









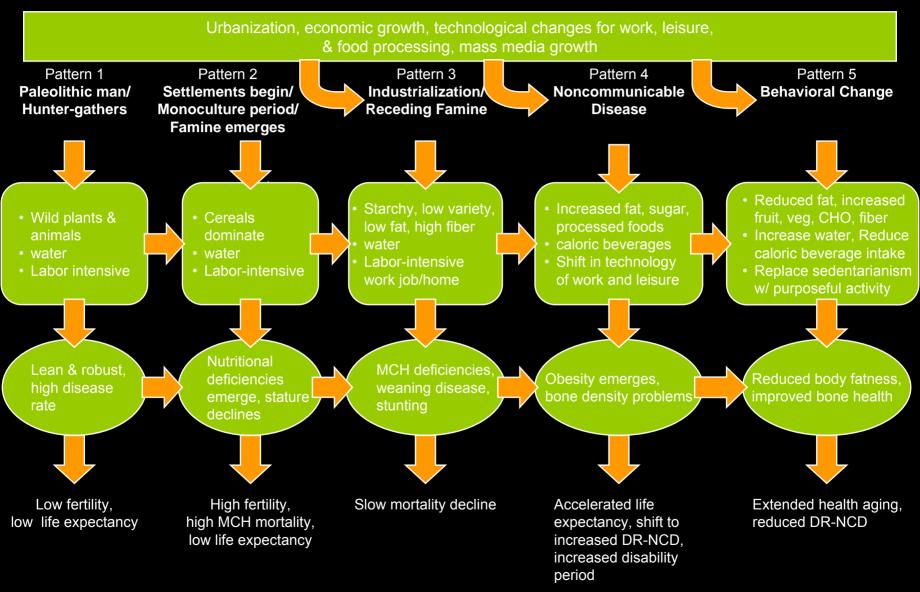




Outline: Why is this occurring?

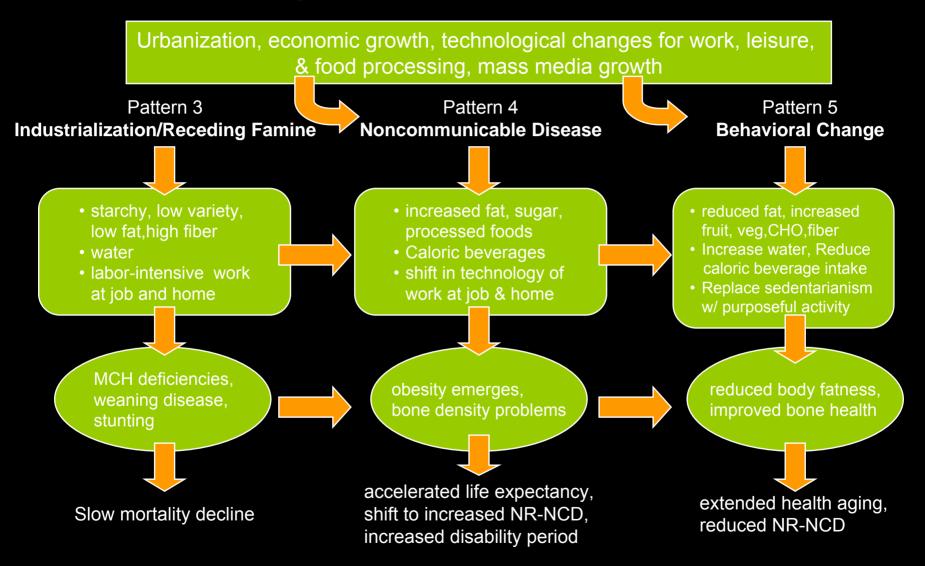
- Global Patterns and Trends
- How we eat : start with diet quality, quantity
- What We Drink
- How We Move
- The World is Flat and Fat: globalization has occurred for centuries
- How do we proceed

Figure 1. Stages of the Nutrition Transition



Source: Popkin 2002 revised 2006.

Stages of the Nutrition Transition



Source: Popkin (2002). Pub. Health Nutr 5:93-103.









Over the last 20 years in the lower and middle income transitional world and the past 60-150 years for the higher income world

- BMI distribution: major shift upwards
- Foods, beverages consumed change to processed ones almost completely in many subpopulations
- Modern global food industry becomes dominant
- Modern technology at home and in the economic marketplace, travel, leisure becomes globally available
- Globalization of modern mass communication





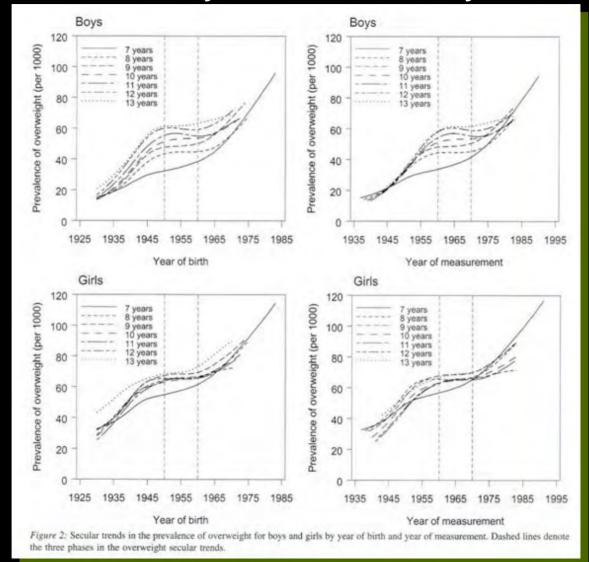




High Income vs. Transitional and Low Income Countries

- Trend toward a higher BMI in higher income countries reaches back a century but major increase seen in the mid 80's to the present.
- In contrast, minimal obesity in most of developing and transitional world until the last 20-30 years with very large, rapid shifts upwards in the past 20 years.
- Now at a point where the world is fat and the dynamics are leading our dietary and activity patterns and obesity patterns toward some type of convergence, at least for the present!

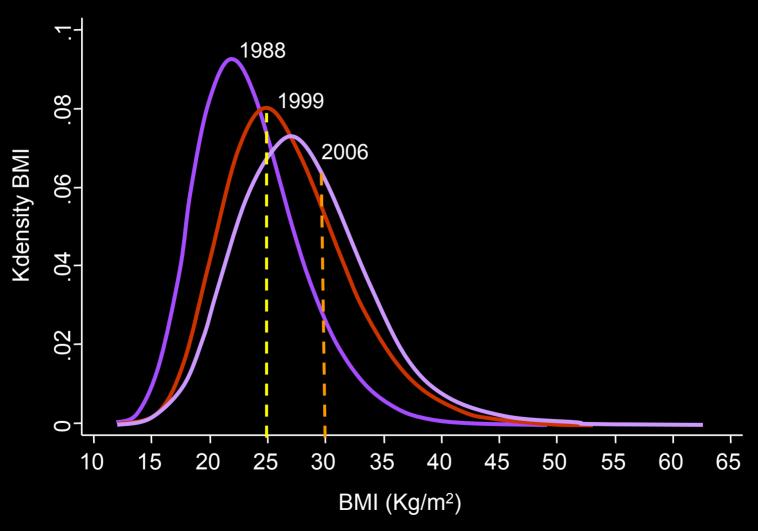
Prevalence Trends of Overweight in Danish Children: Obesity Increases Gradually





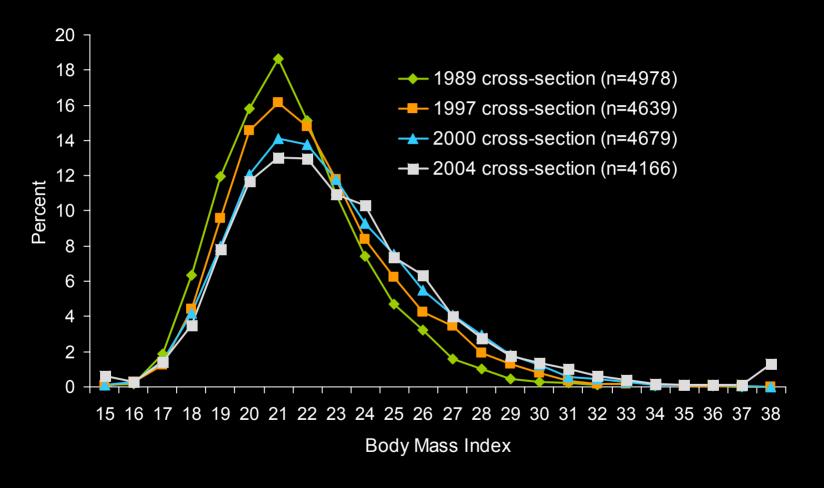
El 54% de los uruguayos tiene sobrepeso u obesidad.

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

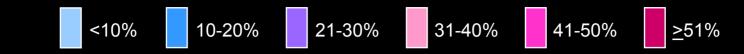


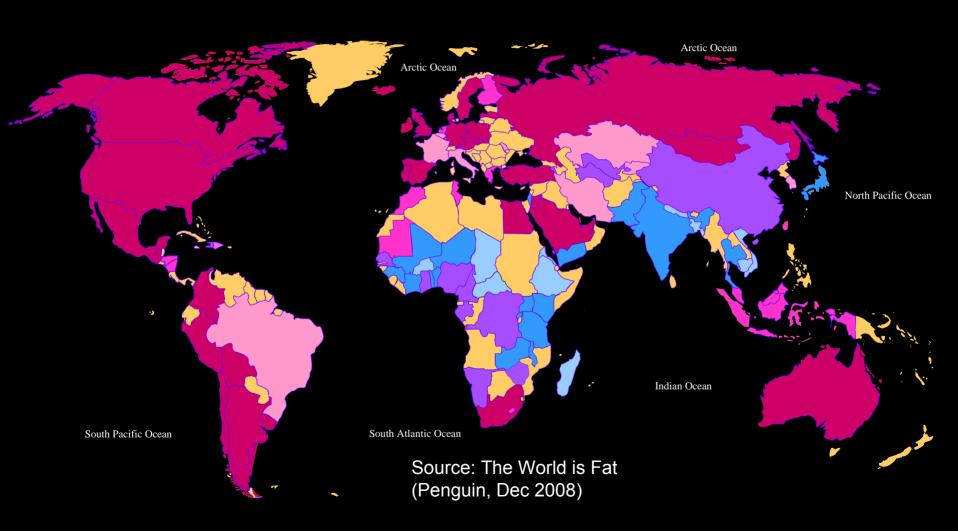
From Juan Rivera

Overweight more than tripled among Chinese men and doubled among women. The 11-Year Change in the BMI Distribution for a Cross-Section of Chinese Adults 20-45.

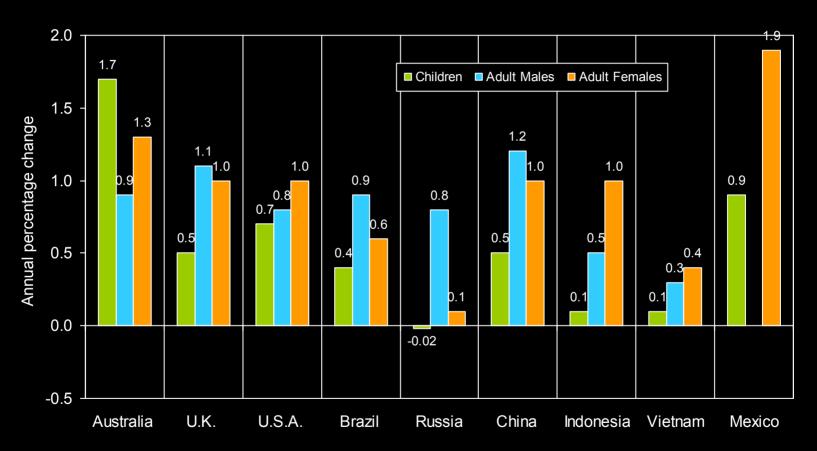


Patterns Of Overweight & Obesity Globally For Nationally Representative Samples (Percentage overweight + Obese)

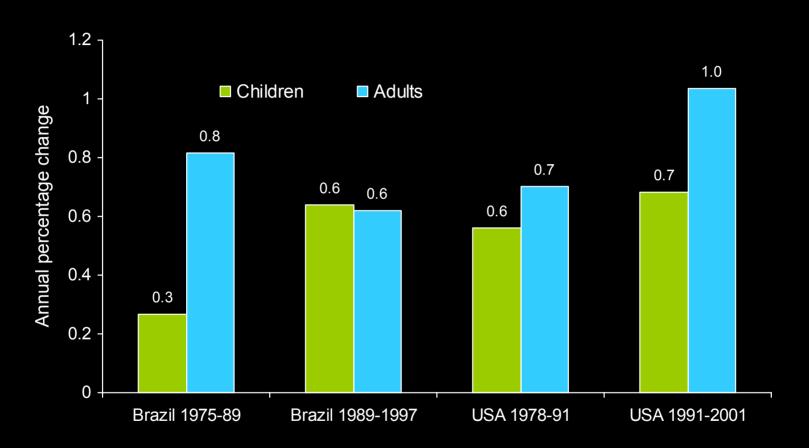




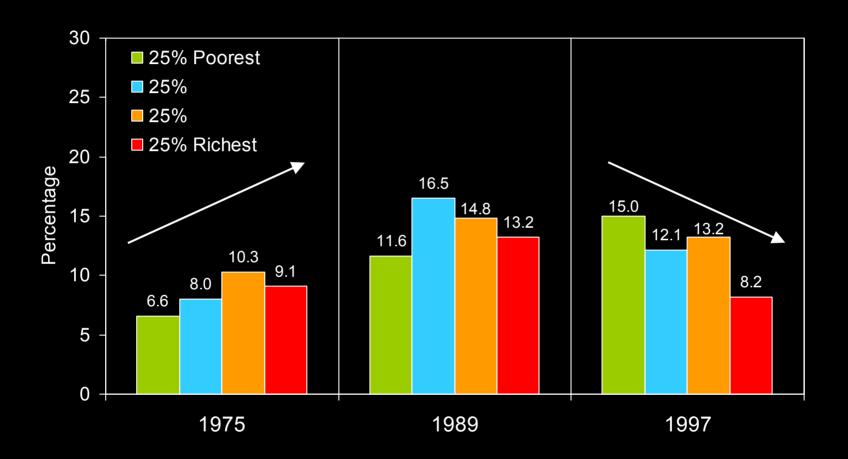
Annual Absolute Change in the Prevalence of Overweight and Obesity in 7 Countries from 1985/1995 to 1995/2006 (BMI≥25.0 for adults; IOTF equivalent for children)



Annual Absolute Change in the Prevalence of Overweight in 2 Countries in Two Successive Periods



The Shifting of Obesity Toward the Poorest Women In Southeast Brasil











The burden of disease is shifting rapidly towards the poor.

- By burden, we refer to the greater prevalence of poor diets, sedentarianism, obesity, NR-NCD's among the poor
- Evidence from Brazil points to a clear shift in obesity and other risk factors.
- Studies on the shifts in diet among various income groups in China point towards a similar shift occurring there in 10-15 years
- These relationships replicated across many countries in smaller studies.





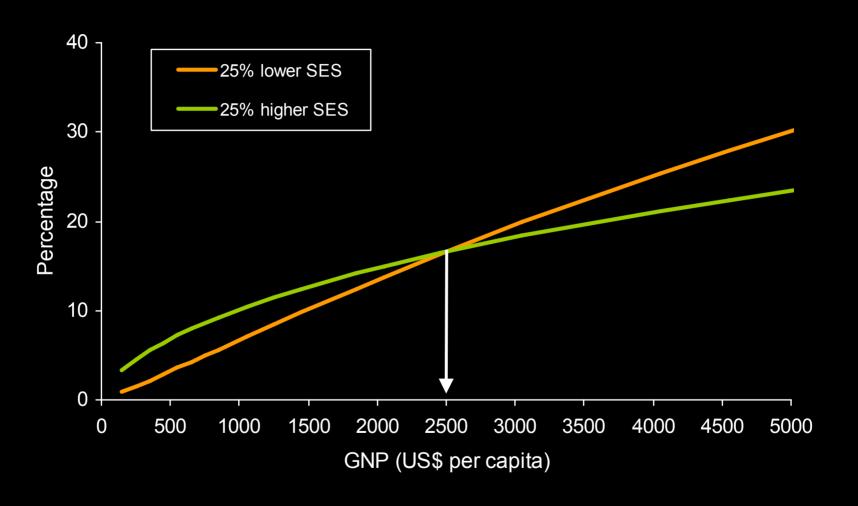




Multilevel Study: Gross National Product, Household SES and Obesity Across 37 Countries

- Probability of obesity as a function of individual SES, the country's per capita GDP and an interaction term between household SES and per capita GDP from a multilevel logistic model
- National wealth and individual SES as joint predictors of obesity: a study on 148,579 women from 37 developing countries
- Monteiro,. Conde, Lu, and Popkin (2004). Obesity and inequities in health in the developing world. IJO 28:1181-1186 [women] and a review: 2004 Bull WHO 82: 940-46 (added men)

Predicted Prevalence (%) of Women's Obesity in Extreme SES at Different Country's GNP









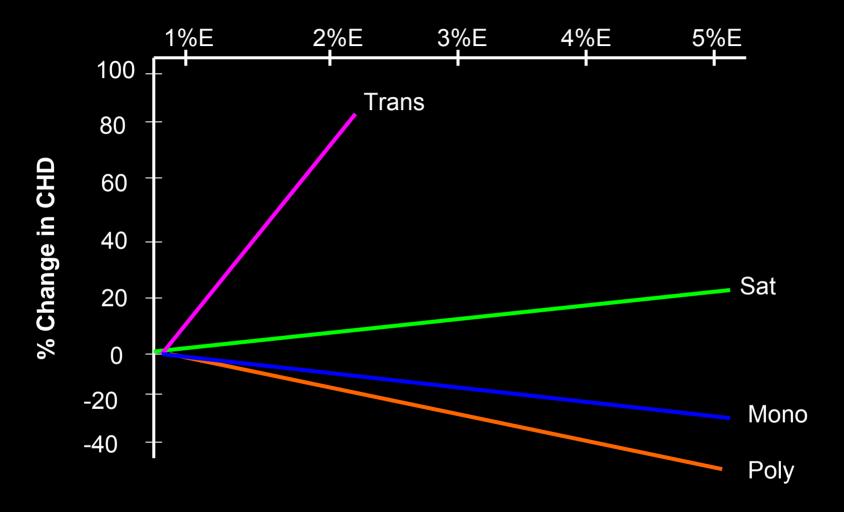


Dietary Quality issues may be better understood than quantity

- Transfats very often removing transfats is viewed as a way to address obesity which it is not the case. Actually shifting to other fats might actually slightly increase the energy density of many processed foods.
- Fruits and vegetables unclear affects on obesity. The idea that these low energy dense foods are the answer is yet to be clearly shown.



The transfat story: one of the more studied. Transfats have a threefold greater impact than other saturated fats on CHD.



Hu et al, NEJM 1997: 337

Slide provided by Walt Willett









What drives caloric increases and leads to added energy imbalance?

- Energy density: minimal long-term research
- Food components: unclear except for few 12 mo. long-term diet studies that show high protein, high fat, or high complex CHO can work if calories are reduced.
- Reasonable clarity on caloric beverage effect but no clear sense about the mechanisms
- But what is driving dietary change and keeping calories higher: that is much clearer









Sources of Major Global Dietary Shifts

- Increased intake of caloric sweeteners
- Edible oil increases in most of the lower and middle income economies
- Increased animal source foods
- Increased intake of processed foods, refined carbohydrates
- Reduce intake of fruits and vegetables and legumes
- Reduced preparation time, increased intake of pre-cooked foods

From Traditional to Modern Meals



From Traditional to Modern Snacking









From Traditional to Modern..... Marketing of Food





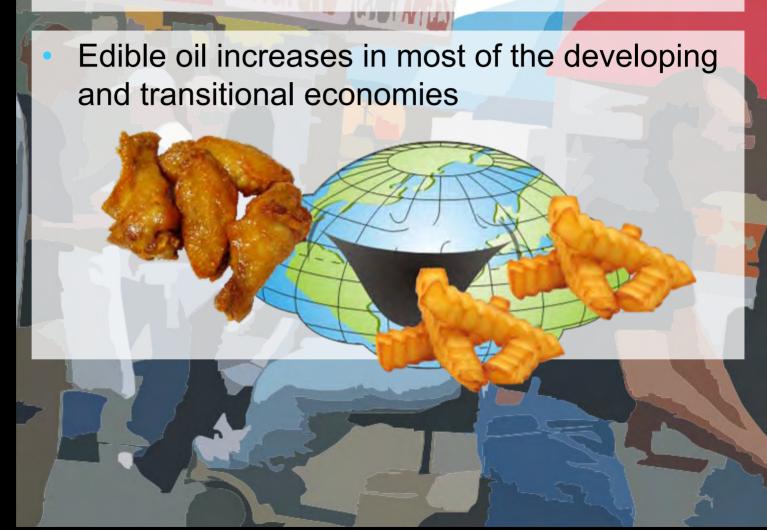






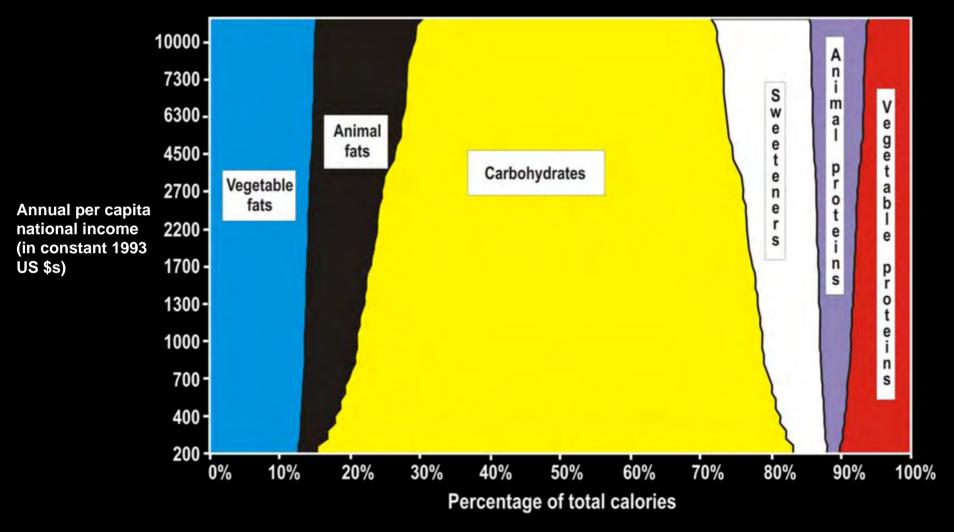


Major Global Dietary Shifts



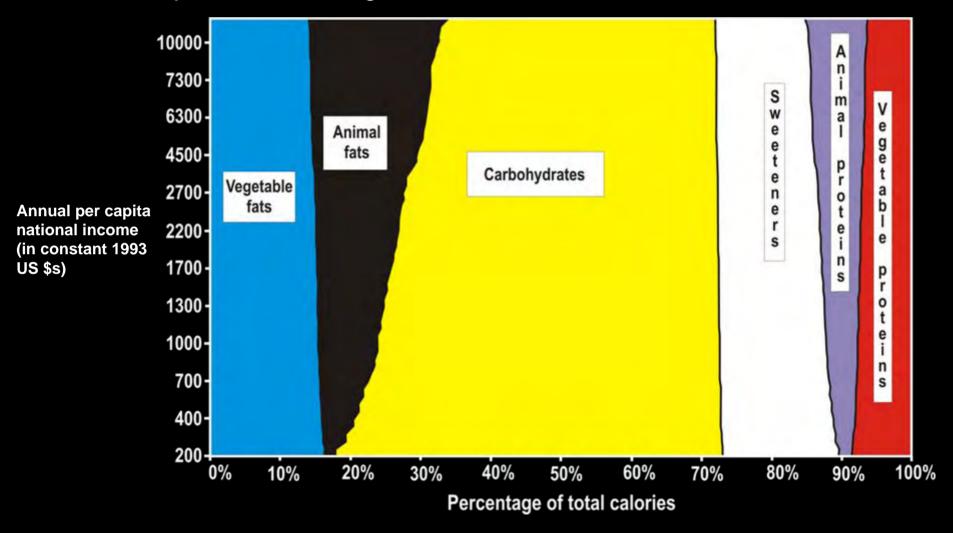
"Over 1.3 billion people in the world are overweight"

Relationship Between the Proportion of Energy from Each Food Source and Gross National Product Per Capita with the Proportion of the Population Residing in Urban Areas Placed at 25%, 1990



Source: Food balance data from the FAOUN; GNP data from the World Bank; regression work by UNC-CH Drewnowski & Popkin (1997) Nutr Rev 55:31

Relationship Between the Proportion of Energy from Each Food Source and Gross National Product Per Capita with the Proportion of the Population Residing in Urban Areas Placed at 75%, 1990



Source: Food balance data from the FAOUN; GNP data from the World Bank; regression work by UNC-CH Drewnowski & Popkin (1997) Nutr Rev 55:31

Edible Oil Consumption Still Rising in China (grams per day per capita)

Year	1989	1997	2006
Poorest (lowest income tertile)	11.8	26.5	30.8
Middle income tertile	15	29.7	30.9
Richest (highest income tertile)	17.4	31.3	30.9
Average for total adult population	14.8	28.9	30.9
% of all calories per capita from edible oil	4.9	11.2	12.4

Source: China Health and Nutrition Survey for adults aged 20-45





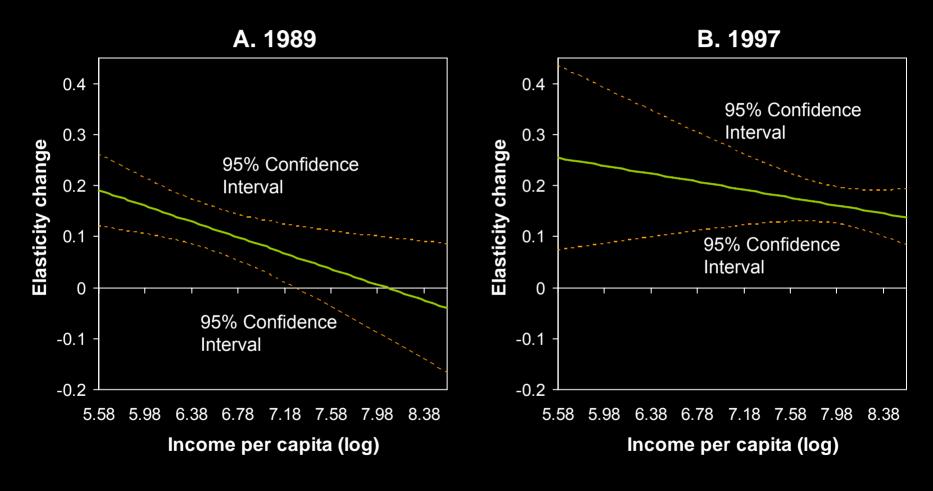




The Effect of Income Changes on Total Fat Intake in China

- For every 10% increase in income, intake of the proportion of energy from fat is increasing greater among the poor than the rich in China. Most importantly there are significant changes found in all income groups
- Source: Du et al, SSM_59:1505-1515; Popkin and Du (2003) J Nutr. 133:3898S-3906S. & Guo, Mroz, Popkin (2000). Econ Dev Cul Chg 48:737-760

The Relationships Between Income Changes and the Proportion of Energy from Fat Consumed: Income Elasticity and the Change in the Income Elasticity Between 1989 and 1997 in China



Source: Du et al, SSM 59:1505-1515.









Major Global Dietary Shifts (cont)

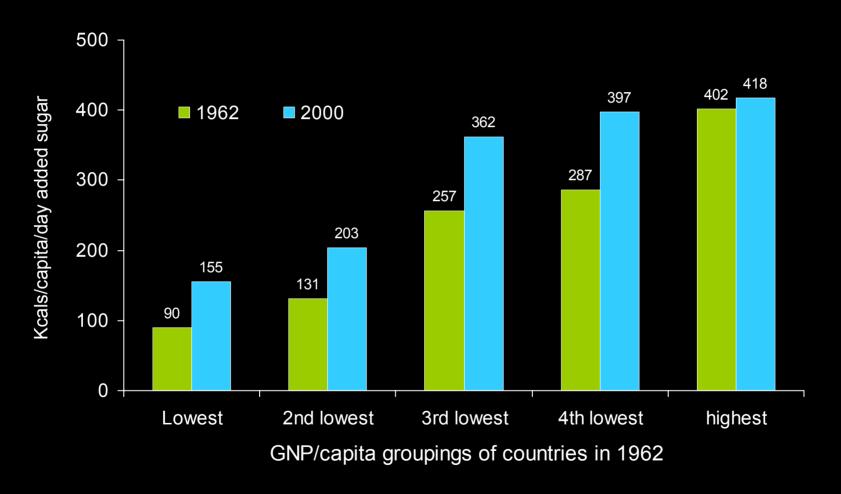
- Increased intake of caloric sweeteners, predominantly from beverages but also small amounts in thousands of processed foods
- Causes of global beverage intake: varied.
 Certainly combination increased accessibility,
 lower price, & income dynamics, marketing



"Over 1.3 billion people in the world are overweight"

The Relationship Between Changes in Gross National Product per Capita and Caloric Sweetener

Note: The Major Changes Affect the Lower and Middle Income Countries!



Source: Popkin and Nielsen (2003) Obesity Res 11









What is driving the increasing intake of sweeteners

- Shift from food to beverages as source of sweeteners. 1/3rd to 2/3rds Beverages in US
- Is there habituation to sweeteners that pushes outward our need for them? Unclear, untested
- Is the intense noncaloric diet sweetener revolution affecting our needs for total sweetness?
- Many unanswered questions in this area







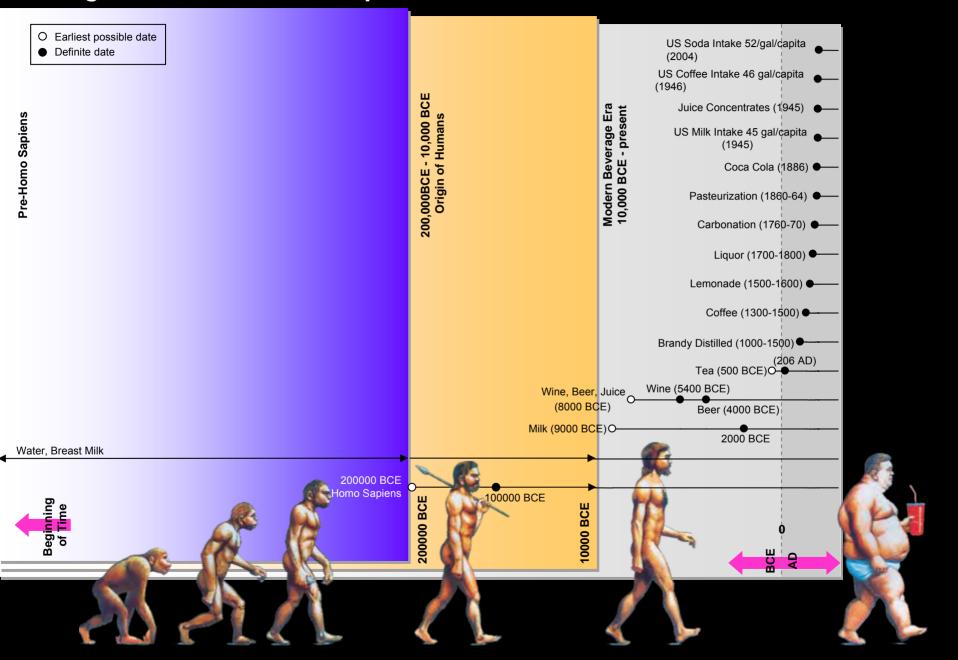






"Over 1.3 billion people in the world are overweight"

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









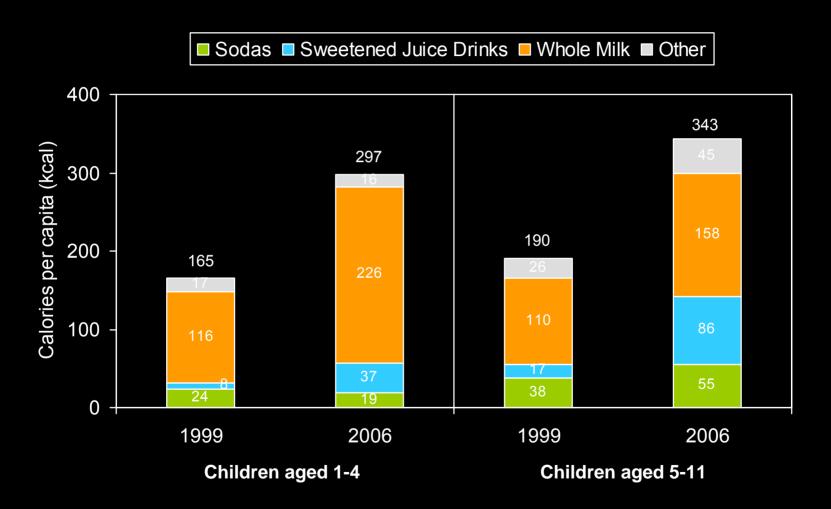


Caloric Beverages and Weight Gain

- Studies of appetitive sensations (e.g. hunger, fullness, prospective consumption) support the view that fluids are less satiating than solid foods
- Dietary compensation over shorter, longer periods. Beverages by macronutrient composition have same effect. Minimal food calorie reduction is found



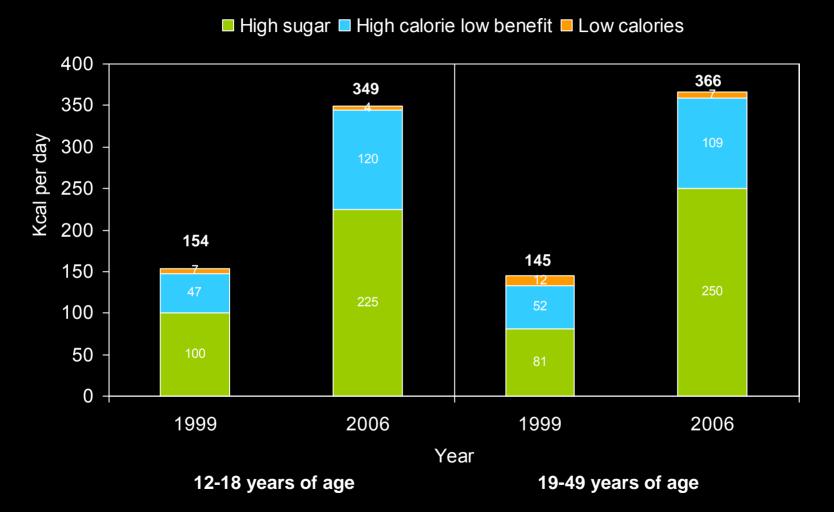
Daily Beverage Consumption Trends of Mexican Children, 1999-2006



Note: Sweetened juice drinks include 100% fruit juice with sugar added and agua fresca[water, juice, sugar). Sodas include carbonated and noncarbonated sugar bottled beverages.

Source: Barquera et al, 2008

Beverage Consumption Trends of Mexican Adolescents and Adult Women, 1999 and 2006

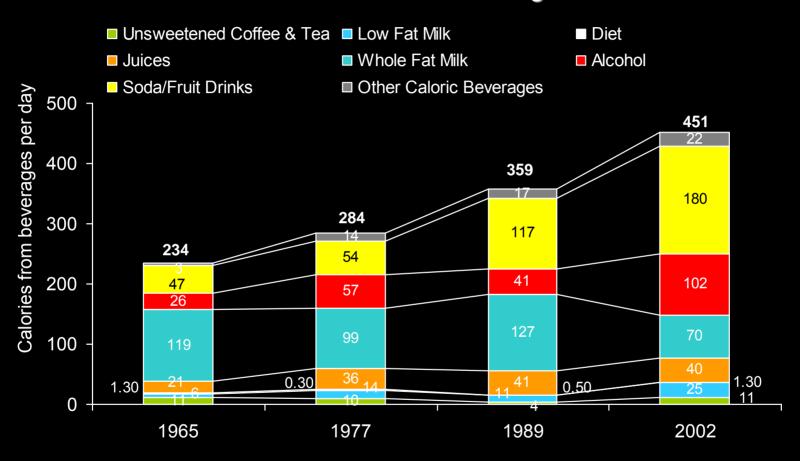


Note High sugar is composed of mainly soft drinks, sweetened juices, agua frescas and alcohol.

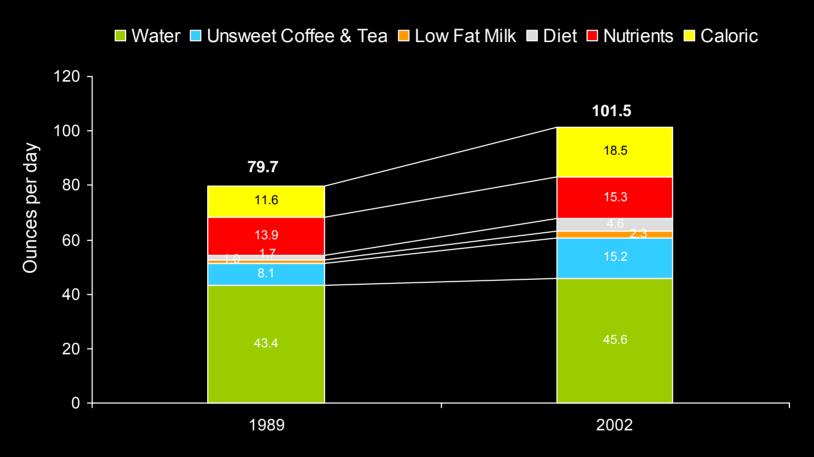
High calorie and low benefit is mainly whole milk. Low calories are slightly sweetened coffee and skim milk

Source: Barquera et al, J of Nutrition (in press for 2009)

Per Capita Change in Calories from Beverages Between 1965 and 2002 among US adults



Little Change in Water Intake, Major Increase in US intake of Calorically-Sweetened Beverages among US adults



^{*}To convert ounces to grams, divide by 0.035 and to convert fluid ounces to milliliters multiply by 29.57.





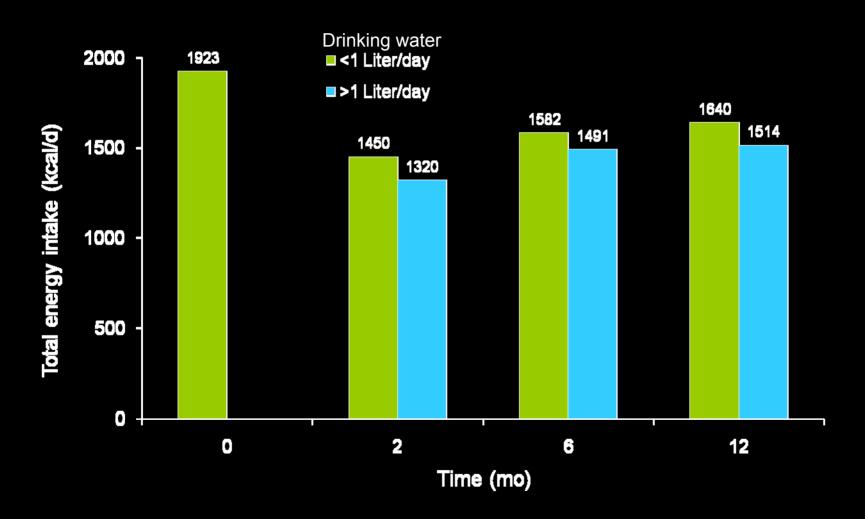




So what about noncaloric beverages?

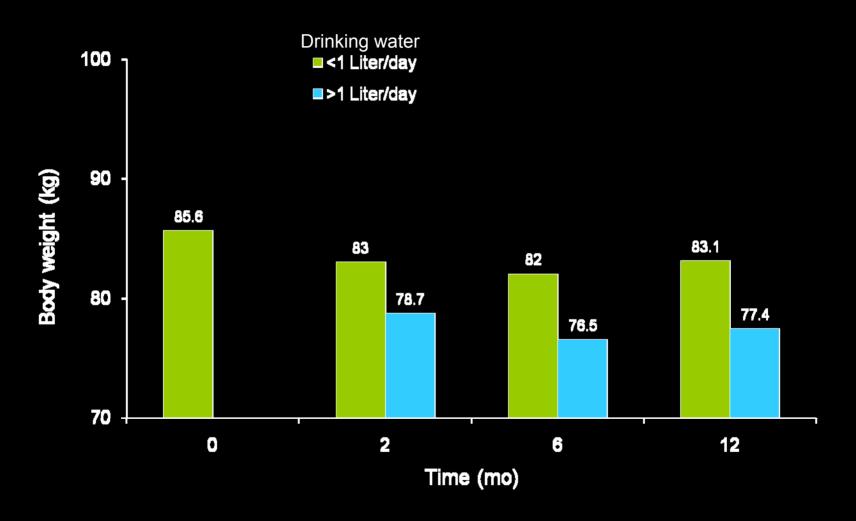
- Water research: very limited. Some studies beginning to suggest important direct calorie replacement and possibly added effects of water on energy intake, weight and metabolic functioning.
- Sweetened diet beverages: This is a complex picture. Our work in process suggests it is the diet linked with these beverages that determines the effect and not the diet beverages per se though there are issues unresolved in the sweetener world related to intense noncaloric sweeteners {see Mattes and Popkin, AJCN (2009) 84:}

The A To Z Study: The Relationship of Water Intake with Adjusted Mean Daily Total Energy Intake



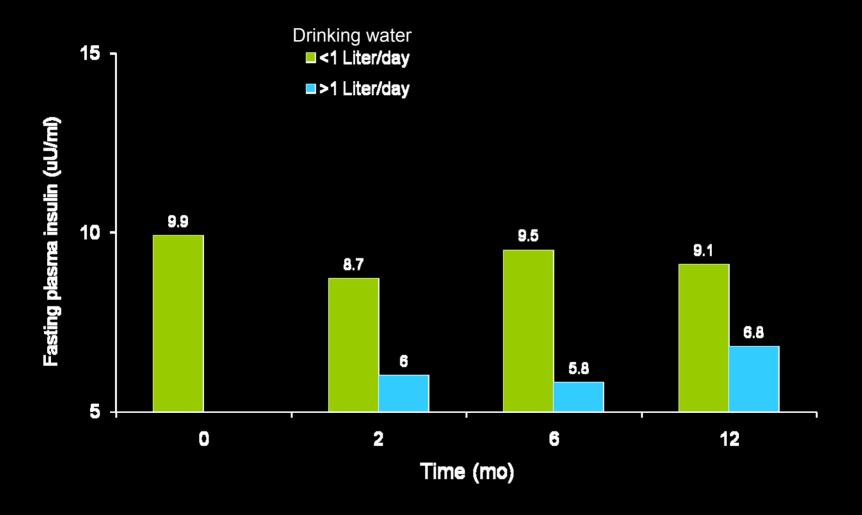
Source: Stookey et al, Obesity (2007) 15:3013

The A To Z Study: The Relationship of Water Intake with Mean Body Weight



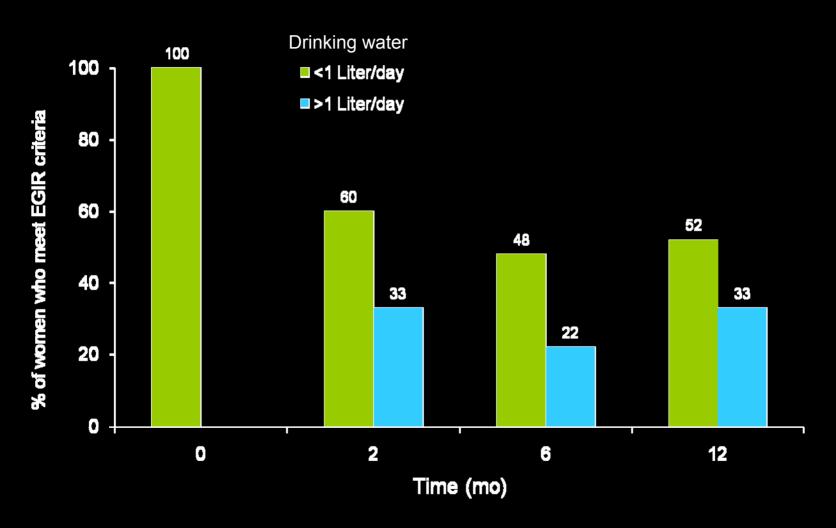
Source: Stookey et al, (in press) Obesity

The A To Z Study: The Relationship of Water Intake with Mean Fasting Plasma Insulin



Source: Stookey et al, manuscript 2008

The A To Z Study: The Relationship of Water Intake with the Metabolic Syndrome



Source: Stookey et al, manuscript 2008









Major Global Dietary Shifts

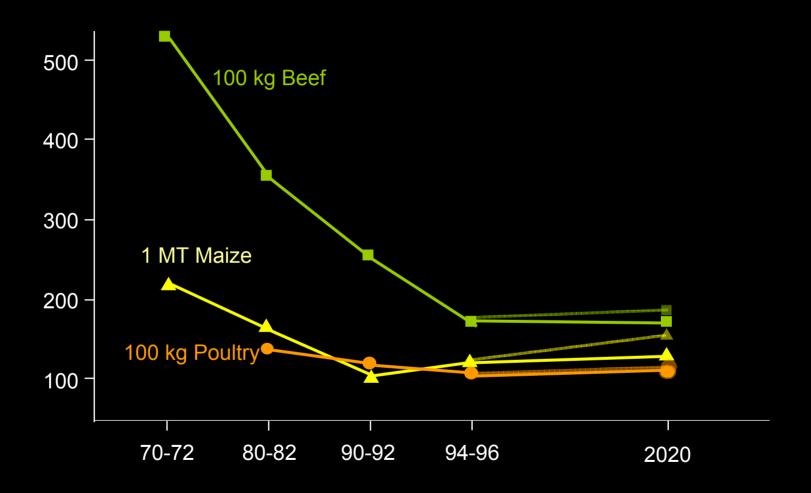


"Over 1.3 billion people in the world are overweight"

Price Policies Are a Great Option: Price Elasticities of Demand

	China 1990	S. Korea 1962-92	Morocco 1969-85
Beef	-1.04	49	-1.63
Pork	98	57	NA
Poultry	53	-1.07	-1.26
Fish	81	34	17

Real World Prices, 1990 US\$











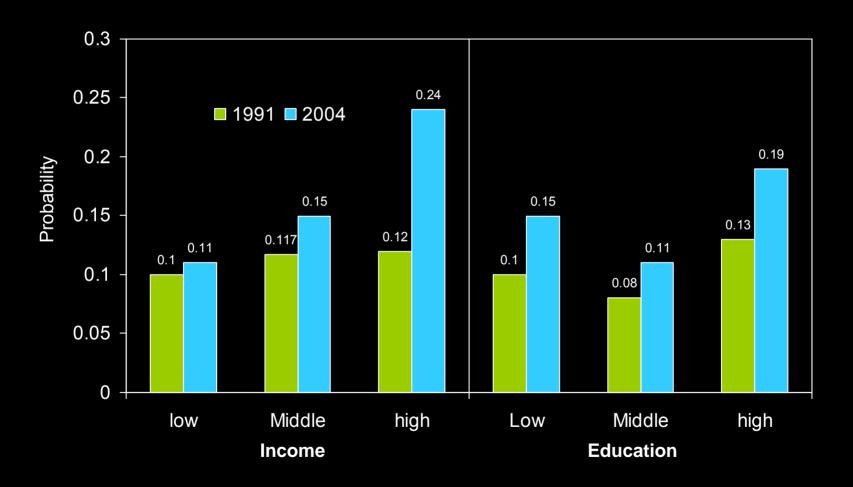
Major Global Dietary Shifts in Eating behaviors

- Increased consumption of fried foods, snacks
- Reduced preparation time, increased processed and prepared foods
- Increased eating away from home



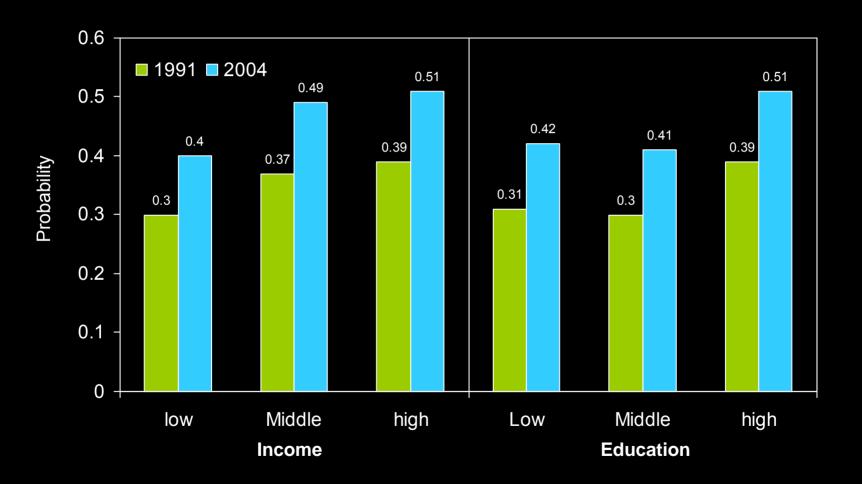
"Over 1.3 billion people in the world are overweight"

The Predicted Probability of Snacking Behavior in China, 1991 and 2004



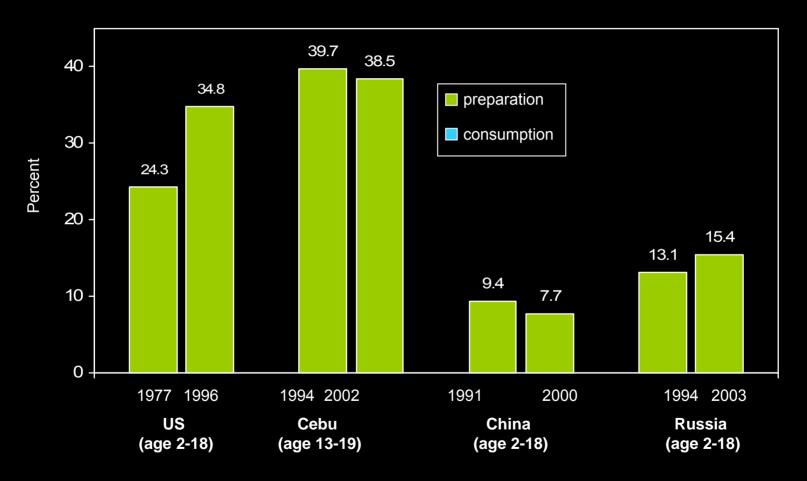
Source: CHNS 1991 and 2004; Adjusted for socio-demographic factors Zhihong Wang et al (2008) Asia Pac J Clin Nutr 17:123

The Predicted Probability of Consuming Excessive Fried Foods in Chinese Urban Residents, 1991 and 2004

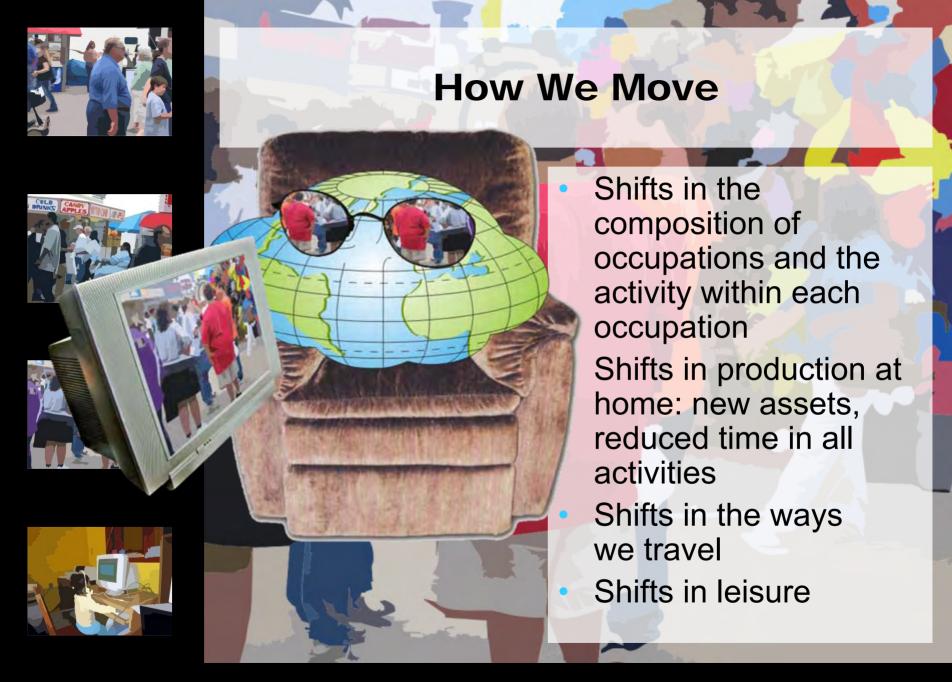


Source: CHNS 1991 and 2004; Adjusted for socio-demographic factors Wang et al (2008) Asia Pac J Clin Nutr 17: 123 Note: excessive fried foods represents more than 20% of kcal from fried foods.

The Proportion of Energy Consumed from Foods Prepared Away from Home among children and adolescents

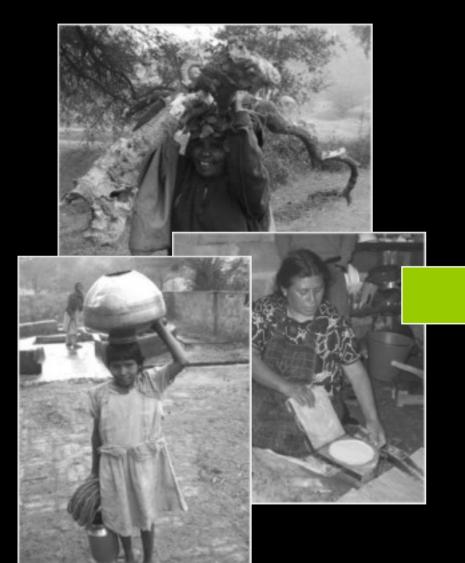


Source: Adair and Popkin, Obes Res.(2005)13:1281



"Over 1.3 billion people in the world are overweight"

From Traditional to Modern Household Production

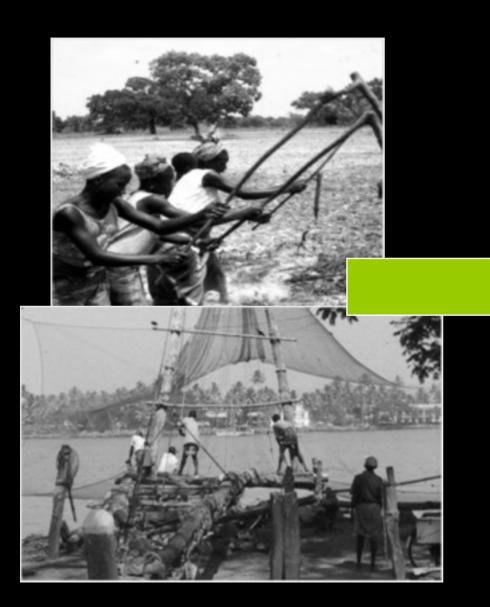




From Traditional to Modern Economic Work at Home

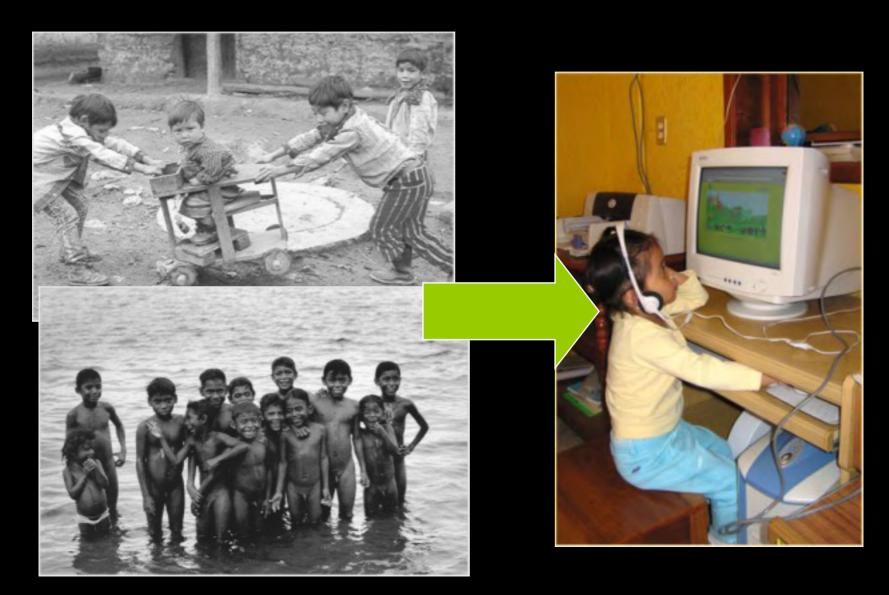


From Traditional to Modern Market Work

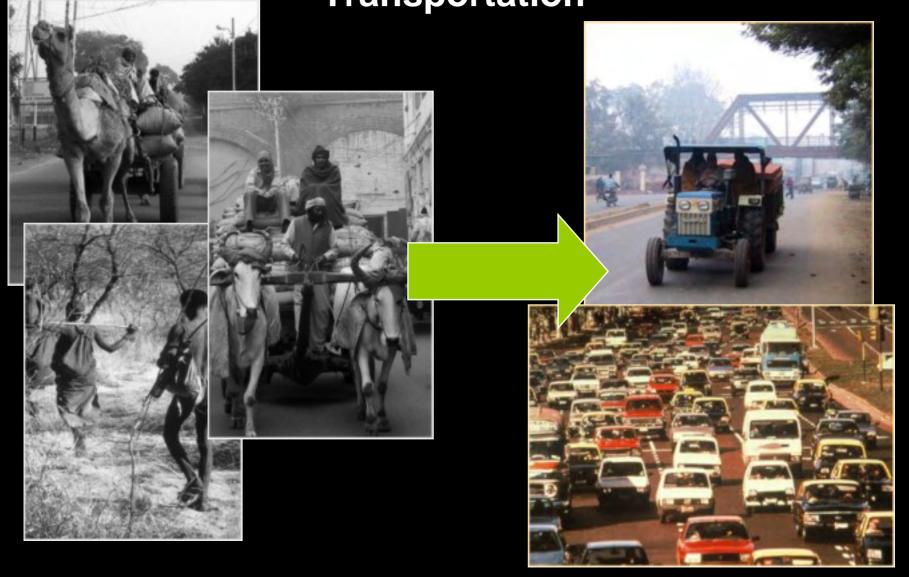




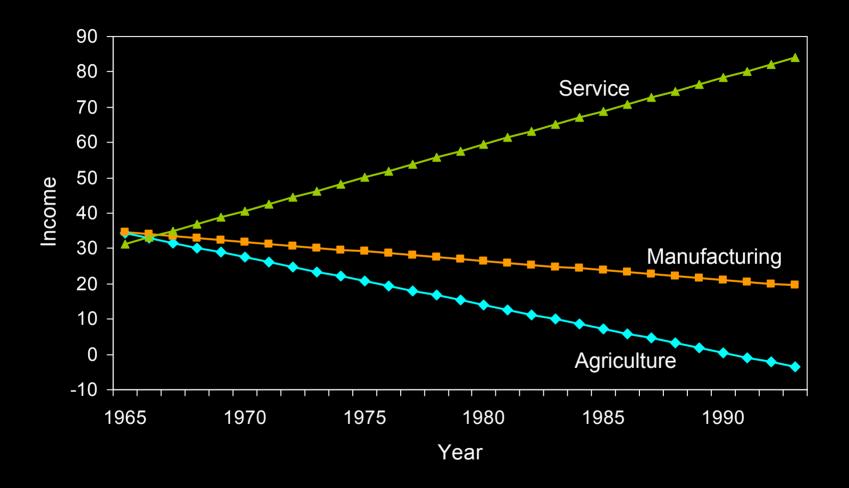
From Traditional to Modern Leisure



From Traditional to Modern..... Transportation

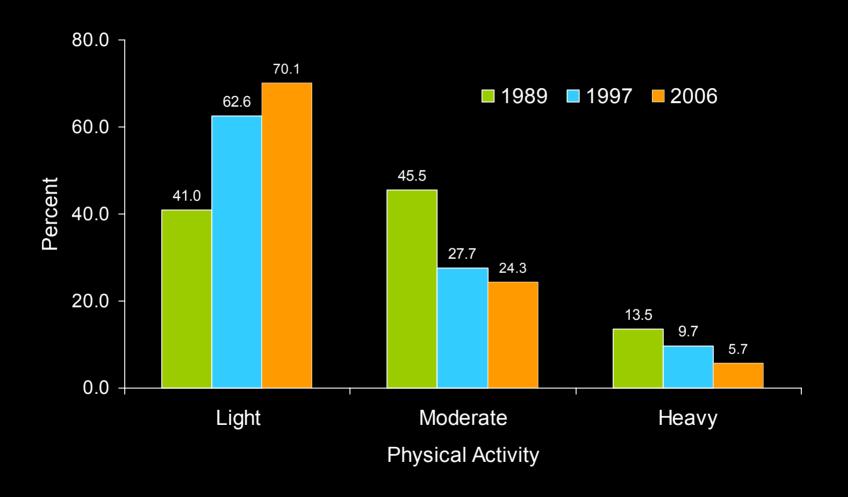


Urbanized Countries have most of the Labor Force in Service Industries (Simulations Assuming 75% of the Population Living in Urban Areas)



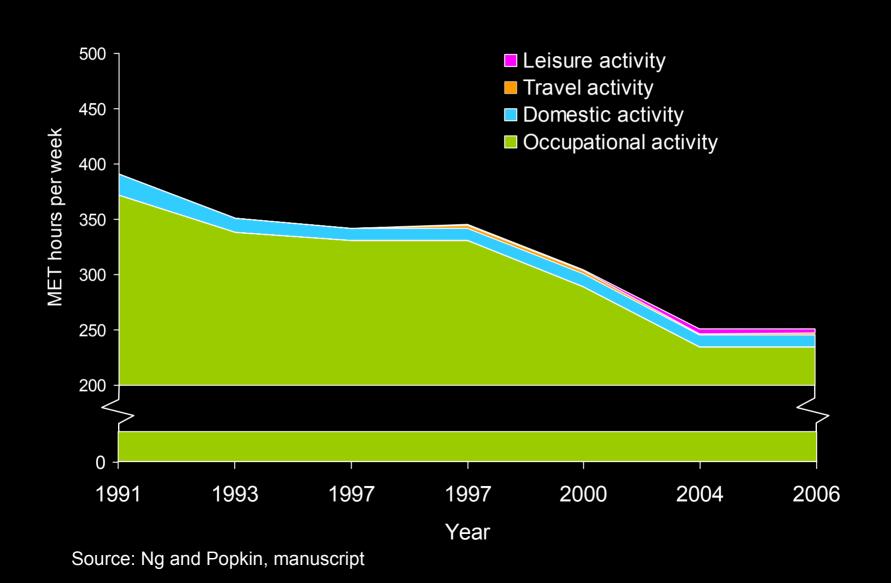
Source: Popkin, B.M. (1999) "Urbanization, Lifestyle Changes and the Nutrition Transition". World Development 27.

Chinese Adults in the Same Occupations Use Much Less Energy: the Physical Activity Profiles of Urban Chinese Adults Aged 20-45, 1989 and 2006

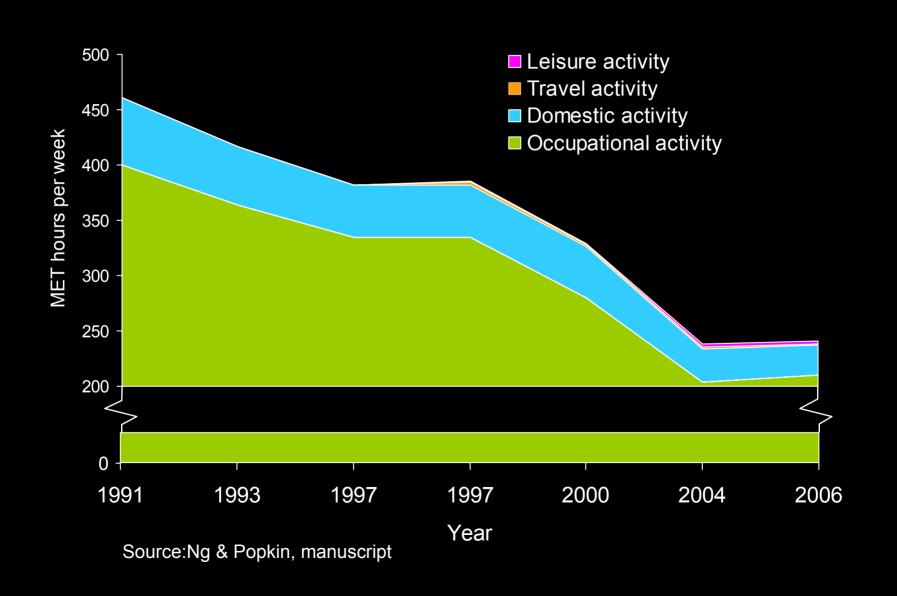


Source: Du Lu, Zhai, Popkin. (2002) Pub H Nutr 5:169-174.

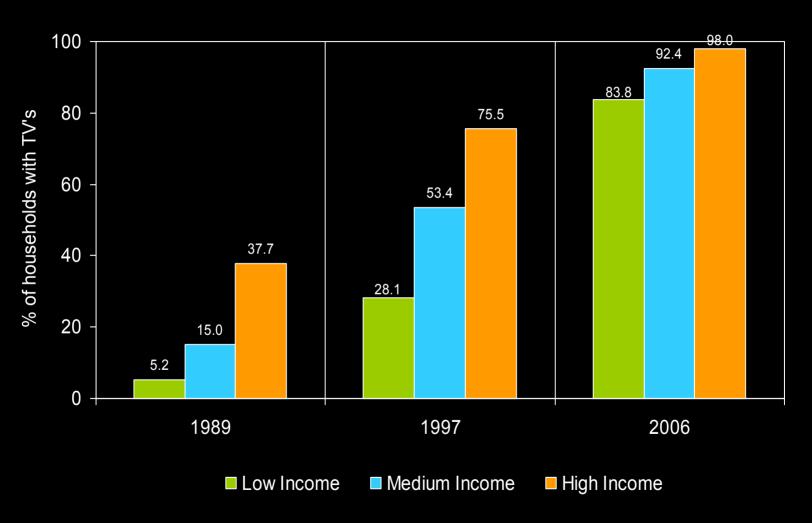
Shift In MET Hours per Week by Activity Among Chinese Men (18-55 Years Old)



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

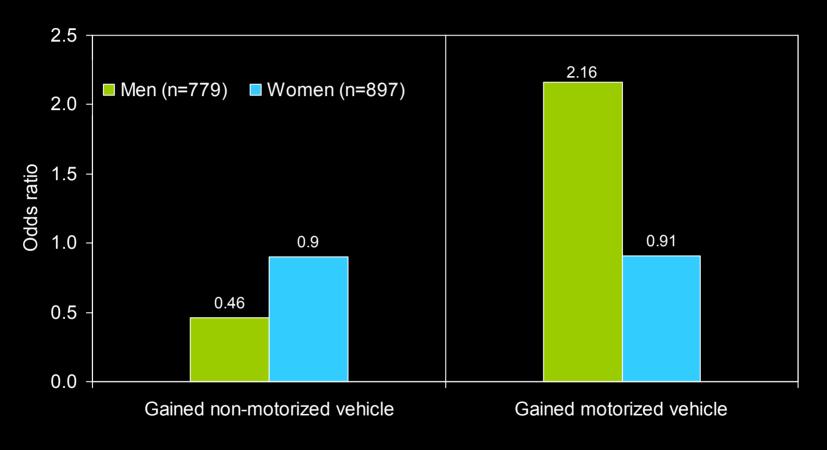


Color TV Ownership Has Skyrocketed in China, 1989-2006 (% Who Own TV Sets among Families with Children from CHNS)



Source: Du Lu, Zhai, Popkin. (2002) Pub H Nutr 5:169-174.

Odds of Becoming Overweight/obese According to Household Vehicle Acquisition: 1989 to 1997



No change in vehicle ownership was the referent category. Adjusted for baseline age, weight, education, urban residence and change in work-related activity, energy intake, smoking status, alcohol consumption, income, and television ownership. Those who were obese in 1989 were excluded.

Source: Bell et al (2002) Obesity Research 10:277_283.









The World is Flat and Fat: Globalization has Occurred for Centuries

- Naïve idea that globalization is a phenomena of the past few decades
- Consider how Columbus et al introduced from the Americas to the cuisines of the world: Chili peppers in Asia, Potatoes in Europe, and tomatoes in Italy are examples. Or noodles from Asia to Italy.
- Recent rapid acceleration in areas such as communications technology, transportation systems, distribution technologies affect how we eat, move, drink. Think of red bull's impact globally in 5 years vs coke in 70 years.









How do we proceed?

- Clearly action needed at all levels; however I believe the only way to produce concerted change is to look to the models of tobacco use, seat belt, other major public health changes
- Regulations, taxation, mass education are key components
- Examples: Mexico Beverage campaign, US Farm Bill, Brazil and Singapore schools









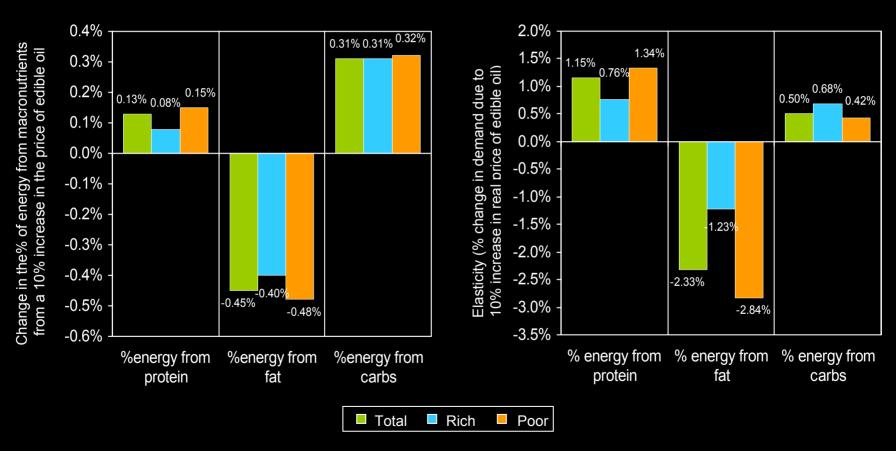
Edible Oil Control in China is Just One Example: Must be Country-Specific

- Edible Oil prices likely to continue falling due to international trade
- Impact is greater for the poor
- Greater disparities in health by income groups
- Regulate composition of edible oils (improve quality)
- Taxes on edible oils (regardless of imported or domestic)
- Encourage steamed/broiled/braised foods

The Effects of Changes in the Price of Edible Oil in China



B. Demand Elasticity for Macronutrients



Source: China Health and Nutrition Surveys





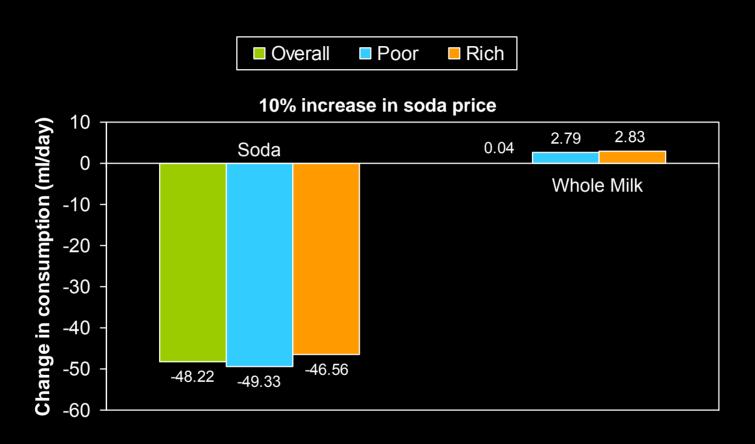




Mexico Initiative on Beverages

- Remove all whole milk, shifted now to 1.5% and later to skim milk all gov't programs
- Schools: working to ban all sugar sweetened beverages, provide safe water, allow water, low fat milk to be sold
- Taxation being considered: tax added sugars in beverages per gram, fat in milk
- National media effort—began Feb 25 with launch of Mex. Beverage Guidelines
- Source:Rivera et al, Salud Publica Mex 2008;50:173-195.

Effects of Price Changes on Whole Milk and Soft Drink consumption in Mexico





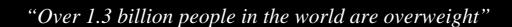






Program and policy effectiveness: Are we ready for preventive action? Major research gaps exist.

- Macroeconomic options: price changes matter, governments subsidize wrong foods now
- Regulations: TV advertising, other advertising, edible oil contents, school meals, school PE, etc
- Reprints (pdf files) and citations can be found on www.nutrans.org. New book The World Is Fat (Penguin Press) forthcoming Dec. 2008











Policy Actions - Next Steps

- Beverages—regulate, restrict, tax, discourage all sugary beverages, fruit juices, saturated fat in milk
- Labeling—simple new options in US, other countries. Calories, servings, and star or check if this is deemed by scientists in the country a healthy choice—new horizons
- Look at refined carbohydrates, sugars and find more targets
- Work on portion size pricing, ways to discourage larger portions.