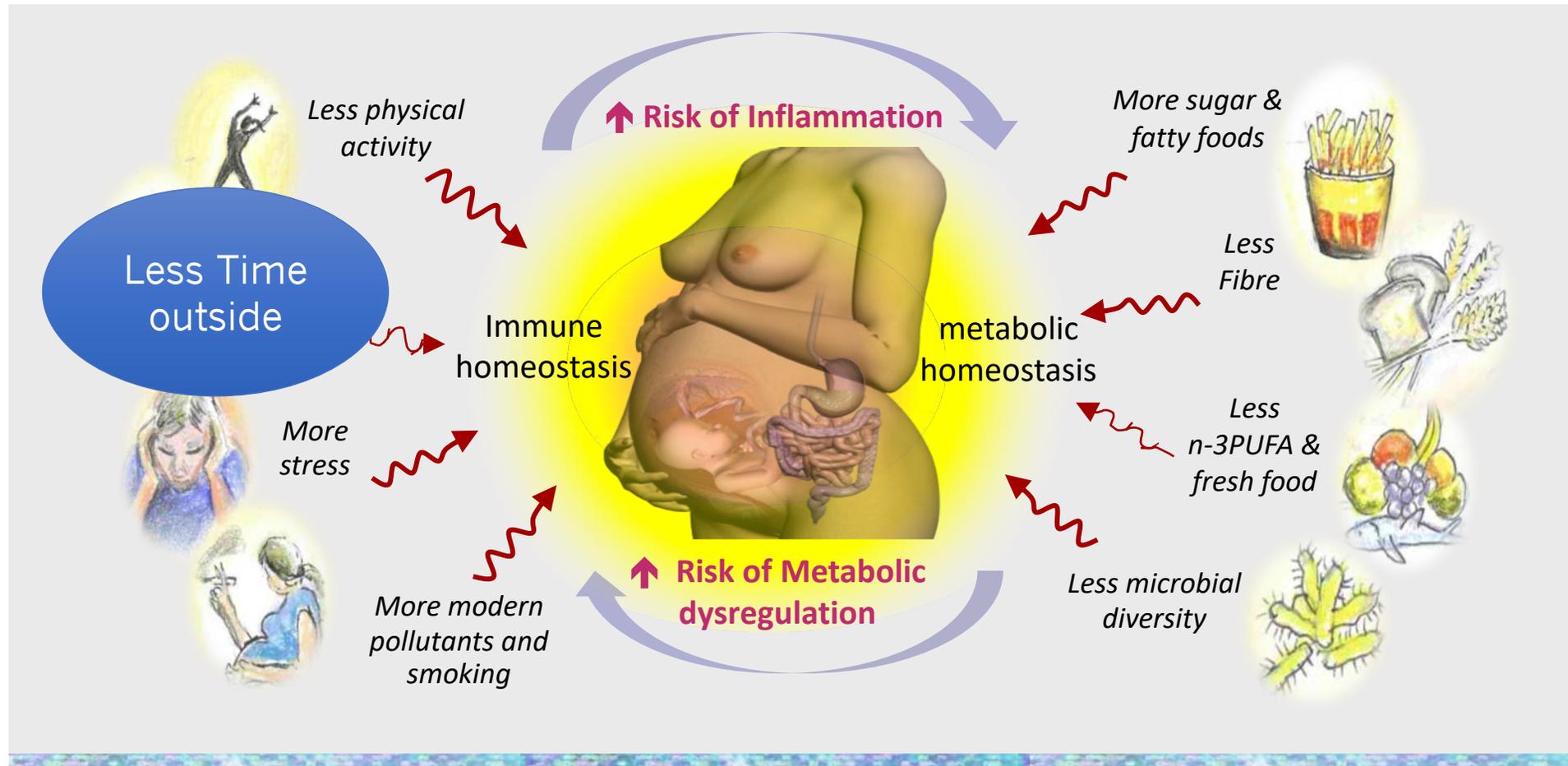
Nature Relatedness-

How is it cultivated in early life?

- Is it connected to diet?
- Skin/intestinal microbiota?
- Genetics?
- Screen time?
- Neighborhood features?
- Medication use?

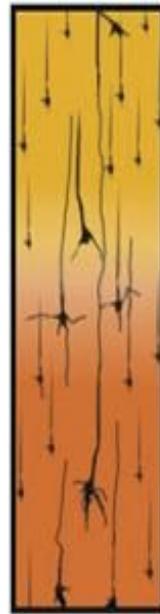
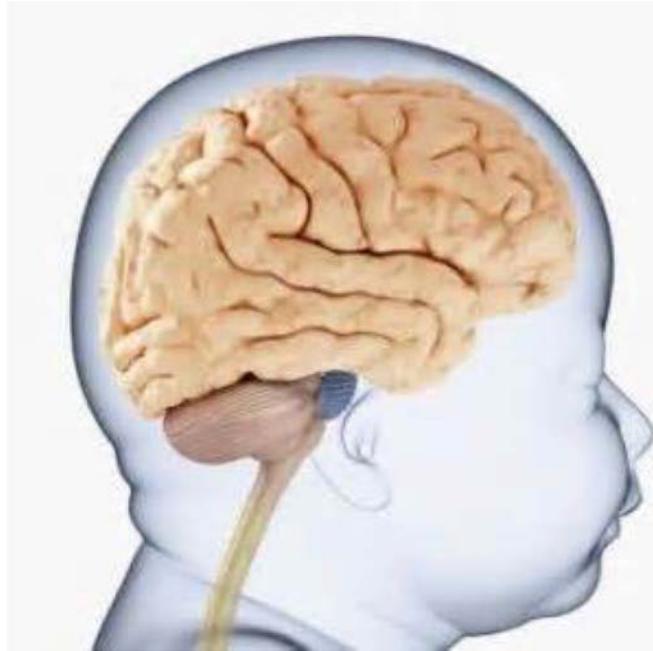


All of these factors have effects on the developing fetus



Early intervention for prevention : multisystem benefits

BRAIN DEVELOPMENT



Newborn



1 Month



9 Months



2 Years



Adult

We are born before our brain is ready

“Your brain is not just produced by genes
It is sculptured by experience”



CASE 1

- Sarah at her 6 week check
- First baby
- Young parents
- Normal antenatal history,
- C/S at 38 weeks
- Normal examination

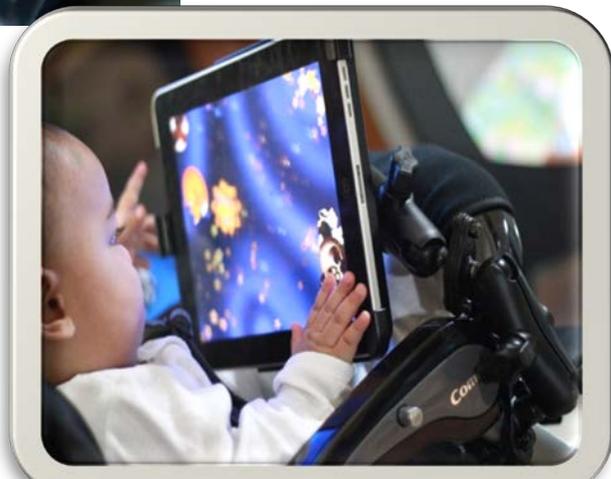
NOT SMILING

Mum in my waiting room :
constantly on her iphone

Early Stimulation

How do we spend our time with our children?
CONNECTING?





CASE 2

- John born at term uneventful pregnancy, first child
- Both parents have professional work
- 1 pad for his first Birthday
- Reported to be very good on ipad, navigating his way around games etc...
- 2 years limited speech development and regression
- 2.5 years: very obvious autistic features and obsessed with his ipad



Today's baby sitters



Peace and Tranquility: *'Occupy Your Child with an iPad Stroller Mount'*

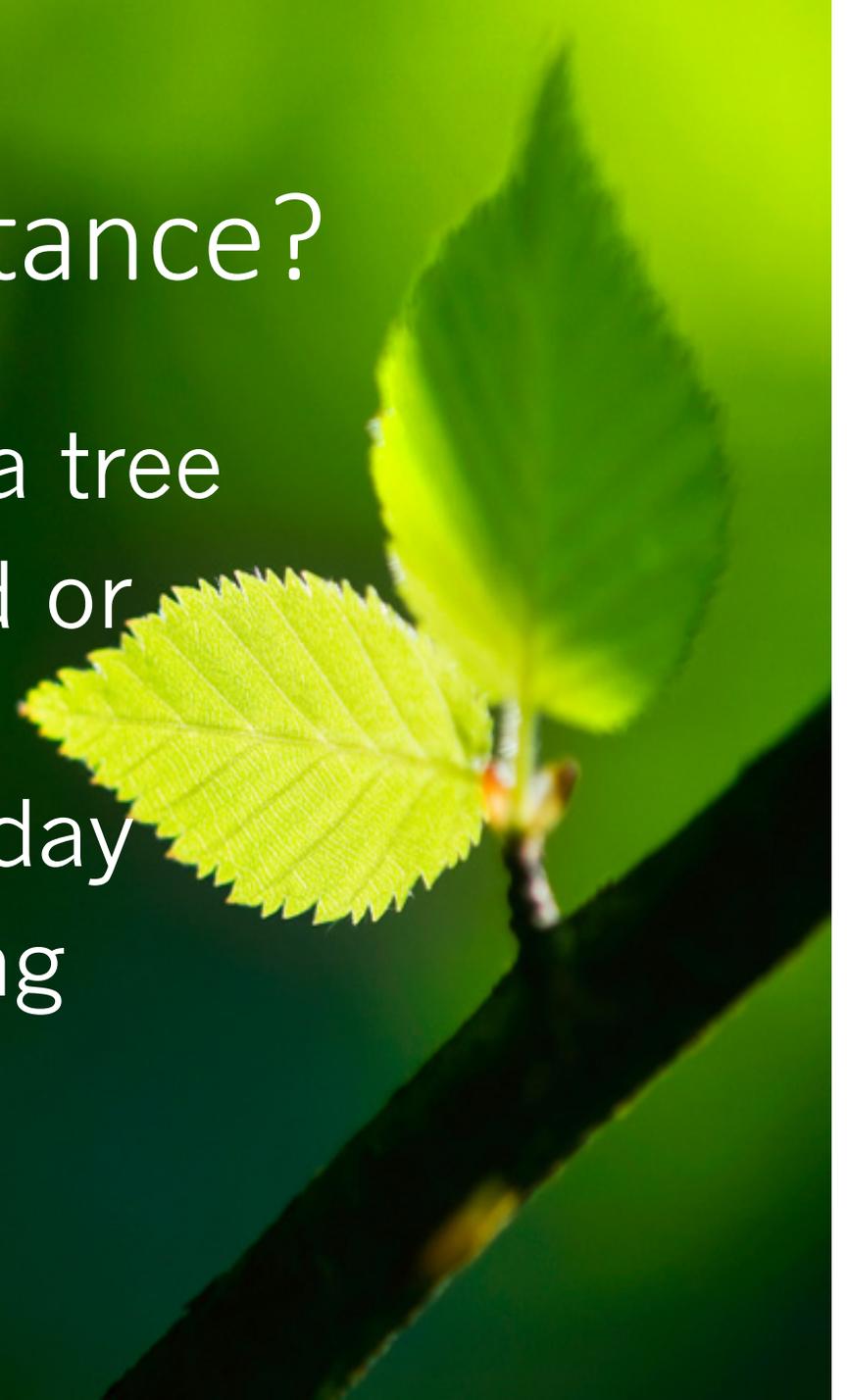
Effects of early electronic use and brain development?

A photograph of a paved road winding through a dense forest of tall, thin trees, with sunlight filtering through the canopy. The road is dark asphalt and is flanked by a thick carpet of brown pine needles. The trees are tall and slender, with green foliage. The lighting is soft and dappled, creating a serene atmosphere.

THE IMPORTANCE OF NATURE

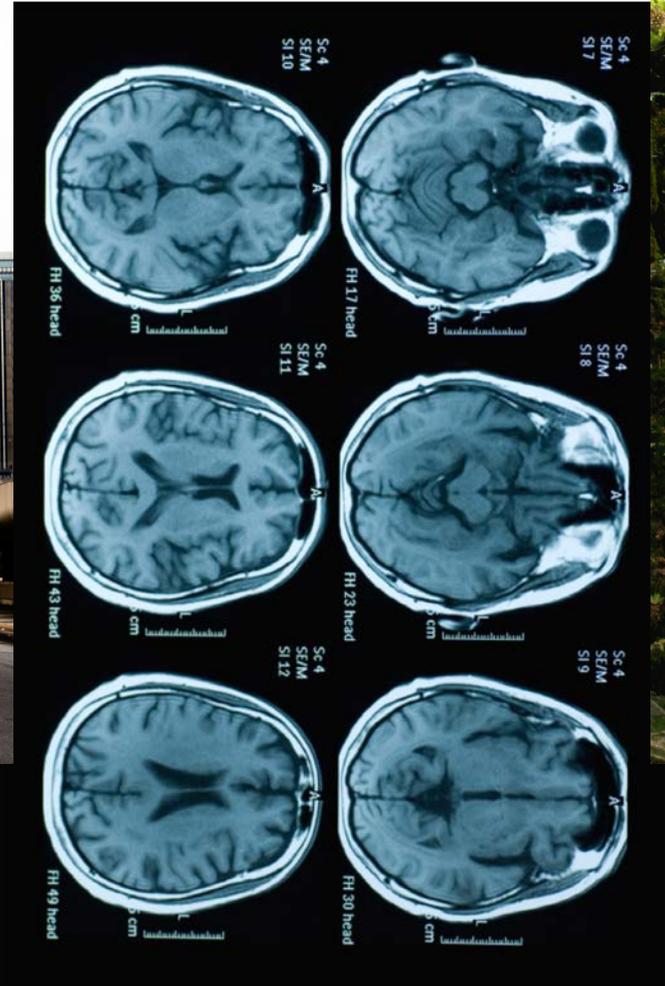
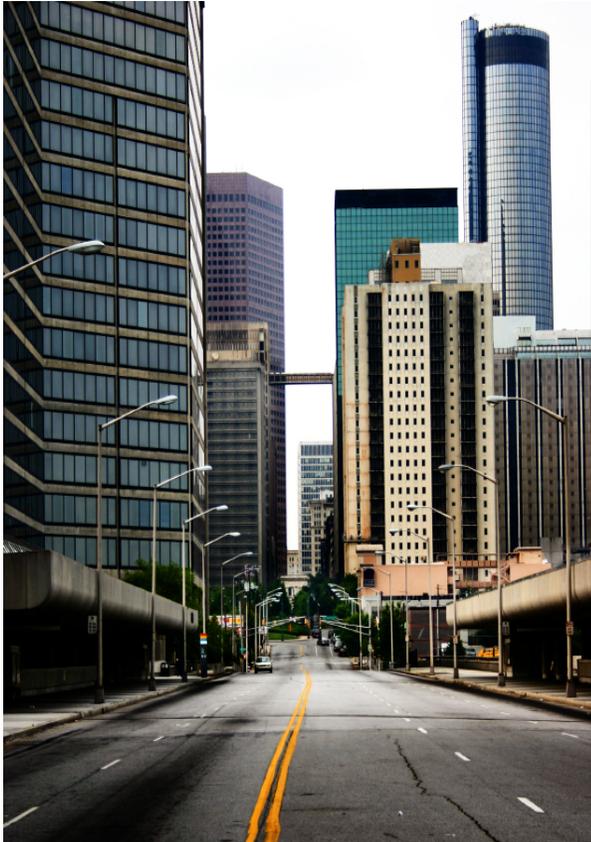
A loss of human inheritance?

- 1 in 4 kids have climbed a tree
- 1 in 3 have never camped or bushwalked
- 1 in 3 play outside every day
- Connection to nature being lost
- Significant reduction in roaming distance



The Brain “on” Nature

2-minute block of rural vs. urban; images presented every 1.5 seconds

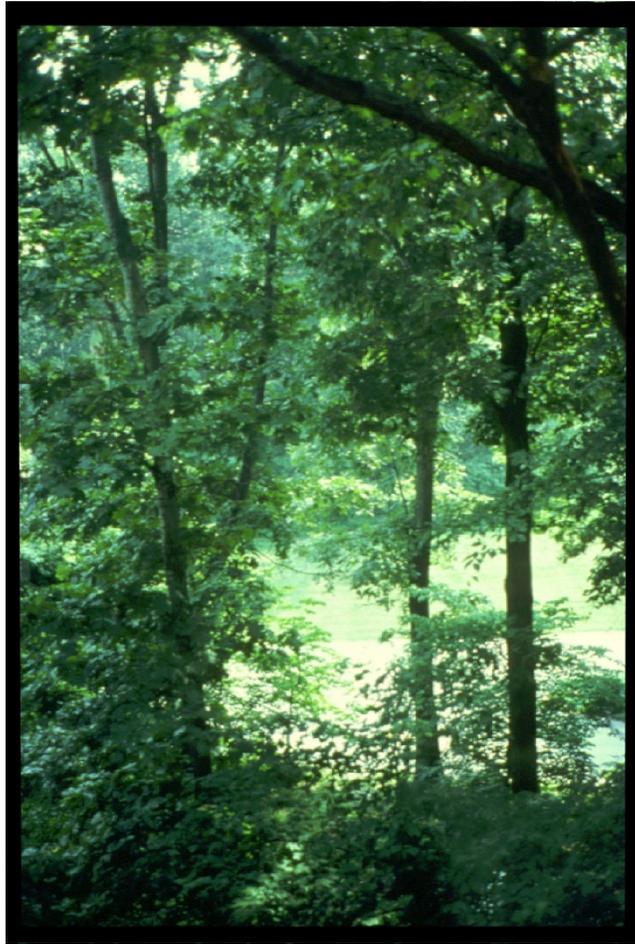


Biophilia and the MRI Scanner

- Rural scenes produced ↑ activity in the areas of the brain associated with...
 - ✓ Emotional stability and **Empathy**
 - ✓ **Love**, depth of love with partner
 - ✓ Response to happy faces
 - ✓ Pleasure, positive memories
- Urban scenes ↑ amygdala activity

Kim GW, et al. Functional neuroanatomy associated with natural and urban scenic views in human brain: 3.0T functional MR imaging. Korean J Radiol 2010;11:507-13.

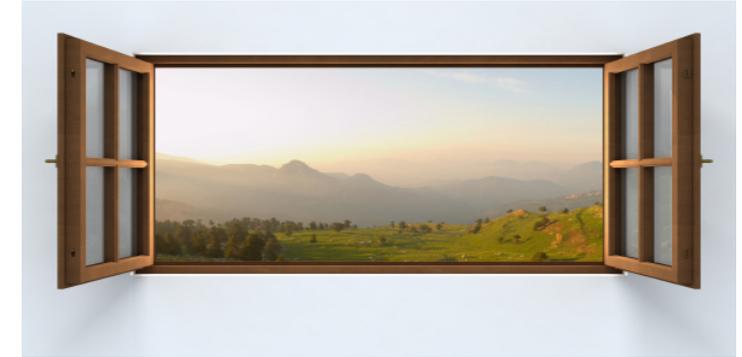
Ulrich 1984- 11 years data, adults who had undergone cholecystectomy



THE TWO TYPES OF ROOMS WITH A VIEW

Nature – In Sickness and in Health

- ✓ shorter hospital stays
- ✓ less post-surgical complaints
- ✓ less potent analgesics
- ✓ lower amount of negative comments placed in the chart by nurses



Ulrich R. View through a window may influence recovery from surgery. *Science* 1984;224:420-1.

“Shinrin-Yoku” – Forest Bathing

- Shinrin-yoku studies have involved over 1000 subjects, 2 dozen different forest settings
- Spending time in forest (vs. built) setting =
↓ stress, depressive symptoms; ↑ vigor
- Objective measurements show ↓ **cortisol**, ↓ blood pressure, pulse rate; ↑ HR variability, ↑ NK activity

Seo SC, et al. **Clinical and immunological effects of a forest trip in children with asthma and atopic dermatitis.** Iran J Allergy Asthma Immunol. 2015 Feb;14(1):28-36. 3-night trip

Nature benefits ADHD

Children with ADHD completed a series of challenging puzzles to ↑ attentional fatigue

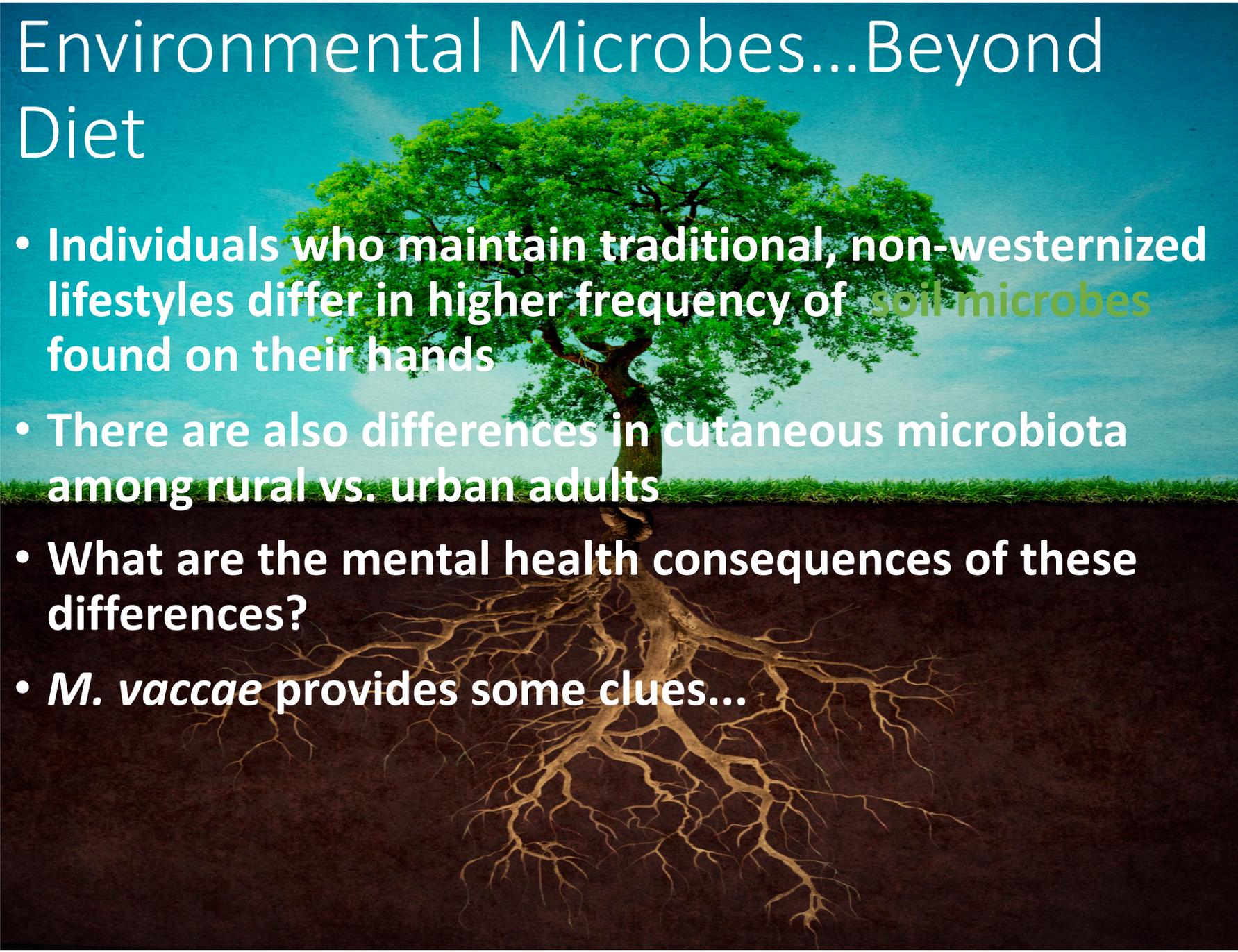
- Then set out on a guided walk for 20 minutes
 - a. **Vegetation-rich urban park**
 - b. **Downtown built area**
 - c. Area clustered with houses.
- Post-walk the child was driven back to a quiet indoor setting for neuro-cognitive testing – attention and executive functioning

Park-walk improvements in cognitive function equivalent to published data w/methylphenidate

Green Space Pregnancy, Depression & Asthma

- Population studies have linked **proximity to green space** to normal birth weight and/or decreased risk of preterm birth
- Similar findings have been reported for residential proximity to green space and **decreased risk of depression** (20% lower) *during* pregnancy **SES gradient
- 10-year follow-up of births in Vancouver - surrounding **greenness** is associated with decreased risk of asthma at preschool age

Environmental Microbes...Beyond Diet

A large, leafy green tree stands in the center of the frame. Its trunk is thick and brown, and its branches spread out, covered in vibrant green leaves. Below the ground line, the tree's root system is exposed, showing a dense network of light-colored roots extending deep into the dark brown soil. The background is a clear, bright blue sky with a few wispy clouds. The overall scene is a natural, outdoor setting.

- Individuals who maintain traditional, non-westernized lifestyles differ in higher frequency of **soil microbes** found on their hands
- There are also differences in cutaneous microbiota among rural vs. urban adults
- What are the mental health consequences of these differences?
- *M. vaccae* provides some clues...

M. vaccae



The subcutaneous administration of heat-inactivated *M. vaccae* in animals

- increases neurotransmitters
- Reduce fear, coped better with stress,
- Reduces inflammation

Siebler PH, et al. Immunization with the immunoregulatory saprophytic bacterium *Mycobacterium vaccae*. Abstracts of the 24th Annual Meeting of the International Behavioral Neuroscience Meeting, Victoria, Canada, July 2-7, 2015. pp 82.

Lowry CA. An immunization strategy for prevention of stress-related neuropsychiatric disease. Abstracts of the 24th Annual Meeting of the International Behavioral Neuroscience Society, Victoria, Canada, July 2-7, 2015. pp 173-74.

Greater vegetative diversity in the view = lower hair cortisol



Why Connectedness to Nature?

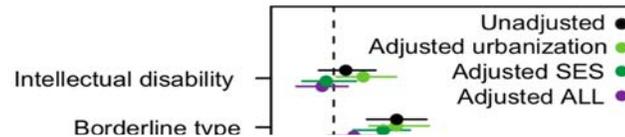
- **ADULTS:** Spending more time in nature increases physical activity, reduces stress, enhances healthy sleep, and increases general well-being.
- **CHILDREN?**



Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood

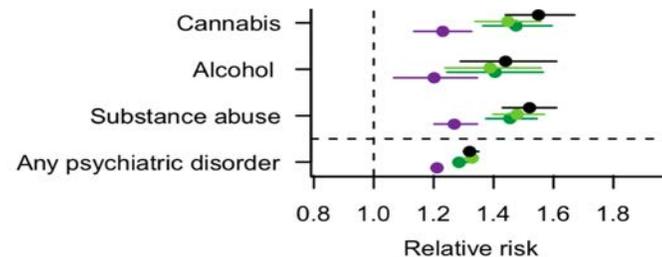
Kristine Engemann^{a,b,c,1}, Carsten Bøcker Pedersen^{c,d,e}, Lars Arge^f, Constantinos Tsirogiannis^f, Preben Bo Mortensen^{c,d,e}, and Jens-Christian Svenning^{a,b}

Jan 2019



"With our dataset, we show that the risk of developing a mental disorder decreases incrementally the longer you have been surrounded by green space from birth and up to the age of 10. Green space throughout childhood is therefore extremely important."

– Kristine Engemann



Childhood Experience with nature

- Fewer depressive symptoms in adulthood
- Children more likely to develop emotional affinity to and support for protecting biodiversity (Nature stewardship)
- In pre-school children, non-accessibility of green space is associated with risk of emotional problems
- In children aged 11-14, green space exposure (measured via GPS receivers) linked to emotional wellbeing more than moderate-to-vigorous physical activity (accelerometer)

Snell, et al. 2016;26:111-124 ; Soga, et al. 2016 May 25;13(6). Zach, et al. 2016 Jul;219(4-5):458-67; Ward, et al. 2016 May 11;40:44-50



Review

Impact of Green Space Exposure on Children's and Adolescents' Mental Health: A Systematic Review

Gert-Jan Vanaken *  and Marina Danckaerts



5. Conclusions

In children and adolescents, there is significant evidence for an inverse relationship between green space exposure and emotional and behavioral problems. These beneficial associations are resistant to the adjustment for demographic and socio-economic factors and thus may represent an independent link. The presented evidence suggests potential partial mediation via physical activity, buffering of air pollution and social interaction. Future research is needed to shed more light on confounders, mediators, varying impacts during development and causality. The presented findings warrant the attention of policy makers, urban planners and health care workers in order to protect the mental health of children and adolescents in an urbanizing world, by providing sufficient exposure to green spaces.



21 studies reviewed

NOV 2018

GREEN BLUE PRESCRIPTION



REVIEW

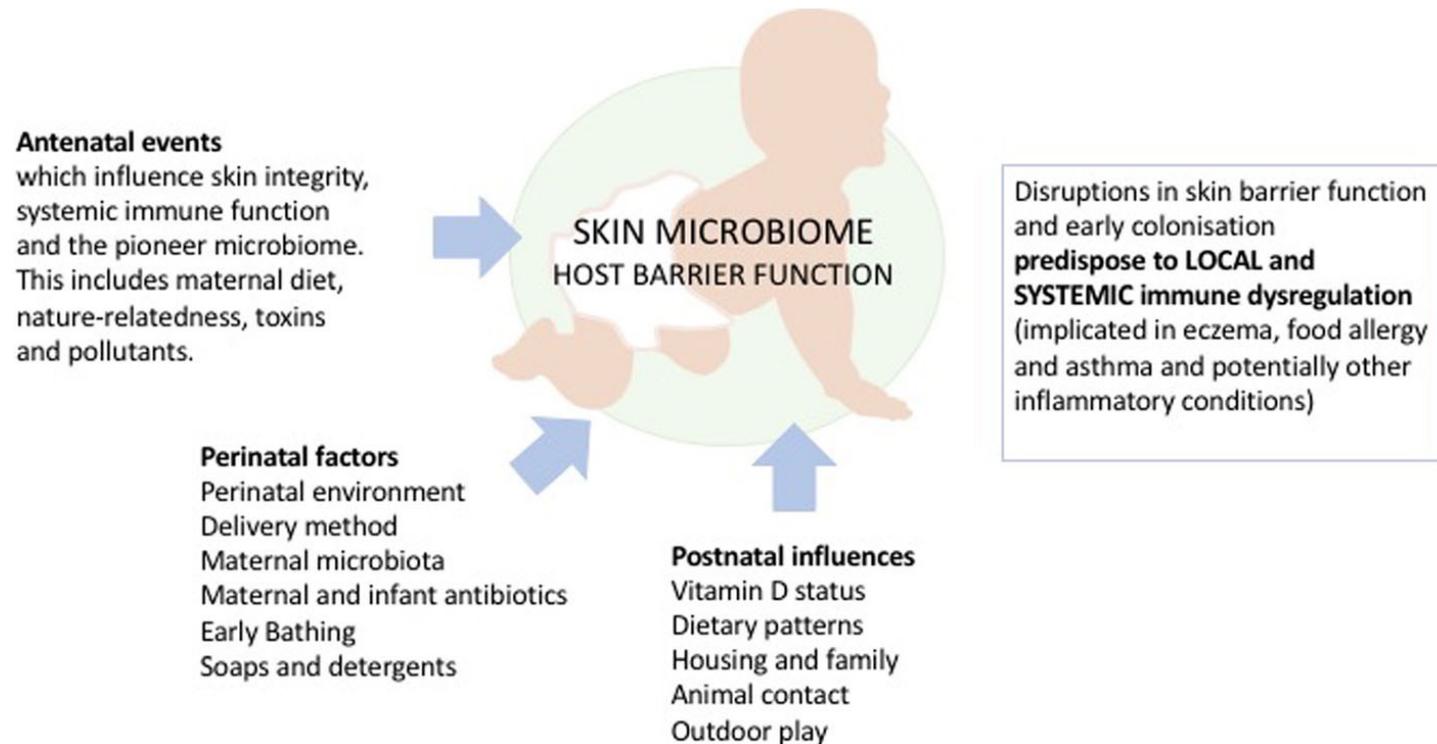
Open Access



The skin microbiome: impact of modern environments on skin ecology, barrier integrity, and systemic immune programming

Susan L. Prescott^{1,2*}, Danica-Lea Larcombe^{2,3}, Alan C. Logan², Christina West^{2,4}, Wesley Burks⁵, Luis Caraballo⁶, Michael Levin^{2,7}, Eddie Van Etten³, Pierre Horwitz³, Anita Kozyrskyj^{2,8} and Dianne E Campbell^{2,9,10}

Early life is a critical period



...for establishment of both the microbiome and immune responses, with long term implications for health. Understanding modulating factors during this period could lead to targets for disease prevention

PLAY & GROW HongKong

Connectedness to nature

- A novel component of healthy lifestyle
- The 1st and only evidence-based early environmental program in Hong Kong
- Randomized controlled trial (RCT)



Study design

- Families with children, 36 months (SD = 3.8), RCT
- **Play&Grow** program: evidence-based preschool intervention with an addition of a novel element, Connectedness to Nature. Once a week for **10 weeks**.
- Each session: short discussion on selected environmental and health topics, games with food and playtime outside, discovering nature, being aware of sounds, touch and smells.
- Lifestyle-related habits: validated questionnaires and activity trackers before/immediately after the intervention

Methods

Intervention content

Nature games



Sobko, T., Jia, Z., Kaplan, M., Lee, A., & Tseng, C. H. (2017) *Pediatric research*,
Sobko, T., Tse, M., & Kaplan, M. (2016). *BMC Public Health*

Food games



Environmental education

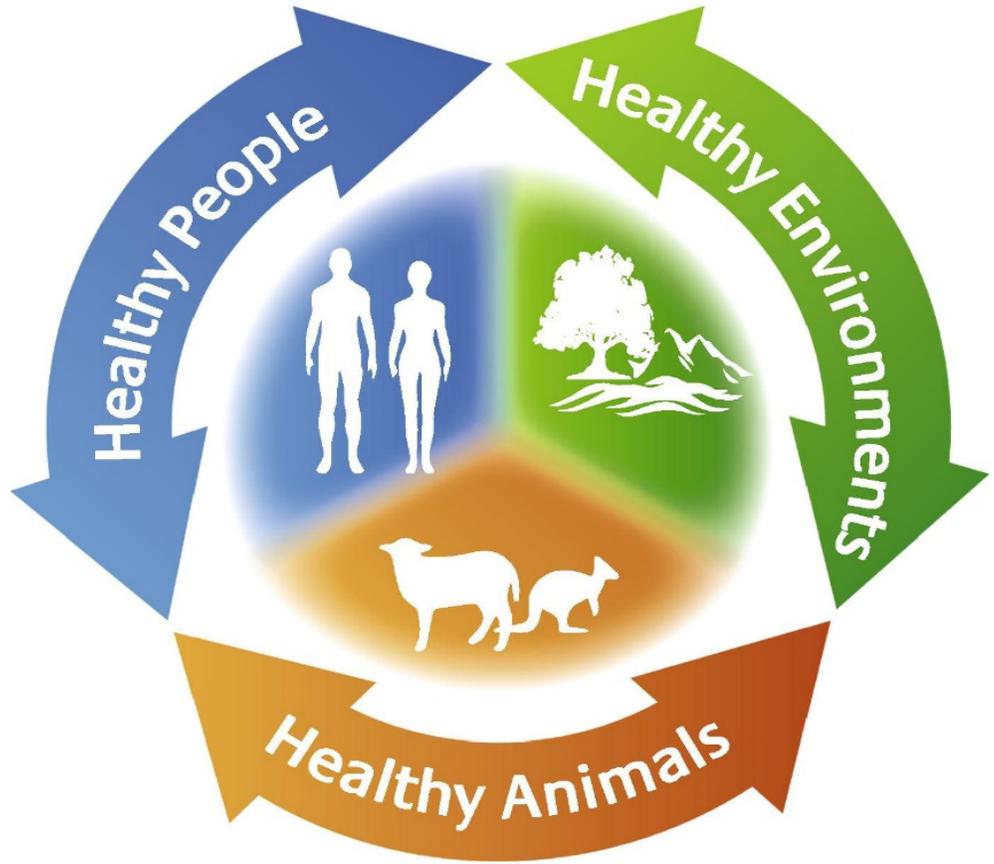


RESULTS

- Significant improvement in
 - connection to nature,
 - enjoyment of nature and
 - nature responsibility
- Eating habits improved
- Physical activity increased

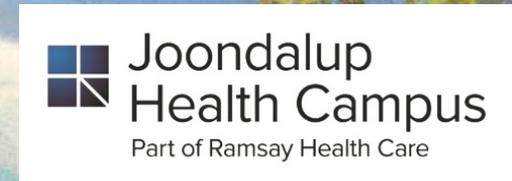


The solution: One Health



ORIGINS PROJECT: The Story of Global Health starts Locally

Change begins in our
community
We cannot underestimate the
power or the importance of
this



AIMS

1. To improve the health of the next generation through a better understanding of how to improve the early environment, early identification of developmental problems and early treatment
2. Developing a robust biobank and databank.
3. To develop sub-studies that may provide answers about common diseases.

ORIGINS Project Platform: 20 months into a 10 YEAR project

20,000+
(‘no’ participant burden)

ORIGINS COHORT
10,000

2,500



ROUTINE HEALTH CARE
biological and clinical data collected from all pregnant women

OBSERVATIONAL COHORT
Participate in ‘active’ follow-up: with more intensive data collection on early exposures, clinical and biological outcomes (e.g. questionnaires, blood, stools)

INTERVENTIONS (CLINICAL TRIALS)
targeting specific high risk groups (e.g. allergic women, obese women, smoking women) with separate consent. Women will be given information for clinical trials and screened for eligibility if they are interested.



Linked to government (PBS) and non government data sets

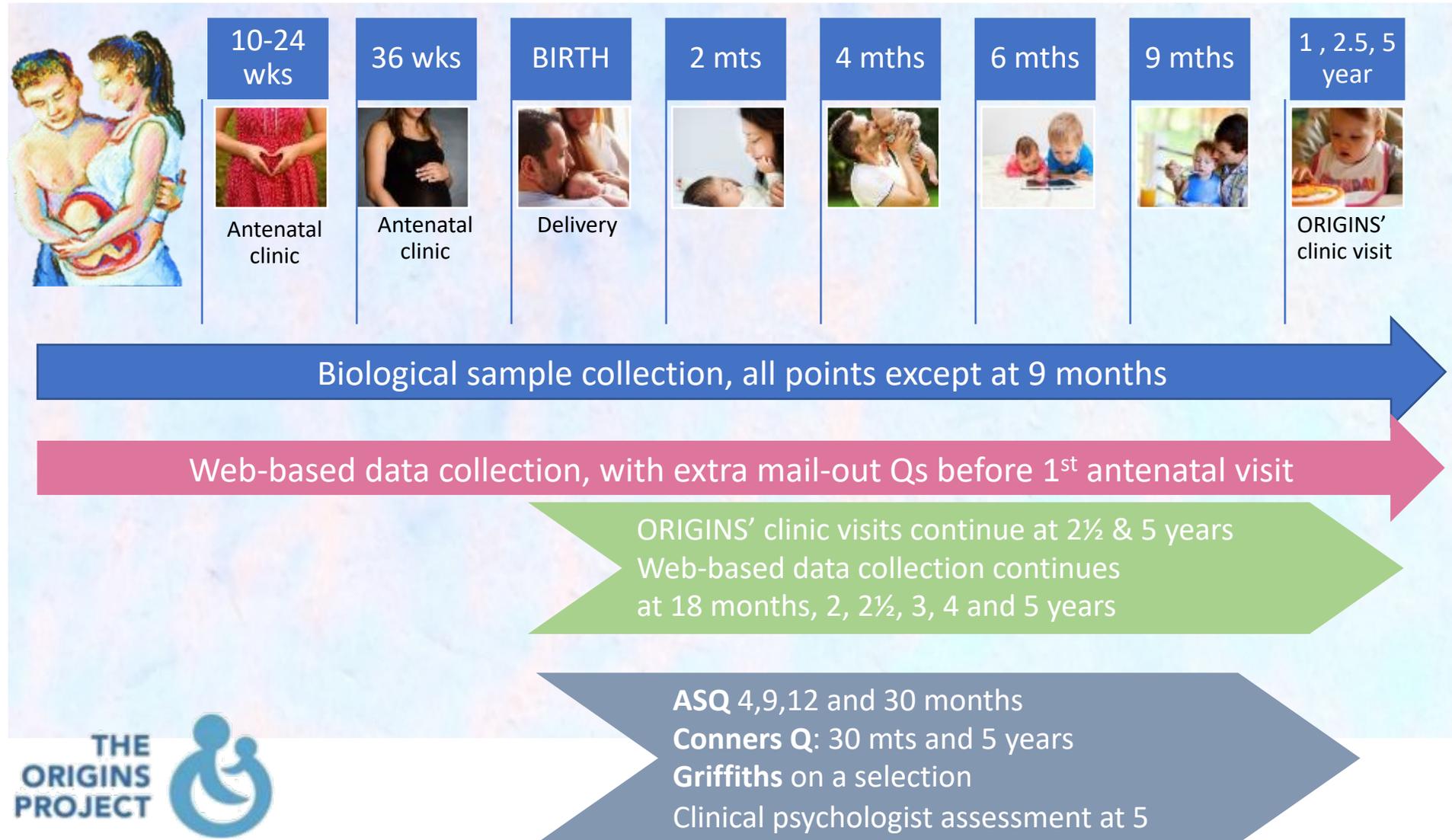
Current ORIGINS
1700 mums
1300 babies
8 sub studies



2,114,991 data-points

37,626 samples

ORIGINS Data & sample capture points: 10,000 (5,000 deep sampling) follow for 5 years



Summary of Specimen Collections

Summary of Biological Sample Collection Events

	18 wk GA	28 wk GA	36 wk GA	Birth, post natal	2 mth	4 mth	6 mth	1 yr	2.5 yrs	5 yrs
blood	M,F	M	M					C	C	C
saliva	M,F	M	M	F,C		M, C	C	M, C	C	C
buccal swab	M,F	M	M	F			M, C	M, C	C	C
stool	M	M	M	C	M, C	M, C	M, C	C	C	C
urine	M	M	M			M, C	M, C	C	C	C
house dust		M						M	M	M
hair		M,F						M, F		
cord blood				C						
placenta sample				C						
meconium				C						
colostrum				M						
breast milk					M	M	M	M		



ORIGINS Sub-Projects



SYMBA
Allergic
disease

355/652



TALK
Language
development

410/500



BENEFIT
Allergic
disease

43/64



CARE-Dads
Paternal
health

272/1000

**Cashew
study**
Allergies

75/141

AERIAL (NOSE)
Respiratory

22 - pilot

PLAN
Early weight gain
in pregnancy

57

**Screen
ORIGINS**
Technology use

New in 2019

The Engage Study
Parenting &
development

WINDOWS
Personalised medicine

Baby Moves
Biomarkers for
neurodevelopmental

PrEggNut
Allergic disease

Water Study
Infant gut microbiome

Nature Play & Grow Intervention



Nature Play

Nature responsibility

Healthy eating and how vegetables grow

Australian Indigenous flora and fauna

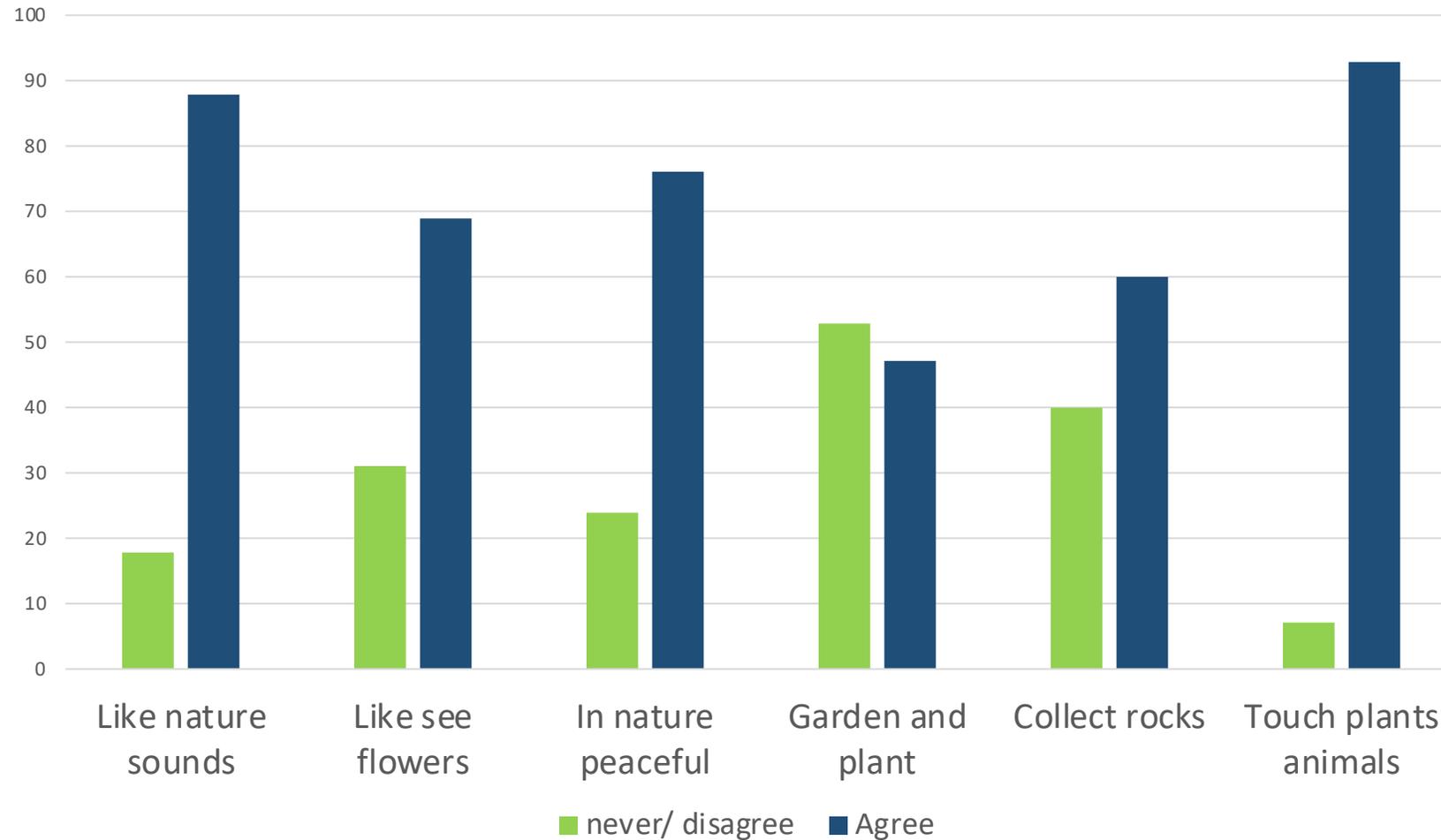


Enjoyment of Nature

- My child likes to hear different sounds in nature
- My child likes to see wild flowers in nature
- Being in the nature makes my child feel peaceful
- My child likes to garden and plant
- My child enjoys collecting rocks and shells
- My child enjoys touching animals and plants

% Enjoyment of Nature at one year

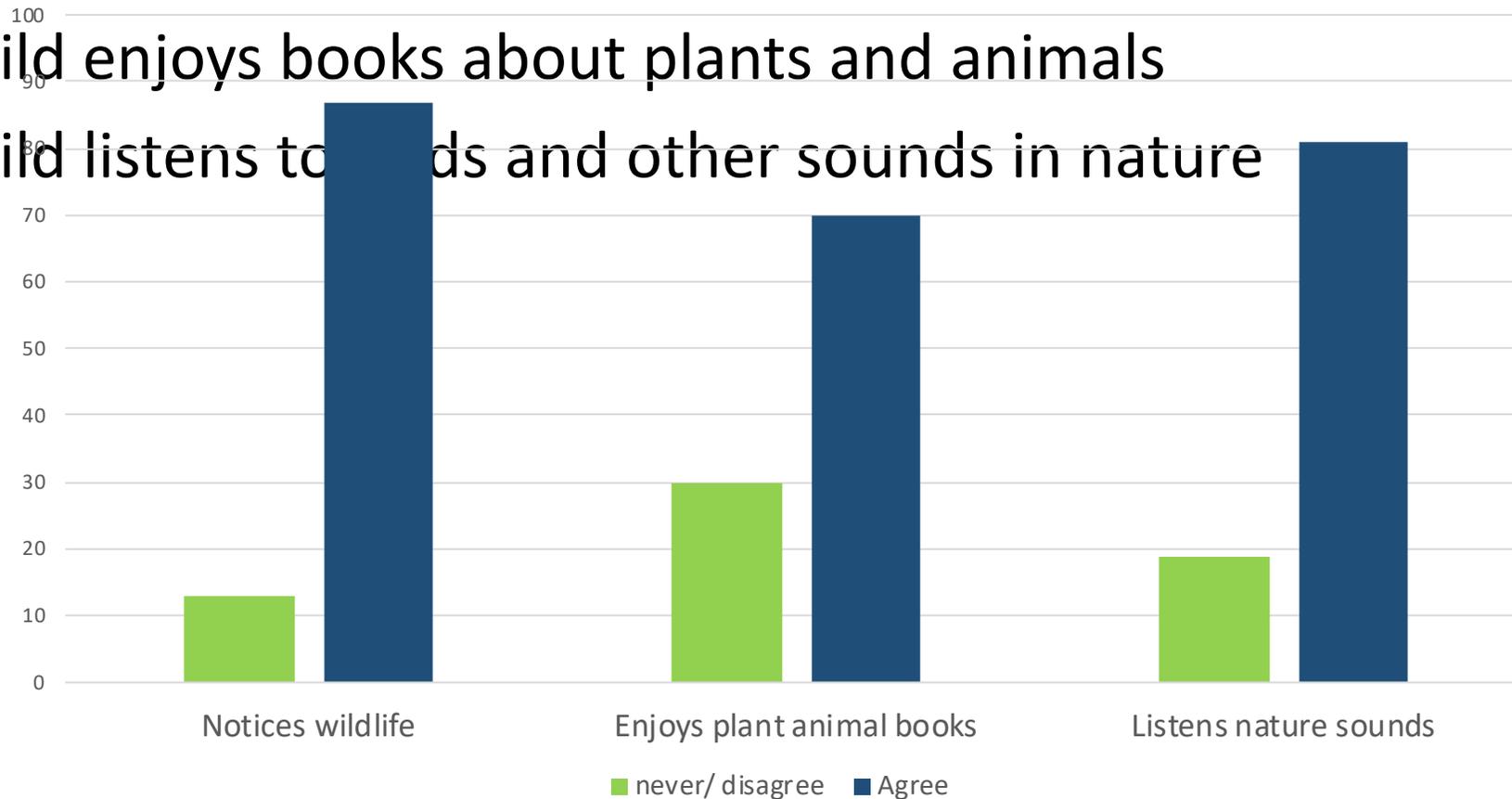
N=220



% Awareness of Nature at one year

N=220

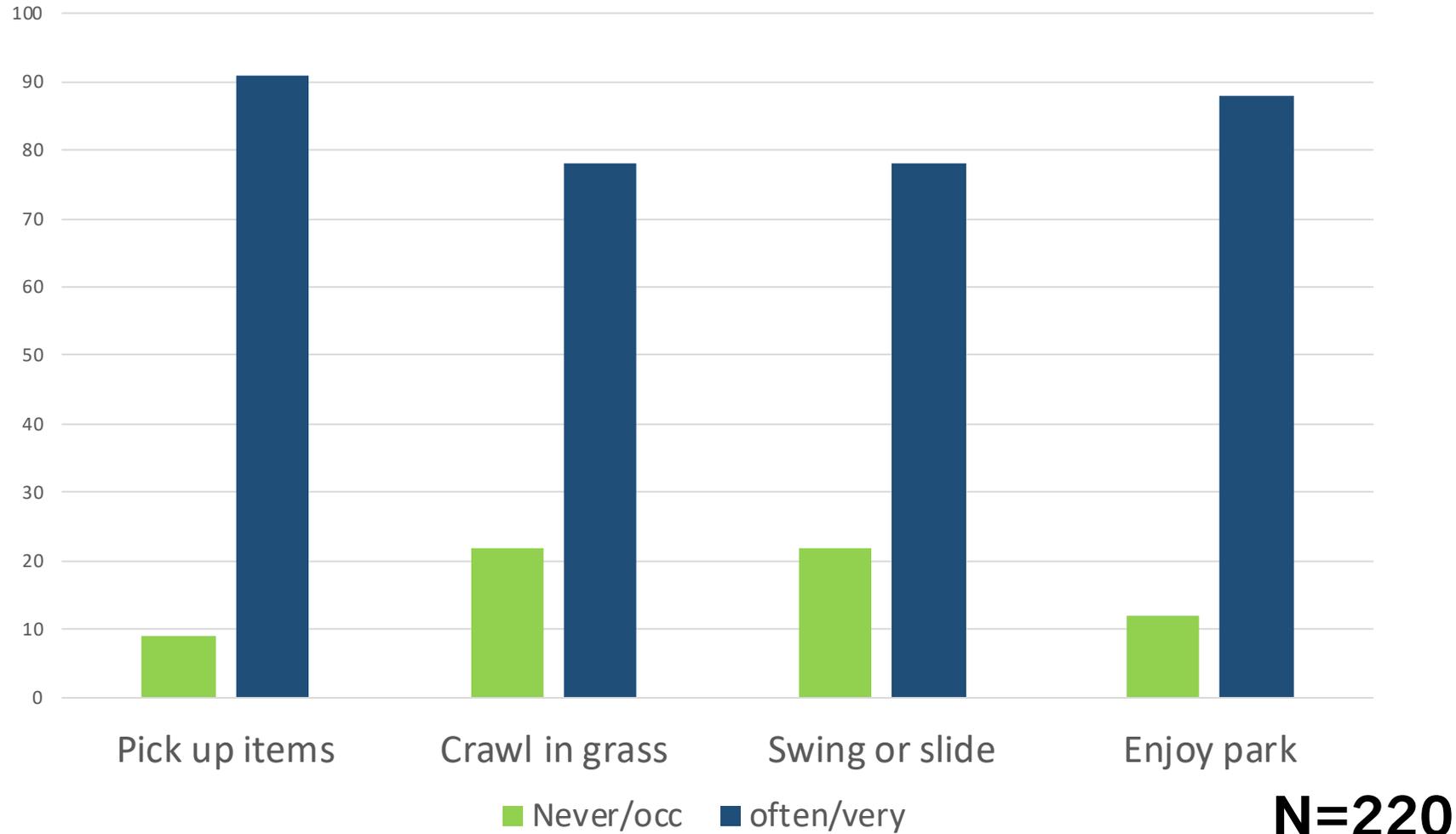
- My child notices wildlife whenever he/she is outside
- My child enjoys books about plants and animals
- My child listens to birds and other sounds in nature



NATURE PLAY AT ONE

- Does your baby pick up natural items, e.g. sticks, leaves, pinecones, gumnuts, rocks?
- Does your baby crawl, scoot, wriggle or roll their way from grass to sand or pull themselves up on a log or tree?
- Has your baby tried swinging on a swing, or been down a slide (with help from an adult)?
- Does your baby enjoy being in a park?

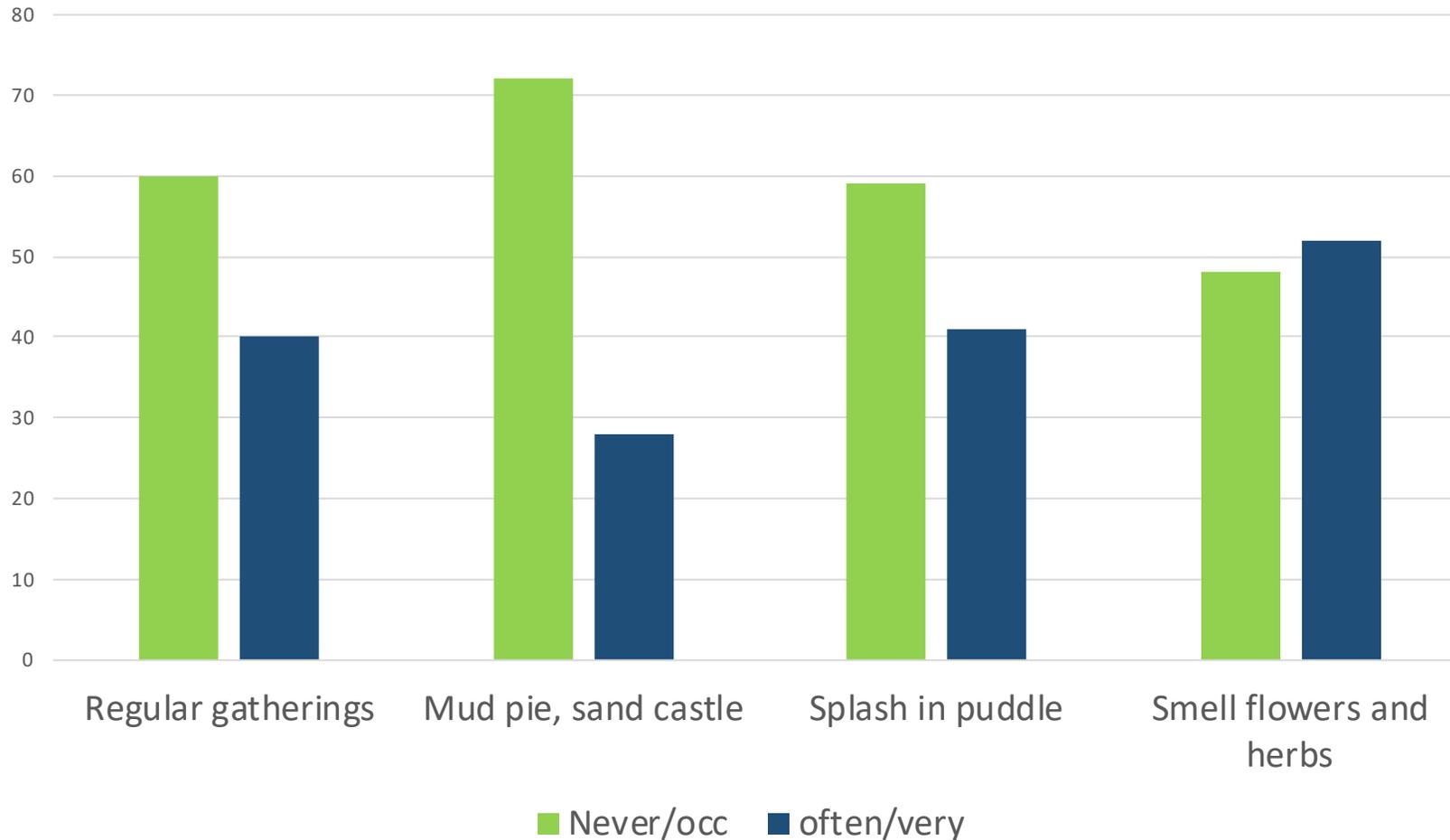
% NATURE PLAY at age one



NATURE PLAY AT ONE

- Do you have regular gatherings with other mothers and babies in a local park?
- Has your baby made a mud pie or built a sand castle?
- Has your baby splashed in a puddle or played in the rain?
- Has your baby smelt flowers or herbs, e.g. Rose, Rosemarie, Lavender?

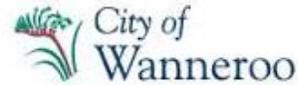
% NATURE PLAY at age one



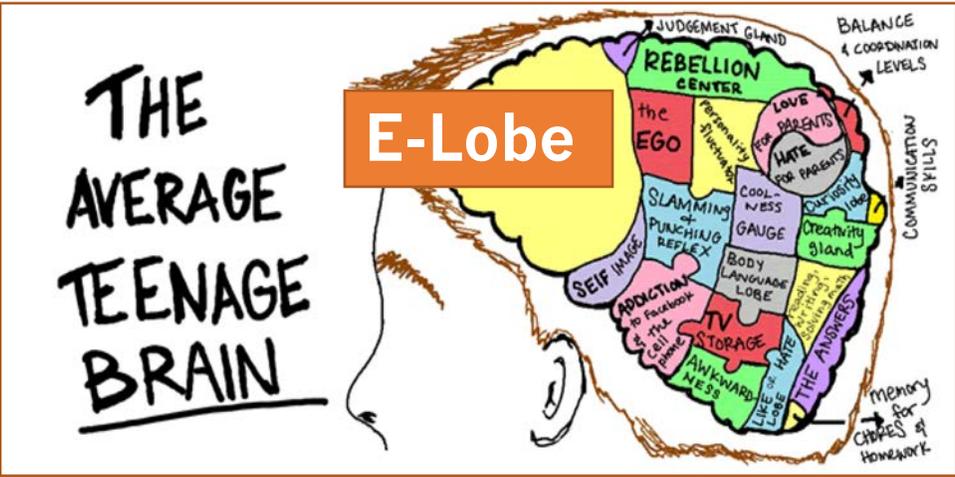
N=220



Engagement and Collaboration



IN A NUT SHELL



REDUCE REPLACE BALANCE



As we look to the future...



...the future is looking to us!