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HEALTH

# Socio-ecological Factors and the Double Burden of Malnutrition Among Children and Adolescents in Low- and Middle-Income Countries

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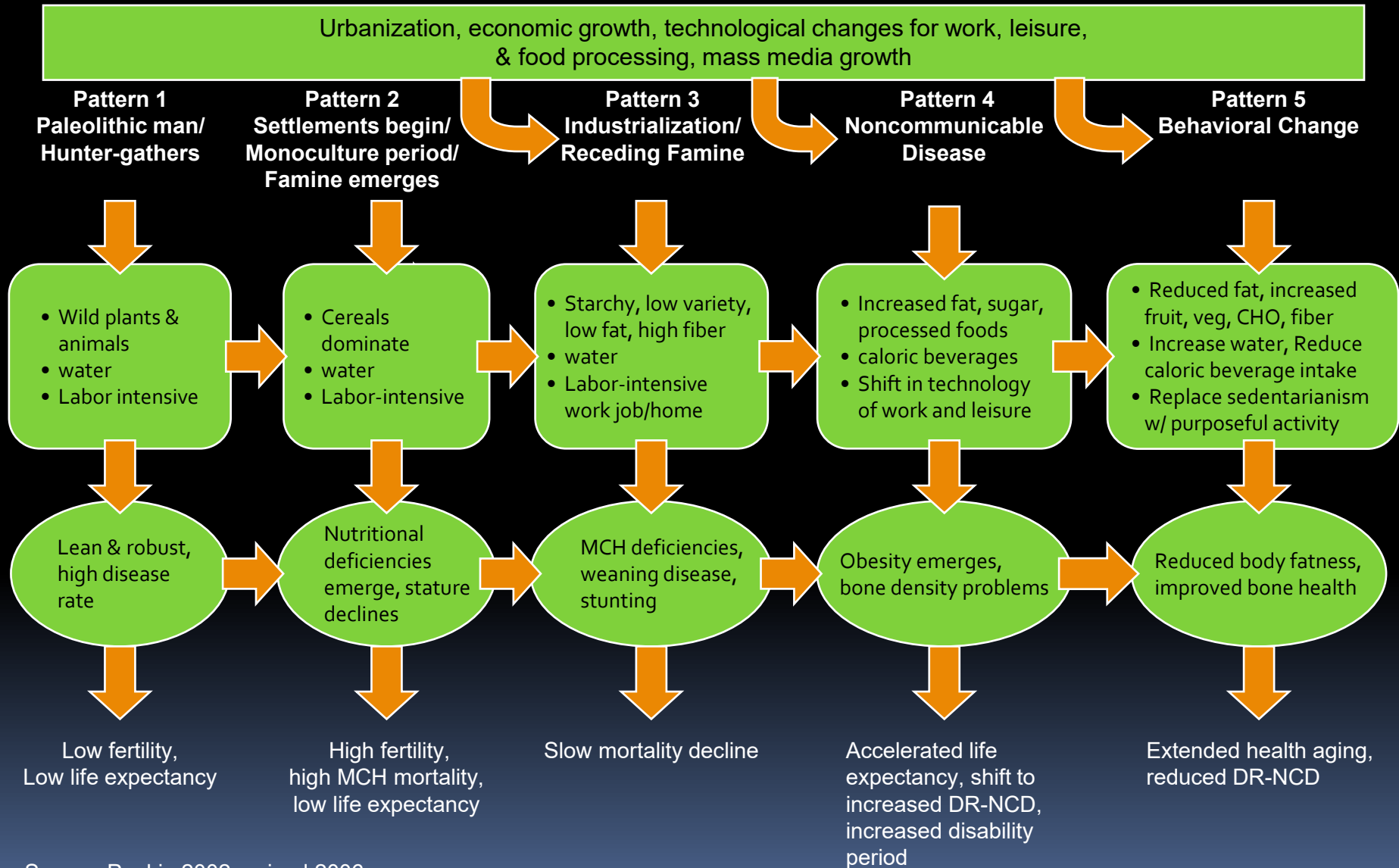
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# Terminology

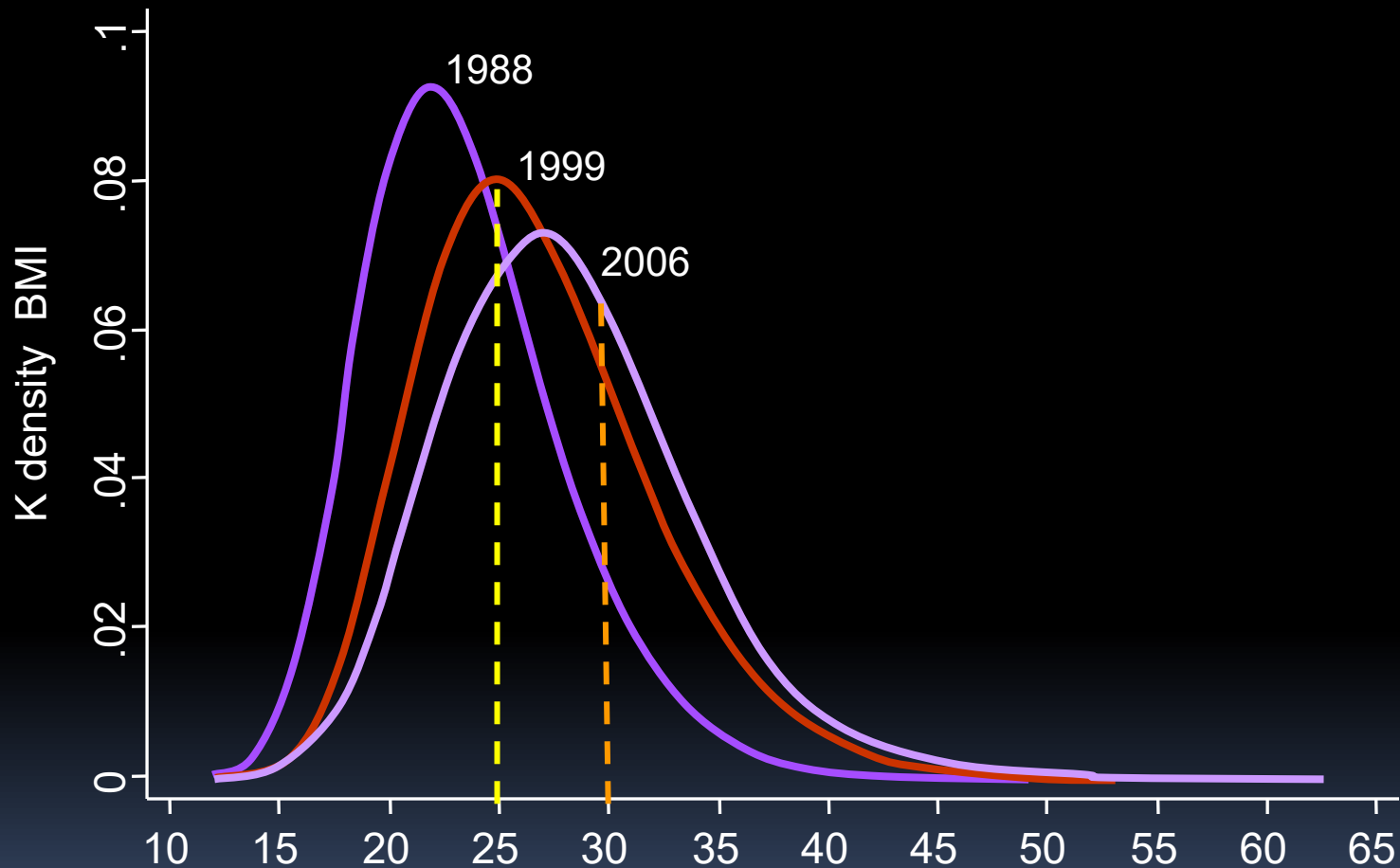
- **Nutrition transition** defines as the changes in dietary patterns and nutrient intakes when populations adopt modern lifestyles during economic and social development, urbanization and acculturation (Popkin BM, 1994)
- **Double burden of malnutrition** refers to “double burden” of malnutrition with under- and over nutrition occurring simultaneously among different population groups in developing countries (FAO, 2006).
- **Stunting**:  $<-2SD$  height for age (HAZ)
- **Wasting**:  $<-2SD$  weight for height (WHZ)
- **Underweight**:  $<-2SD$  weight for age (WAZ)
- **Overweight**:  $BMI > 25$  through 30
- **Obesity**:  $BMI > 30$

# Figure 1. Stages of the Nutrition Transition

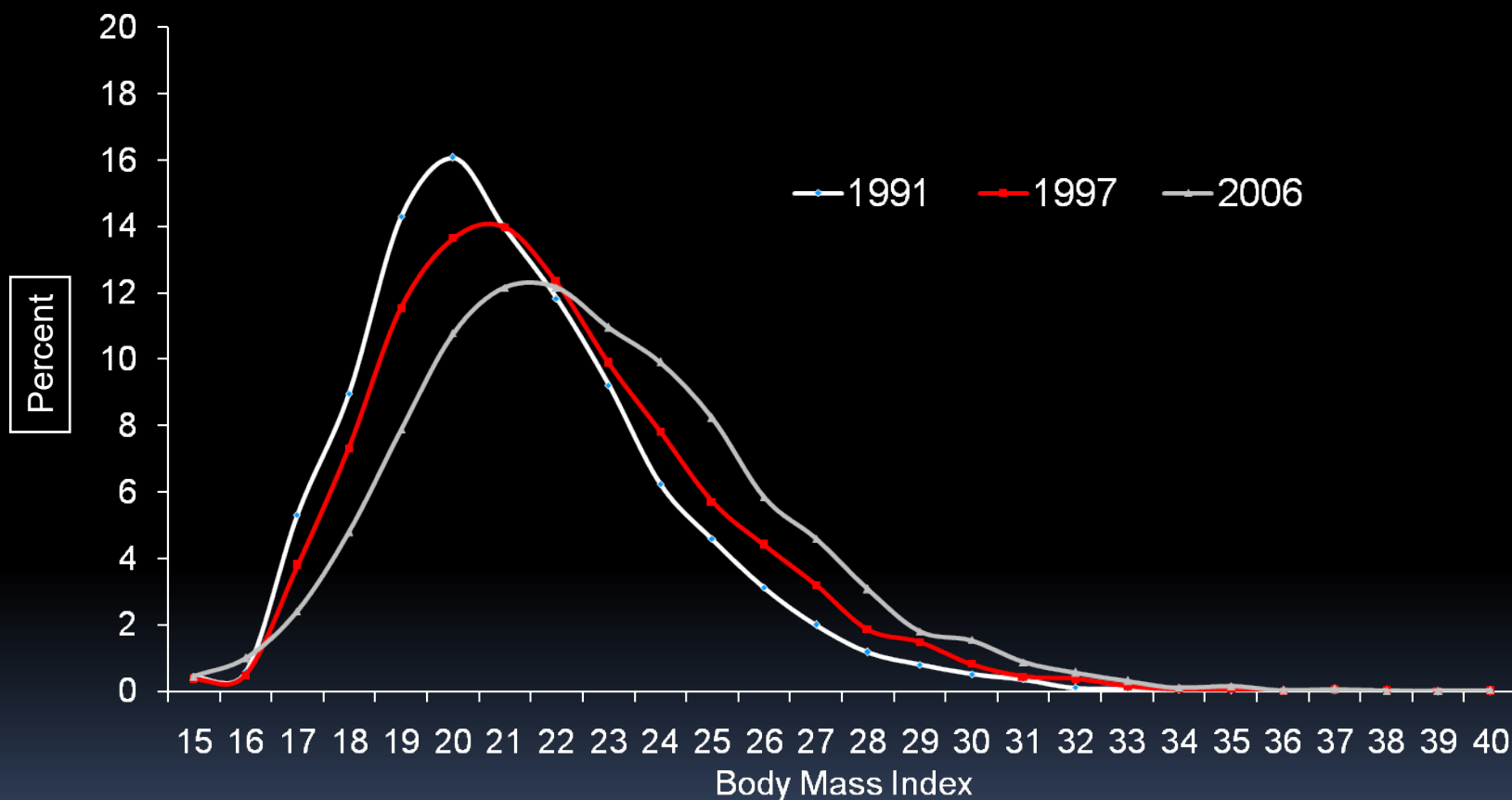


Source: Popkin 2002 revised 2006.

# BMI Distribution Shifts among Mexican women 18-49 y (National Surveys 1988, 1999 y 2006)



## BMI Distribution Shifts Among Chinese Adults, ages 19 and Older



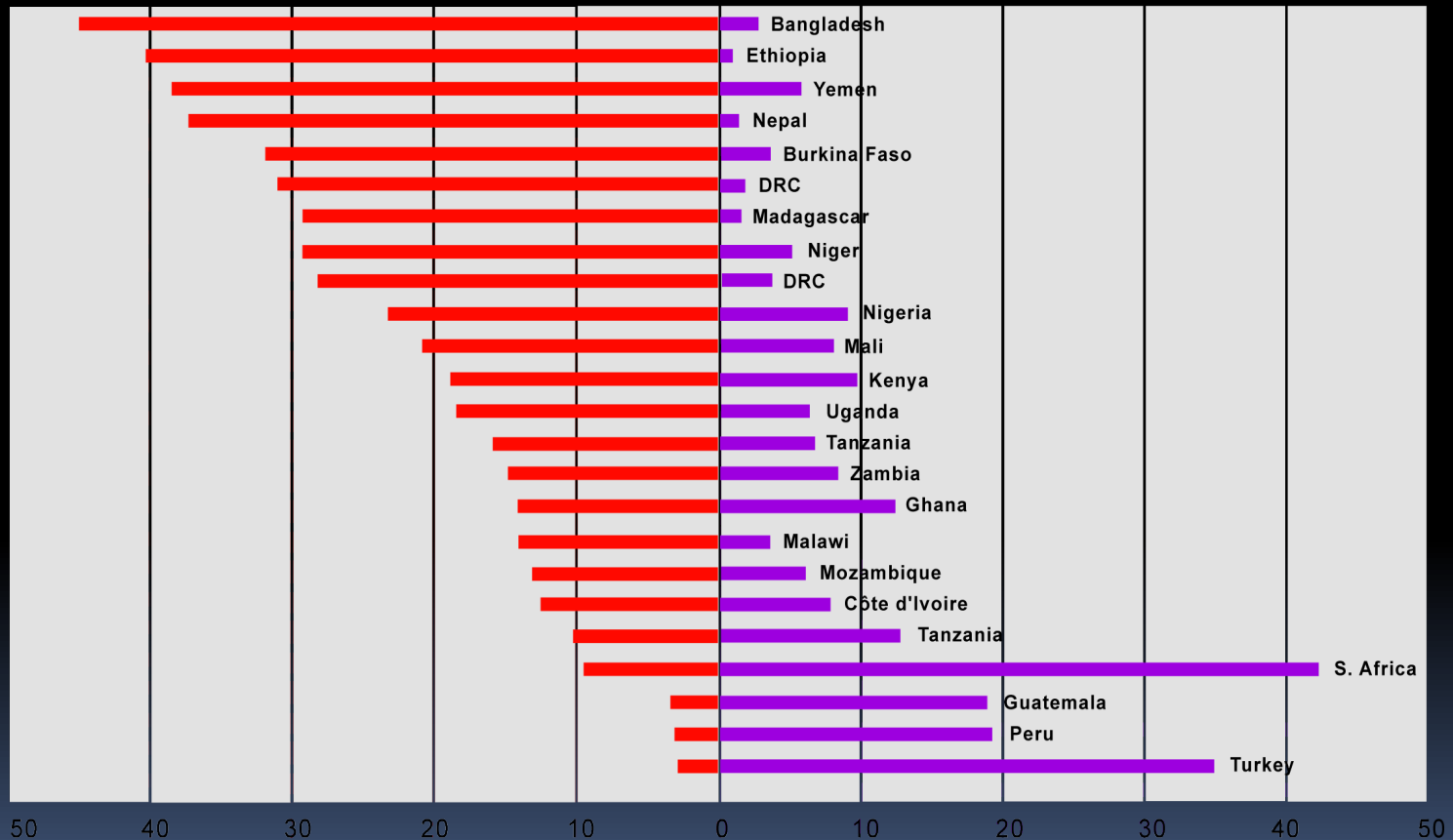
China Health and Nutrition Survey. Males: 10.4-27.1; Females 15.4-27.7

# Double burden of malnutrition in the peer reviewed journal

- **Individual level:**
  - Central adiposity and anemia (Gartner A, 2014)
- **Household level:**
  - Stunted Children and Overweight Mother/SCOWT (Dieffenbach S, 2012)
  - Stunted Children and Overweight Mother/SCOM (Lee J et.al., 2012)
  - Maternal Child Double Burden/MCDB (Oddo VM et.al., 2012)
- **Population/Country level:**
  - Stunting, Underweight, Overweight and Obesity among children (Le Nguyen BK et.al., 2013; Rojroongwasinkul N et.al., 2013, Sandjaja S et.al., 2013)
  - Underweight, Overweight and Obesity among women (Mayanga T et.al., 2014)

# The double burden of malnutrition

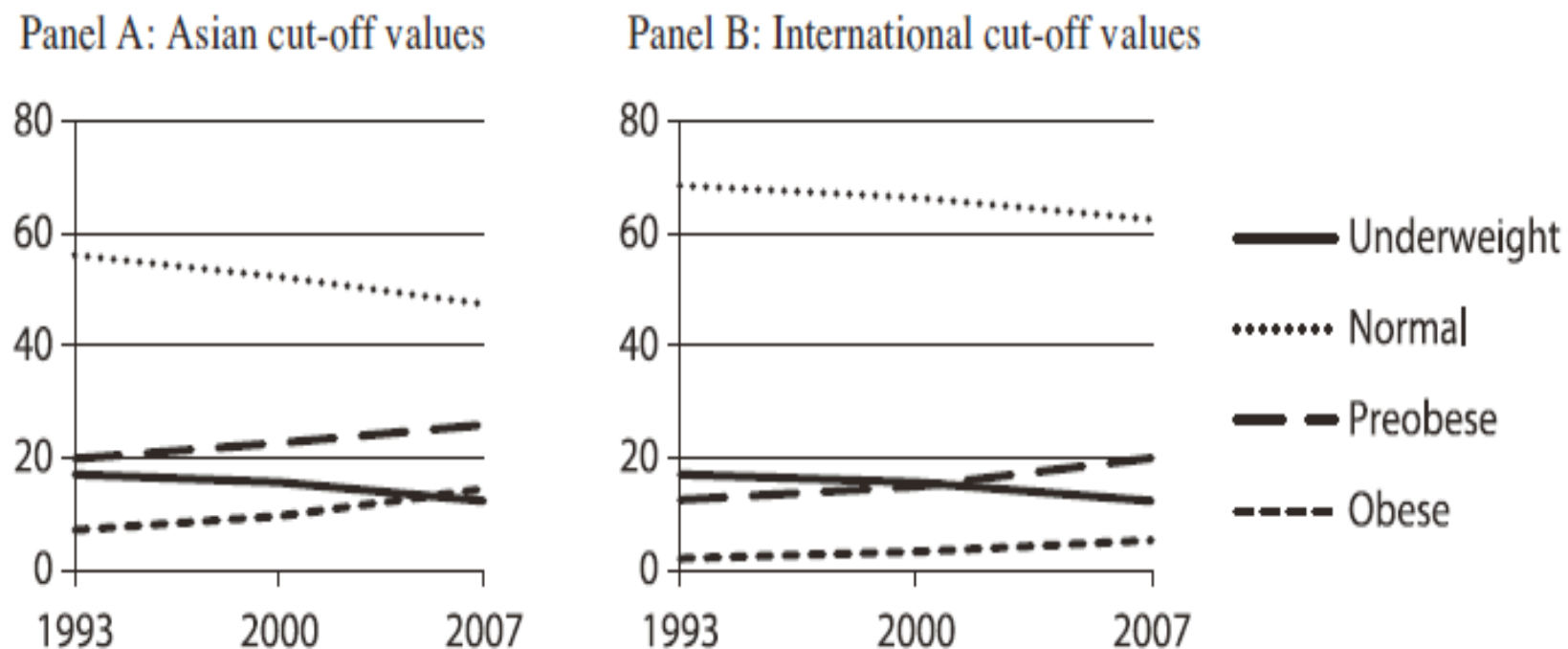
Underweight vs obesity in women in 36 high-stunting burden countries\*



\*Of these 36 countries, data on both underweight (red) and obesity (purple) prevalence among adult females were available only for 24 countries

Source: WHO Global Database on Child Growth and Malnutrition

## Double Burden of Malnutrition in Indonesia

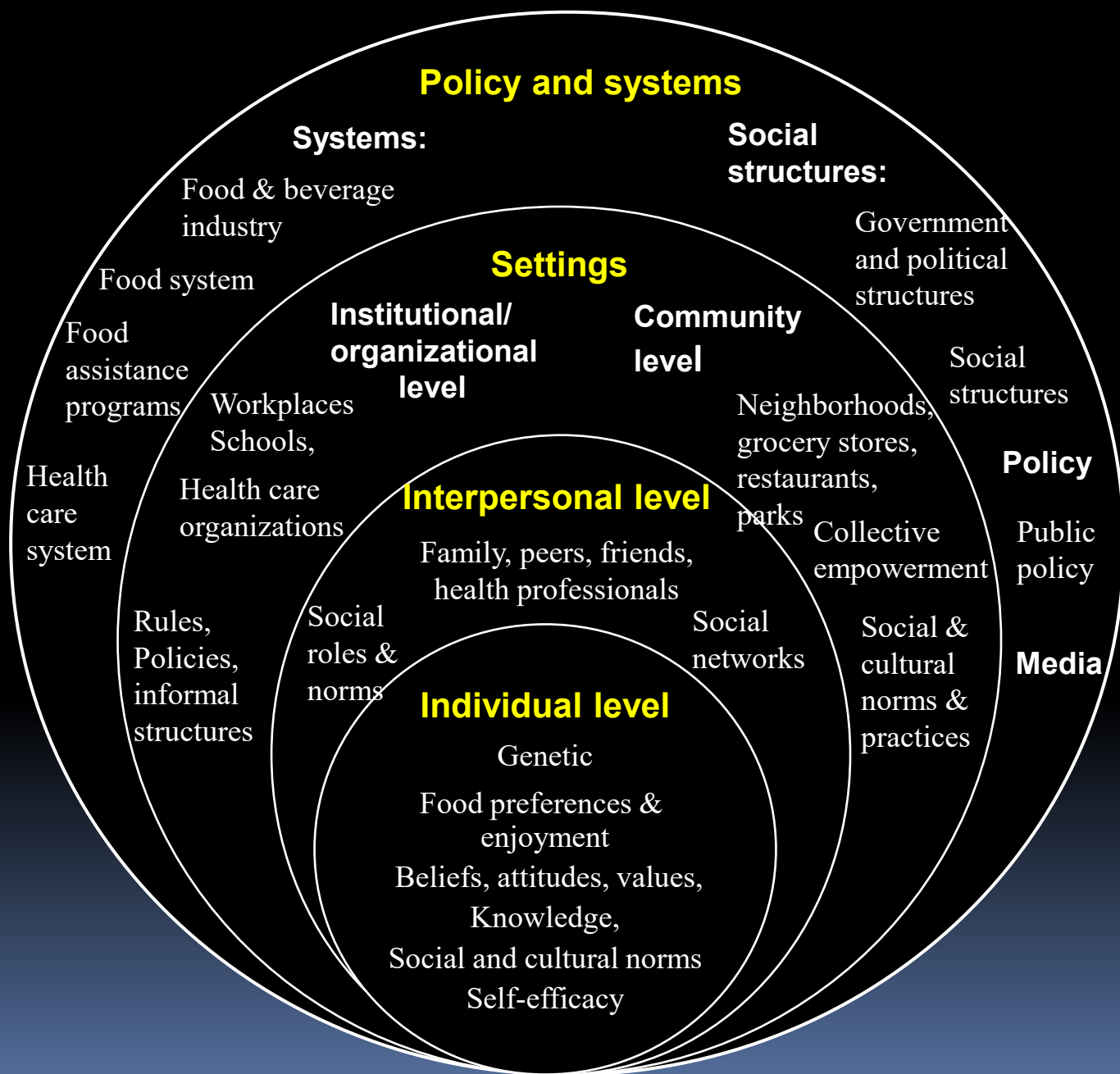


Source: IFLS1, IFLS3, IFLS4

Fig. 2. Share of population in BMI categories over time (in %).



# Socio-Ecological Approach





# INDIVIDUAL LEVEL

# Maternal short stature

- **Brazil** → maternal stature associated with stunting ( $p=0.019$ )  
(Ferreira HS et.al., 2009)  
maternal stature **<145 cm** had **1.2 lower** children's HAZ than mother >160 cm tall ( $p<0.0001$ ) (Felisbino-Mendes MS, 2014).
- **Indonesia** → **OR:2.32** 95%CI: 2.25,2.40 (Oddo VM et.al., 2012)
- **Bangladesh** → **OR:2.11**; 95% CI:1.96,2.26 (Oddo VM et.al., 2012)
- **Mexico** → maternal stature **<150 cm**; **OR=3.6** for child stunting  
(Varela-Silva MI et.al., 2009)



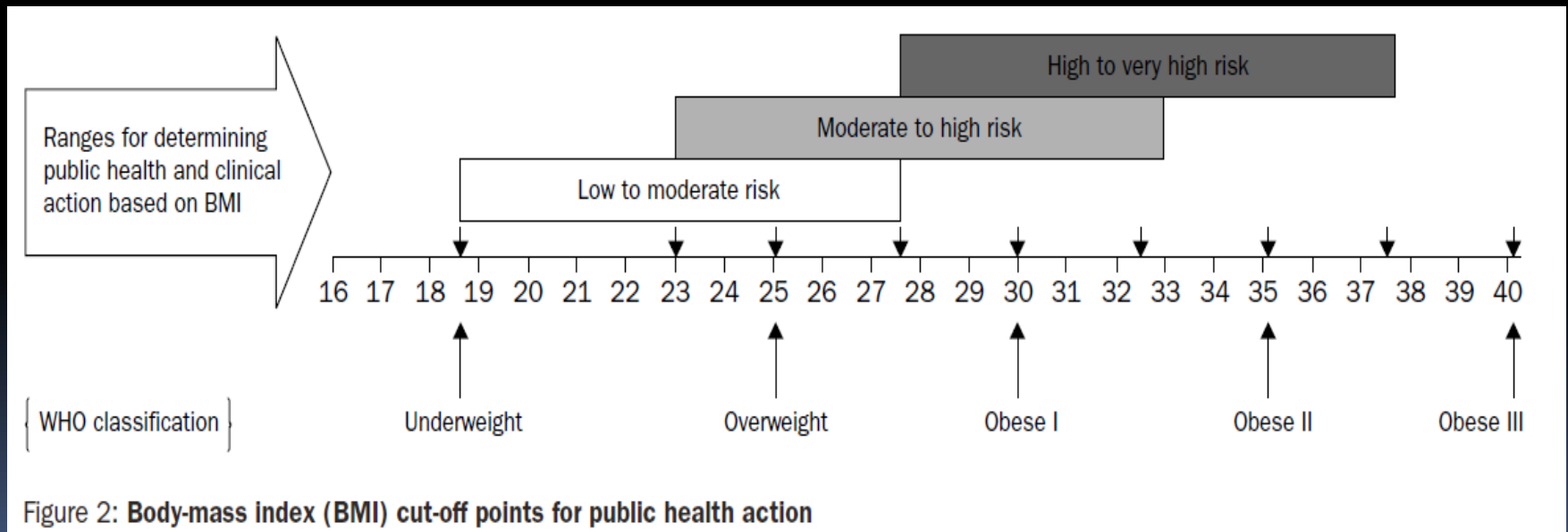
# Barker Hypothesis

- Under nutrition and unfavorable intrauterine environment at critical periods in early life can cause permanent changes (in both structure and function) in developing systems of the fetus (i.e. programming).
- May manifest as disease over a period of time due to 'dysadaptation' with changed environmental circumstances

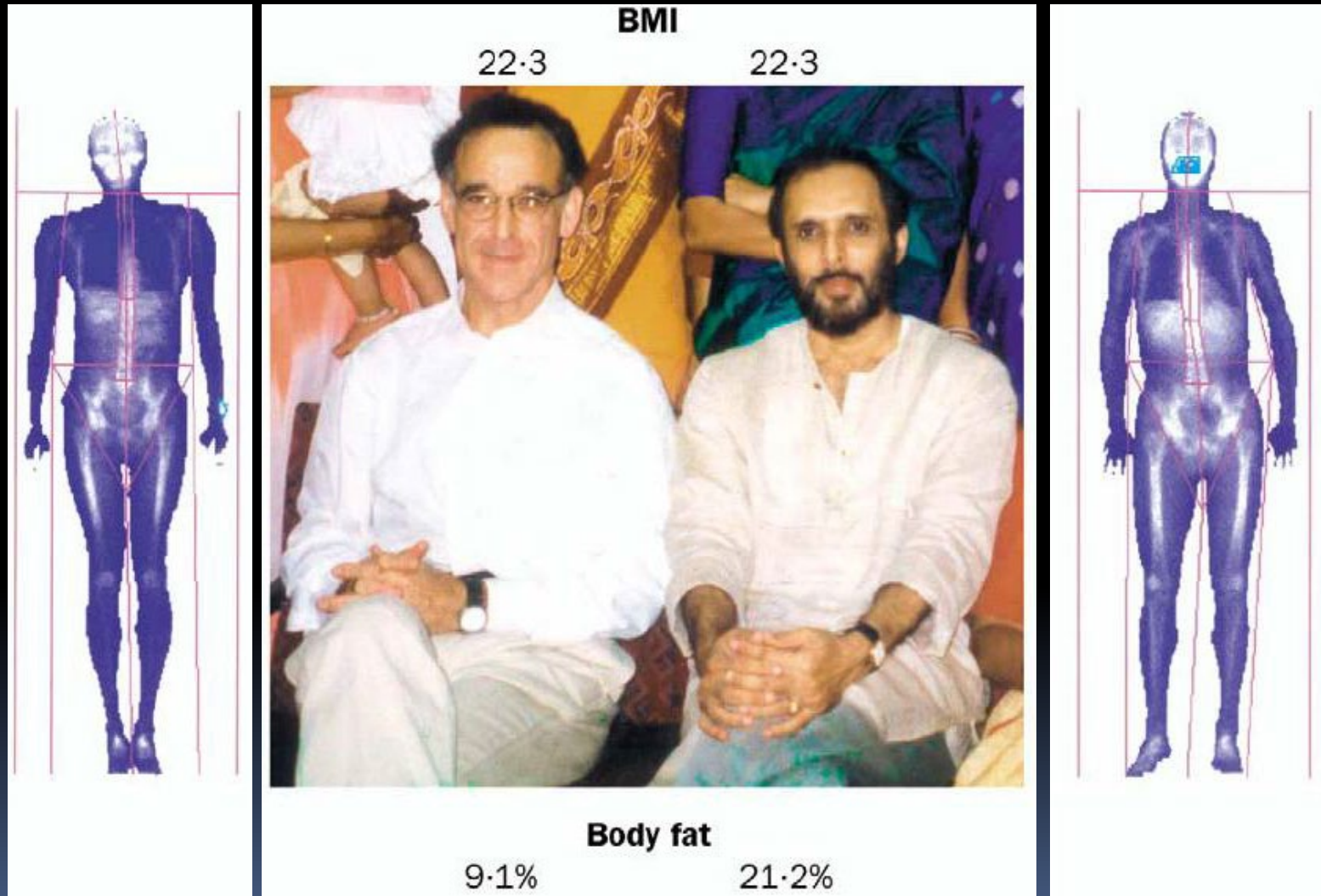
Barker DJP. Mothers, babies and health in later life. Edinburgh: Churchill Livingstone, 1998.

# Biological differences accentuate and speed up the effects of nutritional changes

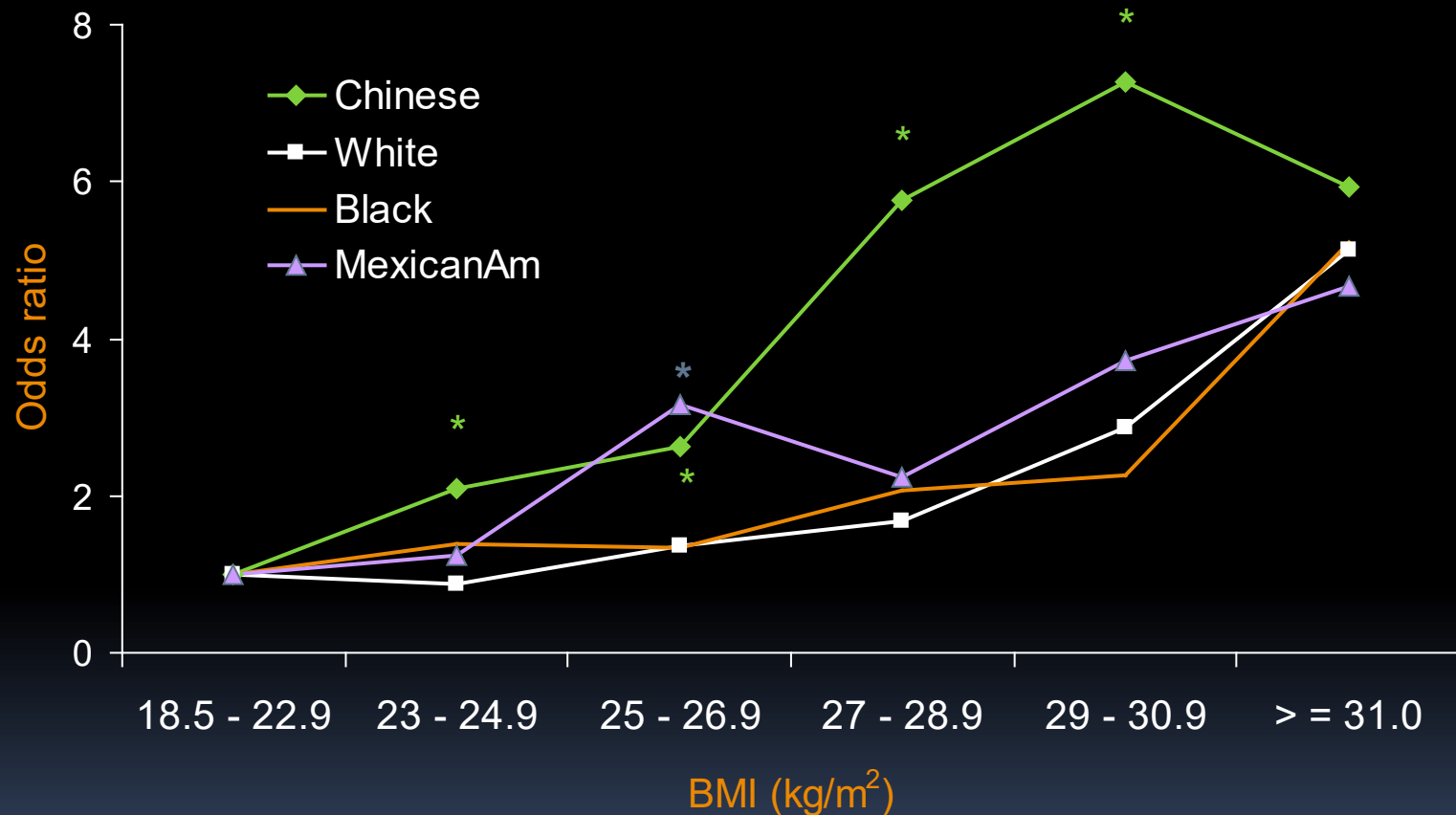
- ◆ There are important body composition differences that lead to shifts in BMI-disease patterns. The Asian recommendation to reduce the BMI cutoff for overweight and obesity are examples.



# The consequences vary by race-ethnicity: Body fat composition in the East vs the West



Compared to US-White males, the **odds of prevalent hypertension** were significantly higher for Chinese men at every level of BMI above the range 18.5-22.9 kg/m<sup>2</sup>. Adjusting for waist: hip ratio attenuated the ethnic differences but did not eliminate them.



\*  $p < 0.05$  from US-White men

Source: Bell et.al., 2002



# INTERPERSONAL LEVEL



# Breastfeeding



- Being breastfed is protective for MCBF in **Indonesia** (**OR:0.84**; 95% CI:0.81,0.84) as well as in **Bangladesh** (**OR:0.55**;95% CI:0.52-0.58) (Oddo VM et.al., 2012)
- Breastfeeding for a minimum period of **30 days** had a protective effect against overweight in preschool children of the semiarid region of Alagoas, Brazil (Ferreira HS et.al., 2009)

# Large family size

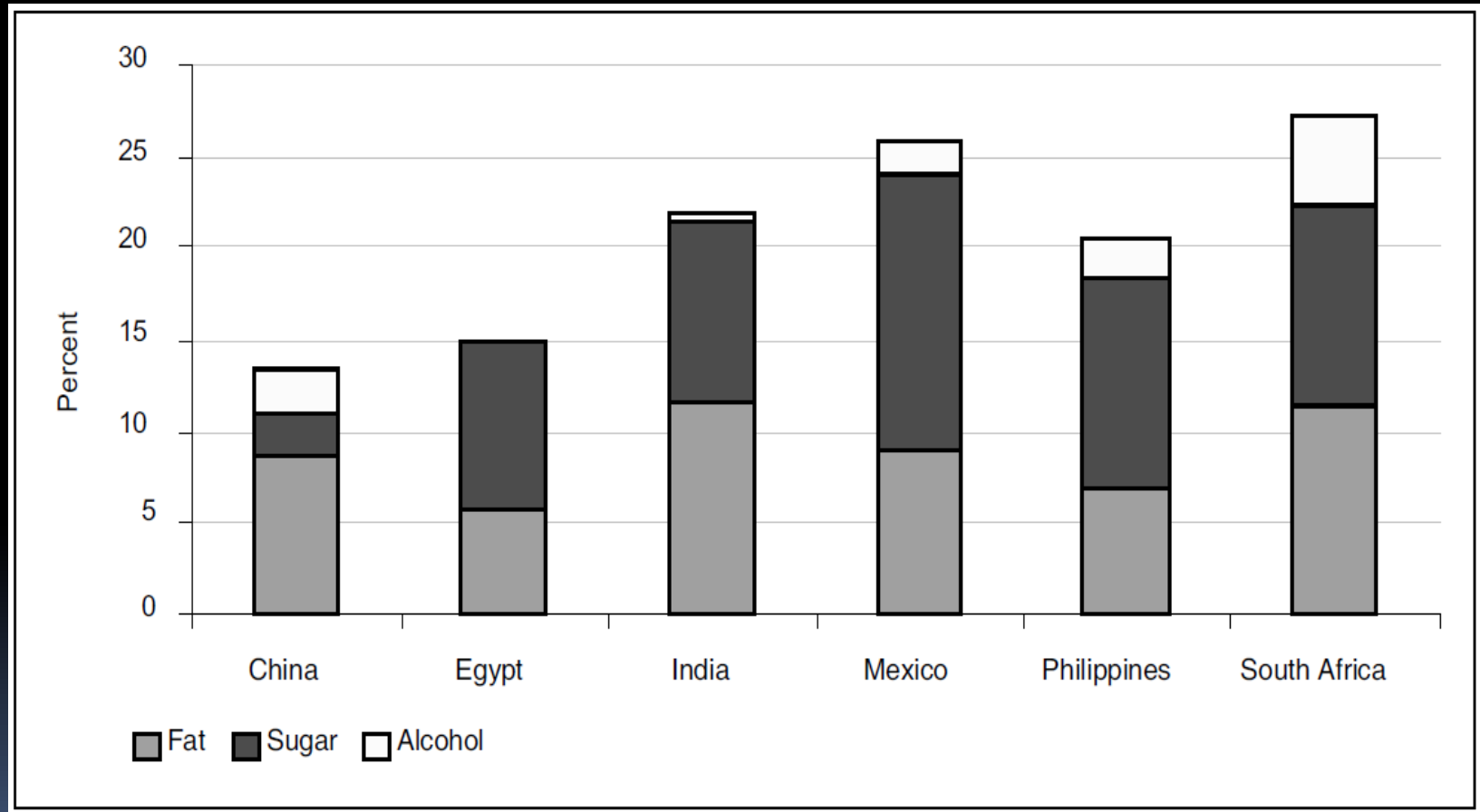


- Large family size was risk factor for MCBD in **Indonesia** (OR:1.34; 95%CI:1.28,1.40) and also in **Bangladesh** (OR:1.94; 95% CI: 1.77, 2.12) (Oddo VM et.al., 2012)

# From Traditional to Modern Meals

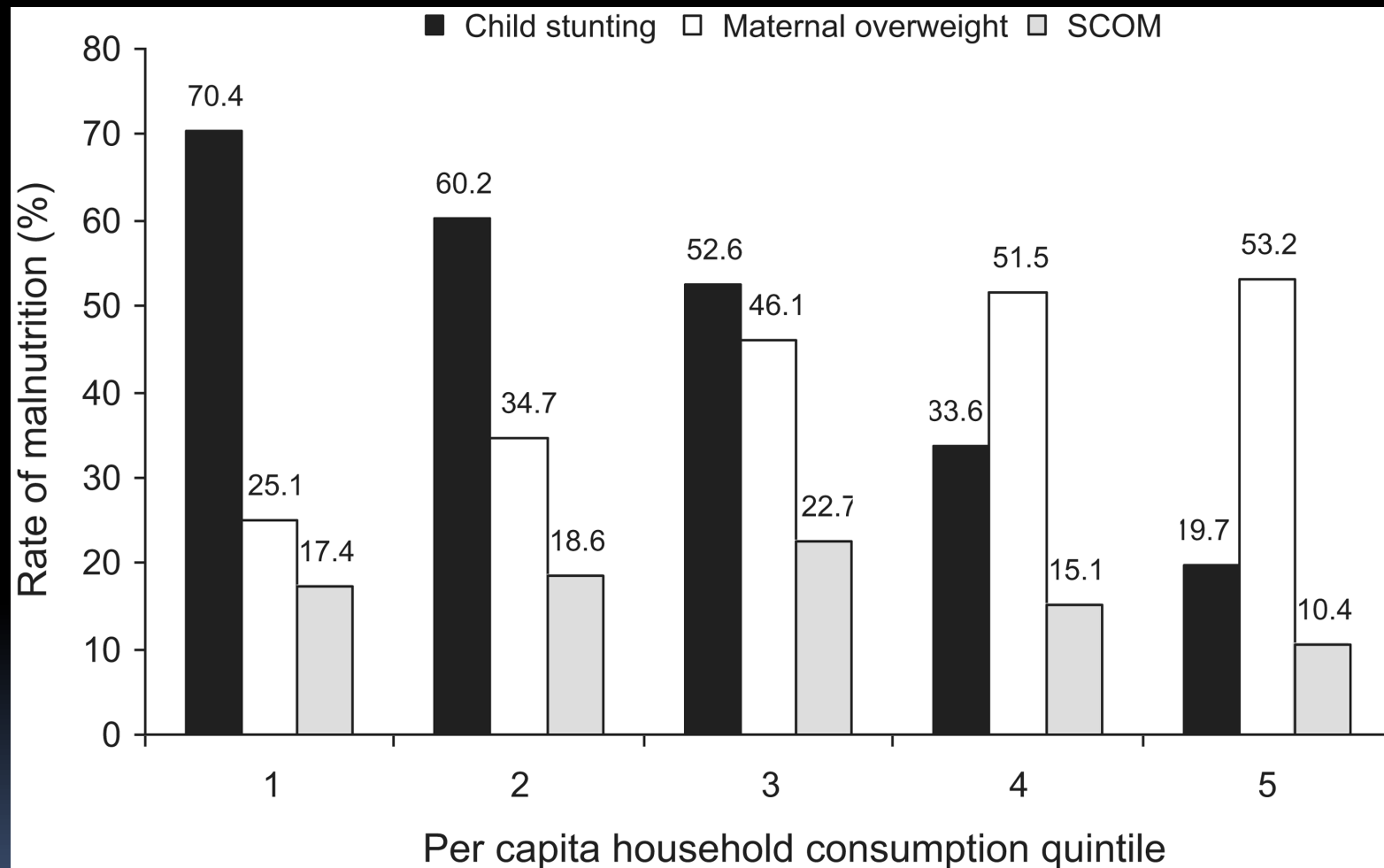


# Percentage of daily energy supply from fat, sugar and alcohol, 2000-2002



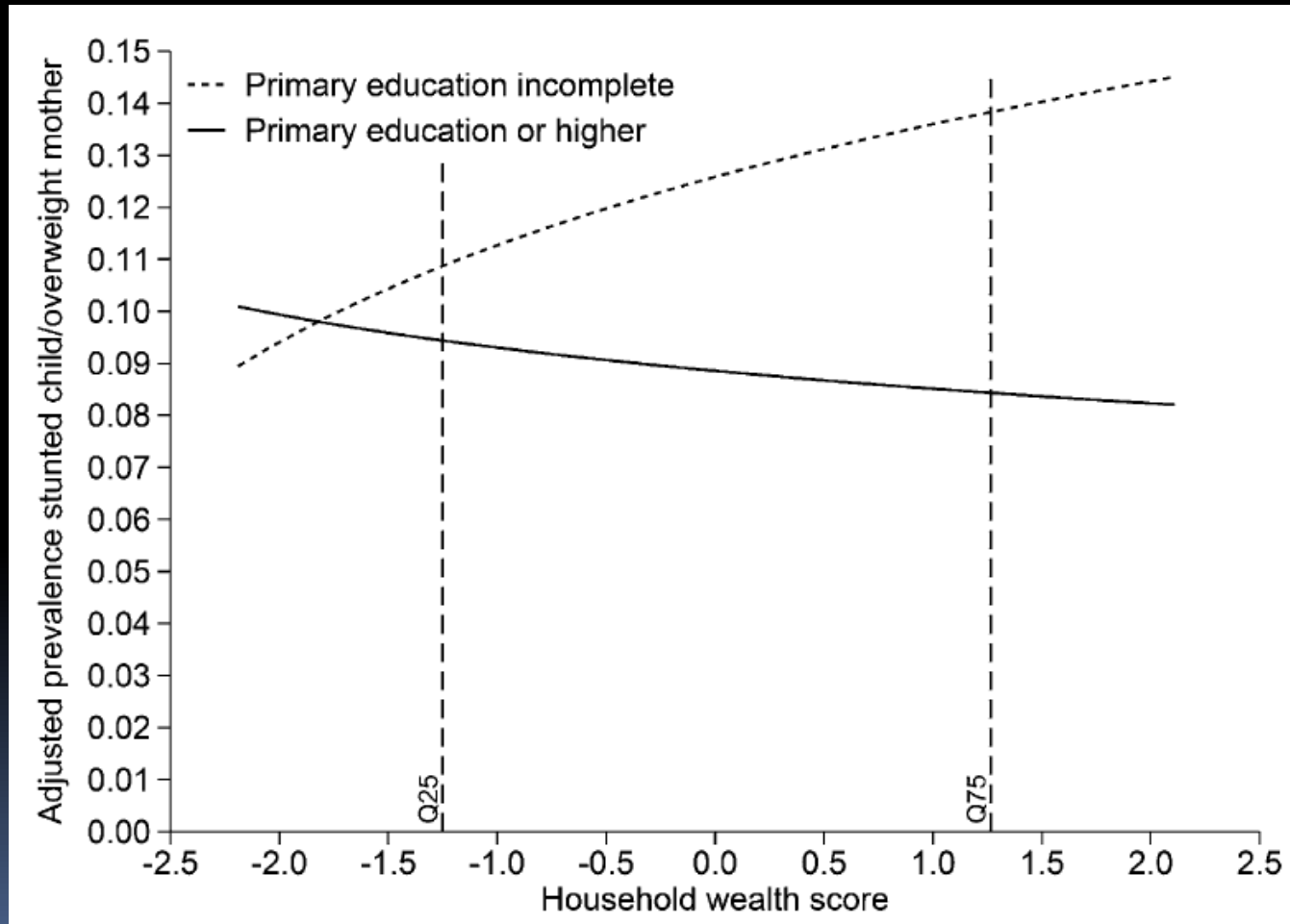
Source: FAO, 2006

# Wealth

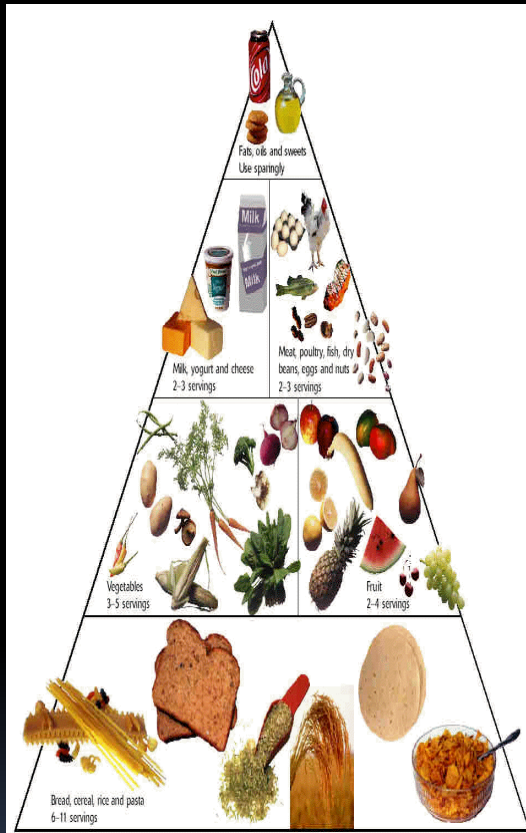


Source: Lee J et.al., 2012

# Maternal education effect?



# Dietary Diversity



- Dietary Diversity Score **positively related** to WAZ ( $p < 0.001$ ) and HAZ ( $p < 0.005$ ) (Ey Chua EY et.al., 2012)
- Food diversity **lower the likelihood** of double burden (Bouzitou G et.al., 2005)
- Maternal nutrition knowledge was correlated positively with children's vegetable intake ( $r = 0.111$ ,  $p < 0.05$ ) and negatively with snack intake ( $r = -0.134$ ,  $p < 0.05$ ) (Poh BK et.al., 2012)

# SETTINGS

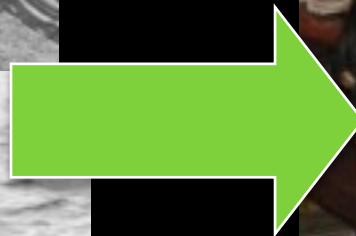


# Rural vs. Urban Area

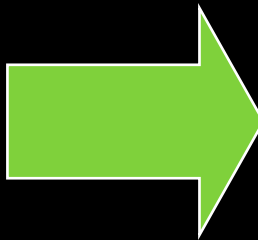


- Significant difference in school children's central fat distribution (CFD) between rural and urban areas in Argentina (Cessani MF et.al., 2013)
- Overweight and obesity higher in urban than rural area in **Indonesia** (Sandjaja S et.al., 2013), **Mauritius** (Caleyacety R et.al., 2012), **Malaysia** (Khambalia AZ et.al., 2012)
- Double burden of malnutrition also occur in rural setting (Oddo VM et.al., 2012)
- Increase prevalence of overweight among both poor rural and urban women (Shafique S et.al., 2007)

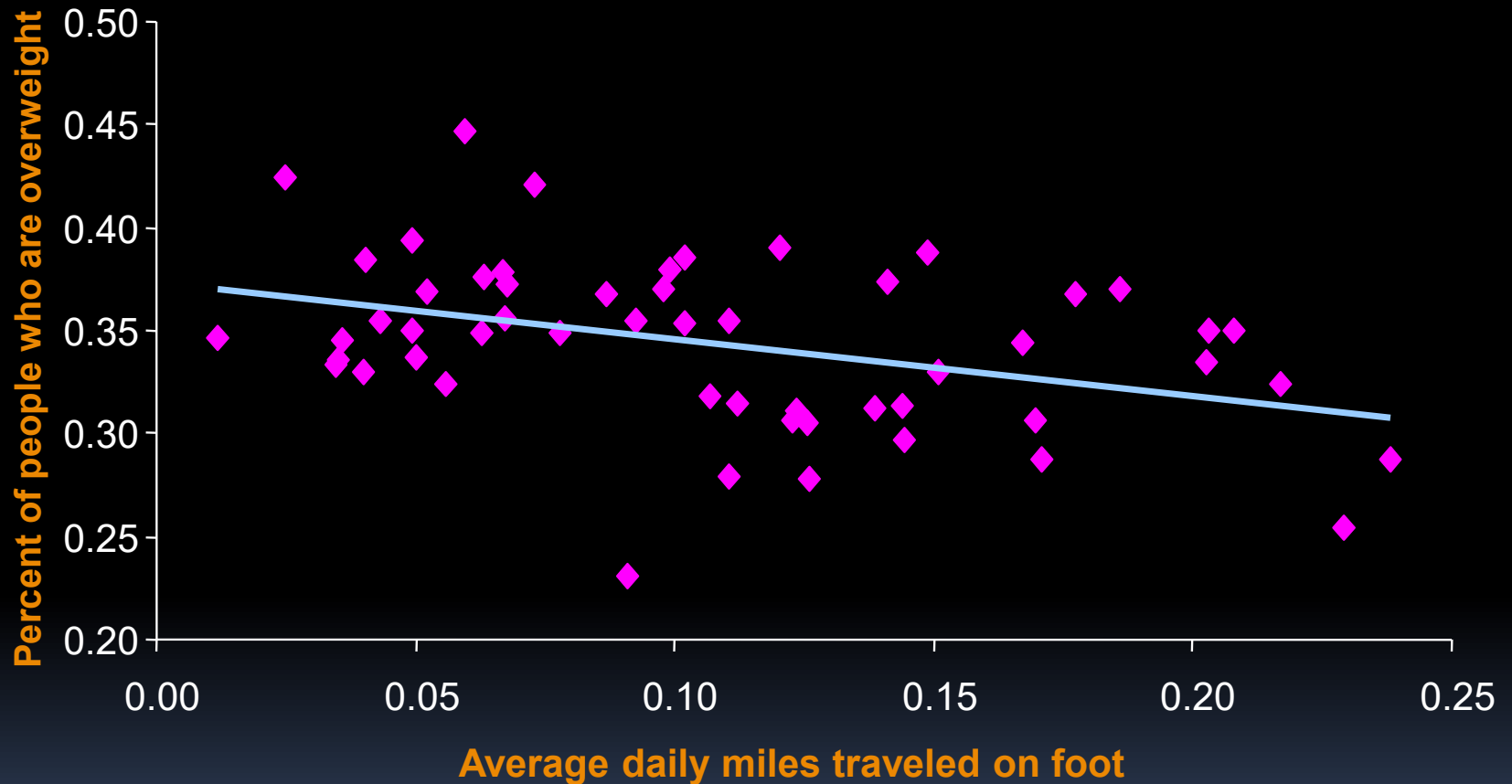
# From Traditional to Modern Leisure



# Shift in Mode of Transportation



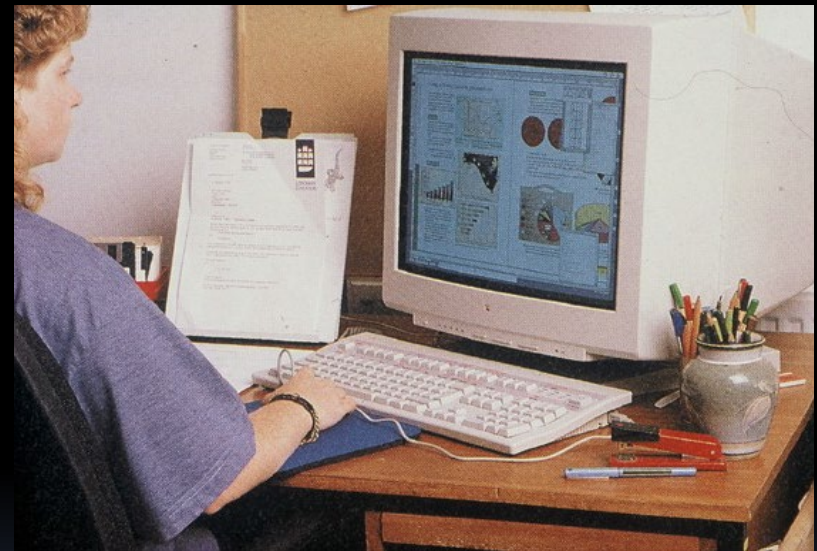
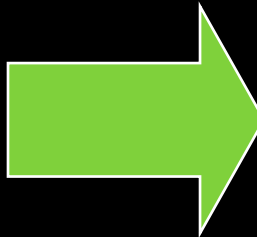
## Fewer People are Overweight in Places Where People Walk More



From the Surface Transportation Policy Project. Based on data from the Nationwide Personal Transportation Survey and the Centers for Disease Control and Prevention.

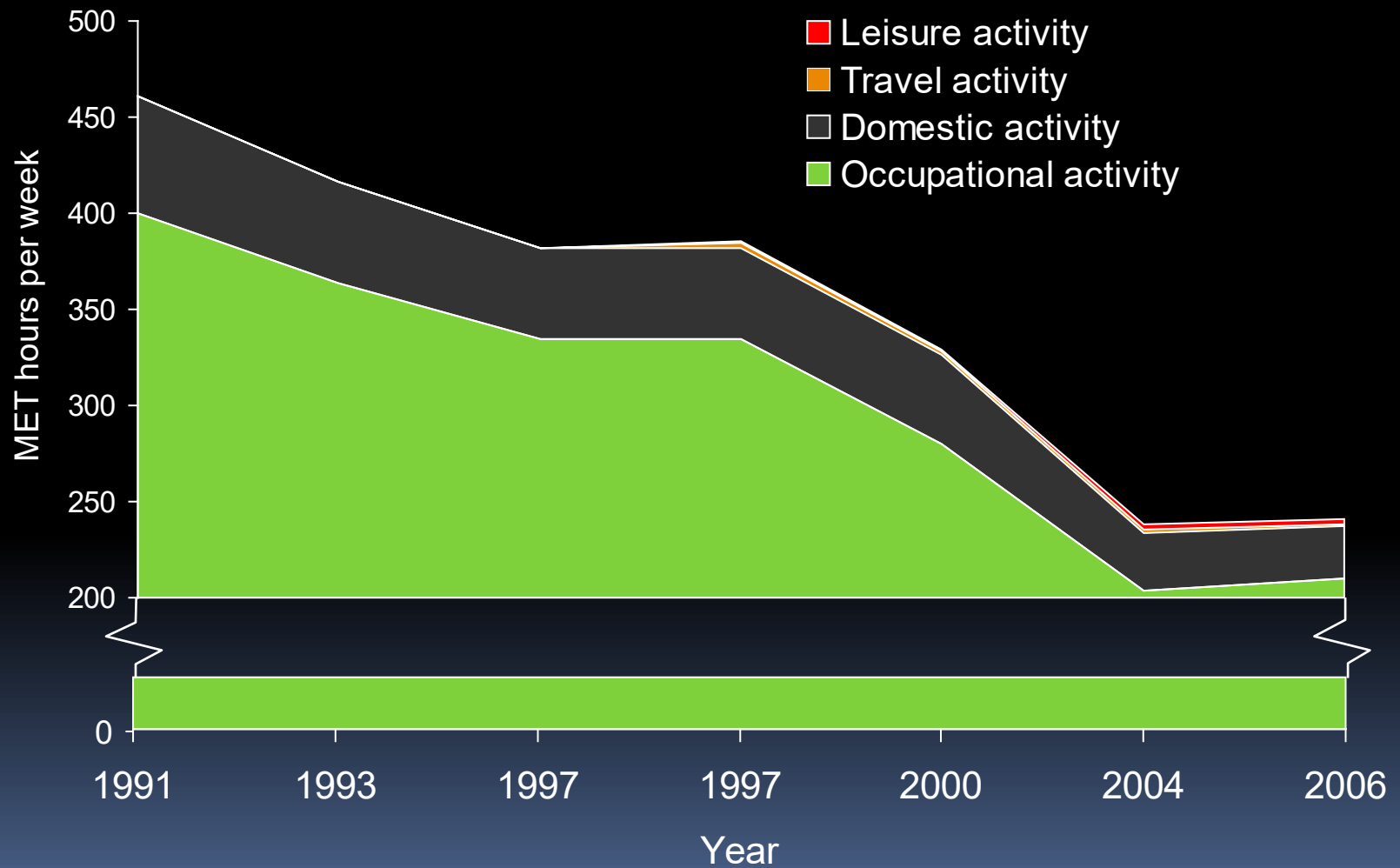


# Shift from labour work to sedentary work



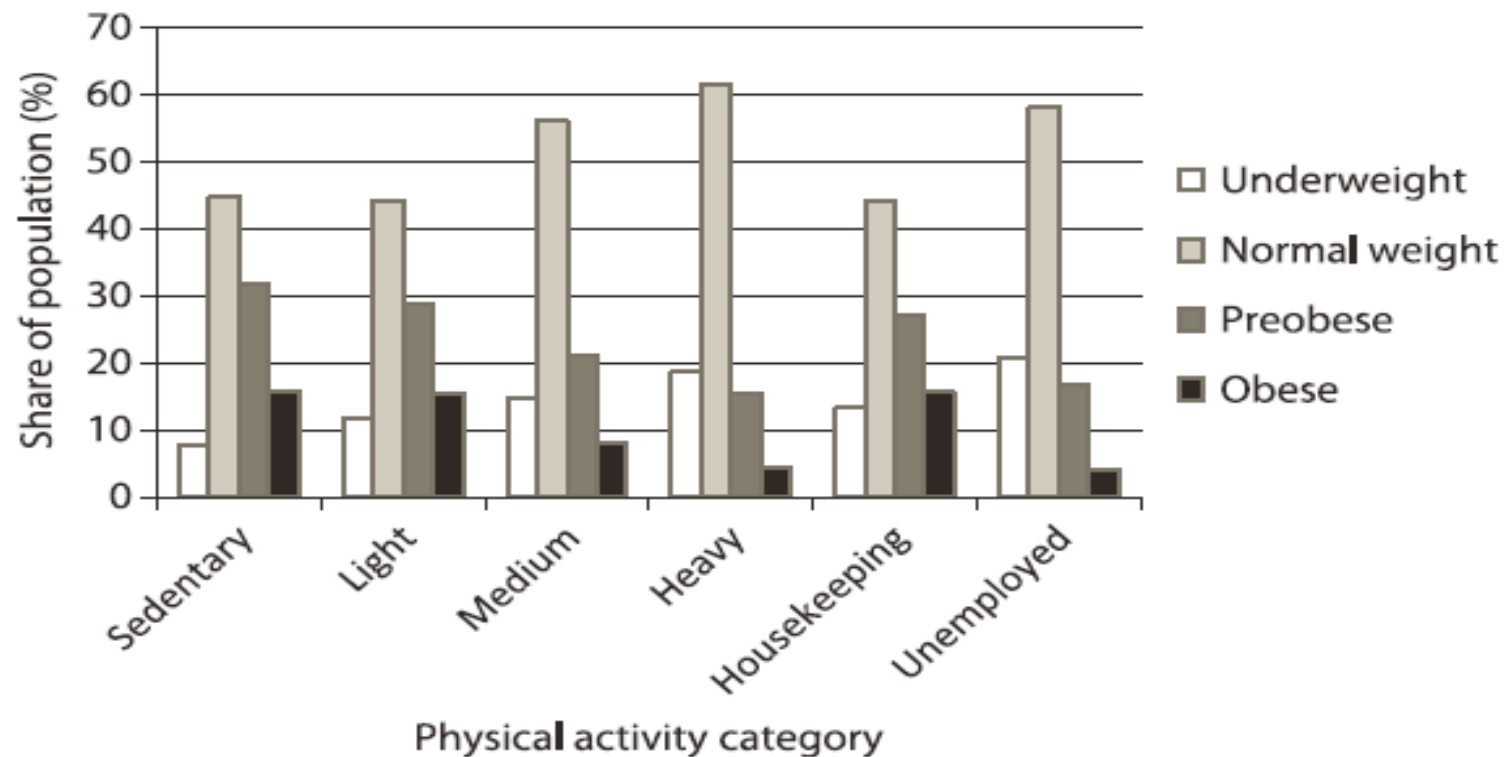
- Changes in PA and diet behaviors in China have occurred at a faster pace relative to other LMICs (Popkin BM, 2014)

## Shift In MET Hours per Week by Activity Among Chinese Women (18-55 Years Old)



Source: Ng ,Norton, Popkin, 2008

## Work-related PA and BMI among Indonesian population



Source: IFLS1, IFLS3, IFLS4

Note: Asian cut-off values were used for BMI categories.

**Fig. 3.** Work-related physical activity and BMI category (1993, 2000, and 2007).

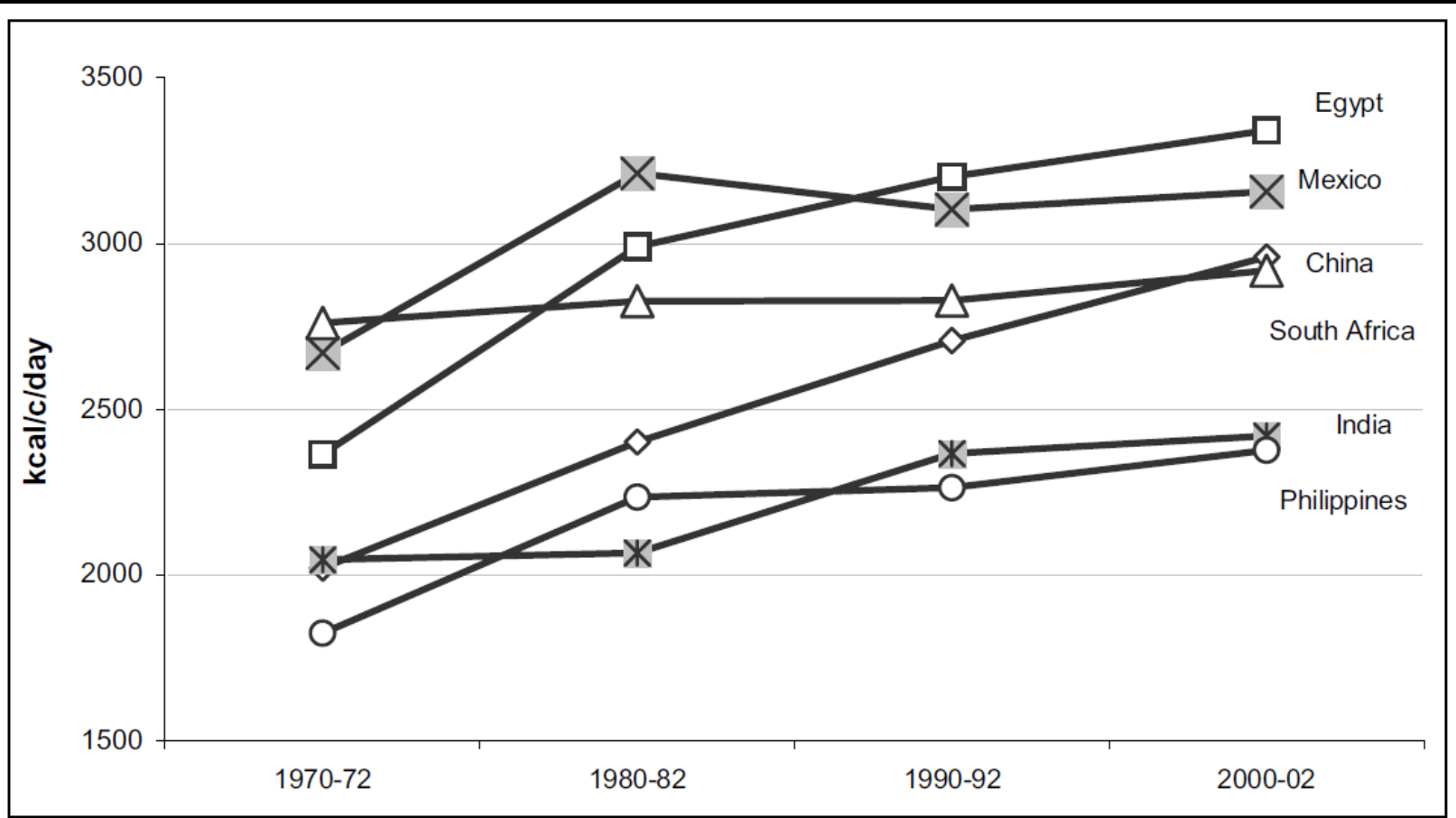


# POLICY AND SYSTEMS



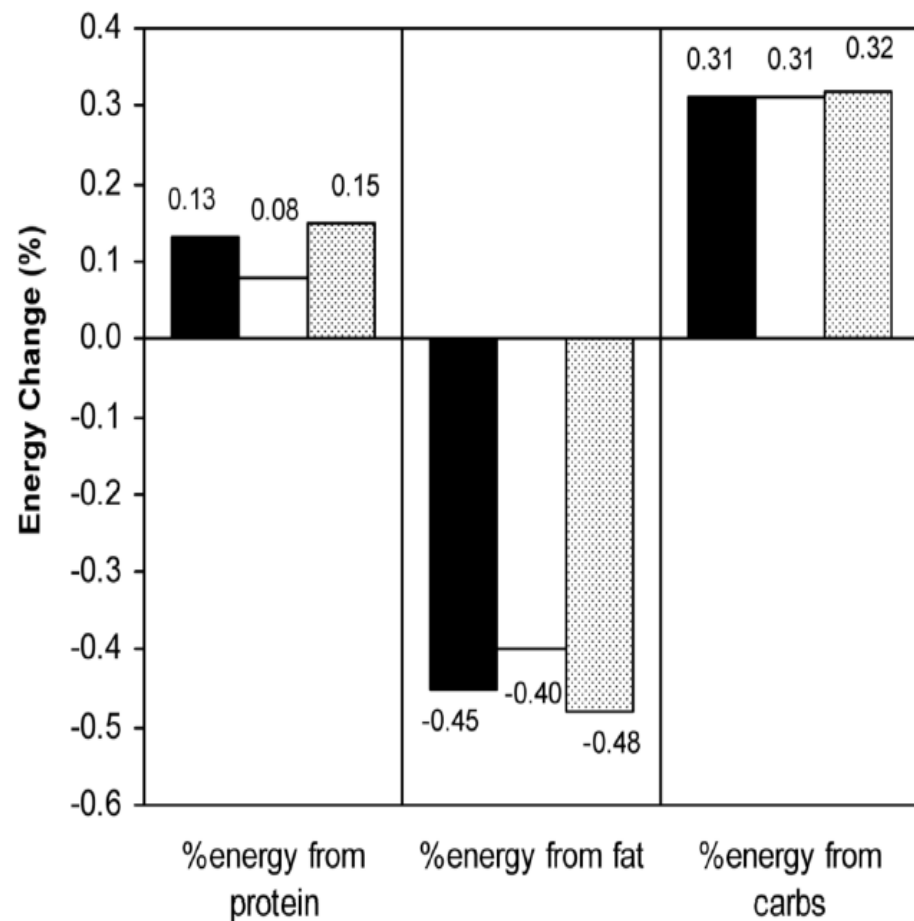


# Trends in dietary energy availability, 1970 to 2000

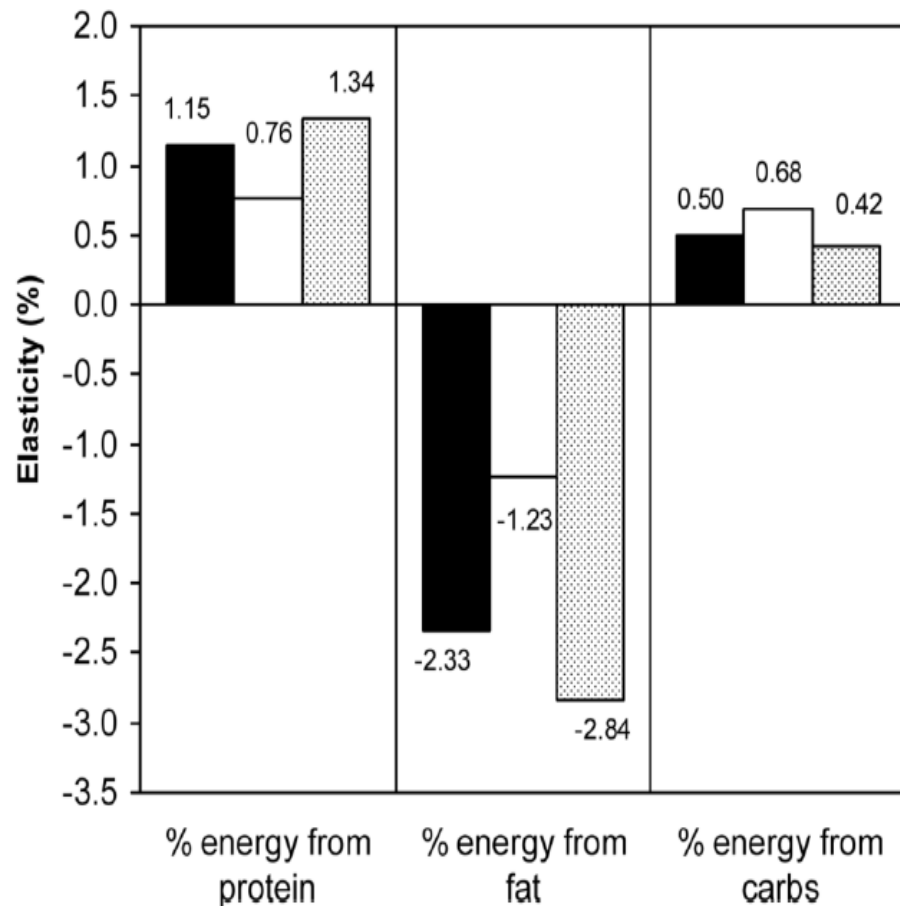


Source: FAO, 2006

**A. Change in the Proportion of Energy Due to a 10% Increase in Real Price of Edible Oils**



**B. Demand Elasticity for Macronutrients Due to a 10% Increase in Real Price of Edible Oils**



■ Total □ Rich ▨ Poor

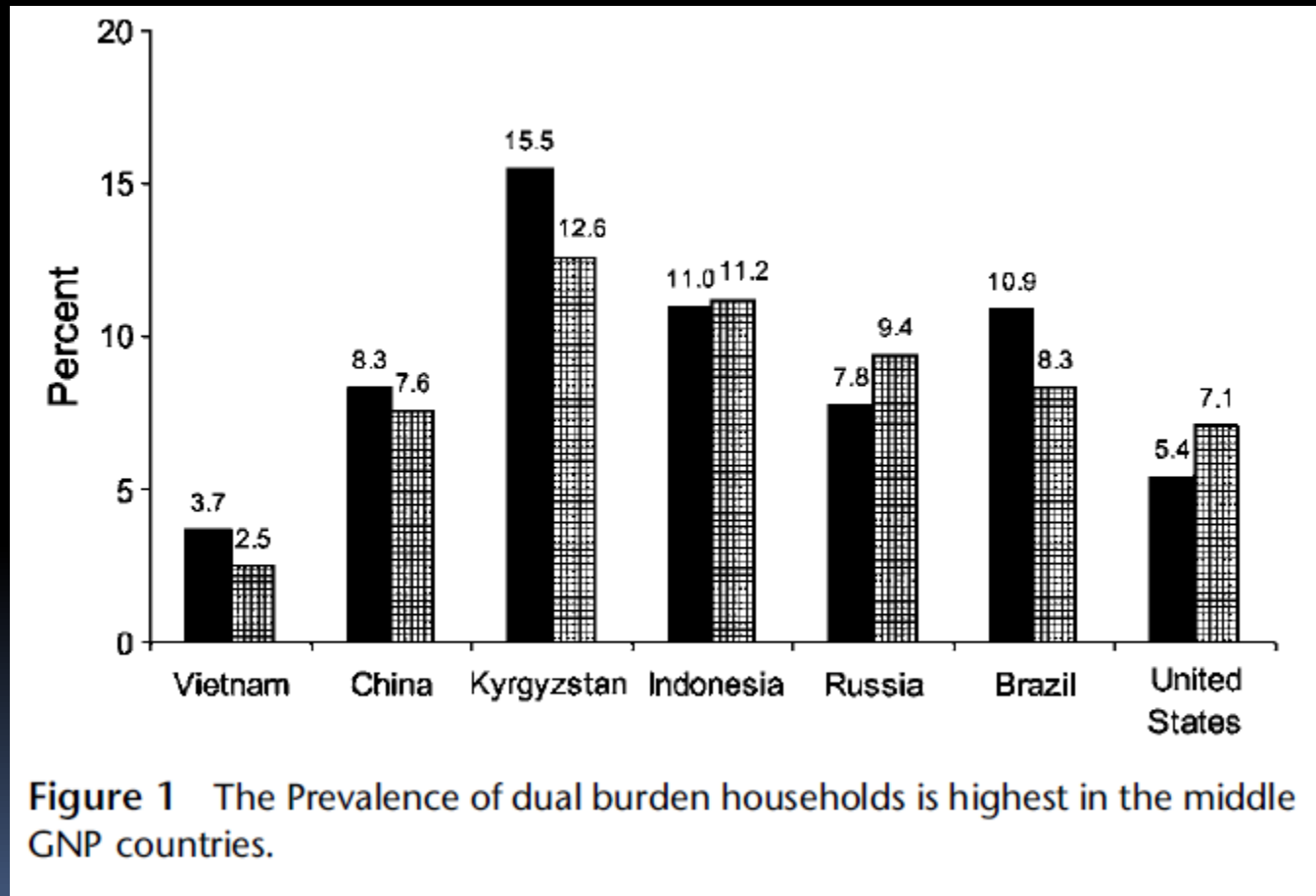
**Figure 3.**

The Effects of Changes in the Price of Edible Oil on Macronutrients (1991-2000)

Source: China Health and Nutrition Surveys 1991,1993,1997,2000

Source: Ng & Popkin, 2008

## Prevalence of Double Burden Households Based on Country's GNP





# Conclusion

- Double burden of malnutrition is a public health phenomenon that associated with arrays of socio-ecological determinants.
- Population undergoing demographic and nutrition transition were the most vulnerable to double burden of malnutrition especially among the middle urban population.
- Addressing malnutrition in all its forms represent an integrated agenda addressing the root causes of malnutrition at all stages of the life course.

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Ricardo  
7 years old

Manuel  
7 years old



**PREVENT STUNTING**  
**GROW THE FUTURE!**

## DISCUSSION