Optimizing nutritional needs for optimal growth in children and adolescents

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Nutrition Programme,

School of Health Sciences,

Universiti Sains Malaysia

Presentation Outline

- NHMS 2022 -Maternal and Child
- Early nutrition
- NHMS 2022- Adolescents
- Growth nutrients
- Take Home Message

Global Nutrition Report 2022 (Malaysia)

https://globalnutritionreport.org/resources/nutrition-profiles/asia/south-eastern-asia/malaysia/

Progress towards the global nutrition targets

- **Childhood stunting** — No progress or worsening
- **Anaemia** — No progress or worsening
- **Low birth weight** — No progress or worsening
- **Childhood overweight** — On course
- **Exclusive breastfeeding** — No data
- **Childhood wasting** — No progress or worsening
- **Sodium intake, women and men** — Off course
- **Raised blood pressure, women** — Off course
- **Raised blood pressure, men** — Off course
- **Obesity, women** — Off course
- **Obesity, men** — Off course
- **Diabetes, women** — Off course
- **Diabetes, men** — Off course

01 OVERVIEW OF THE SURVEY

Survey that aimed to assess health status among women and children in Malaysia

First survey in **2016**

Second in **2022**

All States & Federal Territories Involved

1,029 Areas

13,832 Houses

Overall response rate **74.9%**

1,877 Women Reproductive 15-49 years

6,360 Mothers

17,176 Children 0-5 years

03 CONCERNING COMPLICATIONS DURING PREGNANCY

Diabetes in Pregnancy

13.5% 2016 → 27.1% 2022

High Blood Pressure in Pregnancy

5.8% 2016 → 6.5% 2022

Anaemia in Pregnancy

29.3% 2016 → 19.3% 2022

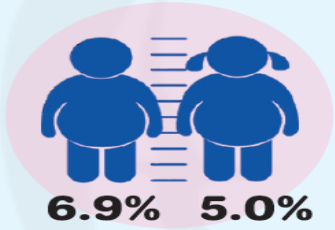
07 YOUNG CHILD FEEDING PRACTICES and ANAEMIA

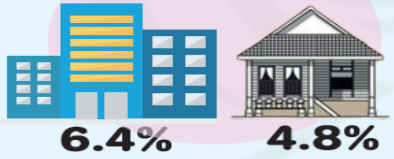
Anaemia among children

46.5%

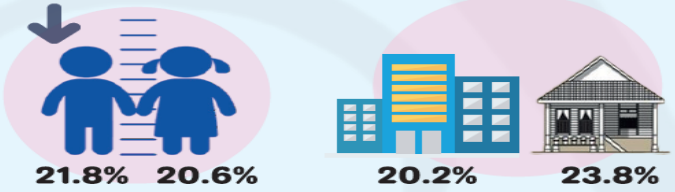
11 THE DOUBLE BURDEN OF MALNUTRITION

6.0%
are overweight





1 in 5 is too short for their age



1 in 10 is too thin for their height

80.3%
parents unaware their children are overweight

26.4%
parents have tried to increase weight of their overweight children

7.5%
parents have tried to reduce weight of their overweight children

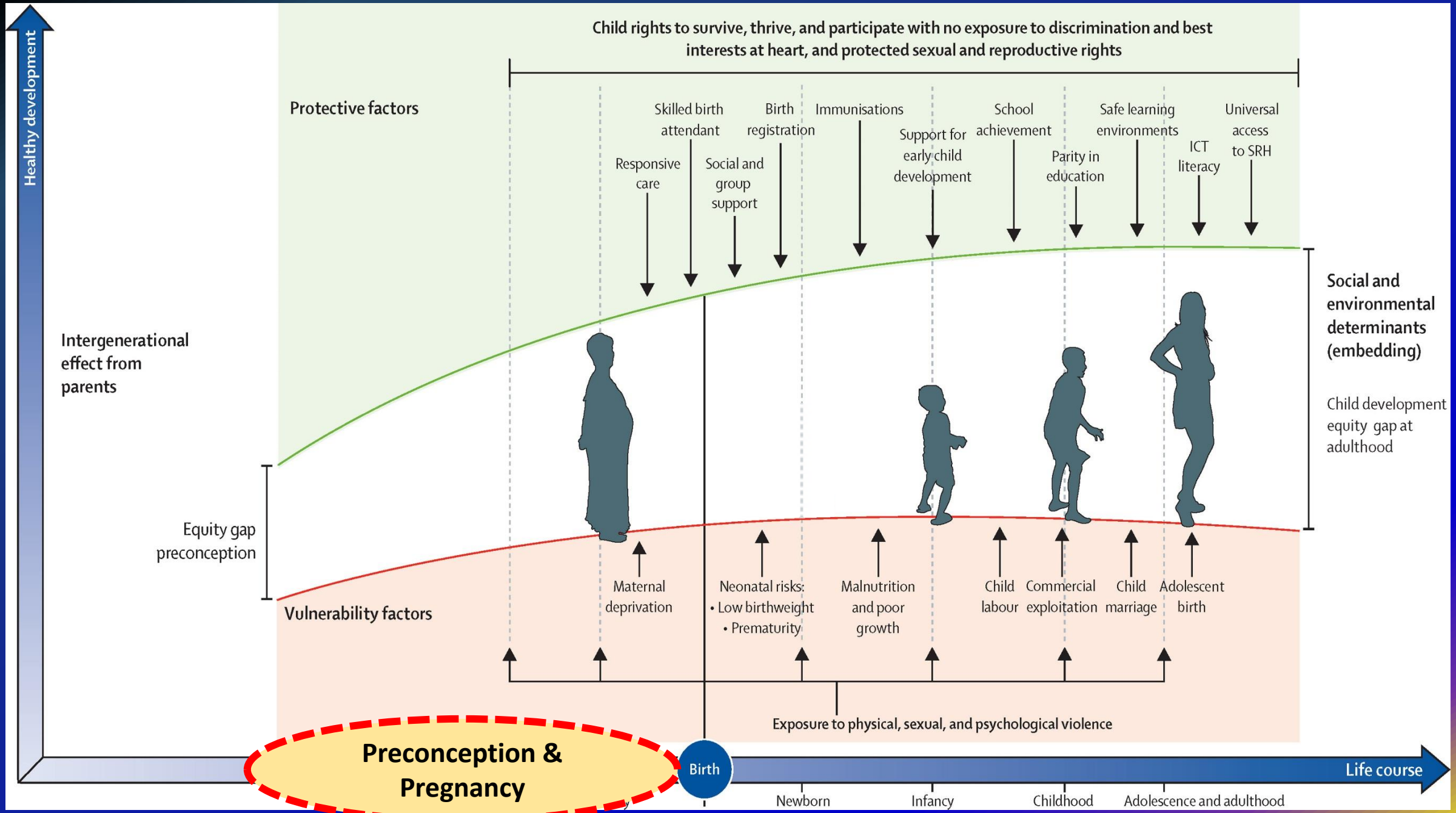
74.4%
parents unaware their children are too thin for height

42.6%
parents have tried to increase weight of their thin children

The Lancet Commissions

A future for the world's children? A WHO–UNICEF–*Lancet* Commission

Helen Clark, Awa Marie Coll-Seck*, Anshu Banerjee, Stefan Peterson, Sarah L Dalglish, Shanthi Ameratunga, Dina Balabanova, Maharaj Kishan Bhan†, Zulfiqar A Bhutta, John Borrazzo, Mariam Claeson, Tanya Doherty, Fadi El-Jardali, Asha S George, Angela Gichaga, Lu Gram, David B Hipgrave, Aku Kwamie, Qingyue Meng, Raúl Mercer, Sunita Narain, Jesca Nsungwa-Sabiiti, Adesola O Olumide, David Osrin, Timothy Powell-Jackson, Kumanan Rasanathan, Imran Rasul, Papaarangi Reid, Jennifer Requejo, Sarah S Rohde, Nigel Rollins, Magali Romedenne, Harshpal Singh Sachdev, Rana Saleh, Yusra R Shawar, Jeremy Shiffman, Jonathon Simon, Peter D Sly, Karin Stenberg, Mark Tomlinson, Rajani R Ved, Anthony Costello*



The Lancet 2020 395605-658DOI: (10.1016/S0140-6736(19)32540-1)

THE LANCET
Volume 334, Issue 8663, 9 September 1989, Pages 577-580

doi:10.1016/S0140-6736(89)90710-1 | How to Cite or Link Using DOI

WEIGHT AND DEATH FROM ISCHAEMIC HEART DISEASE

D. J. P. Barker, C. Osmond, P. D. Winter, B. Margetts and S. J. Simmonds

MRC Environmental Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton SO9 4XY, United Kingdom

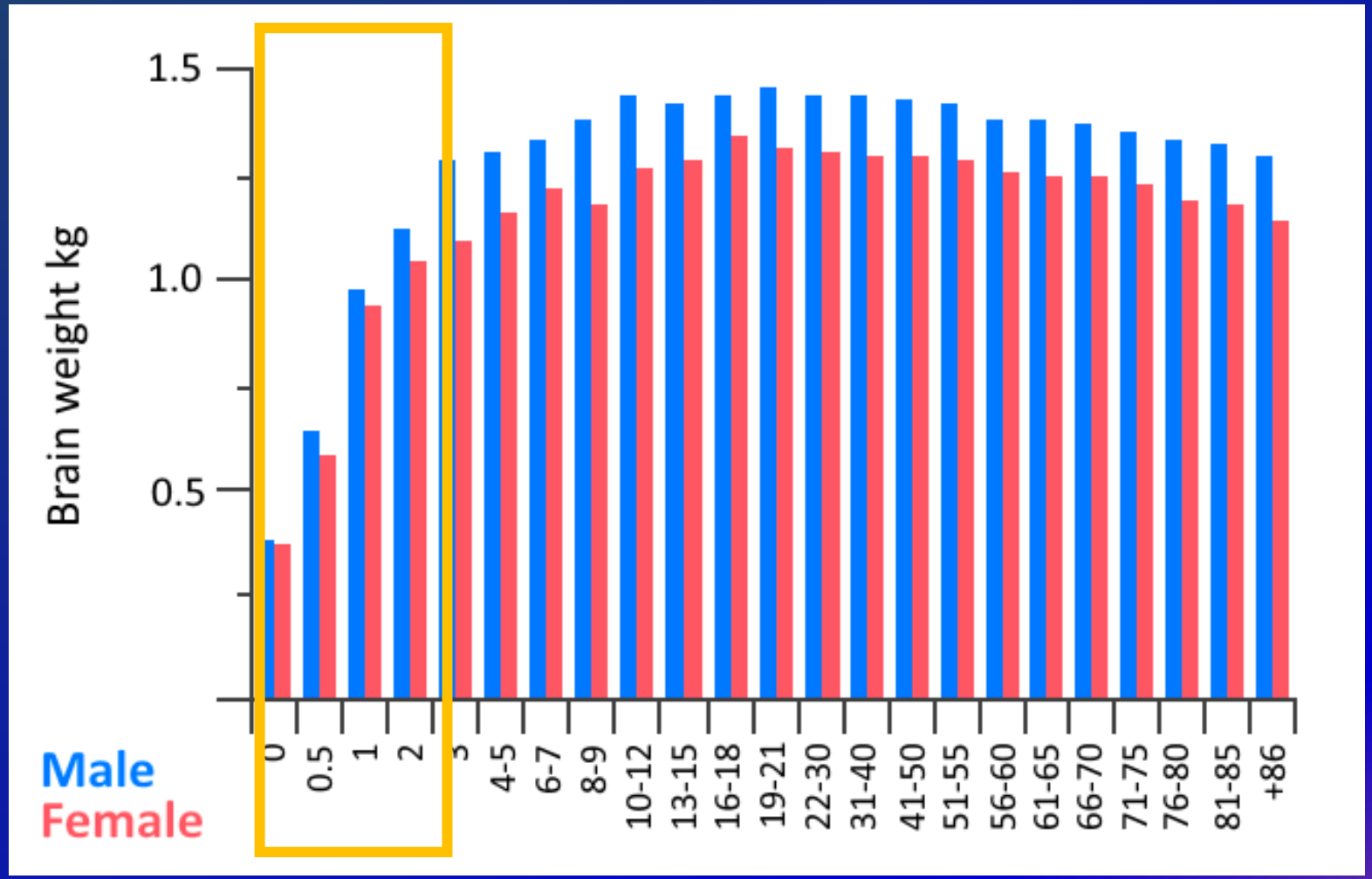
Available online 19 September 2003.

Abstract

Environmental influences that impair growth and development in early life may be risk factors for ischaemic heart disease. To test this hypothesis, 5654 men born during 1911-30 were traced. They were born in six districts of Hertfordshire, England, and their weights in infancy were recorded. 92·4% were breast fed. Men with the lowest weights at birth and at one year had the highest death rates from ischaemic heart disease. The standardised mortality ratios fell from 111 in men who weighed 18 pounds (8·2 kg) or less at one year to 42 in those who weighed 27 pounds (12·3 kg) or more. Measures that promote prenatal and postnatal growth may reduce deaths from ischaemic heart disease. Promotion of postnatal growth may be especially important in boys who weigh below 7·5 pounds (3·4 kg) at birth.

Dr. Barker's hypothesis leading to DOHAD

Brain development



nutrients

MDPI

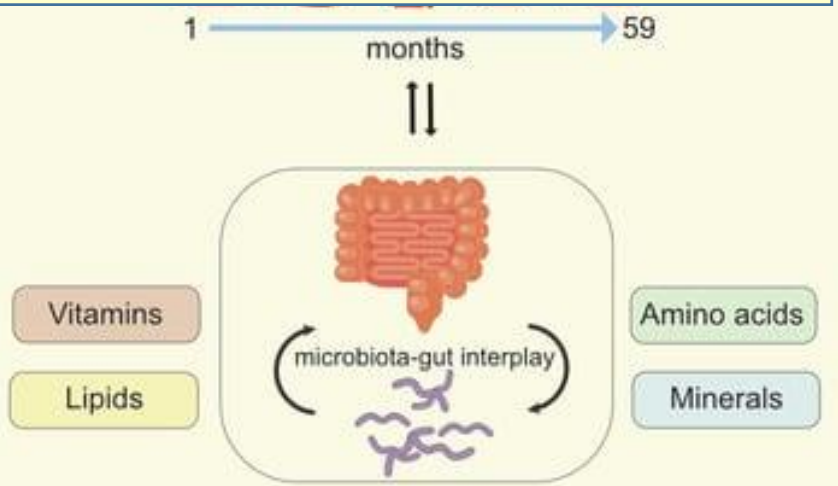
Review

Nutritional Support of Neurodevelopment and Cognitive Function –An Update and Novel Insights

Kathrin Cohen Kadosh [1], Leilani Muhardi [2], Panam Parikh [2], Melissa Basso [1,3], Hamid Jan Jan Mohamed [4], Titis Prawitasari [5,6], Folake Samuel [7], Guansheng Ma [8,9] and Jan M. W. Geurts [10,*]

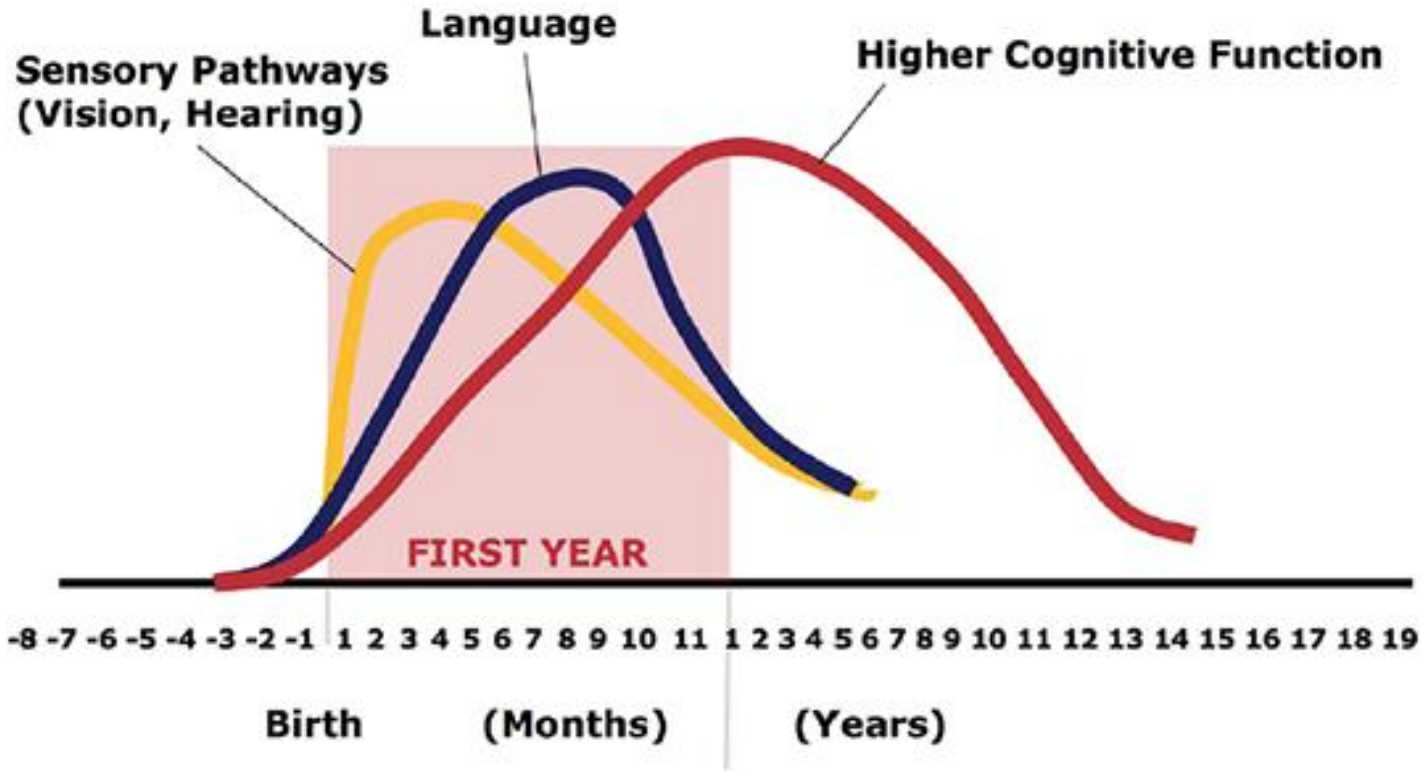
Nutrients **2021**, *13*, 199. https://doi.org/10.3390/nu13010199 https://www.mdpi.com/journal/nutrients

Brain and neurocognitive development

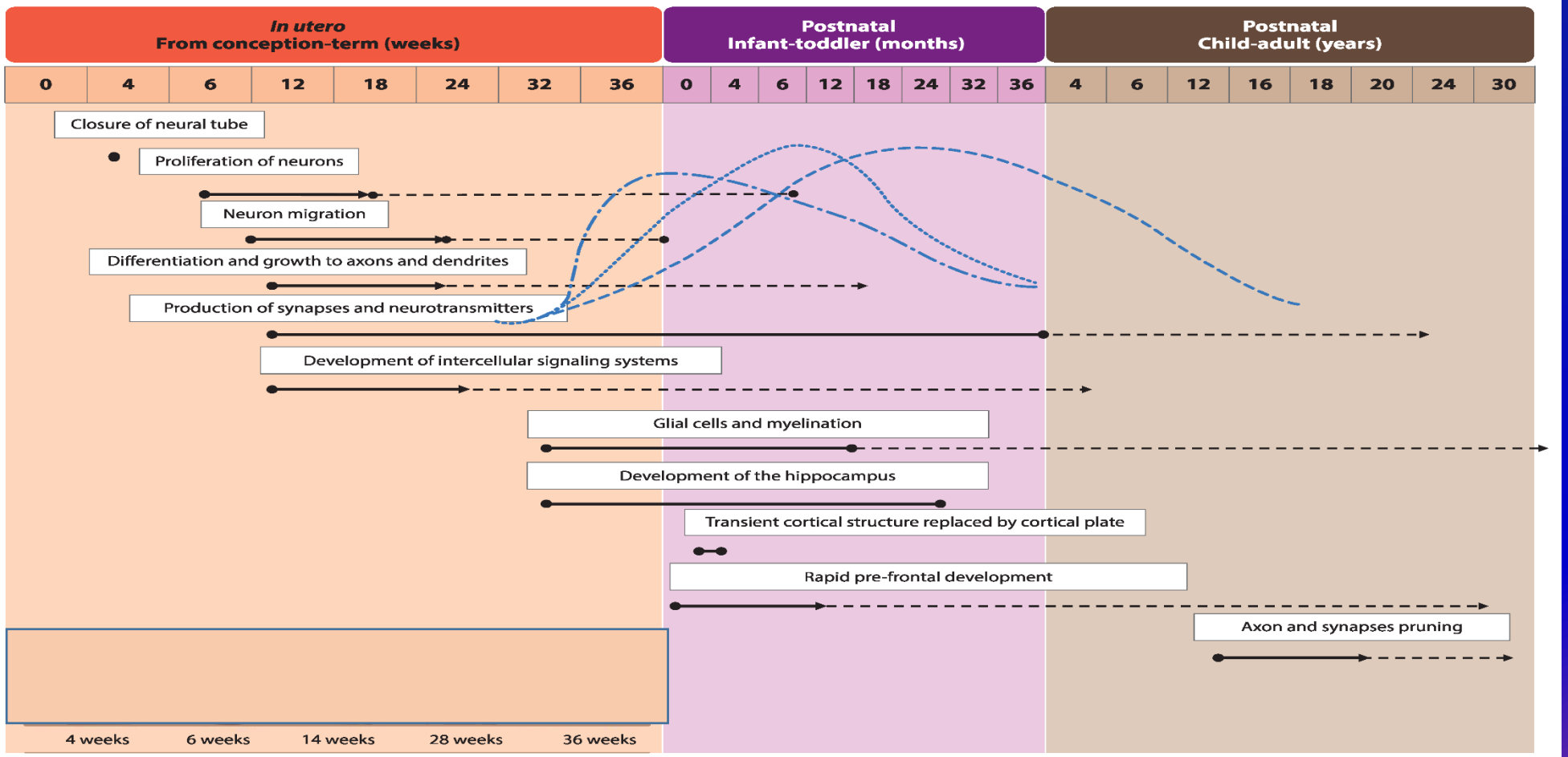


Human Brain Development

Neural Connections for Different Functions Develop Sequentially



Brain development time line



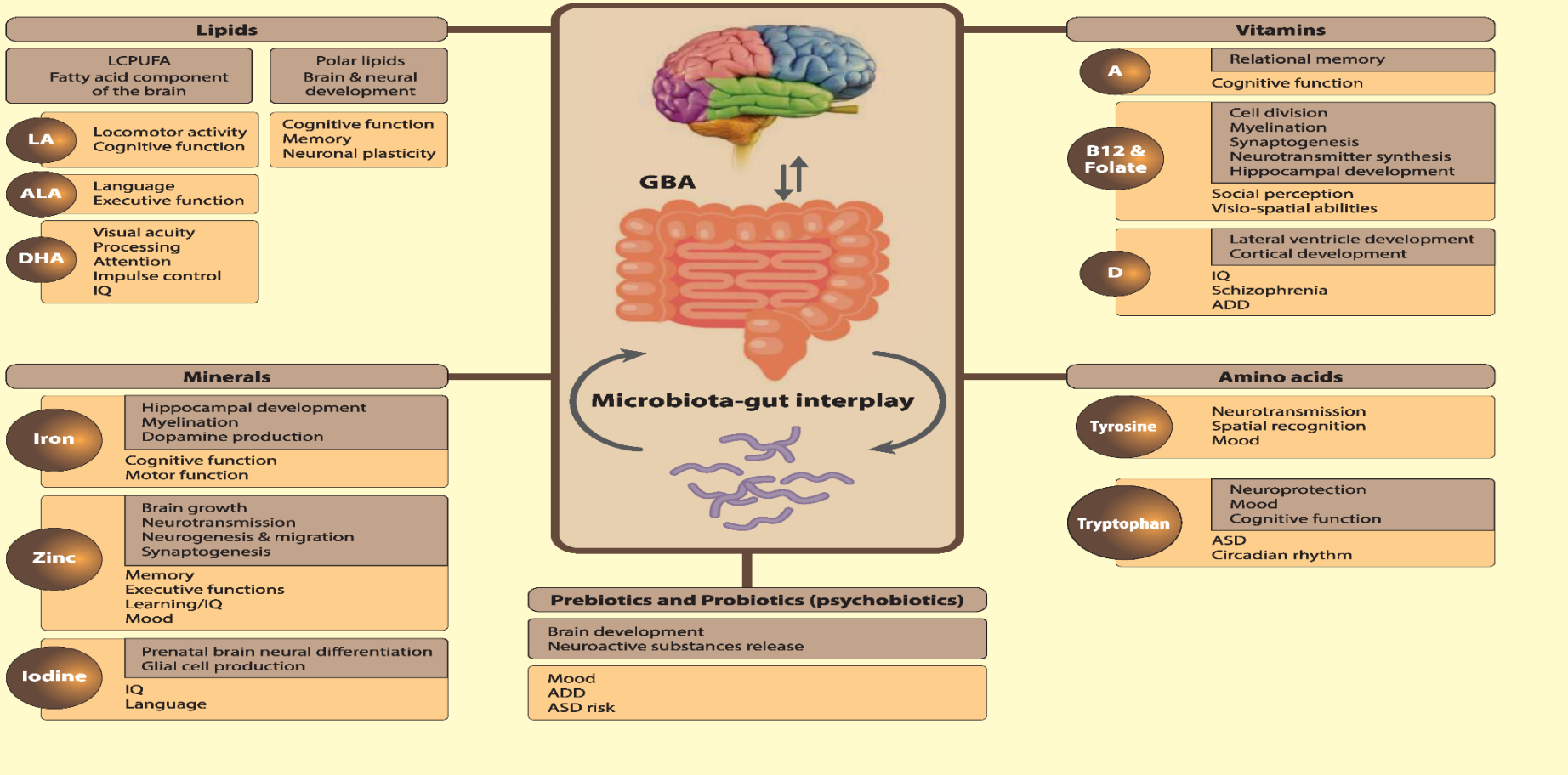
Depicts approximate timelines for experience-dependent synaptic development:

Visual and auditory cortex (seeing/hearing); Angular gyrus/Broca's area (language and speech);

Prefrontal cortex (higher cognitive functions)

Rapid development Prolonged development

Nutrients: Brain and neuronal development

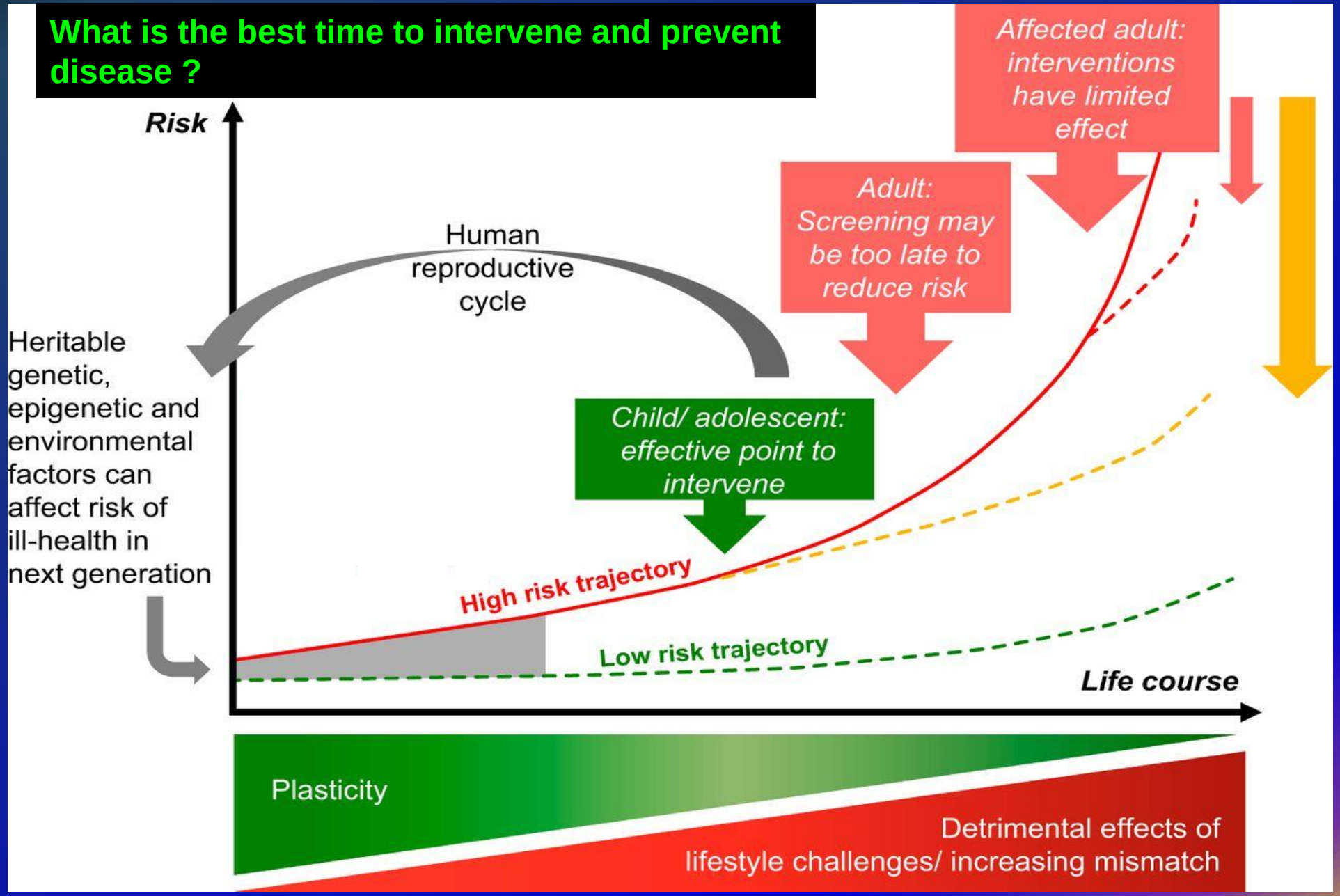


Roles in nervous system development

Affected domain if deficient

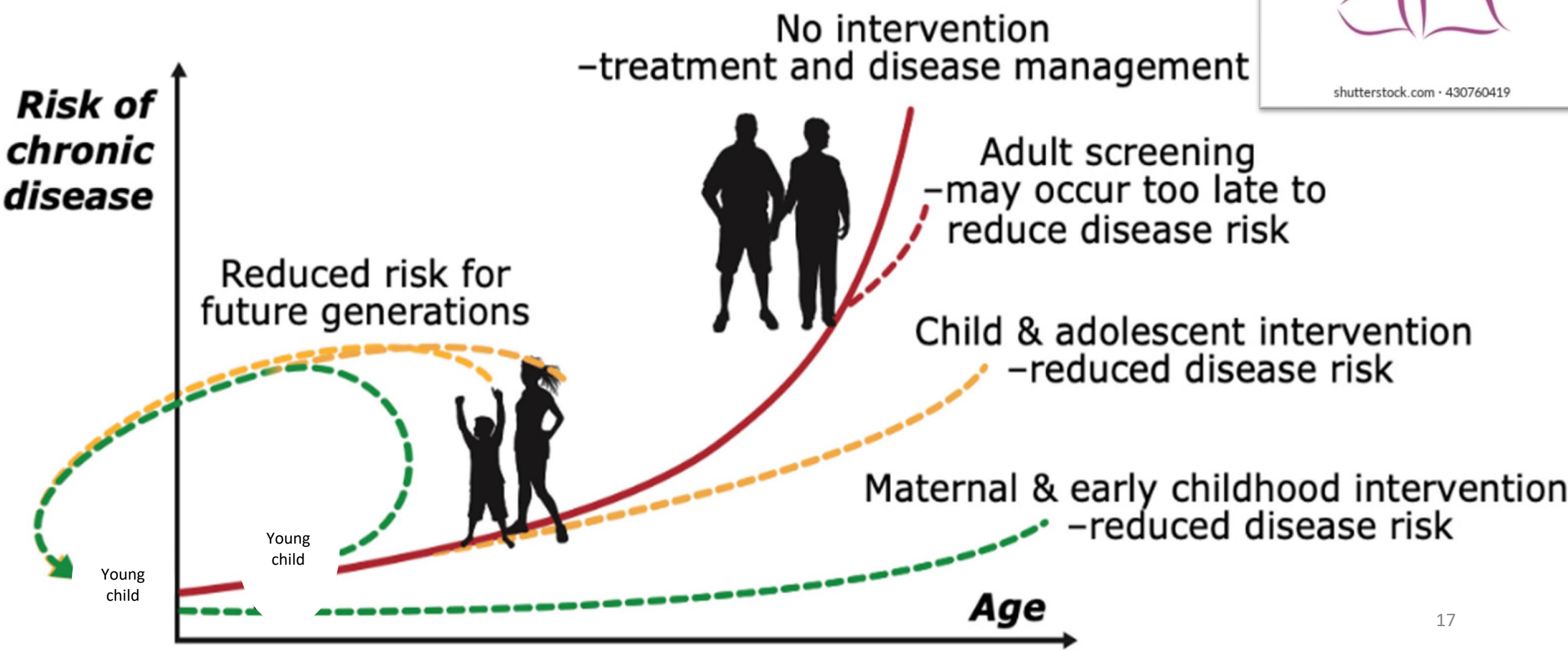
LCPUFA: long-chain polyunsaturated fatty acid; LA: linoleic acid; ALA: alpha-linolenic acid; DHA: docosahexanoic acid; IQ: intelligence quotient; ASD: autism spectrum disorder; ADD: attention deficit disorder; GBA: Gut-Brain Axis

What is the best time to intervene and prevent disease ?



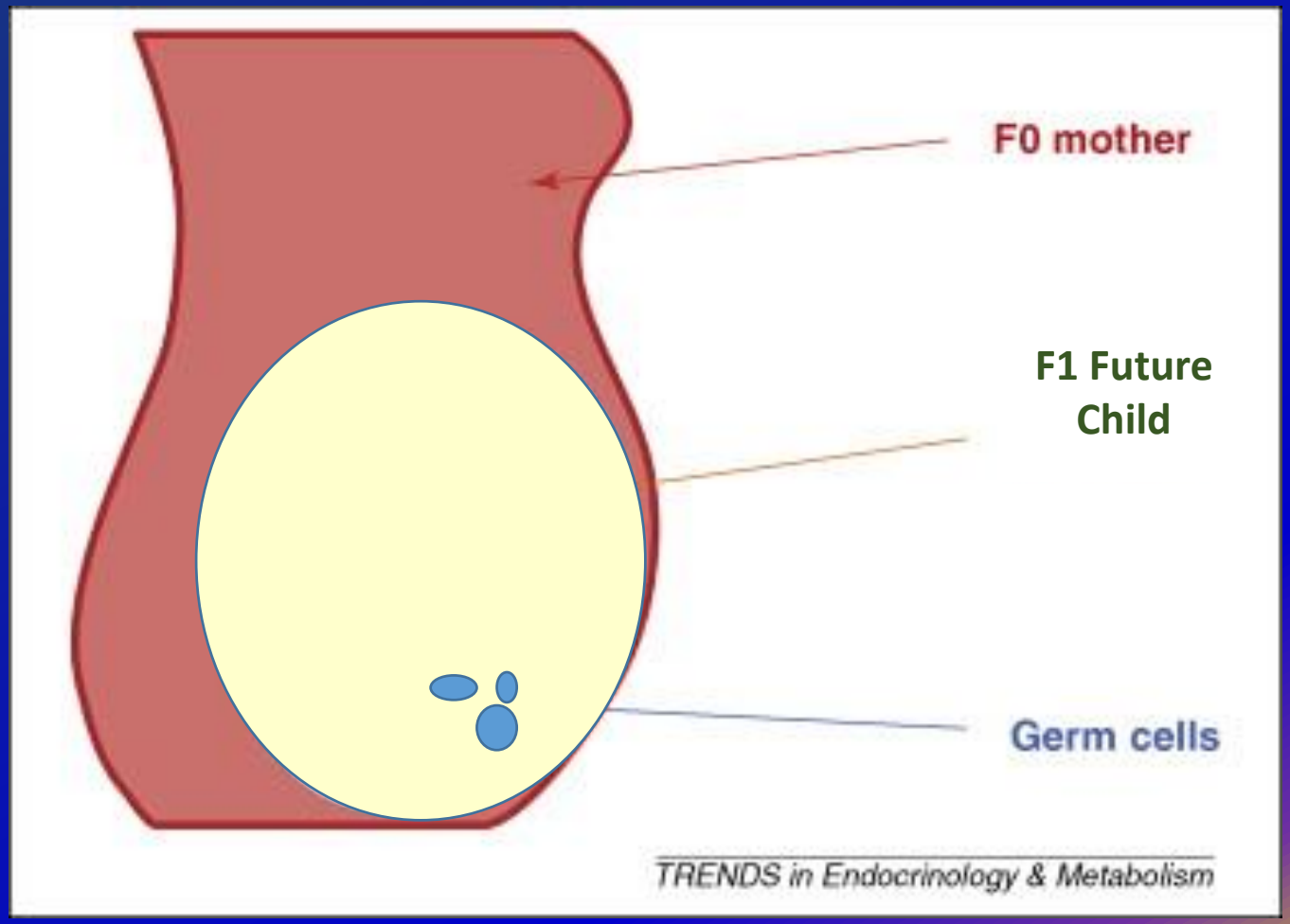
M. A. Hanson , P. D. Gluckman, 2014

The Power of Early Intervention



Multigenerational exposure to an environmental effect.

An environmental insult during pregnancy to a mother (F0 generation) might affect not only the future child (F1 generation) but also the germ cells which will go on to form the F2 generation.

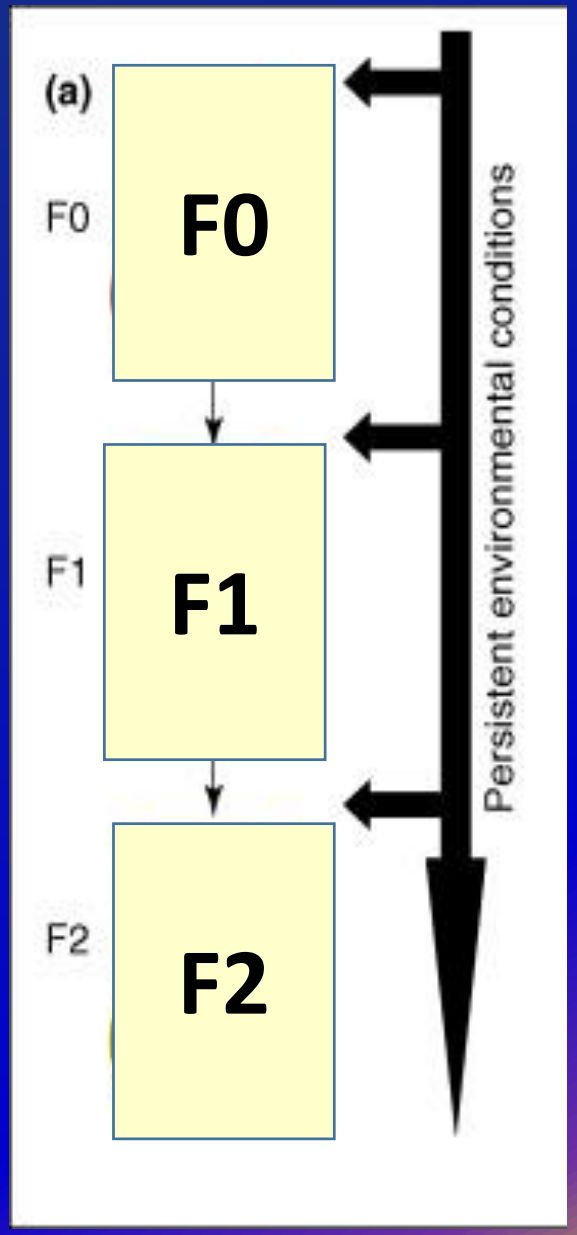


Amanda J. Drake, Lincoln Liu,
Intergenerational transmission of programmed effects: public health consequences,
Trends in Endocrinology & Metabolism, Volume 21, Issue 4, 2010,

Mechanisms for the intergenerational transmission of programming effects.

(a) Persistence of an adverse external environment can result in the reproduction of the phenotype in multiple generations.

(b) The induction of programmed effects in the F1 results in programmed effects on the developing future child (F2) and **so on.**



National Health & Morbidity Survey 2022- Adolescent

03

OVERWEIGHT/OBESE, EATING HABITS & PHYSICAL ACTIVITY AMONG ADOLESCENTS

1 in 3 is *overweight/obese*

4 in 5 are *physically inactive*

2 in 3 are being *sedentary*

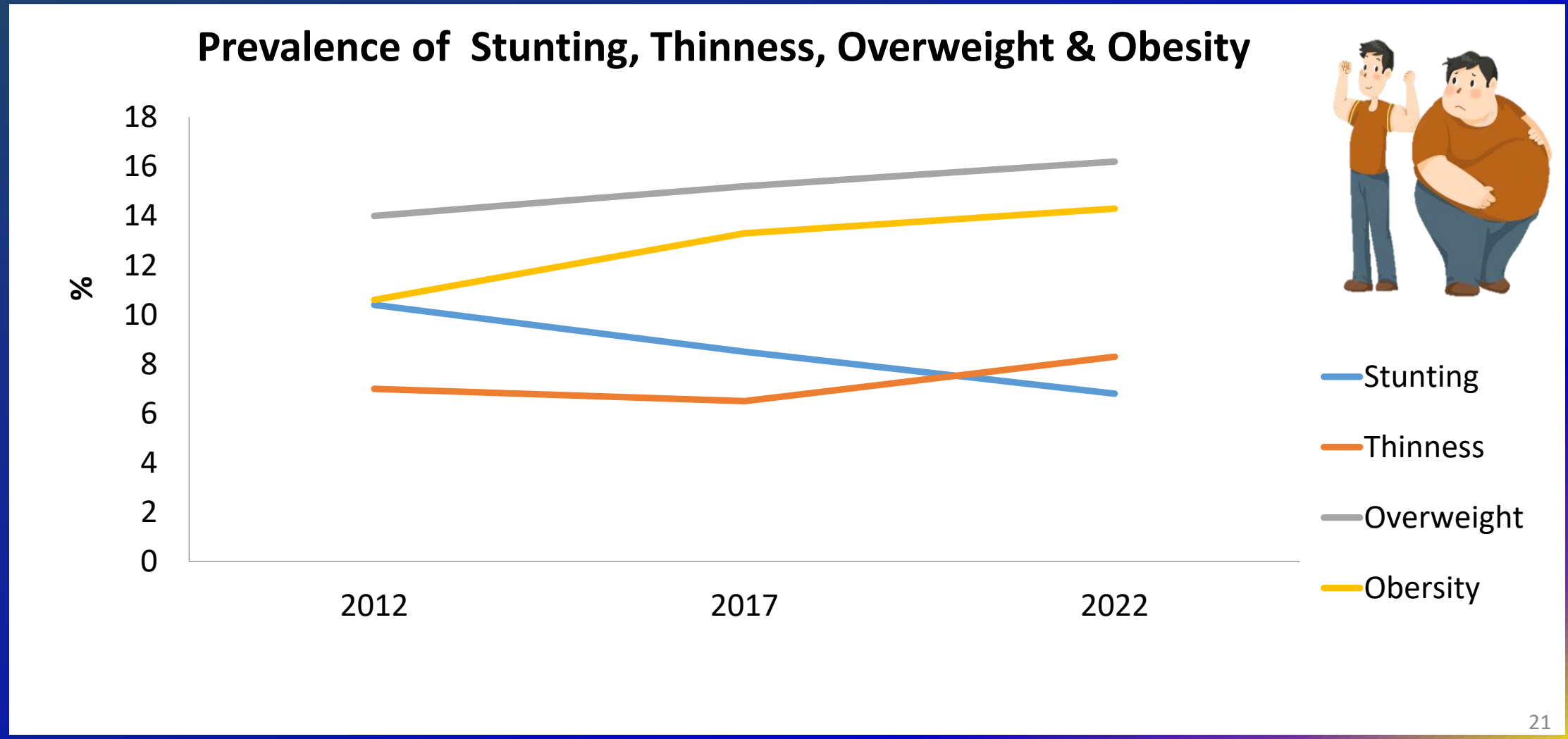
4 in 5 do not eat enough *fruits & vegetables*

1 in 3 drinks *carbonated soft drink everyday*

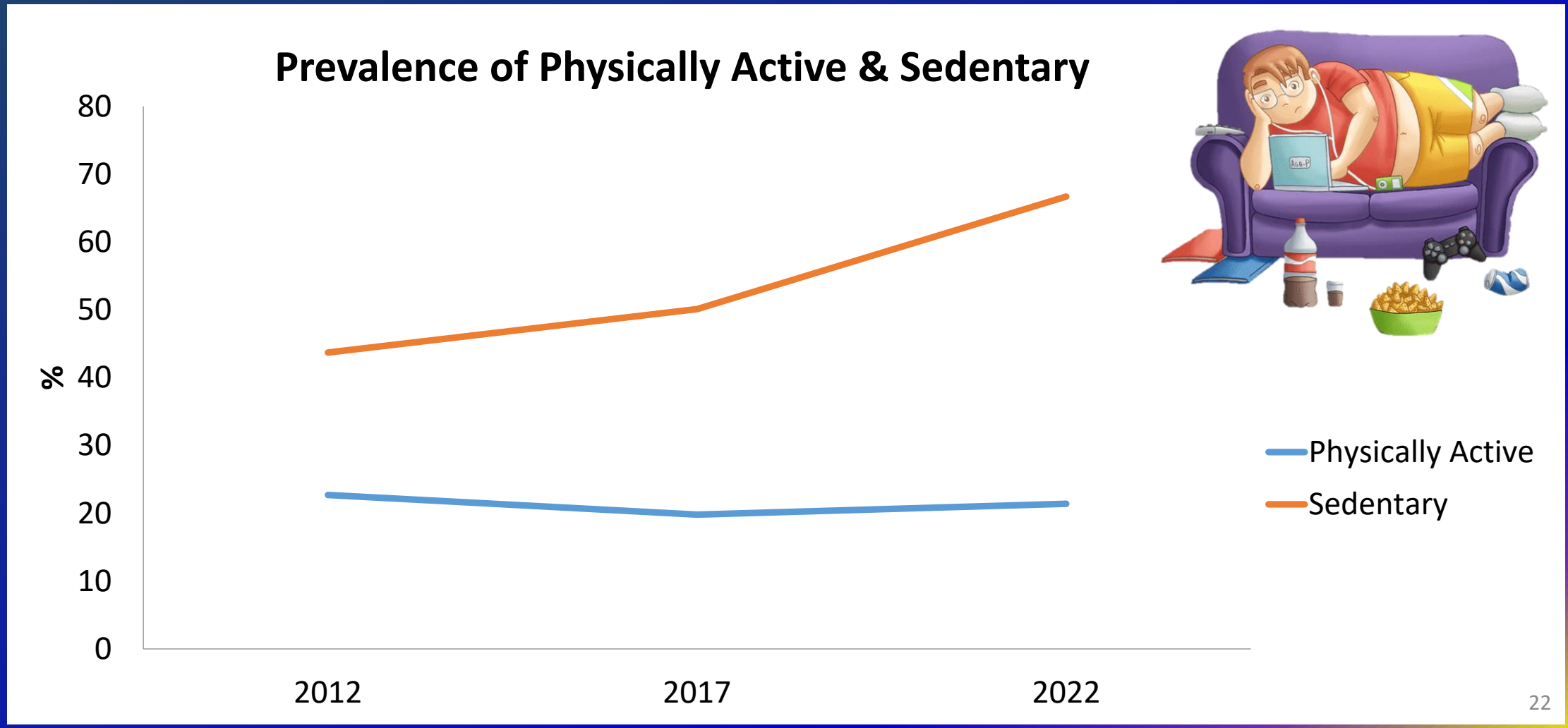
1 in 10 eats *fast food at least 3 days in a week*

"Eat healthily and exercise regularly to prevent overweight/obesity"

Increasing rate of overweight and obesity



Increasing trend of sedentariness



National Health & Morbidity Survey
2022- Adolescent

06 A GROWING CONCERN ON SUICIDAL AMONG ADOLESCENTS

1 in 8 had suicidal thought

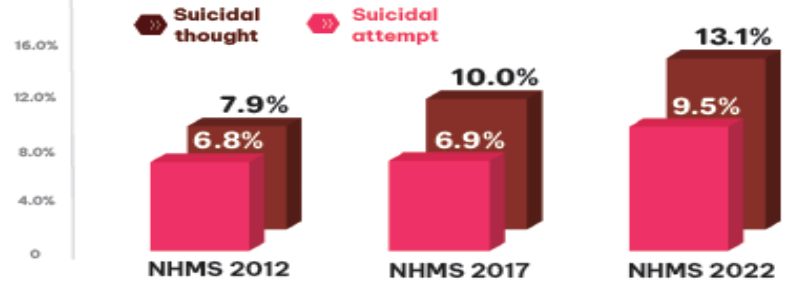
1 in 10 had attempted suicide

More girls than boys

18.5% Had suicidal thought

7.6%

A decade trend in Malaysia



13.4% Had suicidal attempt

5.7%

Are they okay?

(Based on PHQ-9 Scoring)

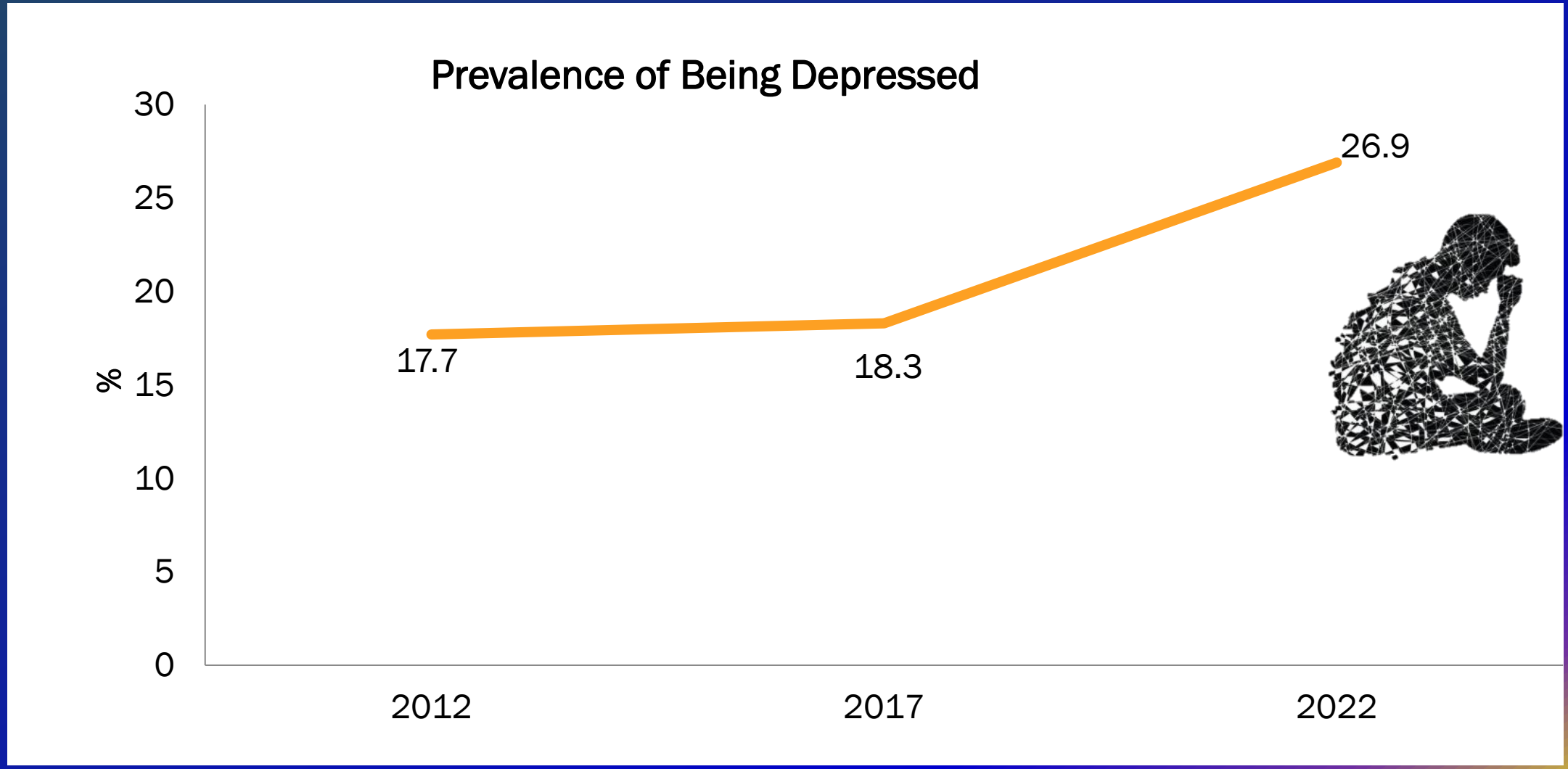
1 in 4 felt **depressed**

Twice as many girls as boys felt depressed

36.1%

17.7%

Depression on the rise!



Norris *et al. BMC Public Health* 2014, **14**(Suppl 2):S6
http://www.biomedcentral.com/1471-2458/14/S2/S6

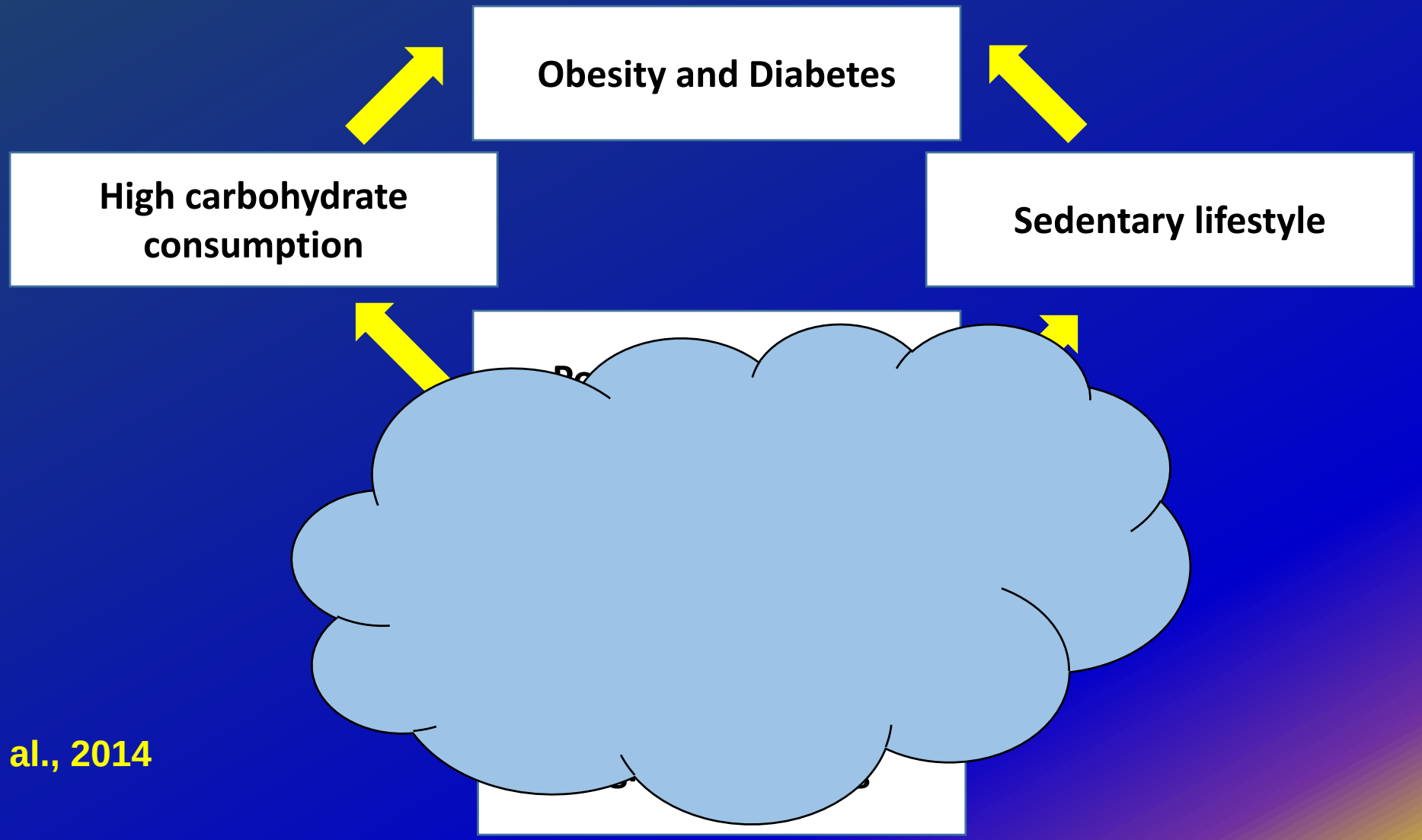
BMC Public Health

RESEARCH Open Access

The life and health challenges of young Malaysian couples: results from a stakeholder consensus and engagement study to support non-communicable disease prevention

SA Norris[1*], H Anuar[2], P Matzen[3], JCH Cheah[4], BB Jensen[5], M Hanson[6]

Stressful life, obesity & diabetes



SA Norris et al., 2014

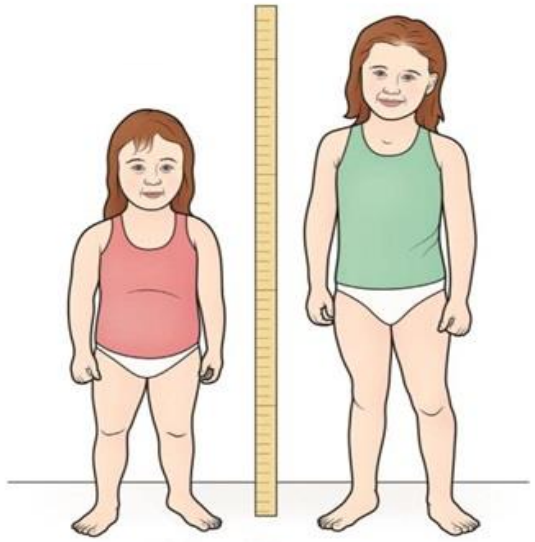
OPEN ACCESS

Pakistan Journal of Nutrition

ISSN 1680-5194

DOI: 10.3923/pjn.2019.455-463

$$BMI = \frac{\text{weight (kg)}}{\text{height (m}^2\text{)}}$$



Research Article

Stunted Children Has Higher Risk of Overweight: A Study on Children Aged 6-12 Years in Eight Provinces in Indonesia

Ghaida Yasmin, Lilik Kustiyah and Cesilia Meti Dwiriani

Department of Community Nutrition, Faculty of Human Ecology, Bogor Agricultural University, Jalan Raya Dramaga, Bogor 16680, Indonesia

Did we learn from research published in year 1996?

Community and International Nutrition

Stunting is Associated with Overweight in Children of Four Nations That Are Undergoing the Nutrition Transition[1]

*BARRY M. POPKIN,[2] MARIE K. RICHARDS AND CARLOS A. MONTIERO**

*Department of Nutrition, School of Public Health, and Carolina Population Center, University of North Carolina at Chapel Hill, Chapel Hill, NC 27516–3997 and *Center for Epidemiological Studies in Health and Nutrition, Department of Nutrition, School of Public Health, University of São Paulo, São Paulo, Brazil*

0022-3166/96 $3.00
Manuscript received 26 February 1996. Initial review completed 7 April 1996. Revision accepted 21 August 1996.

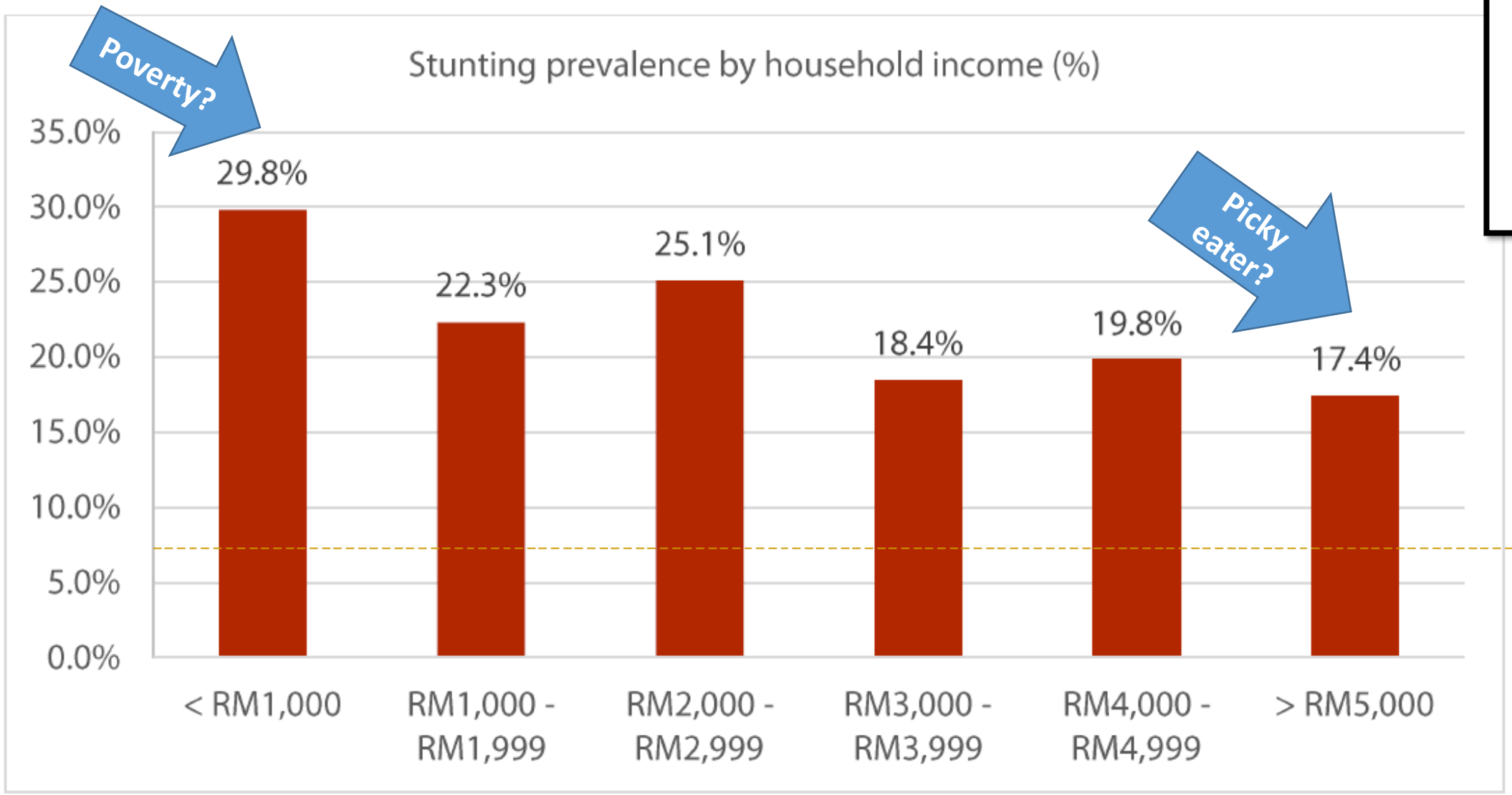
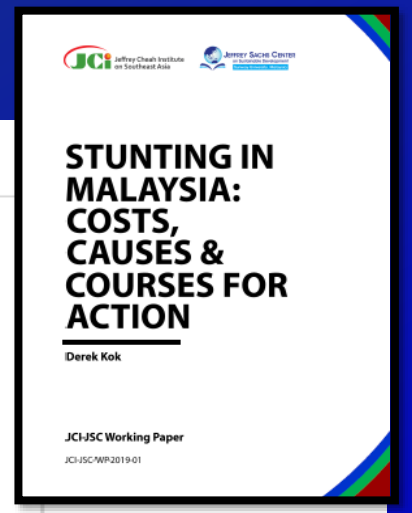


Figure 4: Stunting prevalence by household income in Malaysia (NHMS 2016)



Economics and Human Biology 21 (2016) 172–195

Contents lists available at ScienceDirect

Economics and Human Biology

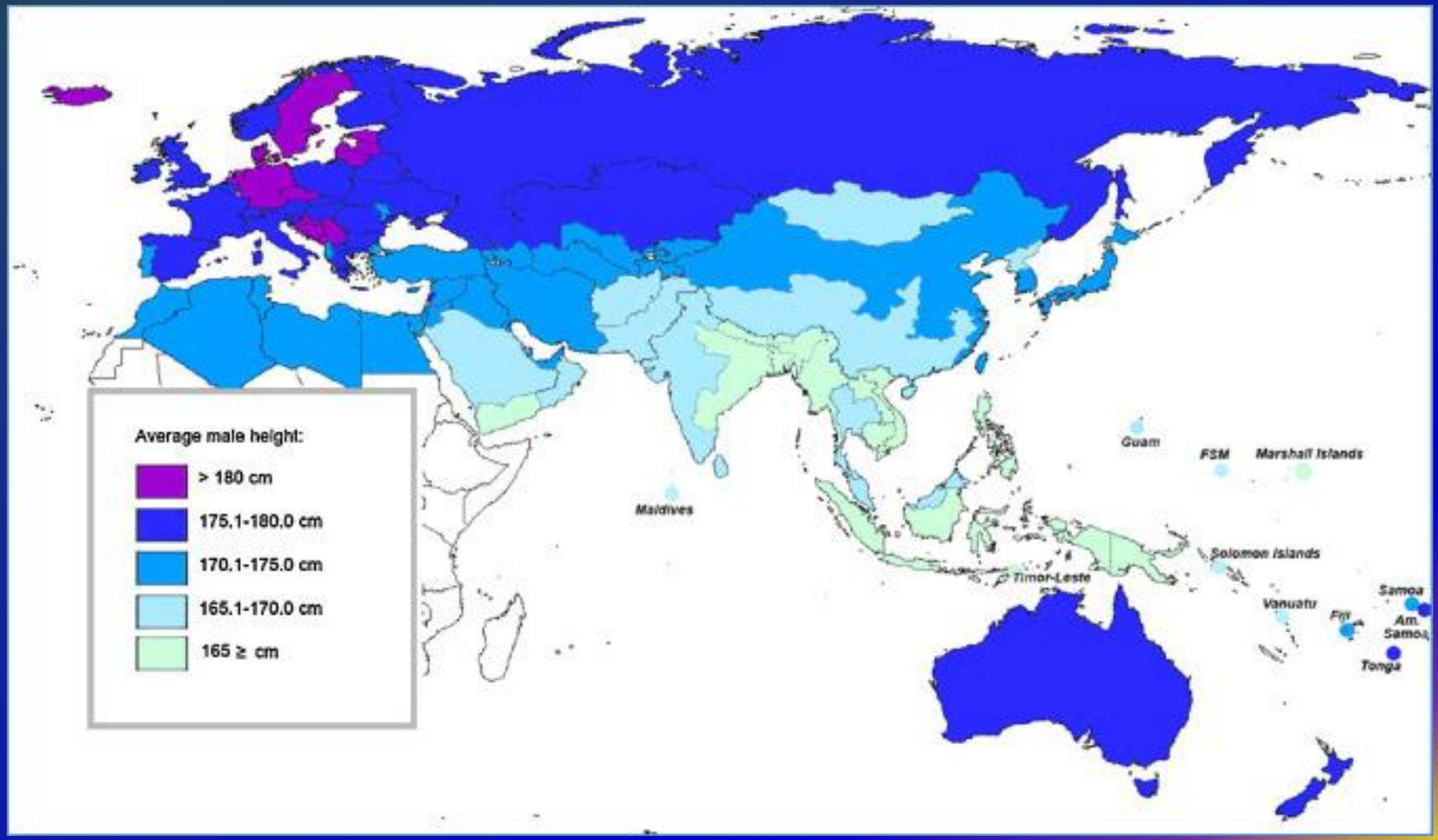
journal homepage: http://www.elsevier.com/locate/ehb

Major correlates of male height: A study of 105 countries

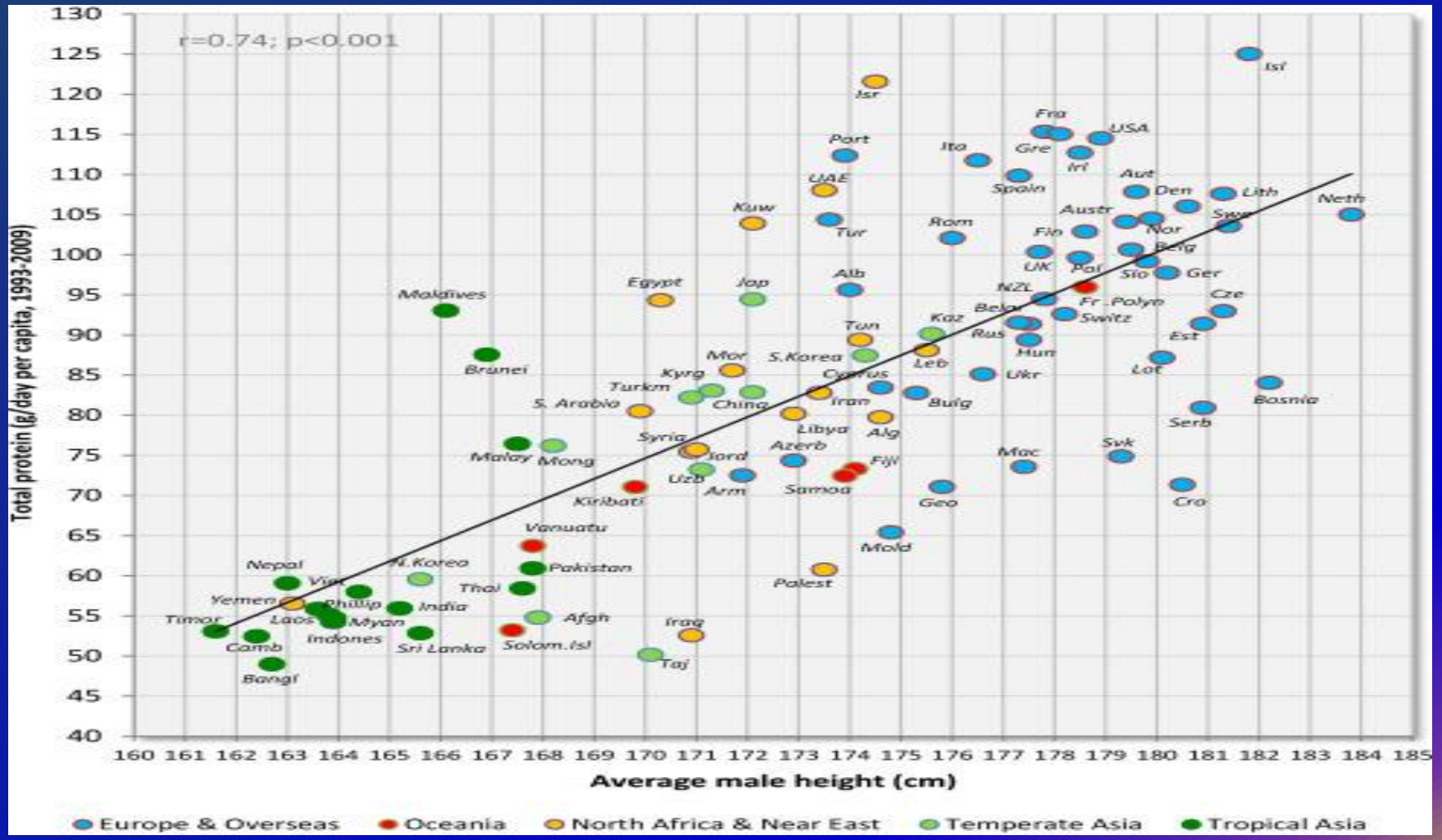
P. Grasgruber *, M. Sebera, E. Hrazdíra, J. Cacek, T. Kalina

Faculty of Sports Studies, Masaryk University, Kamenice 5, 625 00 Brno, Czech Republic

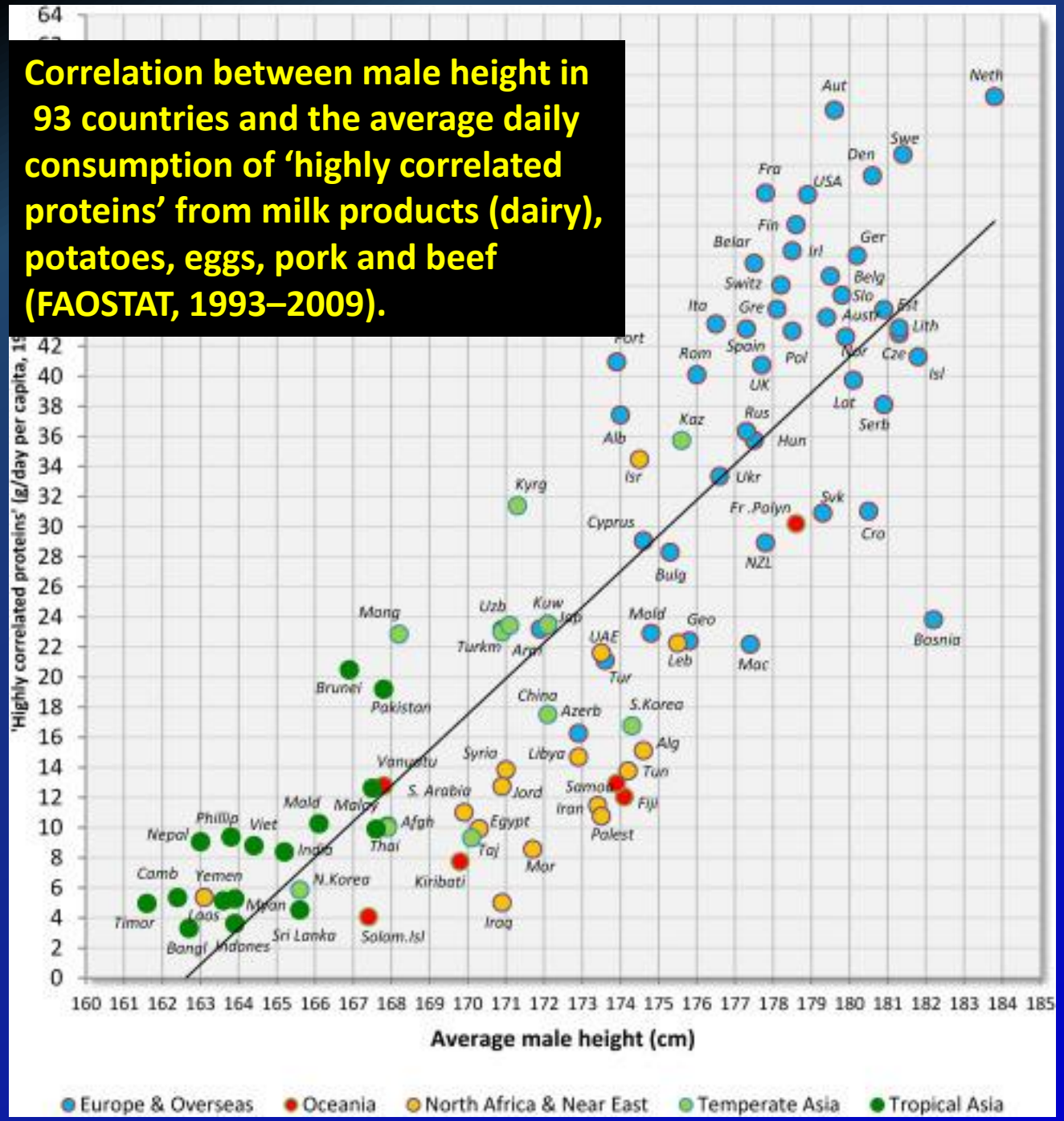
Distribution of male height in the examined areas



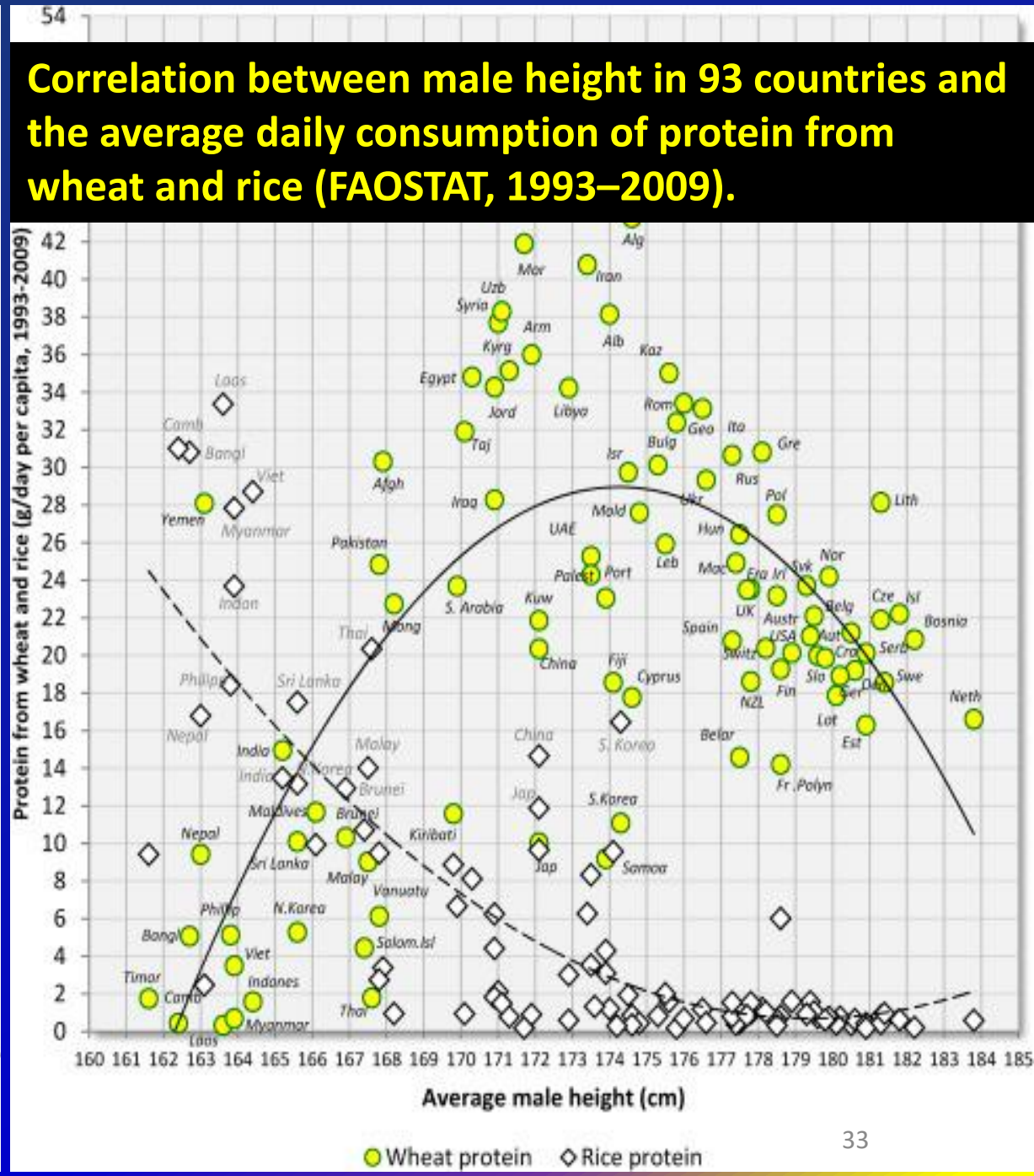
Correlation between male height in 93 countries and the average daily consumption of total protein (FAOSTAT, 1993–2009).



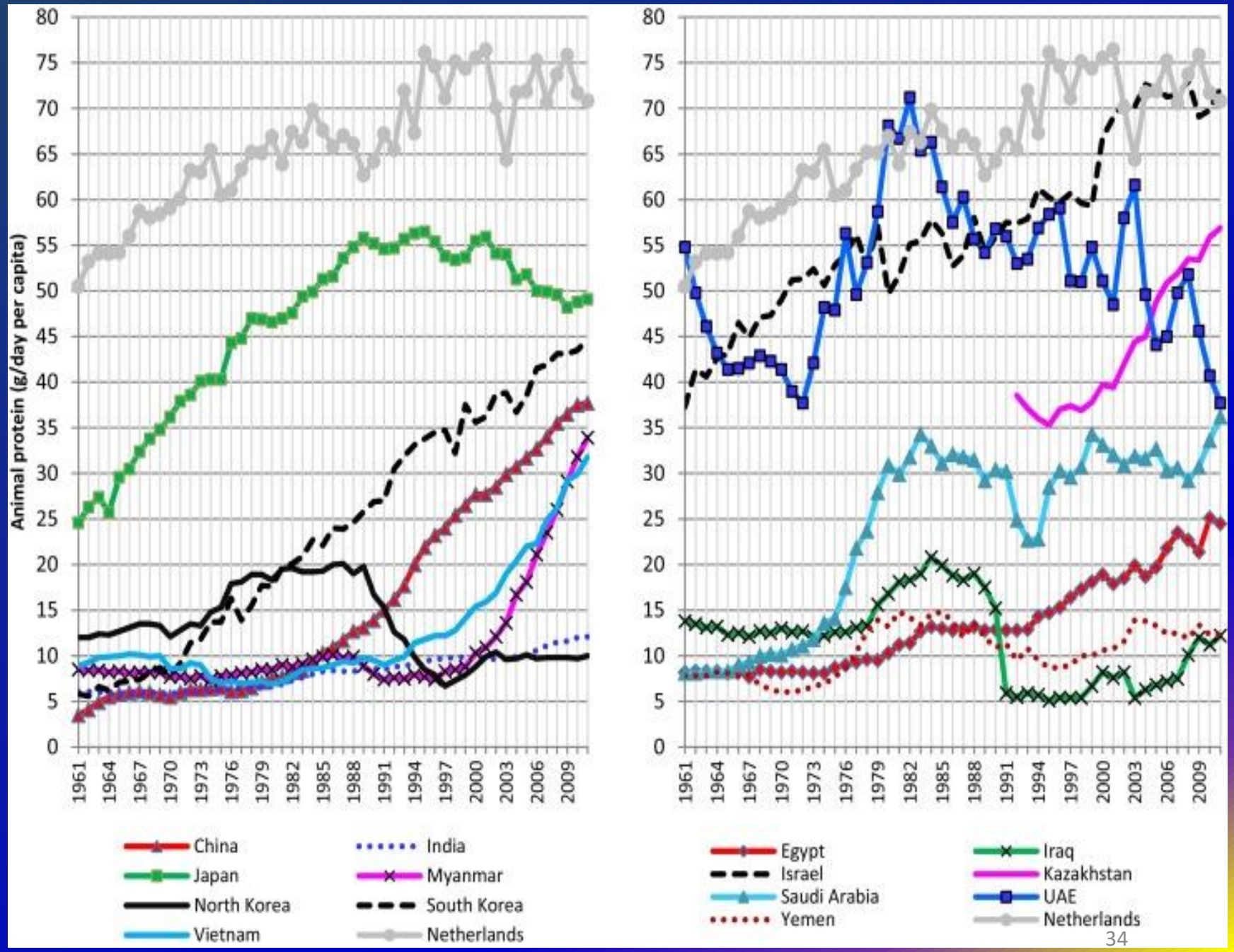
Correlation between male height in 93 countries and the average daily consumption of 'highly correlated proteins' from milk products (dairy), potatoes, eggs, pork and beef (FAOSTAT, 1993–2009).



Correlation between male height in 93 countries and the average daily consumption of protein from wheat and rice (FAOSTAT, 1993–2009).



Trends in the consumption of animal protein in 14 countries between 1961 and 2011, compared with the Netherlands.
Source: **FAOSTAT,**



3 nutrition styles

1. The first nutritional style (in tropical Asia) is based **on rice and is also characterized by a very low consumption of protein and energy**. It is accompanied by very small statures between 162 and 168 cm.

2. The second one (in the Muslim countries of North Africa and the Near East) is based on **wheat and the consumption of plant protein** reaches the highest values in the world. The intake of total protein and total energy is relatively high as well and comparable with Europe, but the average height of young males is still rather short and does not exceed 174 cm.

3. The third one is based on **animal proteins (particularly those from dairy)** and is typical of Northern/Central Europe. This region is characterized by the tallest statures in the world (>180 cm), being matched only by the inhabitants of the Western Balkans, in which we can presume extraordinary genetic predispositions

ELSEVIER

Advances in Nutrition

Volume 10, Supplement 2, May 2019, Pages S88-S96

Effects of Dairy Product Consumption on Height and Bone Mineral Content in Children: A Systematic Review of Controlled Trials

Carmela de Lamas [1 2 3 4 5], María José de Castro [4 5 6], Mercedes Gil-Campos [2 3], Ángel Gil [3 7 8], María Luz Couce [1 4 5 6], Rosaura Leis [1 3 4 5]

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American Journal of
Biomedical Science & Research

www.biomedgrid.com
ISSN: 2642-1747

Research Article

Secular Changes in Relative Height of Children in Japan, South Korea and Taiwan: Is "Genetics" the Key Determinant?

Hiroshi Mori*

Professor Emeritus, Senshu University, Chiyoda-ku, Tokyo, Japan

***Corresponding author:** Hiroshi Mori, Professor Emeritus, Senshu University, Chiyoda-ku, Tokyo, Japan, **Email:** the0033@isc.senshu-u.ac.jp

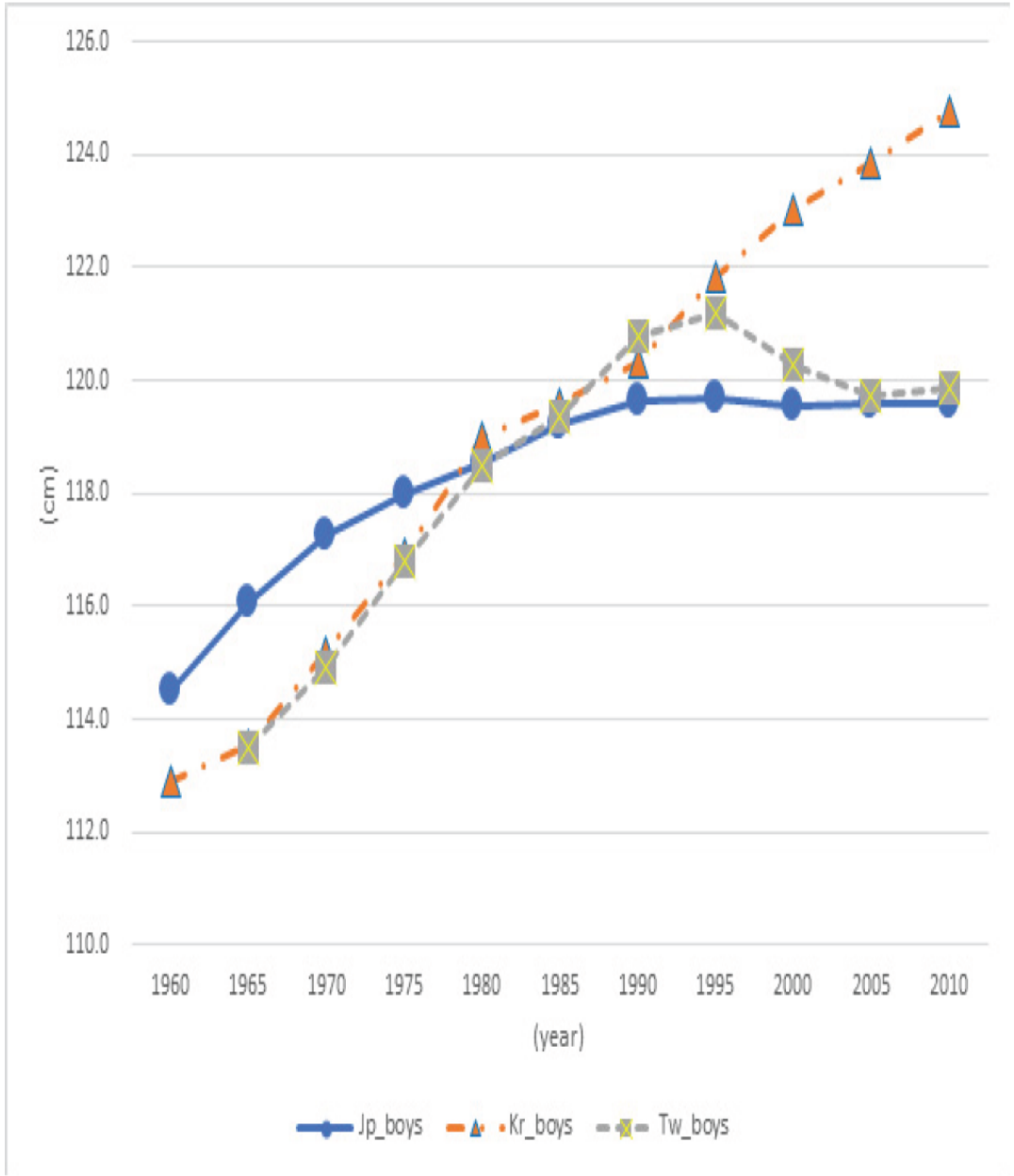


Figure 3: Changes in average height of schoolboys at 1st -2nd grades in elementary school to 2nd -3rd grades in high school in Japanese S. Korea.

EBioMedicine 6 (2016) 246–252

Contents lists available at ScienceDirect

EBioMedicine

journal homepage: www.ebiomedicine.com

Research Paper

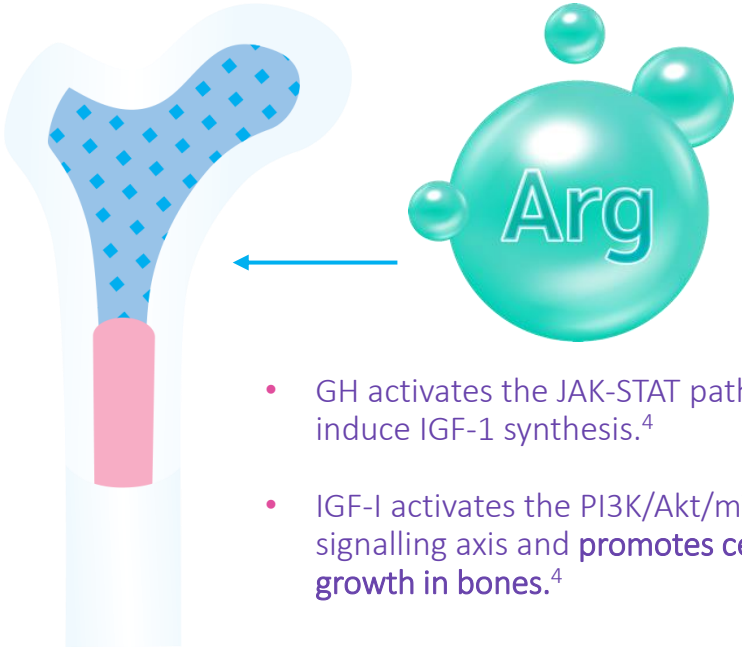
Child Stunting is Associated with Low Circulating Essential Amino Acids

Richard D. Semba [a,*], Michelle Shardell [b], Fayrouz A. Sakr Ashour [c], Ruin Moaddel [b], Indi Trehan [d,e], Kenneth M. Maleta [e], M. Isabel Ordiz [d], Klaus Kraemer [f,g], Mohammed A. Khadeer [b], Luigi Ferrucci [b], Mark J. Manary [d,e]

[a] Wilmer Eye Institute, Johns Hopkins University School of Medicine, Baltimore, MD, USA
[b] National Institute on Aging, National Institutes of Health, Baltimore, MD, USA
[c] Department of Nutrition & Food Science, College of Agriculture and Natural Resources, University of Maryland, College Park, MD, USA
[d] Department of Pediatrics, Washington University in St. Louis, St. Louis, MO, USA
[e] School of Public Health and Family Medicine, University of Malawi College of Medicine, Blantyre, Malawi
[f] Sight and Life, Basel, Switzerland
[g] Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

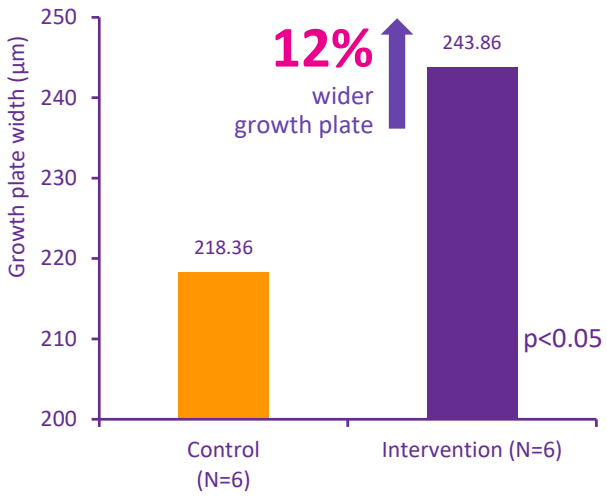
Amino acids are essential for linear growth[1]

- Protein intake has a **dose-dependent physiological role in the linear growth** of healthy children.[1] Stunted children were observed to have significantly **lower serum concentrations of conditionally essential amino acids (e.g. arginine, glycine and glutamine)** and non-essential amino acids when compared with non-stunted children.[2,3]
  - Arginine, in particular, has been associated with the **increased secretion of GH and IGF-I.**[4]



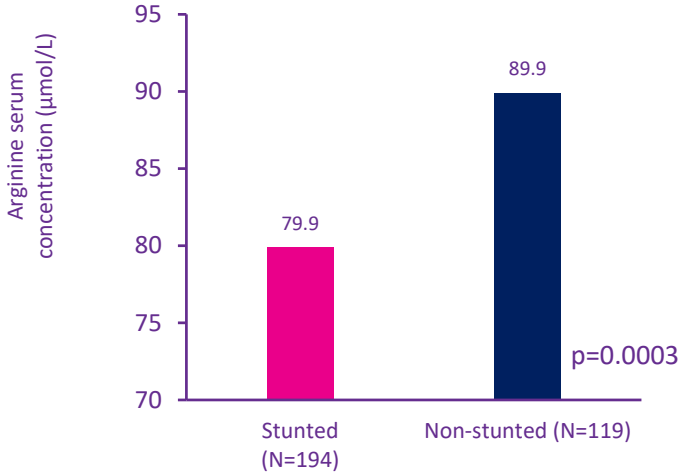
- GH activates the JAK-STAT pathway to induce IGF-1 synthesis.[4]
- IGF-I activates the PI3K/Akt/mTOR signalling axis and **promotes cellular growth in bones.**[4]

Arginine increases width of growth plate in the rat tibia*,[5]



Adapted from Jiang MU, and Cai DP. 2011[4]

Serum arginine levels are lower in stunted children[2,3]



Adapted from Semba RD, et al. 2016 (suppl)[3]

*Rats in the control group received saline (10 mL/kg/day) for 28 days; Rats in the intervention group received arginine dissolved in water (0.045 g L-arginine was mixed with 1 mL water) (10 mL/kg/day) for 28 days

Akt, protein kinase B; **GH**, growth hormone; **IGF-I**, insulin-like growth factor I; **JAK-STAT**, Janus kinase-signal transducer and activator of transcription; **mTOR**, mammalian target of rapamycin;

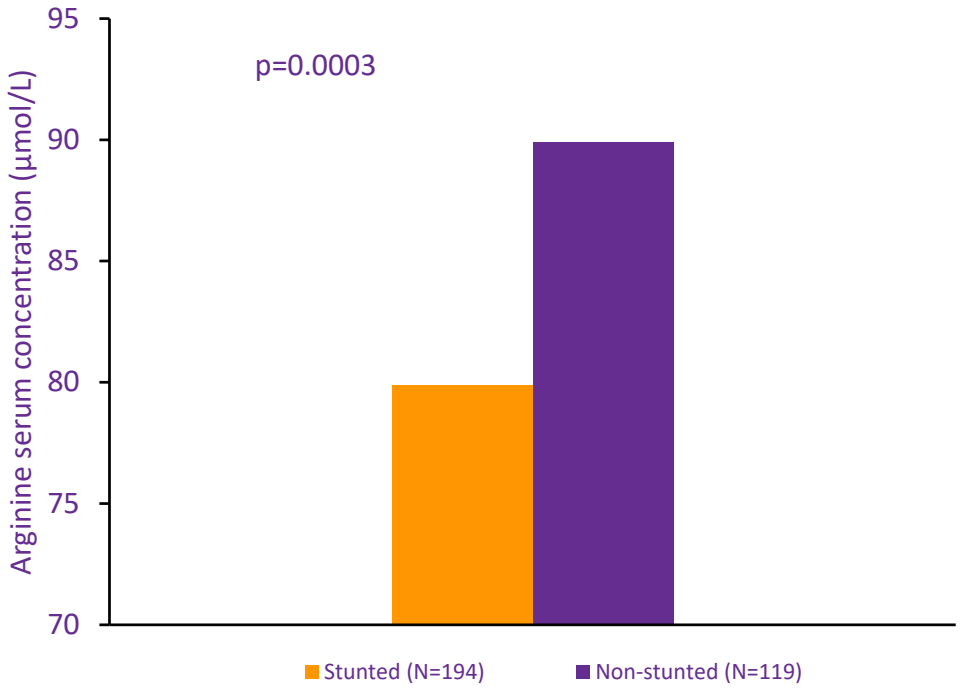
PI3K, phosphatidylinositol 3-kinase

1. van Vught AJAH, et al. *Br J Nutr* 2013;109:1031-1039. 2. Semba RD, et al. *EBioMedicine* 2016;6:246-252. 3. Semba RD, et al. *EBioMedicine* 2016;6(suppl):246-252. 4. Oh HS, et al. *Food Sci Biotechnol* 2017;26(6):1749–1754. 5. Jiang MU and Cai DP. *Neurosci Bull* 2011;27:156-162.

Arginine promotes growth in children

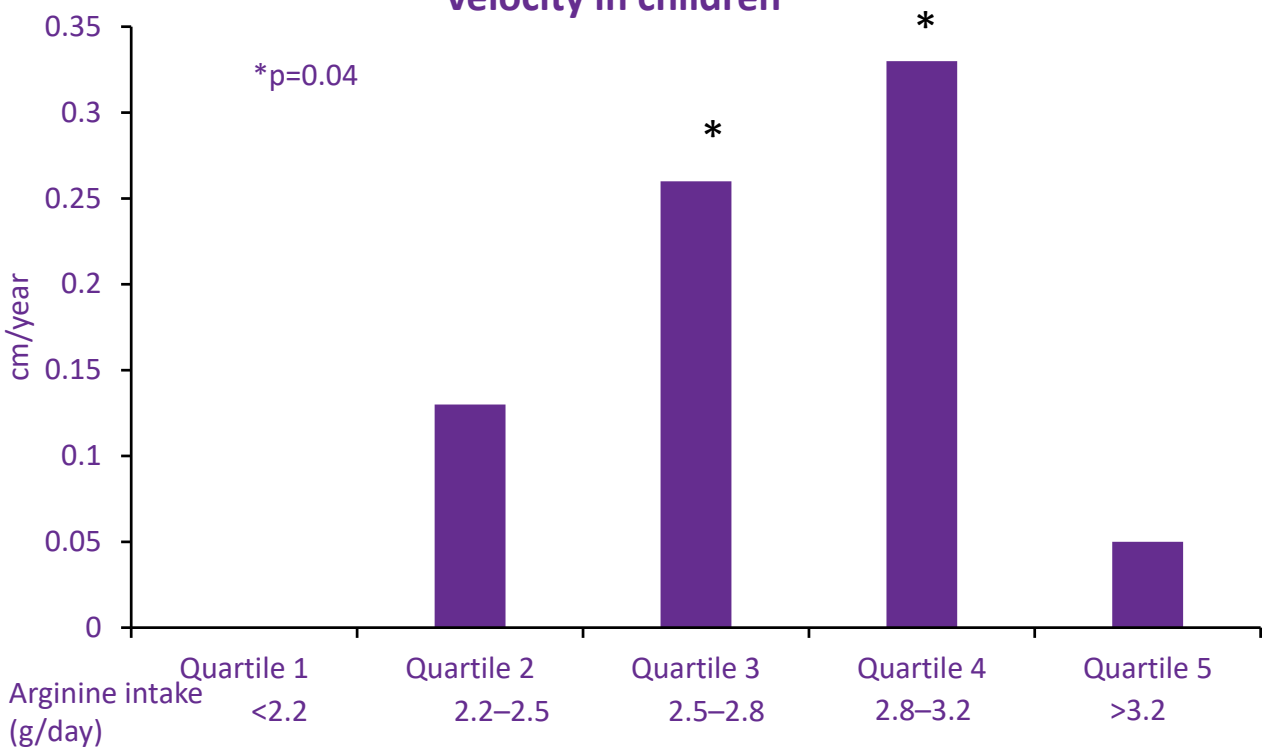
- Children† with an arginine intake between 2.8 and 3.2 g/day grew 0.33 cm/year faster compared with those whose arginine intake was <2.2 g/day.[26]

Serum arginine level are lower in stunted children[27]



Adapted from Semba RD, et al. *EBioMedicine* 2016

Arginine consumption was associated with increased growth velocity in children[26]

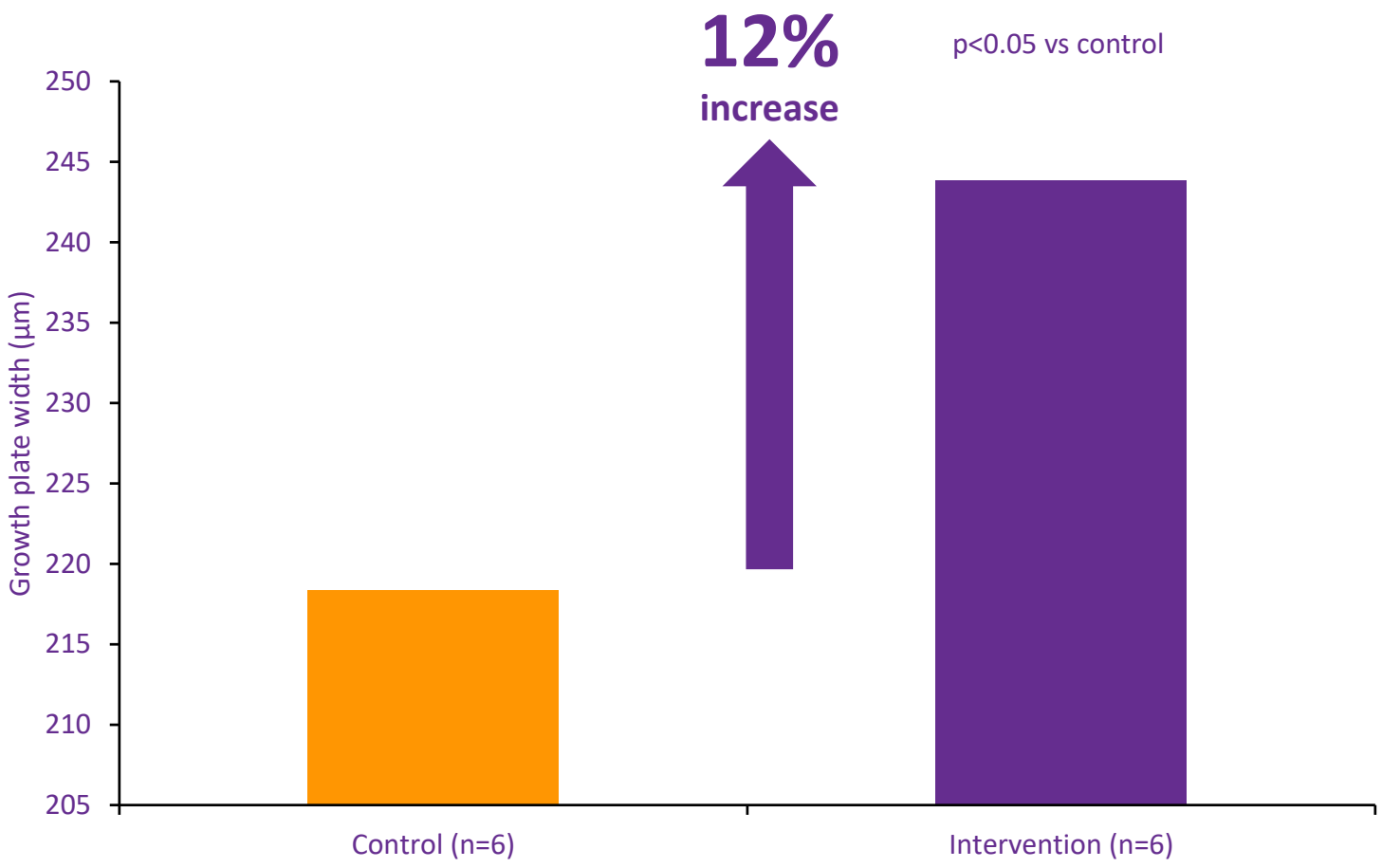


Adapted from van Vught AJAH, et al. *Br J Nutr* 2013

†Data collected from the Copenhagen School Child Intervention (n=261, age 7-13 years) – association between arginine intake and growth velocity was evaluated (adjusted for sex, age, baseline height, energy intake and puberty stage) at the 7-year follow-up.

26. van Vught AJAH, et al. *Br J Nutr* 2013;109:1031-1039. **27**. Semba RD, et al. *EBioMedicine* 2016;6(Suppl):246-252.

Arginine increases width of growth plate in the tibia[28]



Adapted from Jiang MU, and Cai DP. *Neurosci Bull* 2011

- Oral arginine supplement may promote linear growth of long bones through the induction of growth hormone secretion.[28]
- When orally administered in pubertal rats, arginine significantly increased serum growth hormone concentration versus the control group (p=0.015).[28]

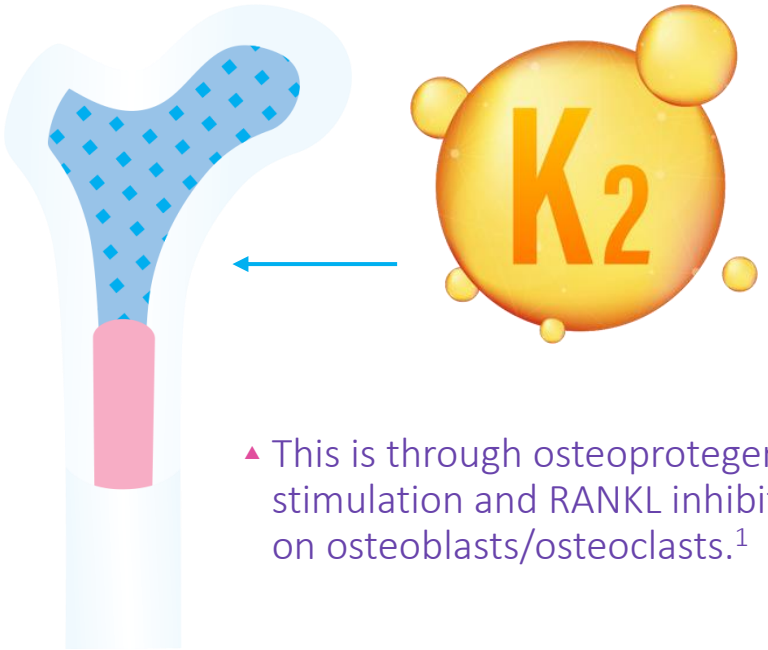
*Rats in the control group received saline (10 mL/kg/day) for 28 days; Rats in the intervention group received arginine dissolved in water (0.045 g L-arginine was mixed with 1 mL water) (10 mL/kg/day) for 28 days.

28. Jiang MU and Cai DP. *Neurosci Bull* 2011;27:156-162.

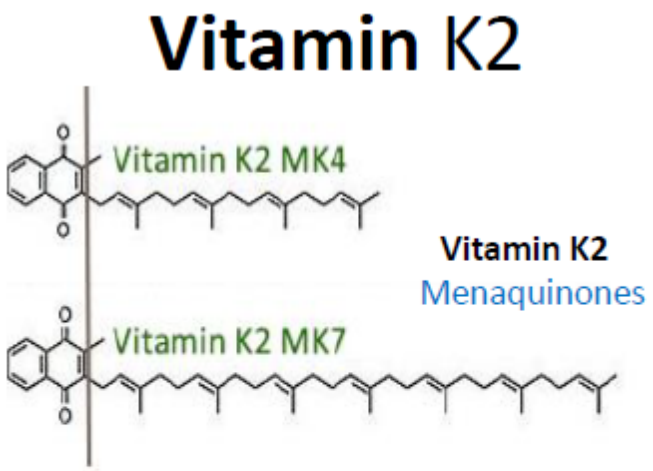
Nutrients that contribute to growth promotion

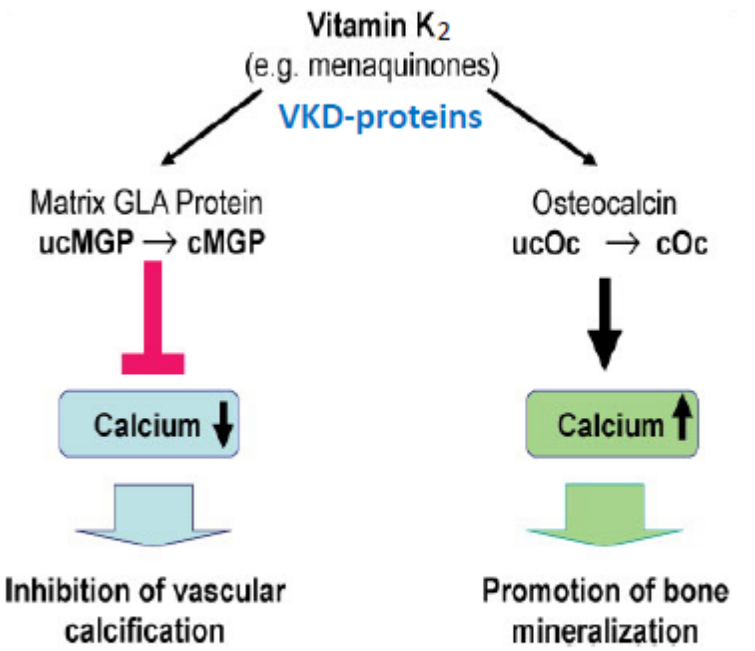
- Other nutrients, such as vitamins, also play a role in **promoting growth**.

  - Vitamin K2, for example, **supports bone formation and suppresses bone resorption.**[1]



  - This is through osteoprotegerin stimulation and RANKL inhibition on osteoblasts/osteoclasts.[1]





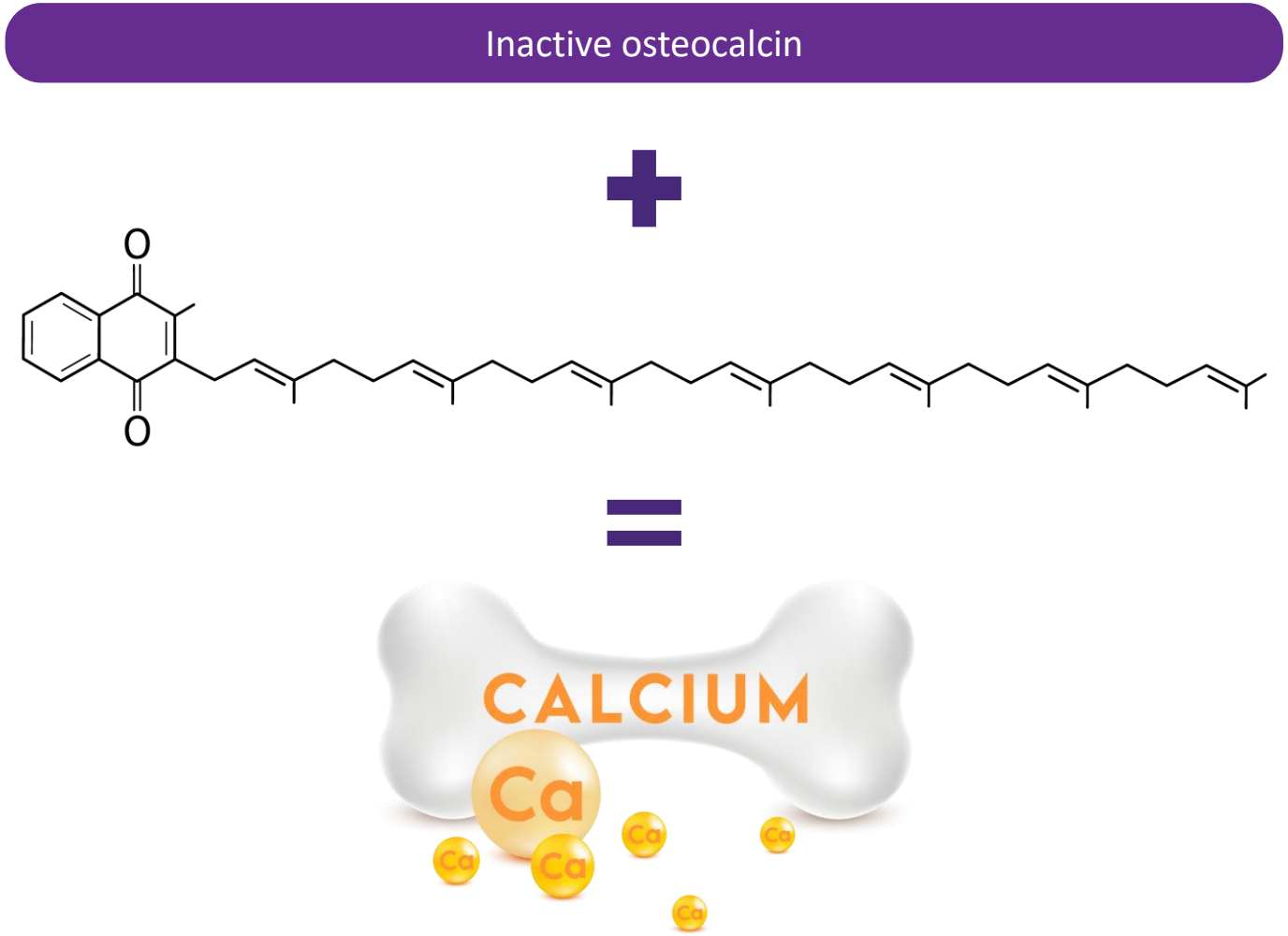
Frontiers CVD Medicine, Feb, 2019 The Bone—Vasculature Axis: Calcium Supplementation and the Role of Vitamin K

RANKL, receptor activator of nuclear factor kappa-B ligand

Akbari S and Rasouli-Ghahroudi AA, *Biomed Res Int* 2018;2018:4629383. 2. Schurgers LJ, et al. *Blood* 2007;109:3279-3283.

Activation of osteocalcin by vitamin K

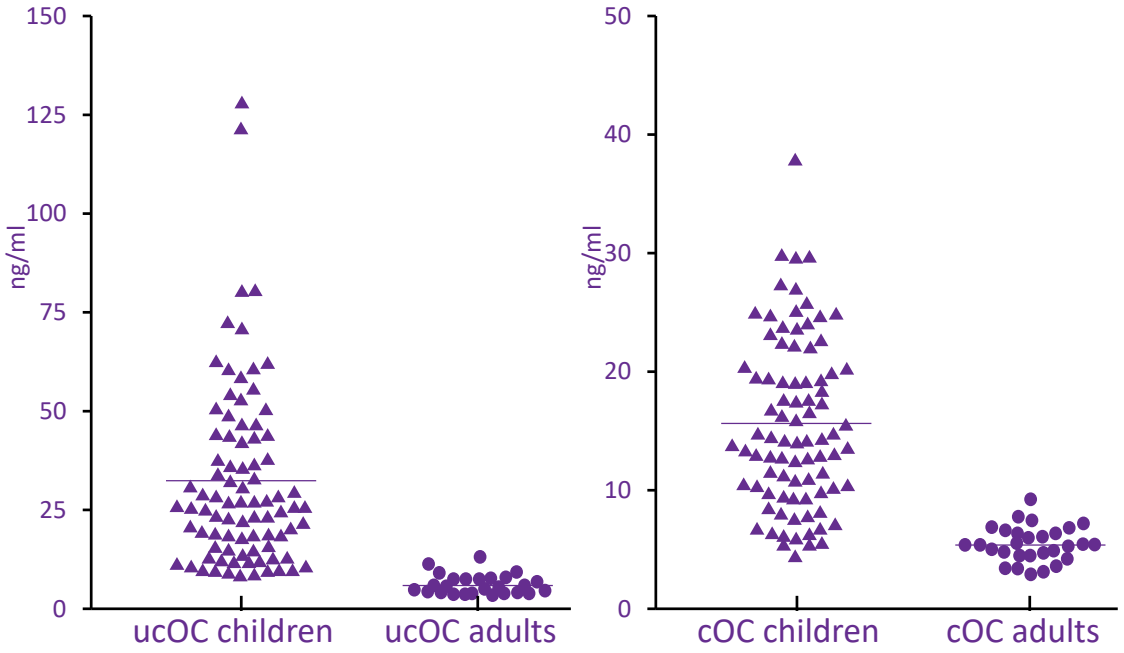
- Vitamin K activates osteocalcin, the second most abundant protein in bone tissue after collagen.[21]
- Osteocalcins are produced by osteoblasts and support bone building by facilitating calcium transportation to the bone.[21]
- Osteocalcins serve as a biomarker for the bone formation process.



21. Van Summeren M, et al. *Pediatr* 2007;61:366-370. **22**. Schurgers LJ, et al. *Blood* 2007;109:3279-3283. **29**. Eapen E, et al. *EJIFCC* 2008;19:123-136.

Better vitamin K status is associated with improved bone health[22]

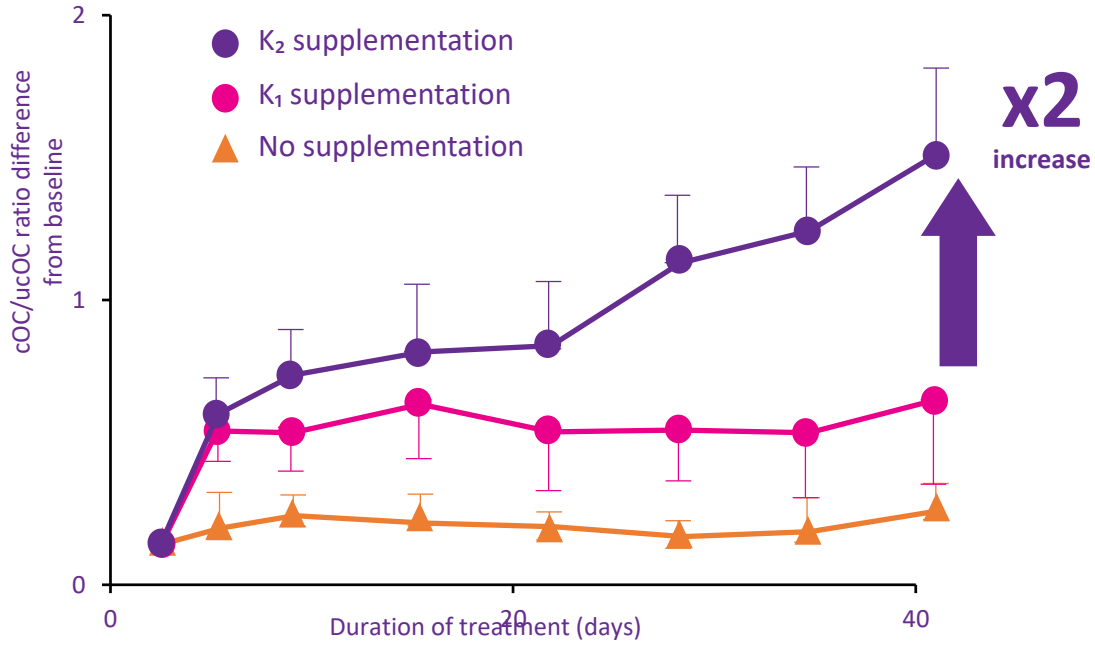
The ratio of ucOC/cOC in children is more than 2 times higher than that in adults, suggesting a poor vitamin K status of growing bone.[21]



Graph adapted from van Summeren et al. *Pediatr Res* 2007

From October 2003 to January 2004, 86 healthy children (aged 3–18 years) and 30 healthy adults (aged 25–35 years) were recruited.

In adults, vitamin K_2 induced osteocalcin carboxylation within the first 3 days and this effect continued in an upward trend until the end of the study period.[22]



Graph extracted from Schurgers LJ, et al. *Blood* 2007

18 healthy volunteers (aged 25–35 years) were randomised to consume vitamin K_2 and vitamin K_1 (OD after meal) for 6 weeks, with a wash-out period of 12 weeks

cOC, carboxylated osteocalcin; **ucOC**, undercarboxylated osteocalcin; **OD**, once daily

21. Van Summeren M, et al. *Pediatr* 2007;61:366-370. **22**. Schurgers LJ, et al. *Blood* 2007;109:3279-3283.

Take home message

1. Nutritional status of children and adolescents in Malaysia need to be improved.
2. In general, nutrition plays an important role in brain development and growth.
3. Adequate intake of amino acids and bone nutrients may improve bone health and growth promotion.
4. Each and everyone of us has a huge responsibility to help ensure a healthy future generation in Malaysia.

RPA 1 : Maternal& Young Child Nutrition

Point D

To develop and strengthen strategies/ programmes/ policies on maternal and young child nutrition.

Thank You...