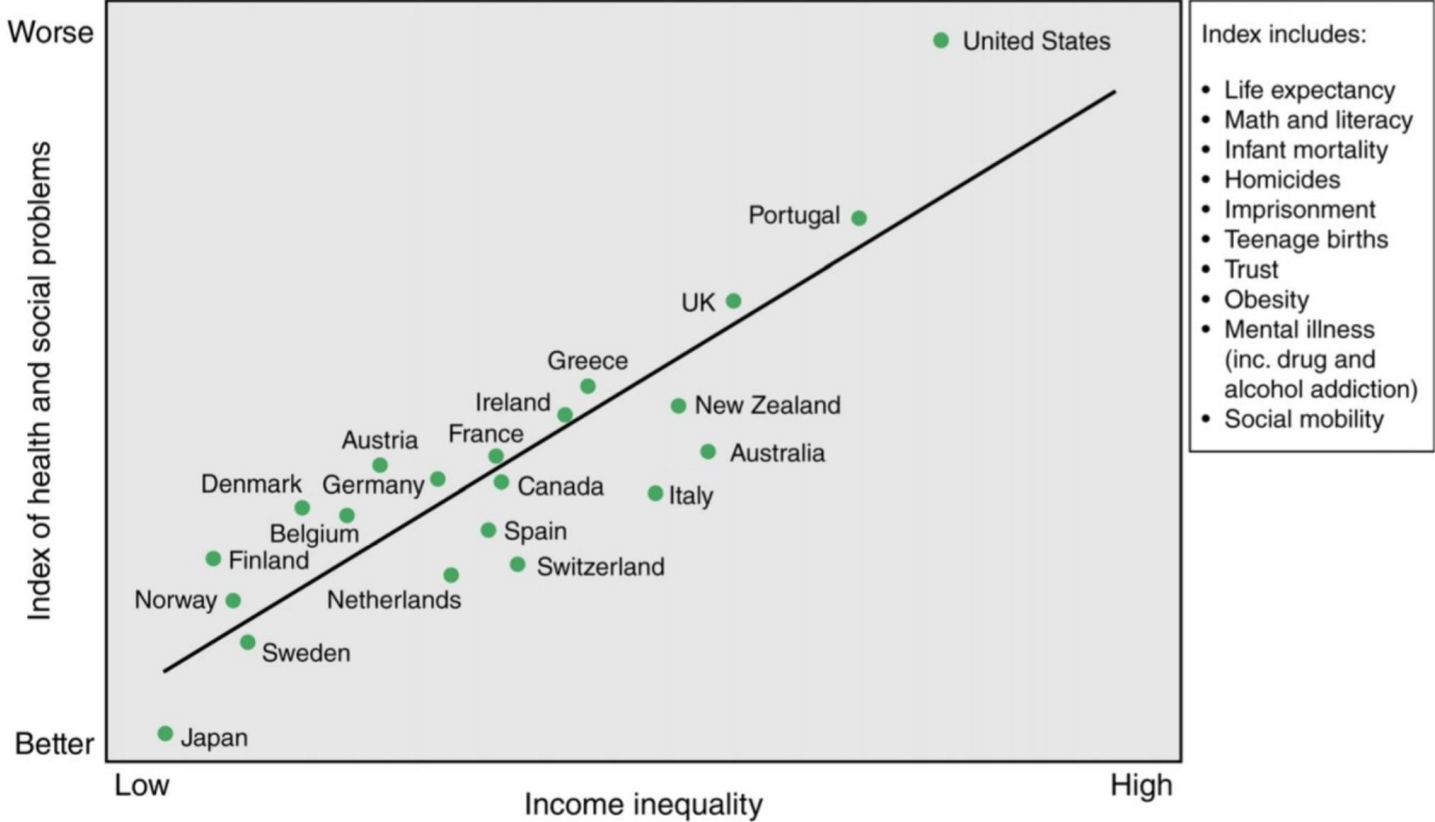# The critical role of childhood adversity in obesity aetiology

Erik Hemmingsson

GIH, Stockholm

Obesity: one of many symtoms of a dysfunctional society

Health and social problems are worse in more unequal countries

Index includes:
- Life expectancy
- Math and literacy
- Infant mortality
- Homicides
- Imprisonment
- Teenage births
- Trust
- Obesity
- Mental illness (inc. drug and alcohol addiction)
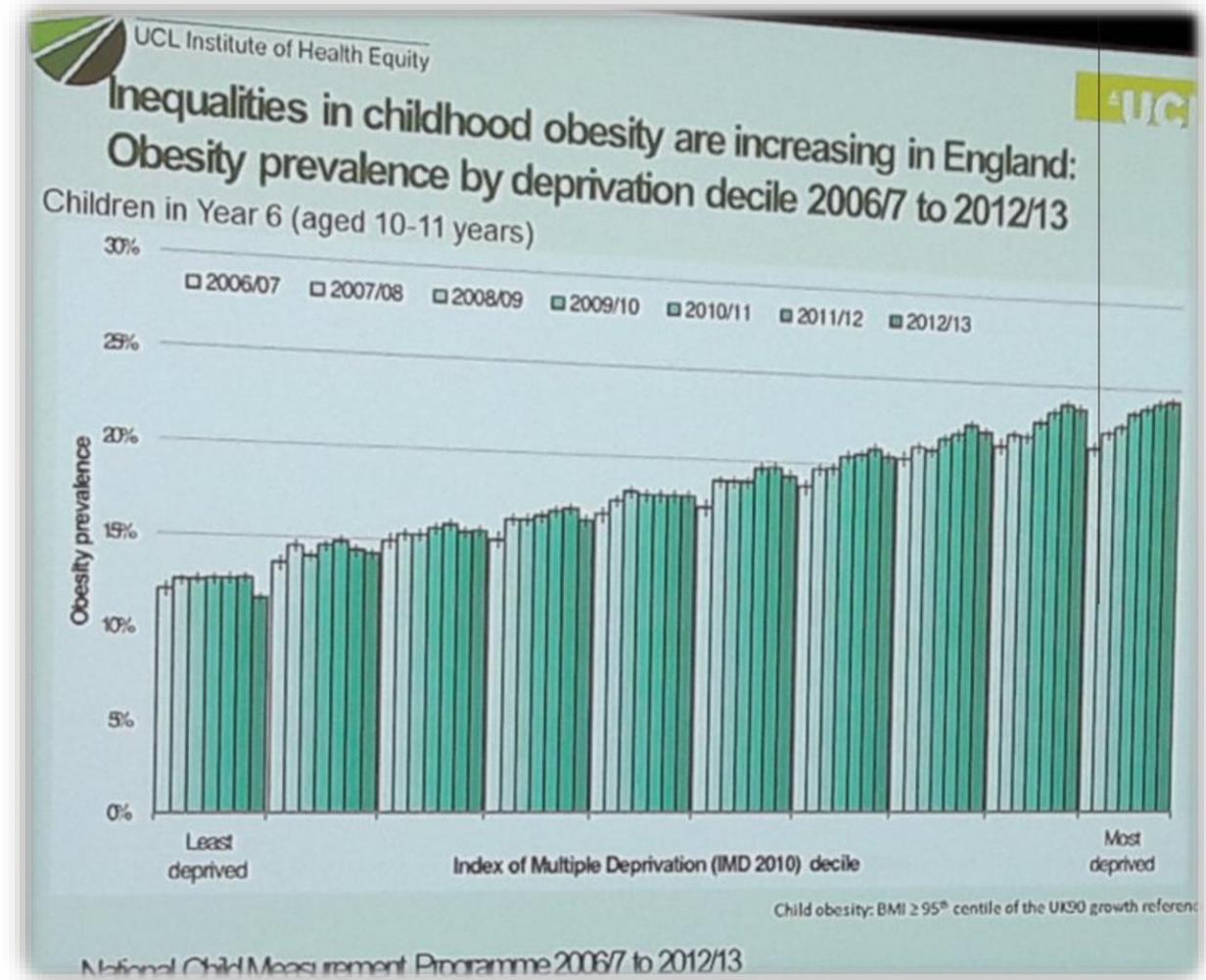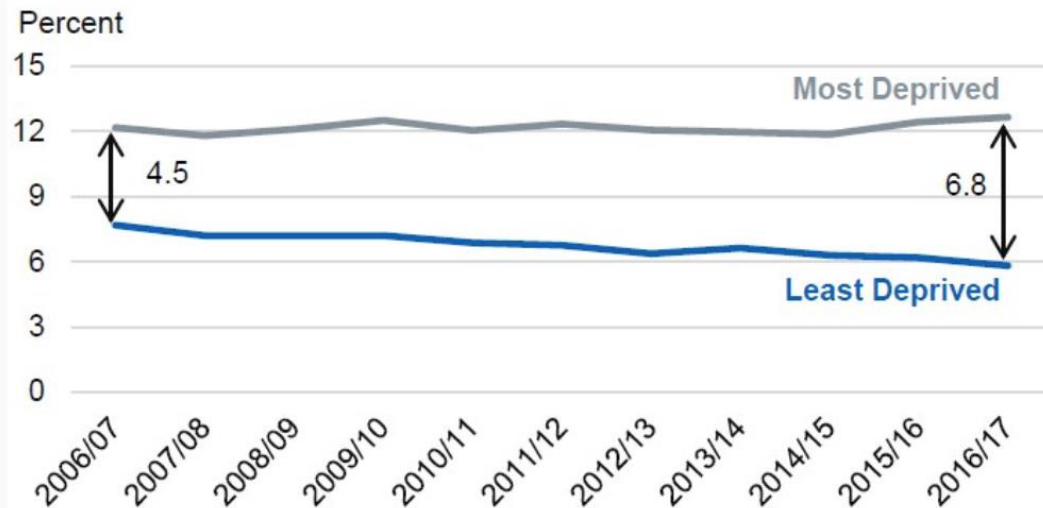- Social mobility

The neglected aquarium

Prof. Azeem Majeed @Azeem_Majeed · Apr 5

Health inequalities start very early in life. By the time of school reception year (4-5 years of age), children from the most deprived areas of England are twice as likely to be obese as children from the most affluent areas.
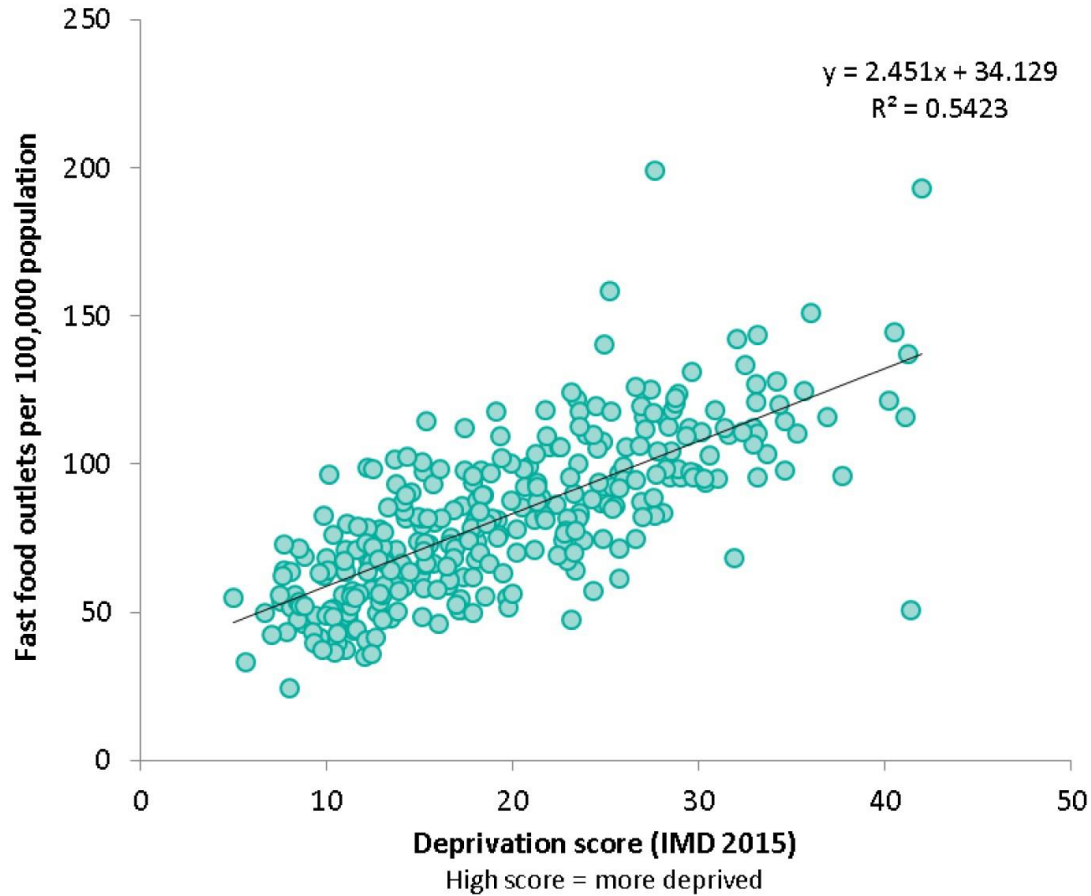digital.nhs.uk/catalogue/PUB3… via @NHSDigital

Reception year

Between 2007/08 and 2016/17, the difference between obesity prevalence in the most and least deprived areas has increased from 4.5 to 6.8 percentage points.

Percent

Most Deprived

4.5   6.8

Least Deprived

2006/07 2007/08 2008/09 2009/10 2010/11 2011/12 2012/13 2013/14 2014/15 2015/16 2016/17

UCL Institute of Health Equity

Inequalities in childhood obesity are increasing in England: Obesity prevalence by deprivation decile 2006/7 to 2012/13

Children in Year 6 (aged 10-11 years)

□2006/07 □2007/08 □2008/09 □2009/10 □2010/11 ■2011/12 ■2012/13

Obesity prevalence

Least deprived   Index of Multiple Deprivation (IMD 2010) decile   Most deprived

Child obesity: BMI ≥ 95ᵗʰ centile of the UK90 growth referenc

National Child Measurement Programme 2006/7 to 2012/13

Relationship between density of fast food outlets and deprivation
by local authority

$y = 2.451x + 34.129$
$R^2 = 0.5423$

Fast food outlets per 100,000 population

Deprivation score (IMD 2015)
High score = more deprived

Density of fast food outlets in England

Fast food outlets per 100,000 population

■ 150 - 232
■ 100 - 150
■ 50 - 100
■ 0-50
□ No data

Top 5 local authorities with the highest levels of deprivation

1 Blackpool
2 Knowsley
3 Kingston upon Hull
4 Liverpool
5 Manchester

Bottom 5

1 Hart
2 Wokingham
3 Chiltern
4 Waverley
5 Elmbridge

Source: Public Health England / English Indices of Deprivation 2015

BBC
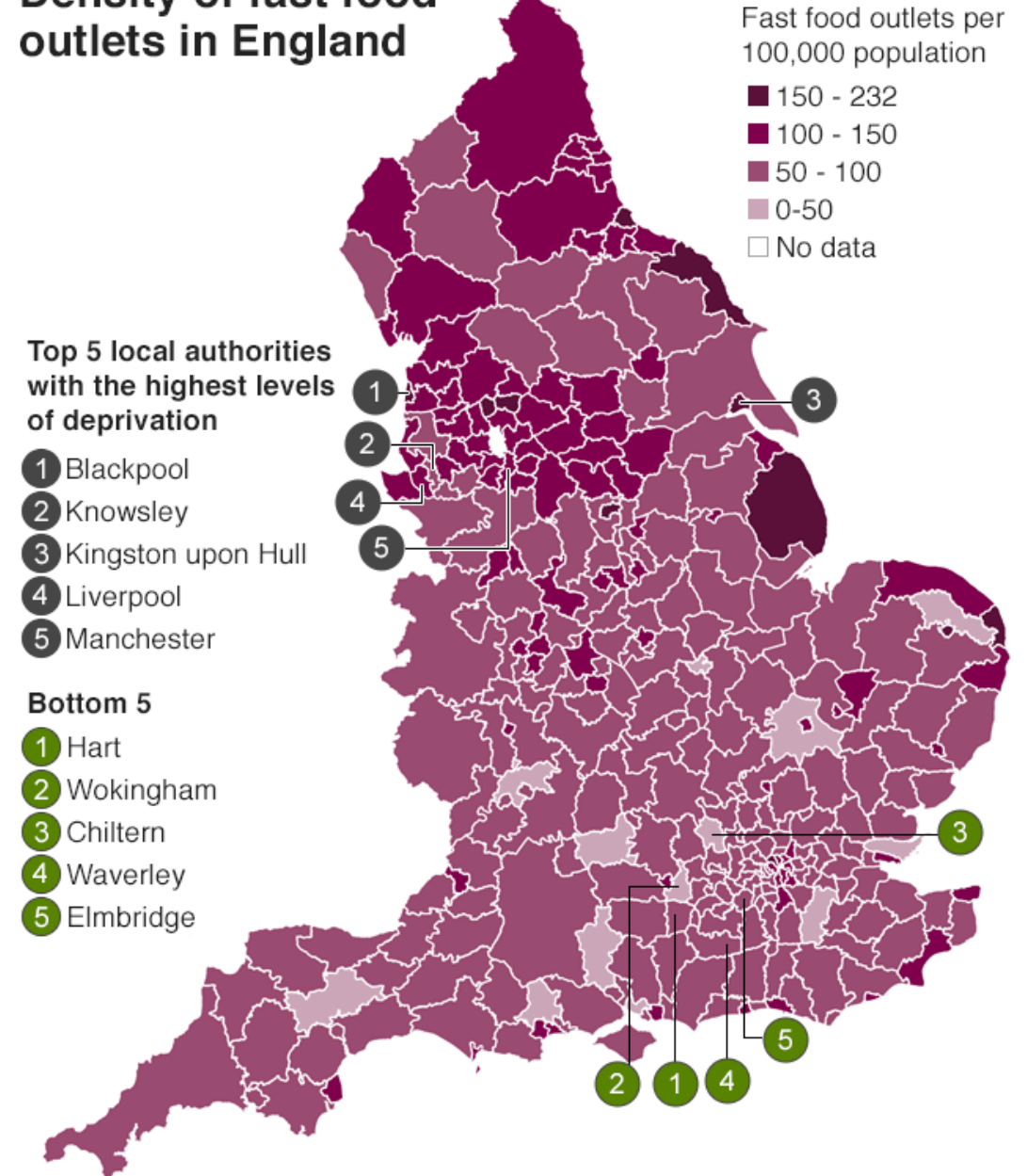
Ultra-processed junk food in Sweden, 1960-2010
(Juul & Hemmingsson, *PHN*, 2015)

-2 %

+142 %

-34 %

+116 %

Kilo/liter per person och år

| 450 | 400 | 350 | 300 | 250 | 200 | 150 | 100 | 50 | 0 |

1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010

iStock.com/Magone

—— Minimalt processade livsmedel
- - - Ultraprocessade livsmedel
—— Processade ingredienser
····· Processade livsmedel
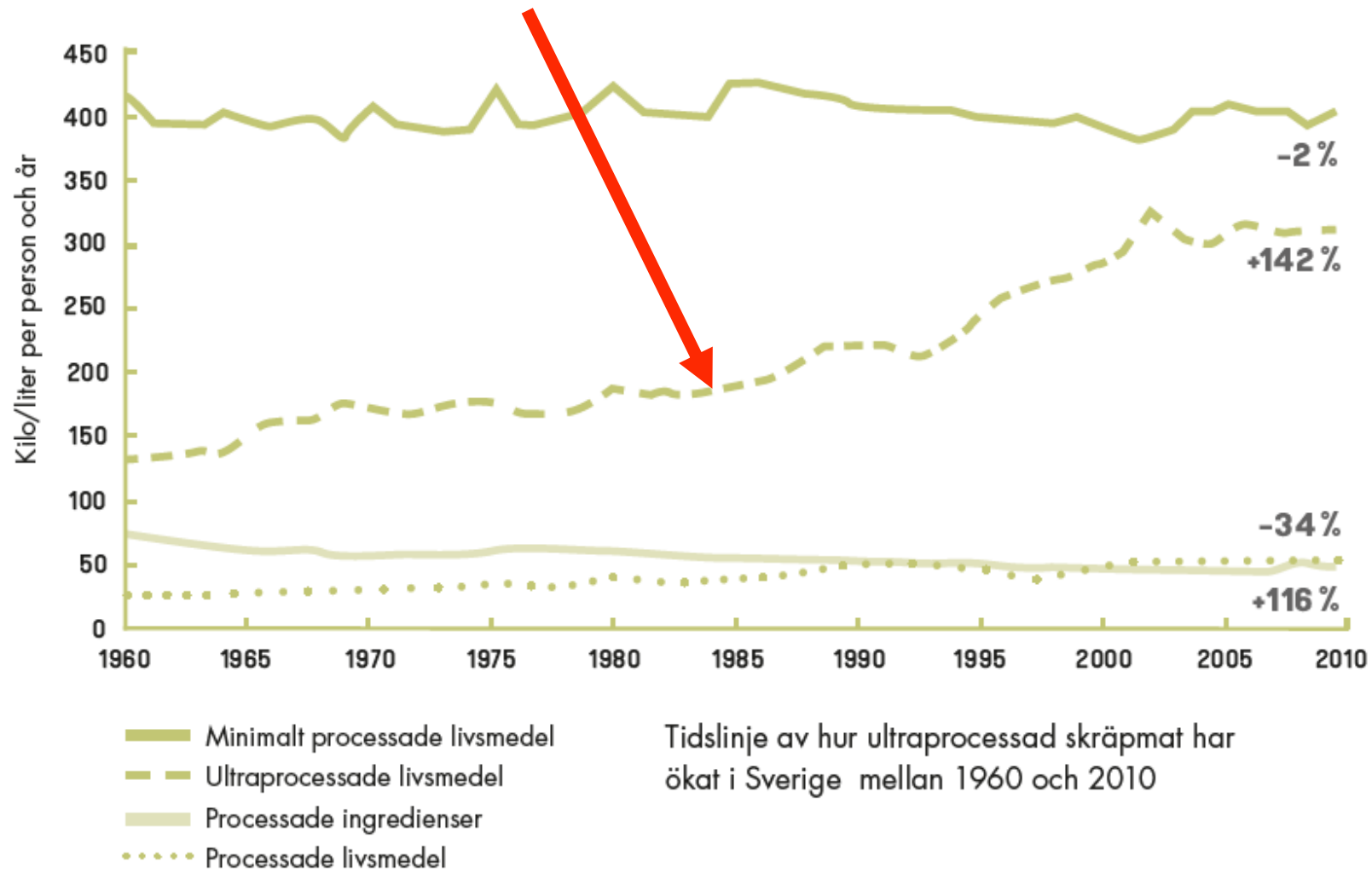
Tidslinje av hur ultraprocessad skräpmat har
ökat i Sverige mellan 1960 och 2010

Fat cell dynamics
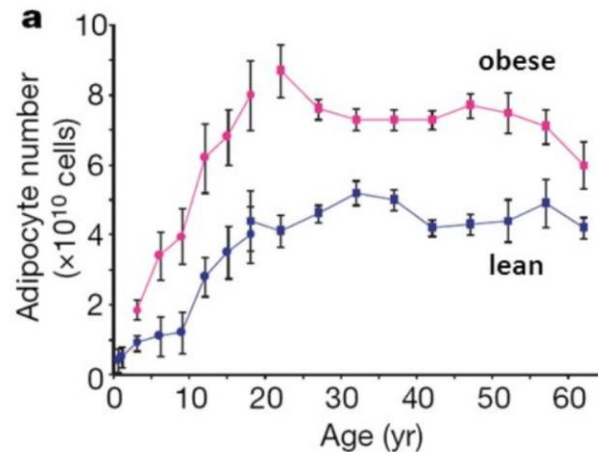## (Spalding et al., *Nature*, 2008)

Spalding, 2008 *Nature*

Figure 2 | Adipocyte number remains stable in adulthood, although significant weight loss can result in a decrease in adipocyte volume. Total adipocyte number from 595 (n lean = 253; n obese = 342) adult individuals (squares) was combined with previous results for children and adolescents[8] (circles; n lean = 178; n obese = 120). **a**, The adipocyte number increases in childhood and adolescence, with the number levelling off and remaining constant in adulthood in both lean (blue) and obese (pink) individuals. **b, c**, Major weight loss by bariatric surgery results in a significant decrease in cell volume (**b**), however fails to reduce adipocyte cell number (**c**), 1–2 yr post surgery (n = 20). All error bars represent s.e.m.; asterisk, P < 0.0001.

Nature Reviews | Disease Primers
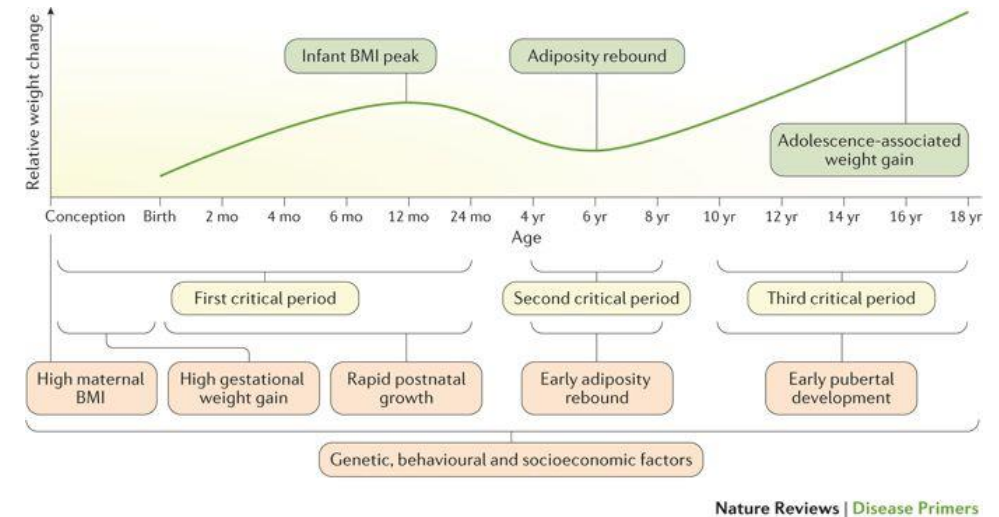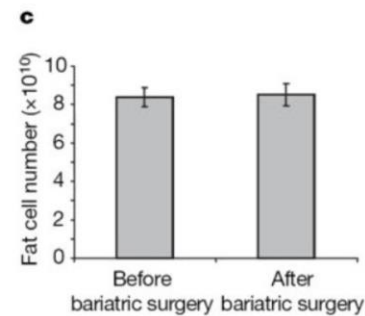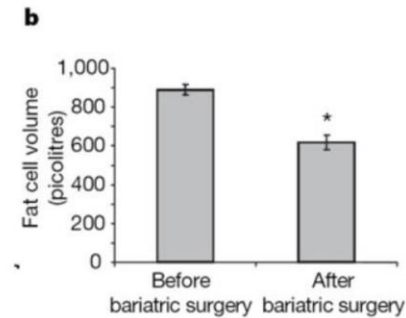
"Weight trajectories seem to be set in place even earlier in life than most of us would expect."

Solveigh Cunningham

To develop better treatment and prevention models, we need a better understanding of the causes of weight gain

Many obese patients anecdotally report negative childhood experiences, bullying and abuse

How does childhood adversity affect obesity risk?

Self-actualization — morality, creativity, spontaneity, problem solving, lack of prejudice, acceptance of facts

Esteem — self-esteem, confidence, achievement, respect of others, respect by others

Love/Belonging — friendship, family, sexual intimacy

Safety — security of body, of employment, of resources, of morality, of the family, of health, of property

Physiological — breathing, food, water, sex, sleep, homeostasis, excretion

Very strong associations between childhood adversity and multiple health outcomes
(Felliti et al., *Am J Prev Med*, 1998)

Legend: 0 abuse, 2 types of abuse, >=4 types of abuse

Categories: Attempted suicide, Injecting drugs, Alcoholism, Bronchitis, Stroke, Smoking, Ischemic heart disease, Any cancer, Diabetes, BMI>=35
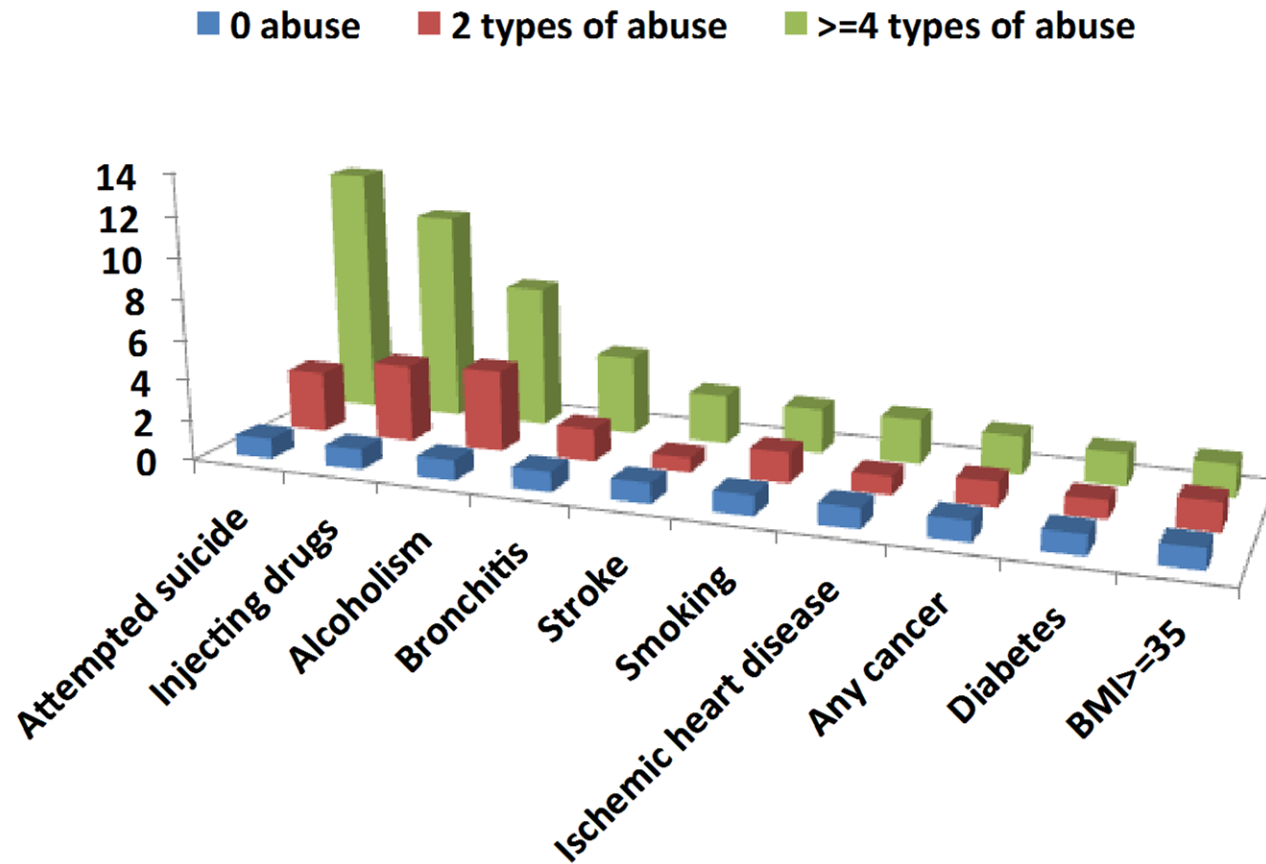
Disturbances in the early social environment plays a huge role in many adverse health outcomes, why not obesity?

Meta-analysis on childhood abuse and obesity

(Hemmingsson et al., *Obesity Reviews*, 2014)

Physical abuse	OR (95% CI)
Fuemmeler, 2009 (men)	0.94 (0.72-1.23)
Grilo, 2001	0.95 (0.44-2.05)
Fuemmeler, 2009 (women)	1.00 (0.75-1.35)
Fuller-Thomson, 2013 (men)	1.12 (0.82-1.53)
Chartier, 2009	1.18 (0.92-1.51)
Afifi, 2013	1.20 (1.02-1.42)
Thomas, 2008	1.33 (1.11-1.60)
Jia, 2004	1.34 (1.03-1.75)
Fuller-Thomson, 2013 (women)	1.35 (1.09-1.67)
Greenfield, 2009	1.41 (1.00-1.99)
Rosmond, 2000	1.65 (1.50-1.82)
Hollingsworth, 2012	2.38 (1.18-4.80)
Dedert, 2001	3.80 (1.01-14.30)
Subtotal (P<0.001)	**1.28 (1.13-1.46)**
Emotional abuse	
Hollingsworth, 2012	0.89 (0.36-2.20)
Grilo, 2001	0.94 (0.50-1.78)
Grilo, 2001	1.01 (0.54-1.89)
Fuemmeler, 2009 (women)	1.01 (0.61-1.67)
Roenholt, 2012	1.11 (0.65-1.88)
Fuemmeler, 2009 (men)	1.22 (0.76-1.97)
D'Argenio, 2009	1.23 (1.08-1.41)
Thomas, 2008	1.32 (1.01-1.73)
Hollingsworth, 2012	2.40 (1.19-4.84)
Johnson, 2002	4.82 (1.71-13.56)
Lissau, 1994	7.10 (2.60-19.30)
Subtotal (P=0.008)	**1.36 (1.08-1.71)**
Sexual abuse	
Fuemmeler, 2009 (women)	0.81 (0.53-1.23)
Grilo, 2001	0.86 (0.39-1.90)
Thomas, 2008	0.88 (0.61-1.27)
Mamun, 2007 (men)	0.96 (0.58-1.58)
Jia, 2004	1.08 (0.76-1.53)
Smith, 2010 (outside family)	1.13 (0.78-1.64)
McIntyre, 2012	1.38 (1.10-1.73)
Hollingsworth, 2012	1.53 (0.76-3.09)
Smith, 2010 (inside family)	1.58 (1.10-2.27)
Chartier, 2009	1.61 (1.14-2.27)
Mamun, 2007 (women)	1.63 (1.02-2.60)
Fuemmeler, 2009 (men)	1.66 (1.03-2.69)
Roenholt, 2012	1.72 (0.76-3.89)
Aaron, 2007	1.90 (1.08-3.34)
Noll, 2007	2.85 (1.06-7.66)
Dedert, 2010	3.60 (1.01-12.83)
Subtotal (P<0.001)	**1.31 (1.13-1.53)**
General abuse	
Grilo, 2001	1.09 (0.60-1.98)
Afifi, 2013	1.13 (1.07-1.20)
Thomas, 2008 (humiliation)	1.18 (1.00-1.40)
Thomas, 2008 (verbal)	1.18 (1.00-1.40)
Alvarez, 2007	1.26 (1.13-1.40)
Hollingsworth, 2012	1.37 (0.56-3.36)
Gunstad (women), 2006	1.44 (0.68-3.06)
Felitti, 1998	1.60 (1.21-2.12)
D'Argenio, 2009	1.65 (1.08-2.52)
Roenholt, 2012	2.78 (1.31-5.89)
Gunstad (men), 2006	4.08 (2.03-8.21)
Johnson, 2002	4.66 (1.65-13.16)
Lissau, 1994	9.80 (3.45-27.82)
Subtotal (P<0.001)	**1.45 (1.25-1.69)**
Overall (P<0.001)	**1.34 (1.24-1.45)**

Heterogeneity for physical abuse: I^2=67.7, P<0.001; Heterogeneity for emotional abuse: I^2=58.7, P=0.007; Heterogeneity for sexual abuse: I^2=41.0, P=0.044; Heterogeneity for general abuse: I^2=76.3, P<0.001; Heterogeneity overall: I^2=65.8, P<0.001.

0.01   0.1   1   10   100

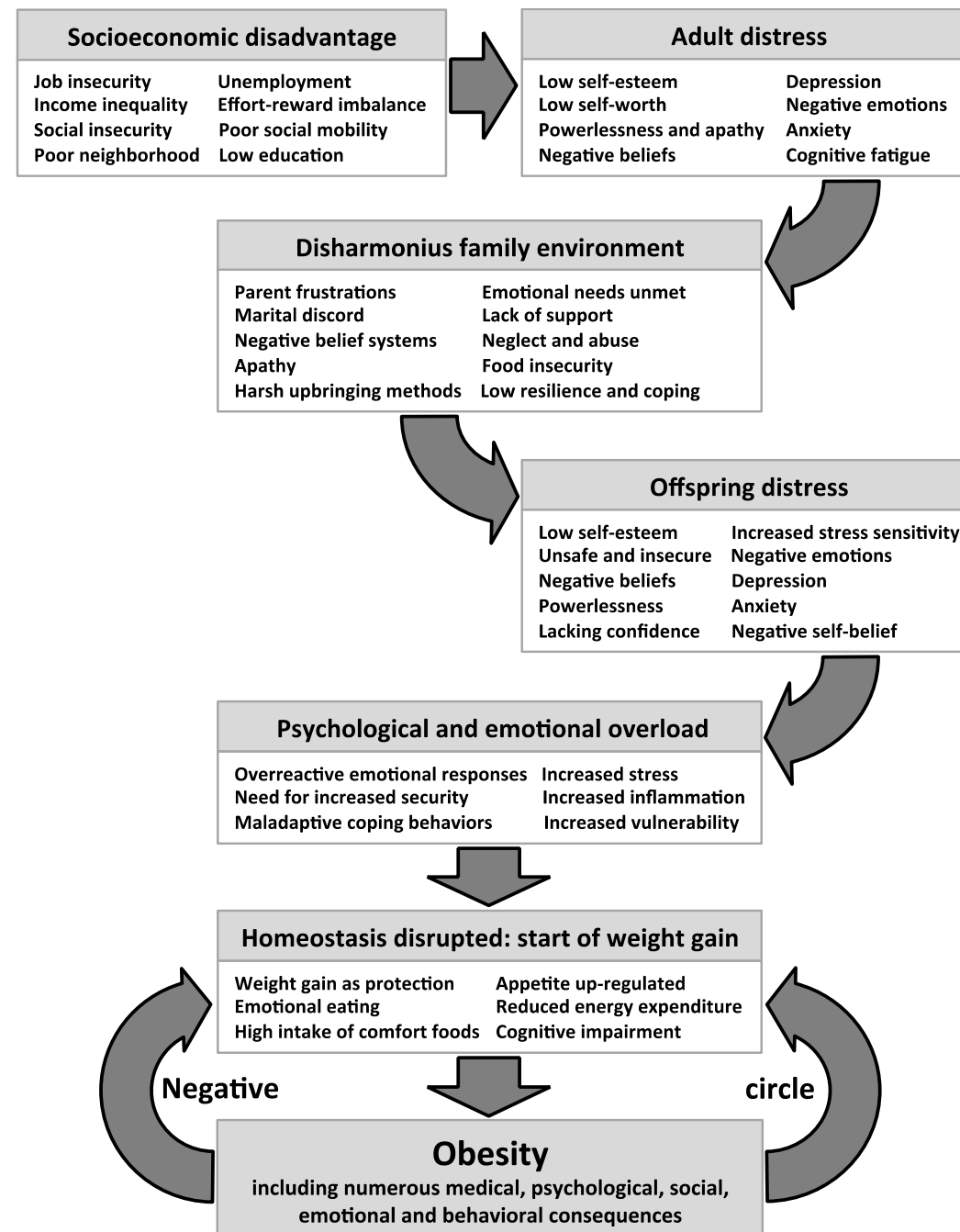Decreased obesity risk   Increased obesity risk
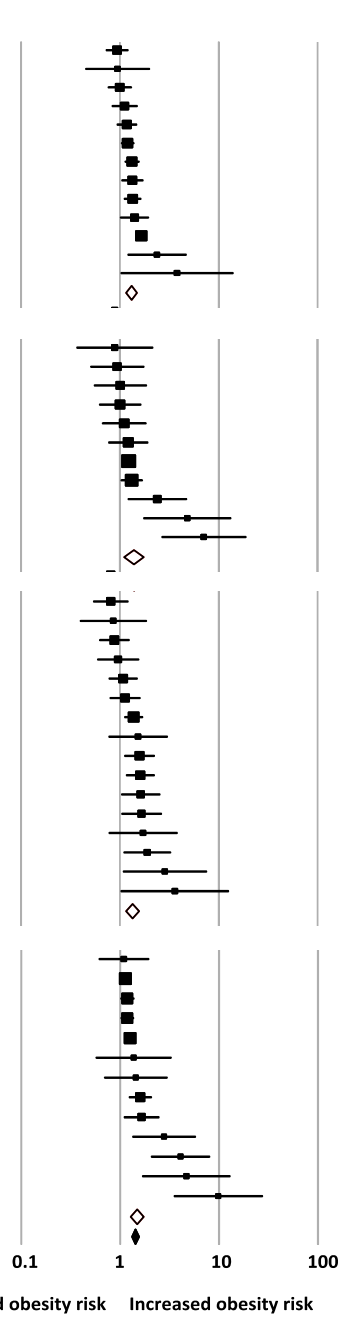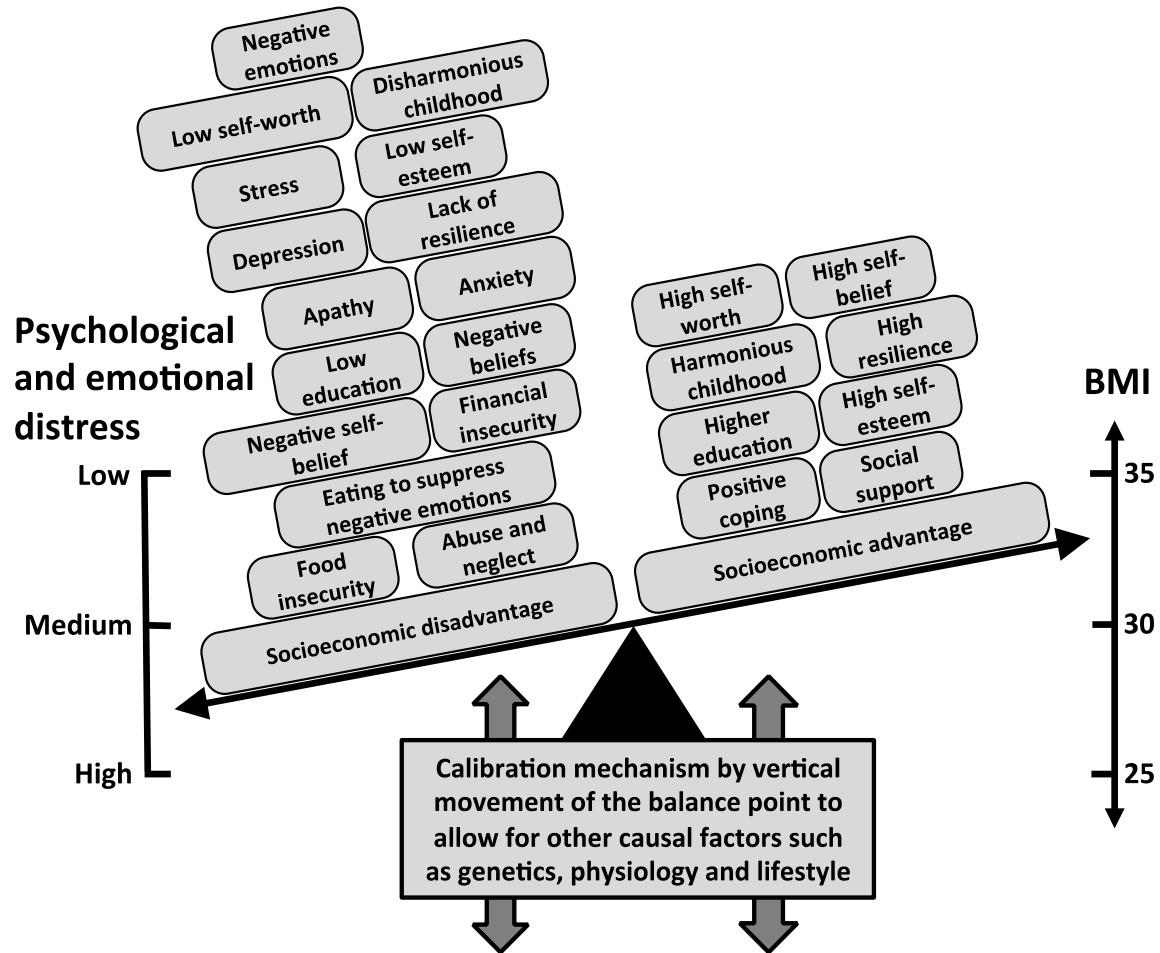
There was also a positive dose-response association

Conceptual review paper

Part 1: Proposed links between socioeconomic adversity and obesity
(Hemmingsson, Obesity Reviews, 2014)

Socioeconomic disadvantage

Job insecurity	Unemployment
Income inequality	Effort-reward imbalance
Social insecurity	Poor social mobility
Poor neighborhood	Low education

Adult distress

Low self-esteem	Depression
Low self-worth	Negative emotions
Powerlessness and apathy	Anxiety
Negative beliefs	Cognitive fatigue

Disharmonius family environment

Parent frustrations	Emotional needs unmet
Marital discord	Lack of support
Negative belief systems	Neglect and abuse
Apathy	Food insecurity
Harsh upbringing methods	Low resilience and coping

Offspring distress

Low self-esteem	Increased stress sensitivity
Unsafe and insecure	Negative emotions
Negative beliefs	Depression
Powerlessness	Anxiety
Lacking confidence	Negative self-belief

Psychological and emotional overload

Overreactive emotional responses	Increased stress
Need for increased security	Increased inflammation
Maladaptive coping behaviors	Increased vulnerability

Homeostasis disrupted: start of weight gain

Weight gain as protection	Appetite up-regulated
Emotional eating	Reduced energy expenditure
High intake of comfort foods	Cognitive impairment

Negative circle

Obesity
including numerous medical, psychological, social, emotional and behavioral consequences

Part 2: Proposed body weight regulation model

What happens when we diet?

Reduced metabolic rate

Increased ghrelin, decreased leptin
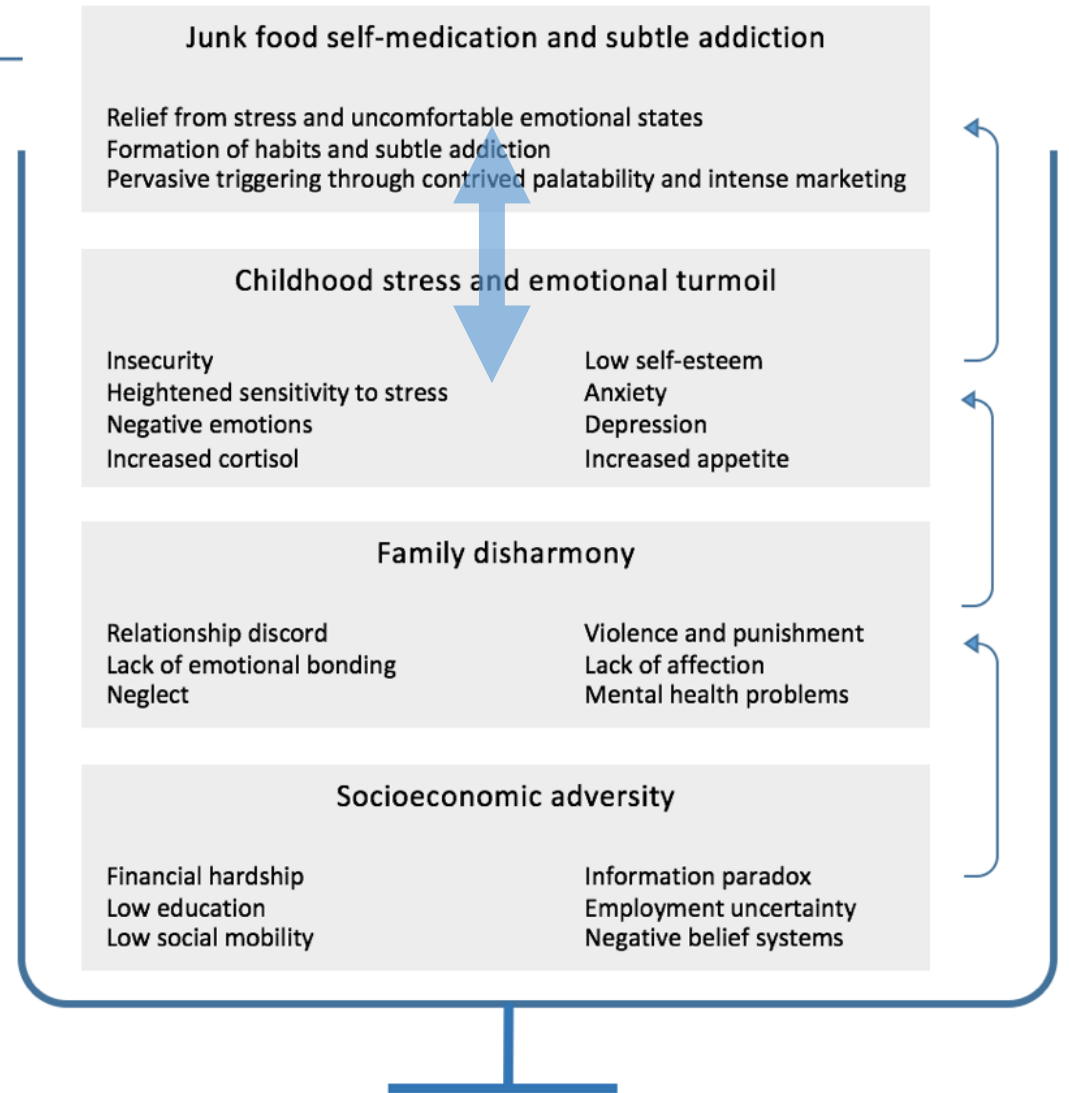
Unchanged adipocyte quantity

Eating and exercise habits often stem from childhood and are difficult to change long-term

Obesity causation, extended and updated model

(Hemmingsson, *Current Obesity Reports*, 2018)

The overflowing cup: how stress drives us towards calorie dense junk food, energy homeostasis disrupted

Weight gain and obesity

Junk food self-medication and subtle addiction

Relief from stress and uncomfortable emotional states
Formation of habits and subtle addiction
Pervasive triggering through contrived palatability and intense marketing

Childhood stress and emotional turmoil

Insecurity

Heightened sensitivity to stress

Negative emotions

Increased cortisol

Low self-esteem

Anxiety

Depression

Increased appetite

Family disharmony

Relationship discord

Lack of emotional bonding

Neglect

Violence and punishment

Lack of affection

Mental health problems

Socioeconomic adversity

Financial hardship

Low education

Low social mobility

Information paradox

Employment uncertainty

Negative belief systems

Suggestion for obesity prevention: clean up the aquarium

Support vulnerable families
Junk food regulation
Inequality
Financial system overhaul
(negative externality, tragedy
of the commons, etc)

Thank you

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