#### Global Obesity: Current Patterns, Dynamics and Future Challenges









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#### Outline: Why is this occurring?

- Dr. Sewell-water and sanitation. My beginnings also
- Global Obesity Dynamics and Consequences
- Major Global Drivers
- How We Move: A cause but not a solution
- The World is Flat and Fat
- Selected economic issues to consider
- How do we proceed

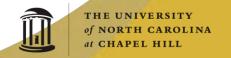
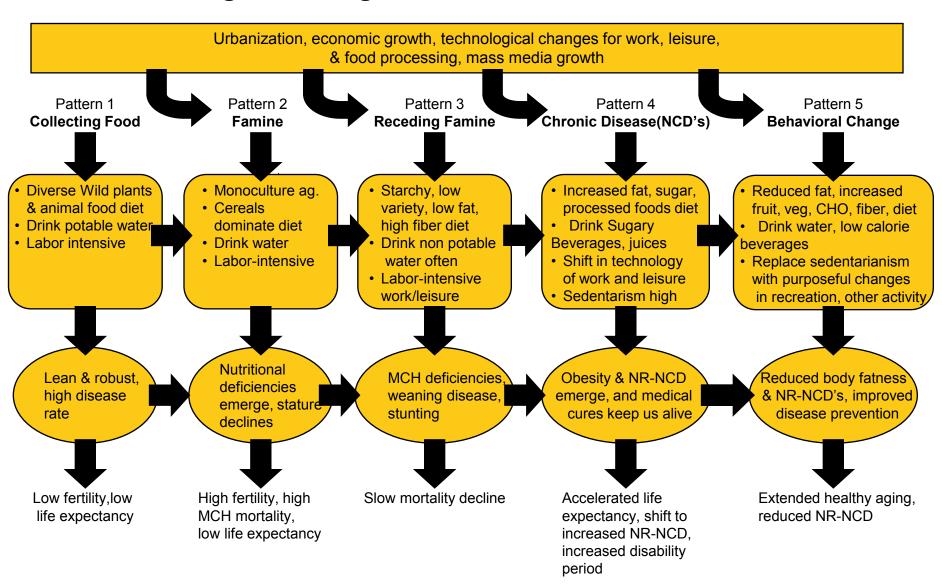


Figure 1. Stages of the Nutrition Transition



Source: Popkin 2002 revised 2013.

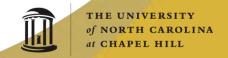
### Mismatch: Biology which has evolved over the millennia clashes with modern technology

Biology	Technology
Sweet preferences	cheap caloric sweeteners, food processing benefits
Thirst and hunger/satiety mechanisms not linked	Caloric beverage revolution
Fatty food preference	Edible oil revolution-high yield oilseeds, cheap removal of oils
Desire to eliminate exertion	Technology in all phases of movement/exertion



## High Income vs.. Transitional and Low Income Countries

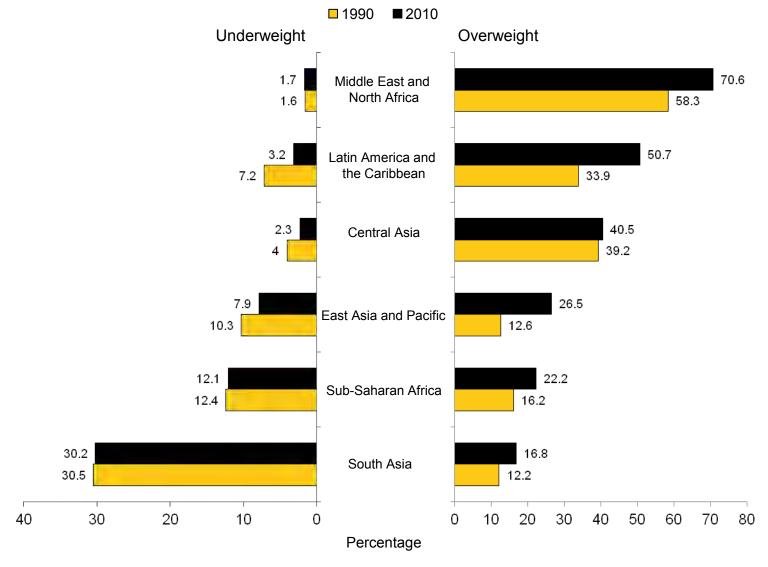
- Obesity has existed in the West for 120 years, Big increase in 1980's
- Low and Middle Income World: last 30 years
- Globally: overweight and obesity exceeds greatly undernutrition in numbers





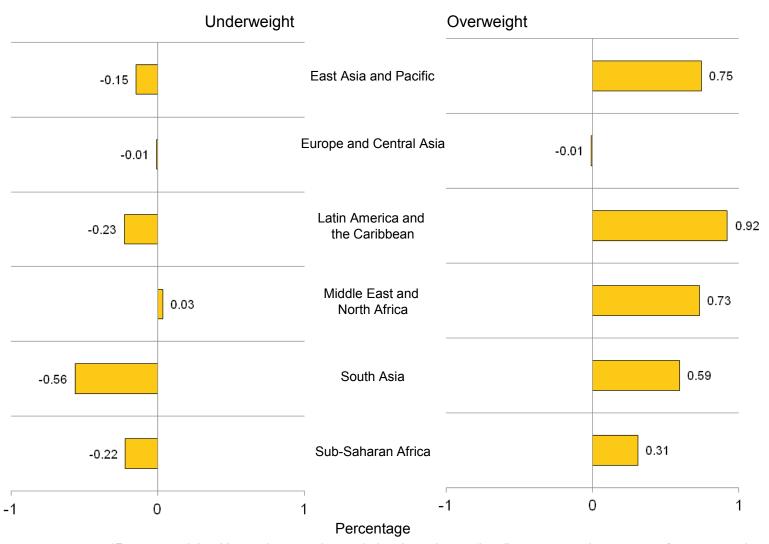
El 54% de los uruguayos tiene sobrepeso u obesidad.

### Shifts in Underweight and Overweight Across the Low and Middle Income World, 1990-2010\*



<sup>\*</sup>Data are weighted by each country's population. based on nationally representative surveys of women aged 19-49 (n=815,609) Underweight is BMI 18.5<. Overweight BMI ≥25 Unpublished data not for use without permission of author.

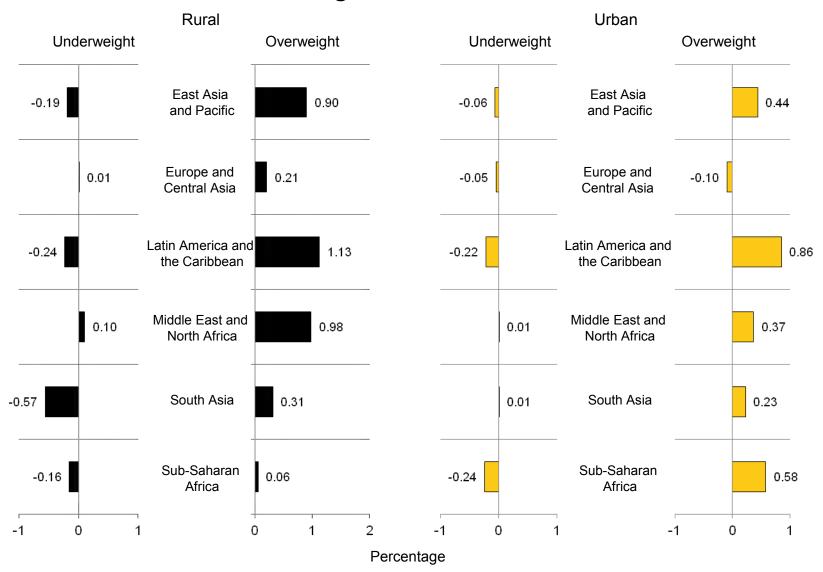
### Regional Population-Weighted Percent Underweight, Overweight, and Annualized Change in Prevalence :1990's to 2000's



<sup>\*</sup>Data are weighted by each country's population. based on nationally representative surveys of women aged 19-49 (n=815,609)

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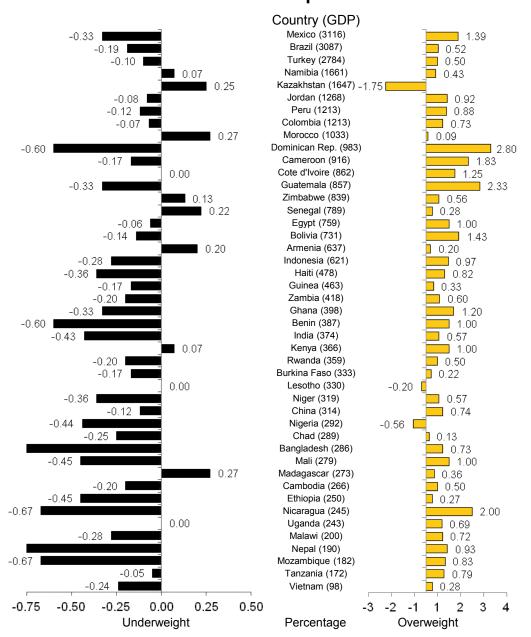
### Regional Population-Weighted Percent Underweight, Overweight, and Annualized Change–1990's 2000's, Rural/Urban



<sup>\*</sup>Data are weighted by each country's population. based on nationally representative surveys of women aged 19-49 (n=815,609)

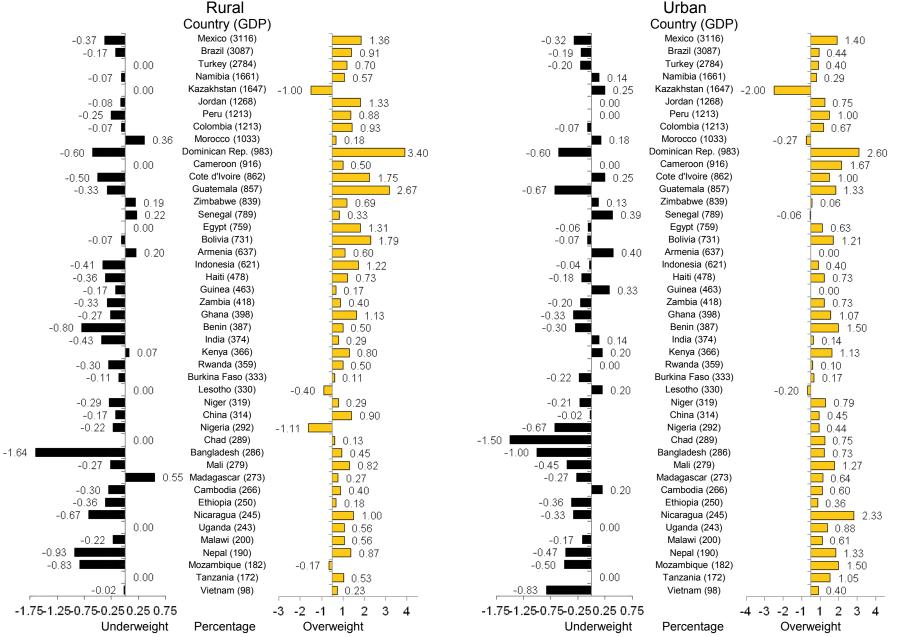
Underweight is BMI 18.5<. Overweight BMI ≥25 Unpublished data not for use without permission of author.

#### Annualized Change in the Prevalence of Overweight and Underweight 1990's-2000's sorted by GNP per capita\*



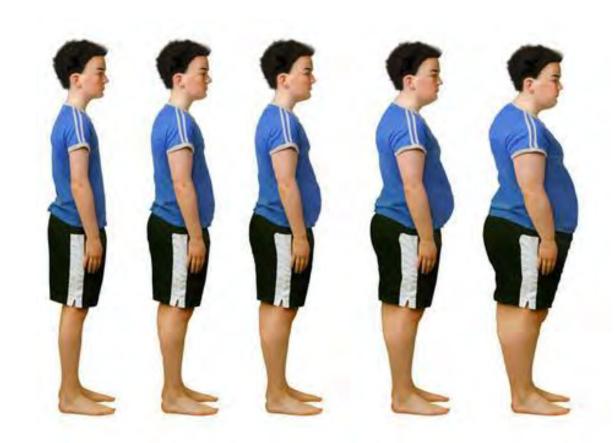
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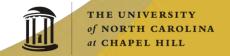


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#### Australian Youth Gain Fat, Shift Body Shape



Based on the research of Olds (2009) EJCN 1-13.



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



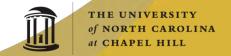
"close to 2 billion people overweight"

of NORTH CAROLINA
at CHAPEL HILL

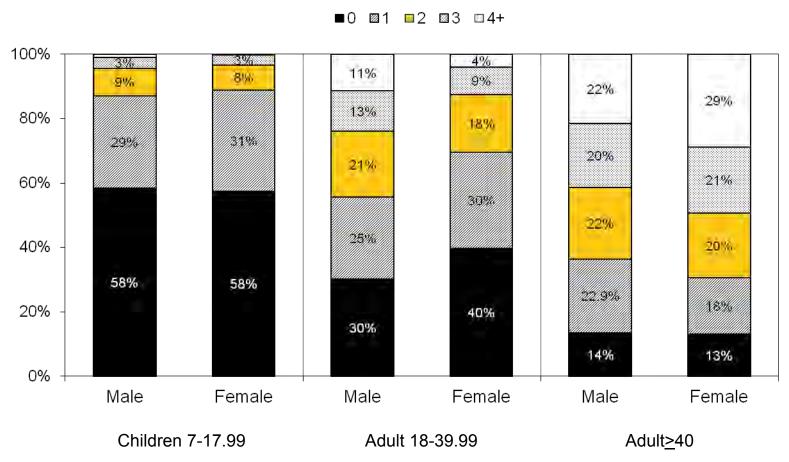
## Chinese Adolescent males ages12-18 face major problems(comparison with NHANES published results)

Males aged 12-18(US 12-19)	China CHNS fasting blood-2009	United States NHANES publications
High HbA1c	1.2%	0.5%
CRP>3	10.4%	8.5%
Glucose≥126 mg/dL	0.7%	0.28%
IFG (100-126mg/dL)	7.5%	20%

Yan et al (2012) Obesity Reviews 13 (9): 810-21 China Health and Nutrition Survey team



### Proportion of The CHNS Sample with CVD Risk Factors by Age Group (age 7-17.99 Years; age 18-39.99 Years, and age ≥40 Years



FOOTNOTES:Yan et al (2012) <u>Obesity Reviews</u> 13 (9): 810-21 Proportion of the population with none, or one or more of the following cardiometabolic risk factors: impaired/diabetic (HbA1c≥5.7%), hypertension (140/90, or age-sex specific percentiles for pediatric population), high TC (≥200 mg/dL), high LDL (>130 mg/dL), low HDL(<40 mg/dL), high TG (≥150 mg/dL), high CRP High CRP (≥3).

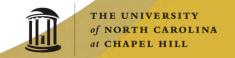
## The burden of disease is shifting rapidly towards the poor.

- Burden of obesity and related chronic diseases are either greater among the poor or shifting to the poor.
- More recent work by Jones-Smith et al (AJE,2011; Popkin, Ng, Adair, Nutr. Reviews 2011; Jones-Smith et al, IJO 2011) suggests majority of countries poor still less overweight but the rate of changes suggest time before the burden shifts to the poor. Others disagree but mainly their focus is on crosssectional data.



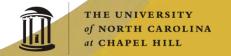
#### **Equity matters also**

 In further results in those 3 papers, we find that as GDP gets higher, the more equitable the income distribution, the more likely it is for the burden of obesity to shift to the poor. This is not terribly surprising either and is an indication of more equitable access to the obesity promoting features of society, such as energy dense foods, sedentary occupations and labor saving devices.



# Major Food System Shifts: Linkages from Farm to Food Sales are Rapidly Shifting

- This represents a major shift away from fresh farmers markets to c-stores and supermarkets for the Low and middle income countries.
- Traditional chain
  - Farmers sale directly in markets or sell to middlemen.
  - Small mills and processors at local level
  - Complex varied distribution
- Rapid transition to modern system varied across Latin America, Africa, Asia at various times over 1980-2010
  - Modern: farmer to processors or supermarkets



# Fresh Markets are disappearing, replaced by convenience stores and supermarkets

- In 1990 15-20% of food sold in supermarkets in Latin America
- In 2000: 60% of the average population share. They are becoming the main buyers in the supply chains for processed foods
- Top 5 chains control two-thirds of the supermarket sector in Latin America (Wal-Mart, Carrefour, Ahold)
- Asia, urban Africa underway

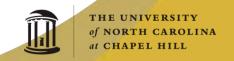




# Shift In Growth and Size of Sales for a Subset of Retailers in Asia

- First wave South Korea(\$42B), Taiwan
  - Annual compound sales growth 2001-09: 10-12%
- Second wave: Indonesia, Malaysia, Philippines, Thailand (\$18B)
  - Annual compound sales growth 2001-09: 13-18.5%
- Third wave: China(\$91B), India, Vietnam
  - Annual compound sales growth 2001-09: 28-50%







- •Income
- Culture
- Market-based food systems











- •Income
- Modernity
- Convenience

## The modern food supply is not what we think it is from our limited measurement

Types of foods & Raw & Perishable		Packaged and processed	Prepared	
Public data	Intake	NHANES Foods as reported	NHANES Foods as reported	NHANES 2007/08: 30% of calories prepared away from home 34% of calories eaten away from home ‡
	Food composition	USDA SR, FNDDS, MPED 7,500 USDA food codes		
Commerci al data	Sales/ purchase	Household panel until 2006 only	Retail Scan & household panels 600,000 UPCs	Consumer panels
	Nutrition	USDA SR	~ 200,000 unique formulations §	At least 1,800 Fast Food items/meals

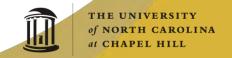
<sup>‡</sup> Poti & Popkin, JADA, 2011 § Ng, & Popkin, JADA 2012



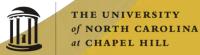


## What drives caloric increases and leads to added energy imbalance?

- Energy imbalance clear major cause
- Understand any diet (high/low protein, fat, or complex carbohydrates diets) all can reduce weight
- The drivers of calorie increases are clear.
- Some beginning sense that lower glycemic foods (e.g.... sugar, refined carbohydrates) may play a role in weight gain, also continued weight loss.







#### **Sources of Major Global Dietary Shifts**

#### Global increases in:

- Caloric sweetener use, especially in beverages
- animal source foods
- refined carbohydrates, ultra refined highly processed foods
- snacking, away-from-home eating, precooked food

#### Global decreases in:

- legumes, vegetables, fruits in most countries
- food preparation time
- Only in Low and middle income world: increased edible oil use and food frying



#### From Traditional to Modern Snacking



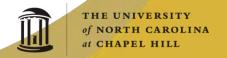


# First major global shift: sweetness, added sugars

Always loved sweetness.

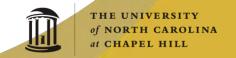
Sweet foods are naturally good and are safe sources of energy and nutrients

What about conditioning, issues of habituation: animal models do not help. We know little.

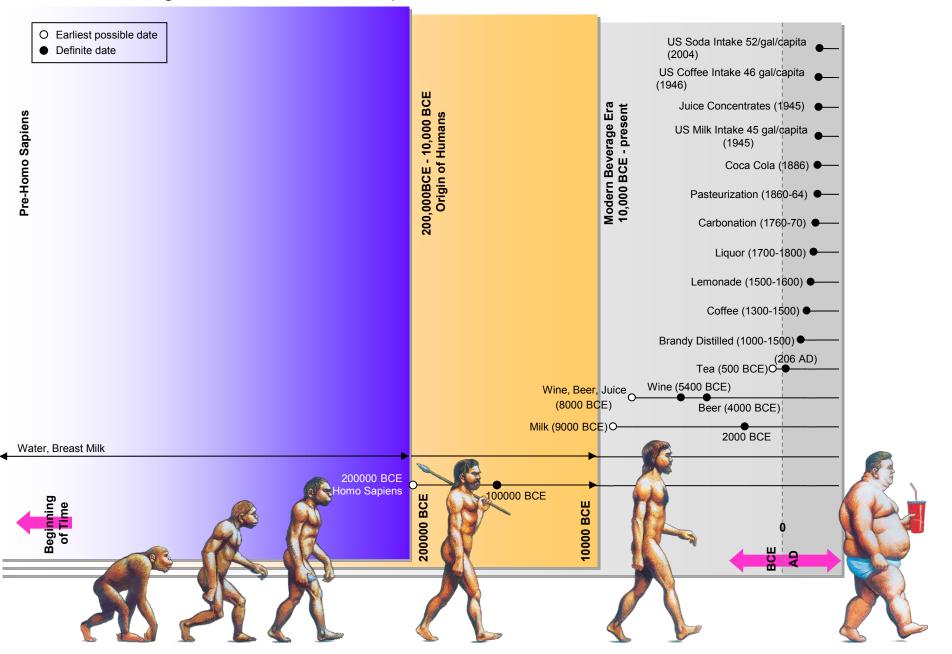


## What are the implications of eating food and drinking water on energy balance?

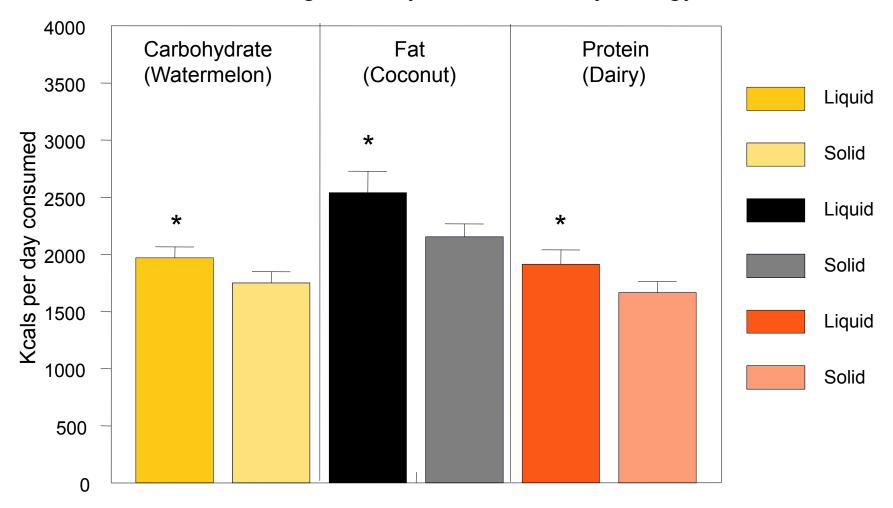
General Properties			
Food	Water		
Hunger – Feeding Sensations that promote attainment of minimal food energy needs	Thirst – Drinking Sensations that promote attainment of minimal hydration needs		
Energy Excess Stored	Water Excess Excreted		
<b>Energy Deficit: Die in 1-2 months</b>	Water Deficit : Die in 3-7 days		



#### Remarkably Short History for Caloric Beverages: Might the Absence of Compensation Relate to This Historical Evolution?



Comparison of consumption of a beverage and a solid food on total Energy Intake shows beverage consumption in any macronutrient form significantly increases dairy energy intake

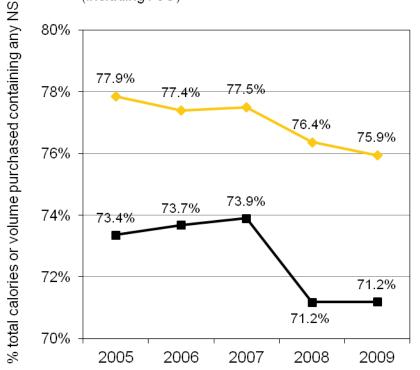


Mourao, .. (2007). "Effects of **food form**..." IJO:**31**(11): 1688-95.

# Total Calories and Volume of Food and Beverages Purchased in the United States Containing Nutritive Sweeteners (NS) and Non-nutritive Sweeteners (NNS), 2005-2009

#### a. Containing any Nutritive Sweeteners (NS)

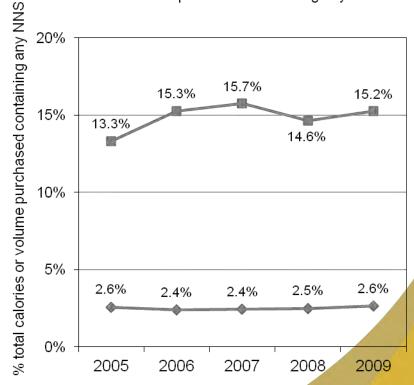
- % total calories purchased containing any NS (including FJC)
- ──── % total volume purchased containing any NS (including FJC)



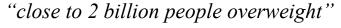
#### b. Containing any Non-Nutritive Sweeteners (NNS)

→ % total calories purchased containing any NNS

---% total volume purchased containing any NNS



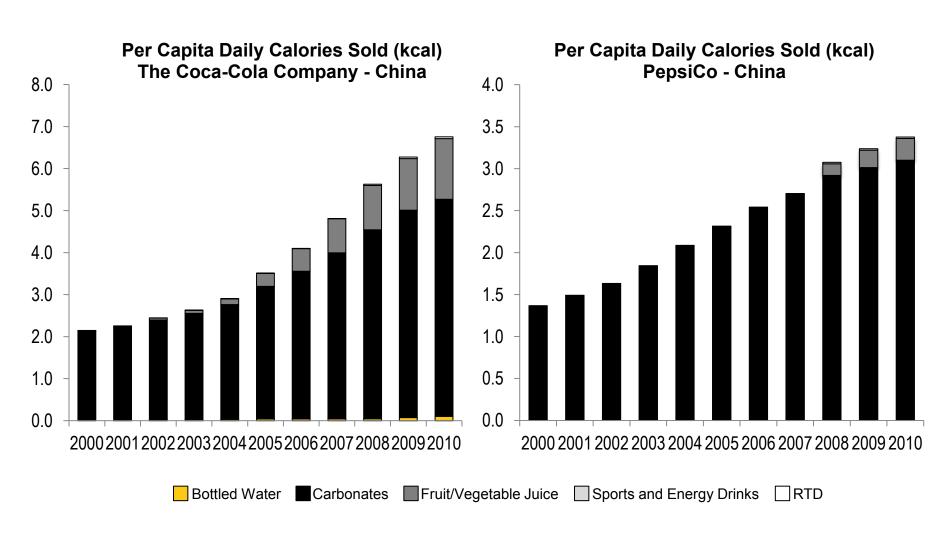
Sources: Nielsen Homescan 2005-2009, Gladson Nutrition Database 2007 and 2010





of NORTH CAROLINA
at CHAPEL HILL

#### Chinese Trends 2000-2010 in Daily Calories



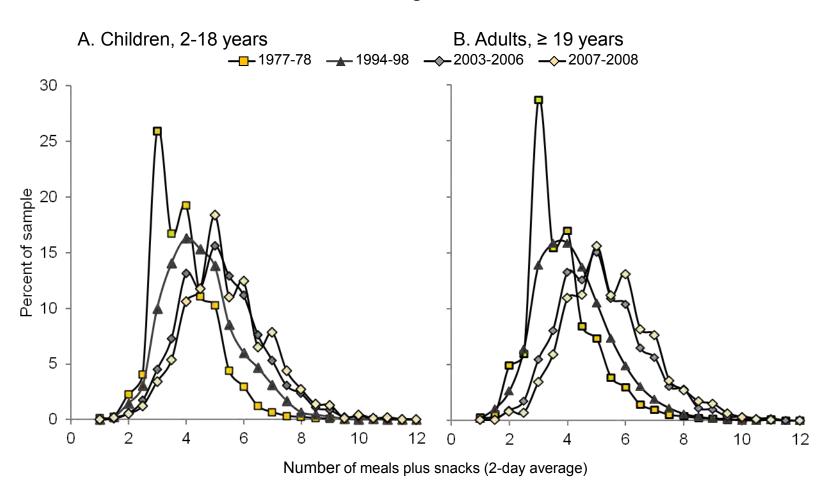
Source: Kleiman, Ng, Popkin, 2012

# Second major global concern: snacking

- Snacking is a norm created by the food industry
- The history of snacking—very rare use until the 1900's except for festivals, royalty, war. No mention of food in early coffee houses. Only in pubs/inns and for meals.
- When did snacking become a norm? Really in the US began post WWII
- Today a different issue: Brazil, Mexico, the US are three countries where our studies show over 22% of kcal come from snacks, increasingly highly processed foods and beverages.

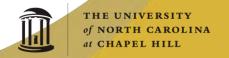


### Daily Meal Frequency Among US Children, Ages 2-18 and US Adults Ages 19 and Older



# Third major shift: Fatty Foods and edible oils in particular

Fatty foods: smoother, affects taste in many ways

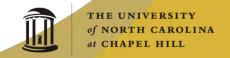






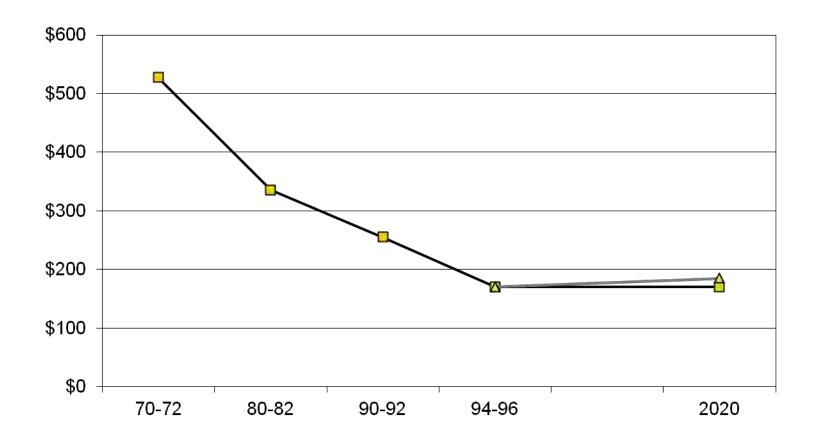
## Vegetable oils: the third leg Edible Oil Consumption Still Rising in China (grams per day per capita)

Year	1989	1991	1997	2006	2009
Poorest (lowest income tertile)	11.8	19.4	26.5	30.8	37.6
Middle income tertile	15	22.4	29	35.4	43.5
Richest (highest income tertile)	17.4	26.9	32.2	33.9	37.7
Average for total adult population	14.8	22.9	29.2	33.4	39.6
% of all calories per capita from edible oil	4.9	7.8	11.3	13.2	14.4



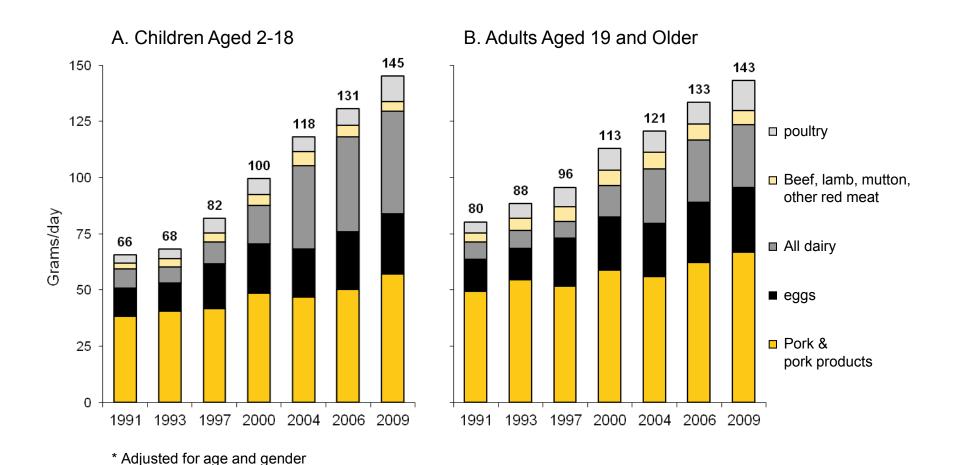
### **Animal Source Foods: the fourth component**

Trends in Global Prices for Beef, 1990 US Dollars



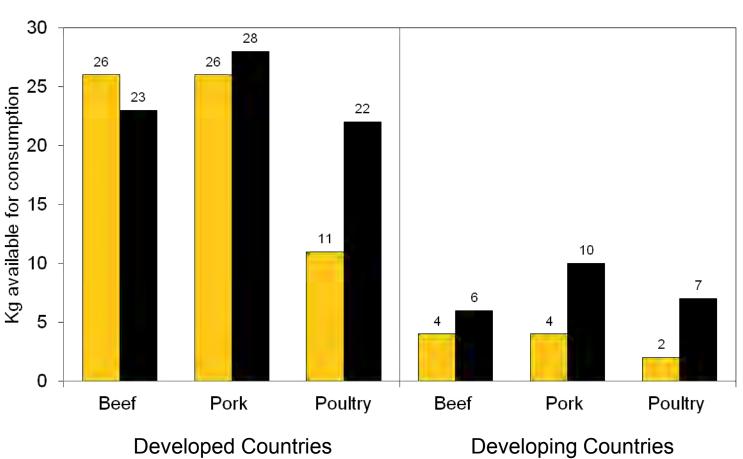
Source: International Food Price Research Institute Cited in Delgado & Courbois 1998

### Daily Intake of Animal Source Foods in China (grams/day),1991-2009\*



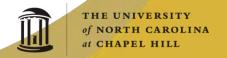
### Dynamics of Developed and Developing Country Beef, Pork and Poultry Food Available for Consumption





## Why the concern about movement and activity

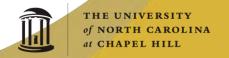
- Important direct health benefits. For kids enhances learning in a vast array of ways.
- Vast array of direct benefits from improved bone health to prevention of diabetes and cardiovascular health to healthier aging
- Important for prevention of 4-5 different cancers
- Indirect benefits via reduced obesity
- Not simple to stop the major declines in energy expended in market and home production, transportation nor to control increases in sedentary activity



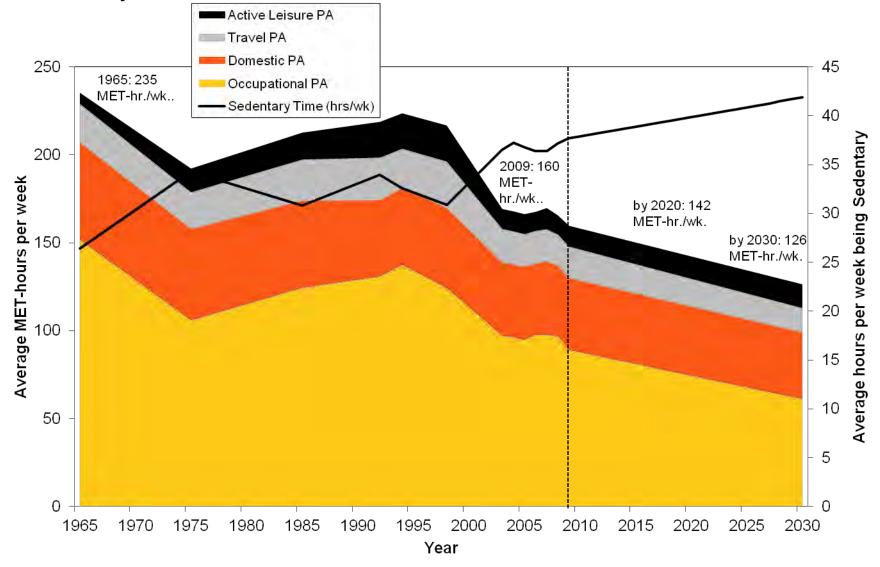
### Context for the following data

- Use a physiological measure called metabolic equivalent of task (MET), which describes the amount of energy spent in accomplishing a task
- a person who slept 24 hours in a day would expend 151
  MET hours per week, and an active adult who did
  vigorous activity for 30 minutes to an hour every day, but
  otherwise had a desk job, would expend between 240
  and 265 MET-hours per week.

Source: Ng S.W. & Popkin B.M. Obesity Reviews (2012). "Modernization, Time Use and Physical Activity: A shift away from movement across the globe"; Obesity Reviews 13 (8):659-80

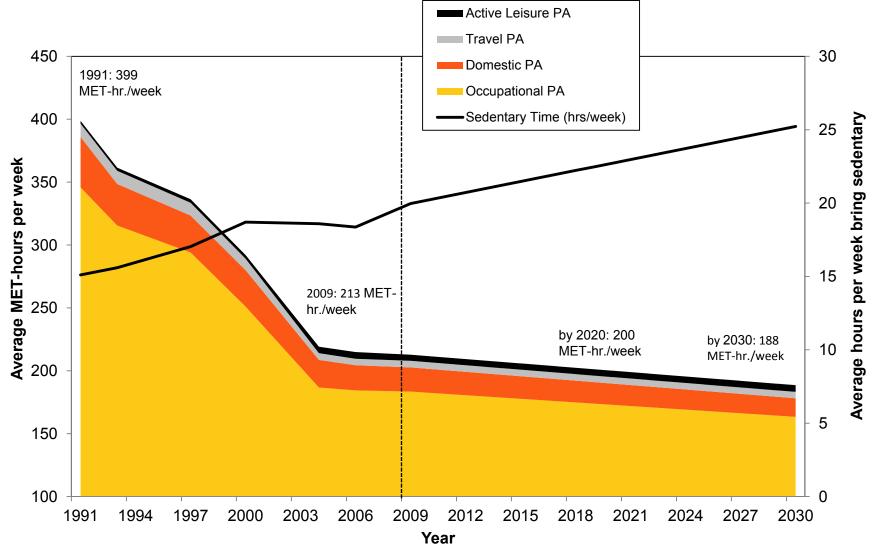


**US Adults** Met-hours Per Week of All Physical Activity, and Hours/Week of Time in Sedentary Behavior: Measured for 1965-2009 and Forecasted for 2010-2030



Source: Ng S.W. & Popkin B.M. Obesity Reviews 13 (8):659-80

Chinese Adults Met-hours per Week of Physical Activity & Hours/Week of Time in Sedentary Behavior: Measured for 1991-2009 and Forecasted for 2010-2030



Source: Ng S.W. & Popkin B.M. Obesity Reviews (2012). "Modernization, Time Use and Physical Activity: A shift away from movement across the globe"; Obesity Reviews 13 (8):659-80



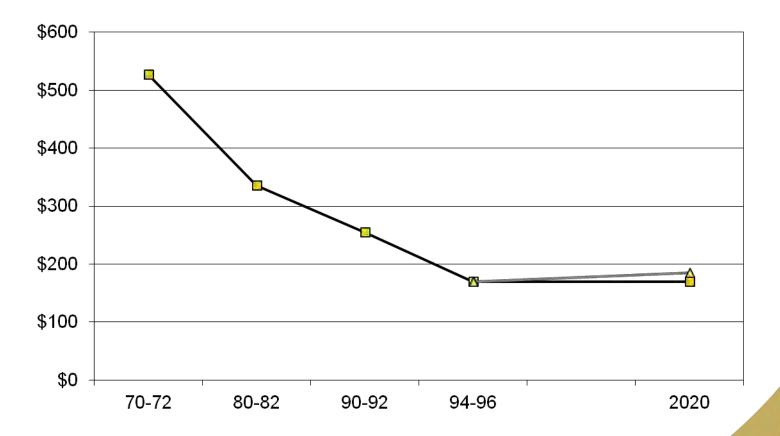


## Food Policy-The Orientation of the Agricultural-Food Sector May be the Key

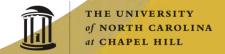
- 1880's: first cash crop research stations-sugar
- Slow evolution of research, subsidies, funding
- Orientation: global spread of US and European approach: focus on basic staples and then animal source foods



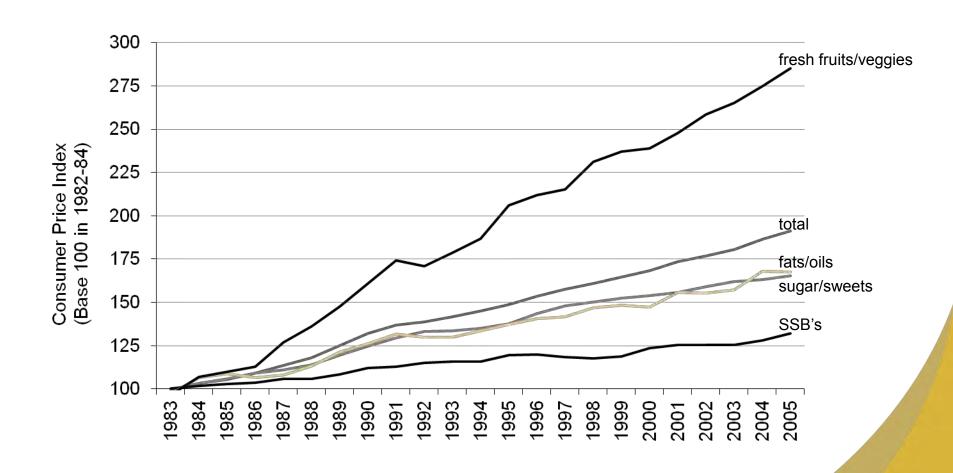
#### Trends in Global Prices for Beef, 1990 US Dollars

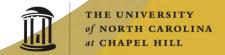


Source: International Food Price Research Institute Cited in Delgado & Courbois 1998



#### Relative Prices in the United States, 1983-2005





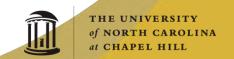
### The Policy Intervention Ladder

- Eliminate choice
- Restrict choice
- Guide choice through disincentives
- Guide choice through incentives
- Guide choices through changing the default policy
- Enable choice
- Provide information
- Do nothing or simply monitor the situation



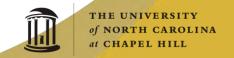
## Global Public Health Solutions to Obesity, Related Comorbidities, Disabilities

- Beverages: new science has led this to become a major target.
- Restrict labeling on package fronts. Gov't sponsored front-of-the label signs designating healthfulness
- Restriction, control for school feeding, many gov't food programs across the globe
- Mass media: control advertising of unhealthy foods and beverages



### **Economic Policies Might Work**

- Tobacco is the prime example of the value of price policy
- Examples show the potential.
- However no examples exist for unhealthy foods taxed for healthy reasons with any linkage to measures of health outcomes—only longitudinal studies linking price changes to beverage changes to health outcomes.

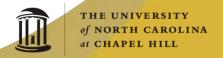


### **Methods: Price Elasticity of Demand**

- Elasticity= % change in demand % change in price
- Own-price elasticity

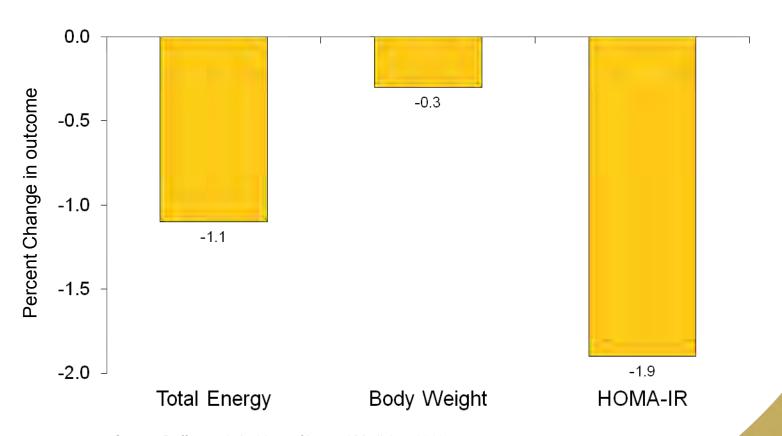
$$\%$$
  $\Delta$  \$  $\longrightarrow$   $\%$   $\Delta$  kcals Negative

Cross-price elasticity

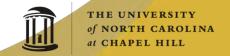


## Adult health significant improvement with a 10% change in the price of soda

US example of a longitudinal study of 5000 adults aged 20-34 over 20 years: similar elasticities seen in research on Mexico and the UK adults.



Source: Duffey et al, Archives of Internal Medicine, 2010

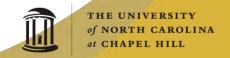




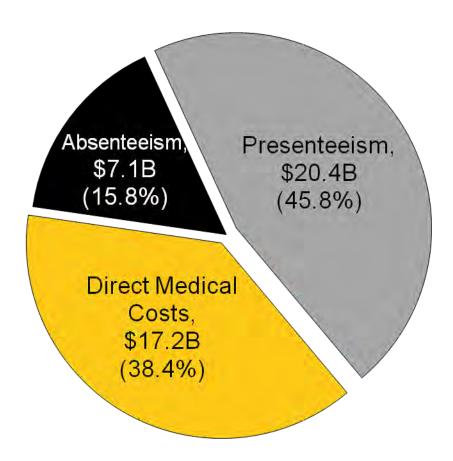


## Why act: obesity debilitates, smoking kills!

- Early mortality not as important as early retirement
- Early disability
- Increased absenteeism
- Increased presenteeism—i.e. lower productivity at work



#### The Indirect Costs of Obesity (BMI 35+) in U.S.

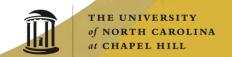


The total annual cost of obesity (BMI 35+) is estimated to be \$44.7 billion among full-time employees in the US

**Source:** Finkelstein E.A., DiBonaventura M., Burgess S.M., Hale B.C. The Costs of Obesity in the Workplace. *Journal of Occupational and Environmental Medicine*, *2010 Oct;52*(10), 971-976.

### Is the private sector the answer?

- Corporate voluntarism abounds: few rigorous evaluations. We are involved in one factory to fork analysis which examines the pledge in reduction of calories sold but also purchases by key subpopulations and ultimately dietary intake.
- Private sector activities are increasing with the major focus on fulltime workforce.
- Also not just food manufacturers but some retailers initiated major activities (e.g.... Wal-Mart, Safeway, Kroger)



## Global changes among insurers, companies

- Discovery: largest insurer South Africa works not just directly with employees of small companies but also with supermarket chains in areas they live in, provides incentives for healthy eating. Only subset of employees enrolled.
- Safeway: US essentially has had constant health costs for five years by working with 100,000 employees across the US and with an insurance company on this topic Only subset of employees enrolled.
- Many factories do this at worksite but other smaller ones use insurers to handle the major shifts

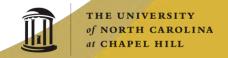
### Other companies

- Dow Chemical: individual consultation with RD, also group consultation, support groups, funded membership in programs such as weight watchers. Covered both employees and families.
- General Mills: screening tool created in 2004. At each manufacturing location developed classes, competitions, nutrition centers.
- Energy Corp of America: 300 employees.
   Comprehensive wellness program rare for smaller companies. Followed up risk assessment with in-person coaching session.



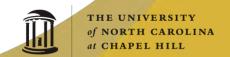
# Now think of the individual outside the company context: The Economic Costs to the Individual Is Reduced Today

- Tremendous increase in medical, pharmacological and surgical treatments for the risk factors and diseases that are related to obesity
  - Statins for cholesterol
  - Metformin for diabetes
  - Many successful Blood Pressure medications
  - Over 1.5 million procedures performed in 2008 in the U.S. aimed at opening up clogged arteries



## The Economic Costs to the Individual Reduced Today

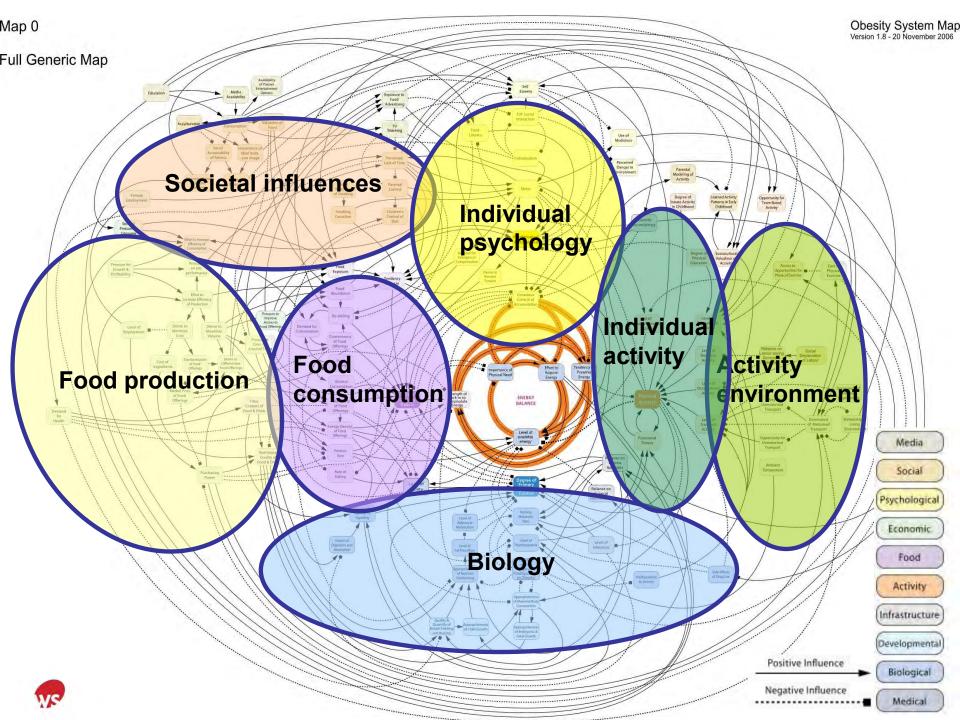
- Among today's obese population, the prevalence of high cholesterol and high blood pressure are now 21, and 18 percentage points lower, respectively, than among obese persons 30 to 40 years ago (Gregg et al., 2006)
- Today's obese population has better blood pressure and Cholesterol values than normal weight adults had a few decades ago because of medications (Gregg et al., 2006)
- Being obese is not so costly anymore



# But it is those without insurance, the low income and SES of the world who are most vulnerable

- The array of successful interventions in low and middle income countries or even high income countries are few
- UK Foresight initiative very promising before ended by different politics of voluntarism. But very interesting to see what the UK started.





## And by leveraging wider policies and funding on prevention e.g. for children



#### **Schools**

- All schools have a legal duty to promote pupils wellbeing, including health
- School assessment takes account of wellbeing indicators
- The voluntary **Healthy Schools Programme** is very popular with heads: 98% of schools participate, 75% have been accredited

### Healthier Food

- £650m 2005-11 to support food and nutritional standards for **food in schools**
- Growing popularity of breakfast clubs as part of schools extended services
- Cooking is compulsory in primary schools

### Physical Activity

- £783m 08-11 to support **PE/Sports Strategy** 5 hours per week
- £235m 08-11 to create/regenerate **3,500 play spaces** in parks/public spaces
- Cycling/school transport

#### **Early Years**

- New national Sure Start Children's Centres one-stop shop for advice on parenting, health, childcare, employment (full network of 3,500 by spring 2010)
- Developing authoritative, evidence-based messages on eating and active play for children under five
- Healthy Child Programme for children under five

### A £372m Investment in Tackling Obesity



#### Children

- National programme to weigh and measure all 4 and 11 year olds
- Ads for unhealthy food banned around children's TV and other media

#### Healthier Food

- Widespread front of pack labelling on food in stores
- Powers to restrict proliferation of fast food restaurants near schools and parks
- Project to supply fresh fruit and vegetables in stores in deprived areas

### Physical Activity

- Be Active, Be Healthy National Physical Activity Plan setting the goal of increasing activity in 2 million more adults by 2012
- £30m invested in nine **'Healthy Towns,'** which lead the way in improving the built environment

### Incentives & Workplace

• Business Health Check Tool to promote boardroom reporting of staff health and wellbeing; get 75% of large firms to sign up

#### Personal Advice & Care

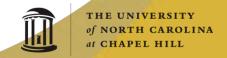
- £66m in **local allocations** to support local action on overweight and obesity
- · National contract of child weight management providers
- All adults aged 40-74 to have BMI assessed as part of vascular risks

### Low and middle income countries

- Little documentation of some very impressive efforts so June Bellagio meeting to get documentation, push evaluation
- Trade policies, taxation changes in Western Pacific
- Major set of programs and policy changes in Mexico(beverage panel, national consensus obesity prevention, strong school food and beverage policy, front of the package label), Chile a few(e.g. label bad foods)
- Thailand, many others started some effective components
- To date no major declines in overweight in LMIC's after some initial hope for Brazil

## Conflicts between current programs and changing needs

- Two worlds—Infection diseases( HIV-AIDS, malaria, TB,etc) vs.
   NCD's domination of deaths and global situation where NCD's are stressing systems.
- Chile: eliminated undernutrition, fought to keep old programs, adverse effects.
- Mexico: Opportunidades and before that Progressa. As needs changed, income and feeding programs focused on the poor led to increased obesity. Realization led to rapid shifts in food programs, food store content for the poor very quickly
- US: SNAP, WIC, School Feeding histories.



## Global emerging conflicts between the different sides of current agricultural & food system Animal source foods: positive & negative health effects

- Major environmental costs: Water use, carbon emissions, etc. Vast needs for water conservation in ag.
- Globally: modern food system with improved sanitation & control of the cold chain for food linked with access to ultraprocessed foods and beverages.
- Dual burden for many nations: need to address wasting and stunting and also reduce the risks of NCD's is the major challenge. Complex intergenerational issues.



### In the US see the conflicts daily

- Major health and health care costs
- Critical economic burden of obesity and all the nutritionrelated chronic diseases
- A food industry that is motivated to sell more calories unless price, regulatory and other changes shift the equation
- The enormous size and power not only of the food industry but equally of all the biological forces that have led us to our current global situation must be addressed



### THE BOOK

"The most serious epidemic ever is insidiously engulfing the world. Barry Popkin draws upon his decades of research and experience to describe its origins—and a set of potential solutions. Those interested in the future of mankind should read this book."

Walter Willett, author of Eat, Drink, and Be Healthy, and chair, Department of Nutrition, Harvard University

