

**ASSESSMENT OF NUTRITIONAL STATUS IN
DUAL NUTRITION BURDEN ERA**



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NUTRITION TRANSITION IN INDIA



SEVENTY YEARS AGO

When India became independent the country was not self-sufficient in food grain production; 80% of Indians were poor and food insecure

Country faced two major nutritional problems:

✿ threat of famine and the resultant acute starvation due to low food production and the lack of an appropriate food distribution system

✿ Prevalence of macro- & micro-nutrient deficiencies were high due to:

- 🌍 low dietary intake because of poverty and low purchasing power;

- 🌍 high prevalence of infection because of poor access to safe-drinking water, and sanitation;

- 🌍 lack of health care facilities and poor utilization of available facilities due to low literacy and lack of awareness

✚ Famine and starvation hit the headlines because they are acute, localised, cause profound suffering and fatalities

✚ Chronic low food intake was a wide spread silent problem leading to under-nutrition and many more deaths than starvation 

NUTRITION & HEALTH STATUS OF INDIANS IN SEVENTIES

- ✿ With Green Revolution India was self-sufficient in food production
- ✿ **BUT** Over 70% of India's population were poor
- ✿ They spent over 70% of their income on food
- ✿ Despite this expenditure, over 70% were under-nourished
- ✿ Access to essential health care was low
- ✿ Morbidity and mortality rates were very high

Mere self-sufficiency in food grain production by itself will not improve household food security or nutritional status of individuals

Better access to subsidised food grains, nutrition, health and family planning services were essential

Access to health care for treatment of morbidity was needed to improve nutritional status in children



MULTI-PRONGED INTERVENTIONS FOR IMPROVING FOOD SECURITY AND NUTRITIONAL STATUS

To improve National Food security:

- Increase food production to meet needs of population growth
- Build buffer stocks
- Build Public Distribution System (PDS).

To Improve Household Food Security:

- Improve purchasing power: employment programme
- Direct or indirect food subsidy.

To improve Nutritional Status of vulnerable groups:

- Food supplementation programmes
- Health care for early detection and treatment of infections



INDEPENDENT MONITORING SYSTEMS FOR ASSESSING IMPROVEMENT IN FOOD SECURITY & NUTRITIONAL STATUS


India built up independent systems for assessing & monitoring

□ *food security*

- availability of food: food production (Agriculture statistics),
- economic access to food: GDP growth, poverty rates, access to subsidised food through PDS, consumption expenditure on food, quantity of food stuffs and macro-nutrients consumed (NSSO Surveys)

□ *nutritional status*

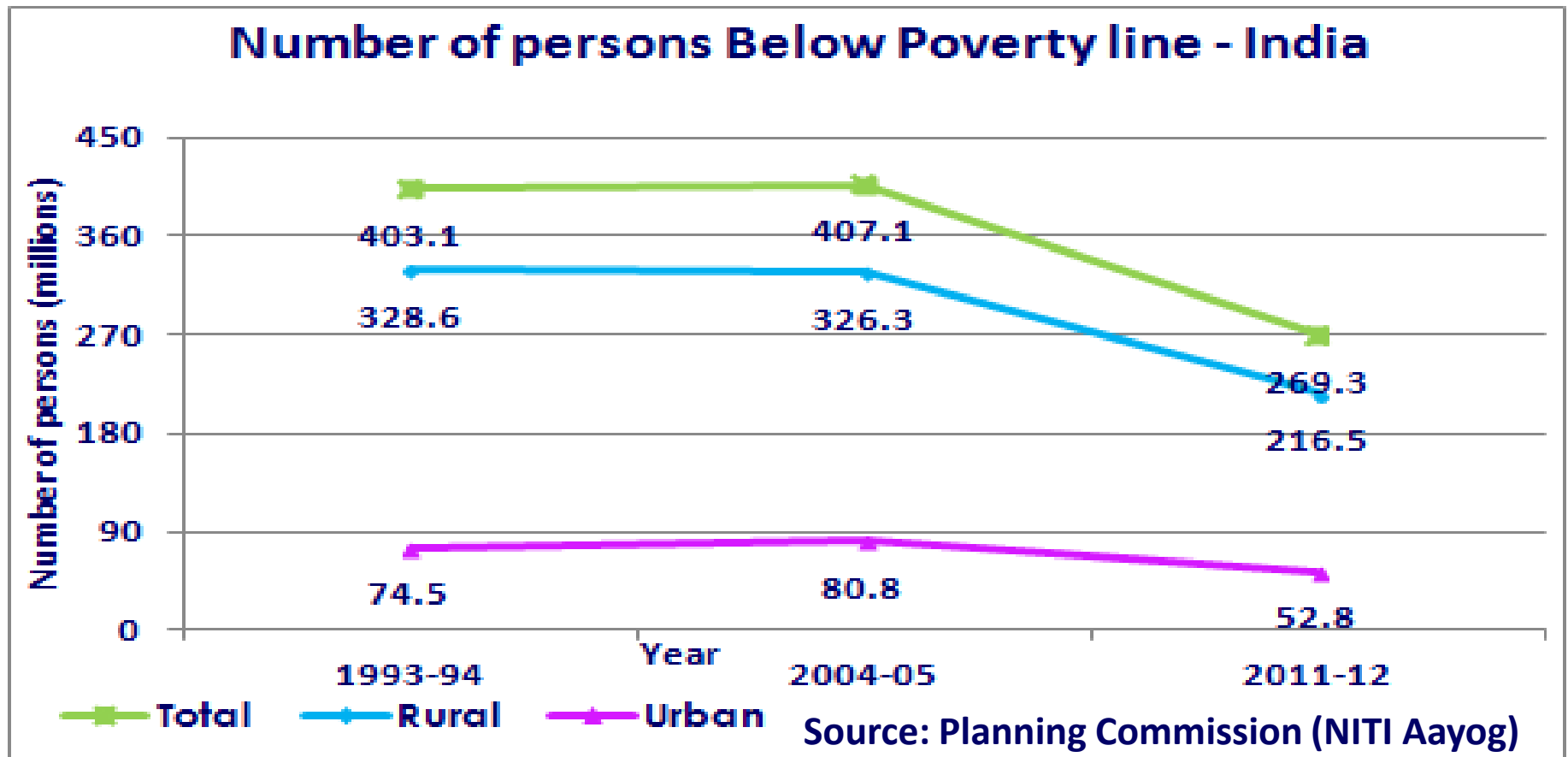
- food and nutrient intake of members of the households (NNMB)
- nutritional status as assessed by anthropometric indices (height, weight, BMI (NNMB, NFHS, DLHS & AHS) and
- prevalence of micro-nutrient deficiencies: anaemia, vitamin A and iodine deficiency (NNMB, NFHS, DLHS & AHS).

These data were analysed and used as inputs to national planning and to assess the progress in the specific sectors, food security and nutritional status 

PROGRESS OVER THE LAST FIVE DECADES



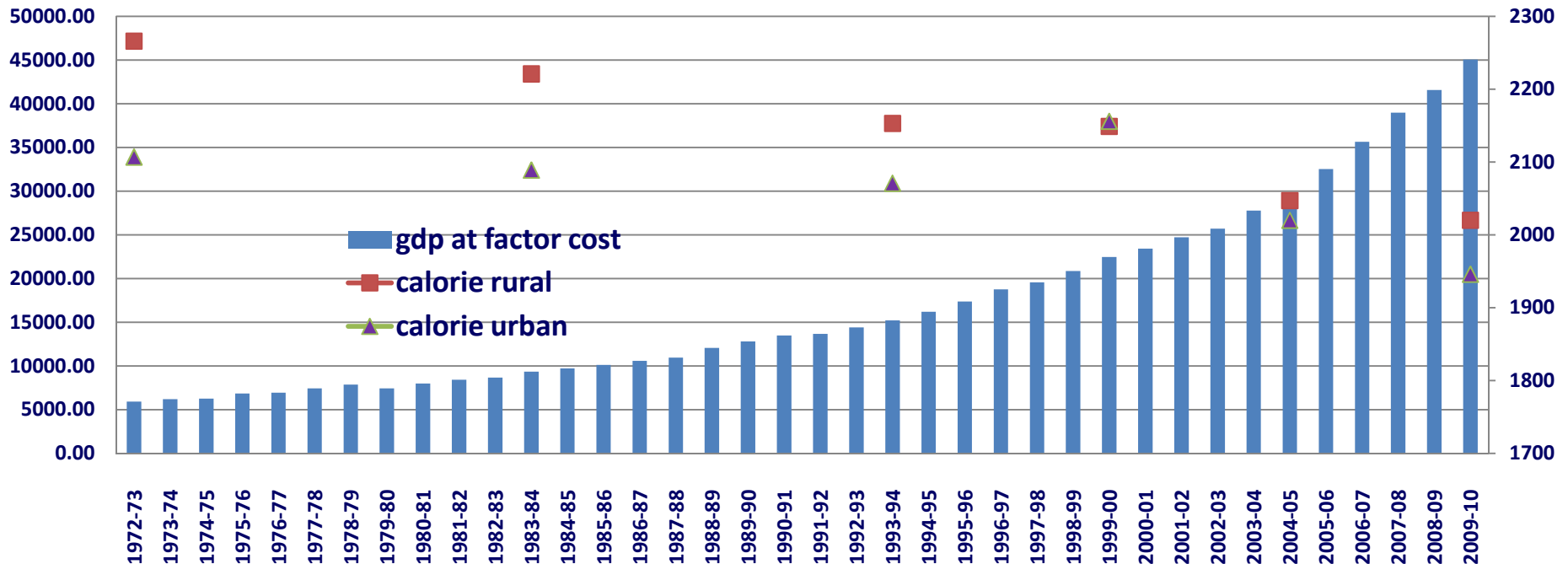
POVERTY ALLEVIATION



- India has been second fastest growing economy in the last decade
- There has been accelerated decline in number of poor persons
- India has achieved the MDG goals for poverty reduction.



UNIQUE INDIANS: GDP RISE GOES WITH FALL IN ENERGY INTAKE



After a relatively slow growth for 3 decades, India became the second fastest growing economy in the last decade

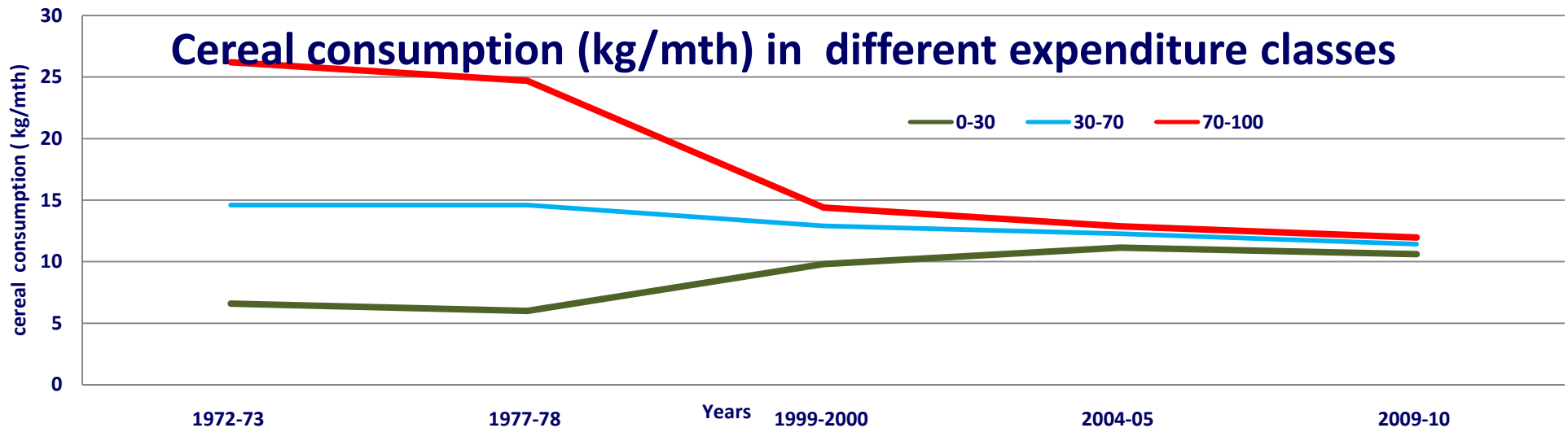
Increase in GDP growth rate and percapita income was accompanied by a progressive reduction in energy consumption.

The average intake is still adequate to meet the energy requirement because of the reduced physical activity.

The reduction in energy intake might have protected Indians from rapid rise in over-nutrition rates.



IMPACT OF POVERTY ALLEVIATION PROGRAMMES AND SUBSIDISED FOOD GRAINS THROUGH PDS ON CEREAL INTAKE



Cereals are the major source of energy in Indian diets.

Over the last four decades there has been a decline in cereal consumption (and energy intake) among the rich and increase in cereal consumption among the poor.

As of 2009-10 cereal intakes are essentially similar in all groups, and is sufficient to meet their requirements.

Perceptive Indians changed their cereal (main source of energy) consumption even before revision of RDA for Indians!



PHYSICAL ACTIVITY



India 2010



India 1960



Until two decades ago Indians had adequate moderate physical activity in domestic occupational and transport domains. So in spite of sedentary discretionary activity, overall physical activity levels in Indians was moderate

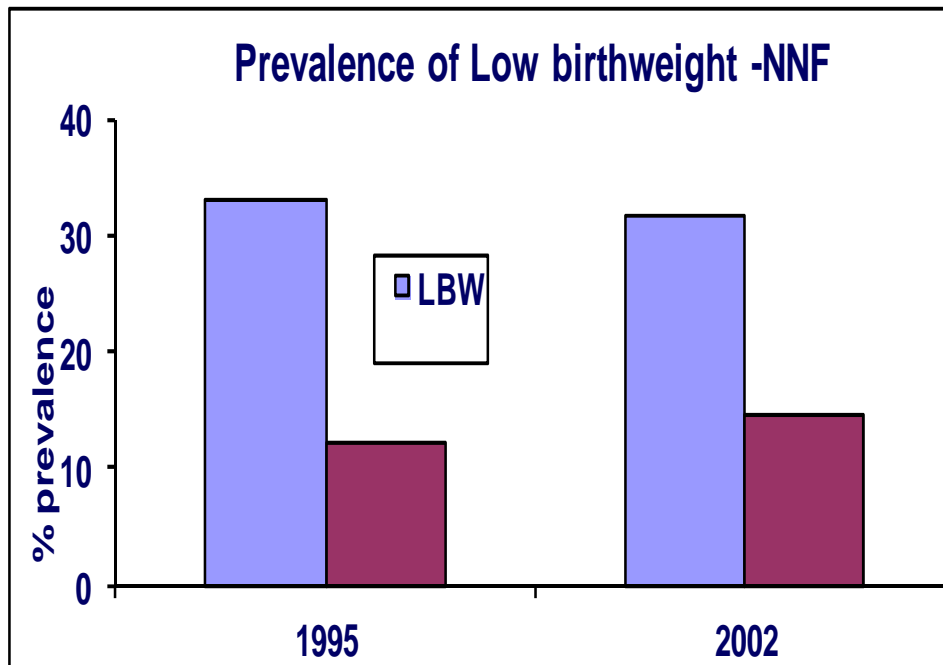
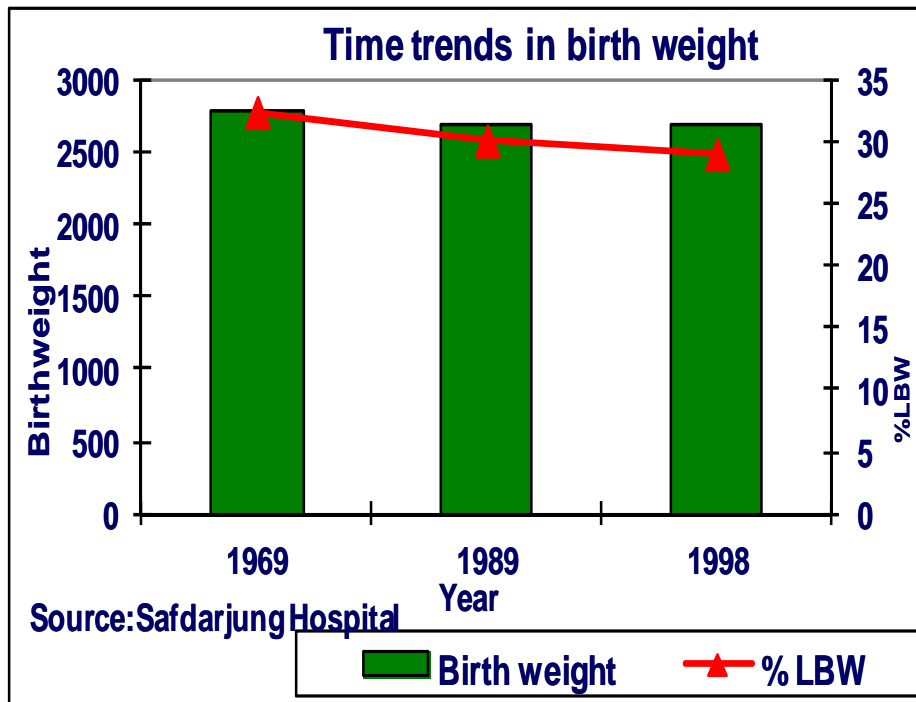
Over the last five decades physical activity in daily chores had declined. Discretionary physical activity continues to be sedentary. 📢

**NUTRITION TRANSITION AND
EMERGENCE OF DUAL NUTRITION BURDEN IN INDIA**



BIRTH WEIGHT OF INDIAN NEONATES





- Over the last five decades there has not been any substantial reduction in LBW.
- Majority of LBW babies are mature. Prevalence of preterm births is about 12%.
- India still has the highest LBW rates in the world, but IMR in India is comparable to other developing countries.
- Small but mature Indian low birth weight babies survive but grow along a lower trajectory as compared to normal birth weight babies. 📢


DUAL NUTRITION BURDEN BEGINS IN UTERO

Low birth weight (<2.5kg) rate in India about 30 %; about 2 % of Indian infants have high birthweight

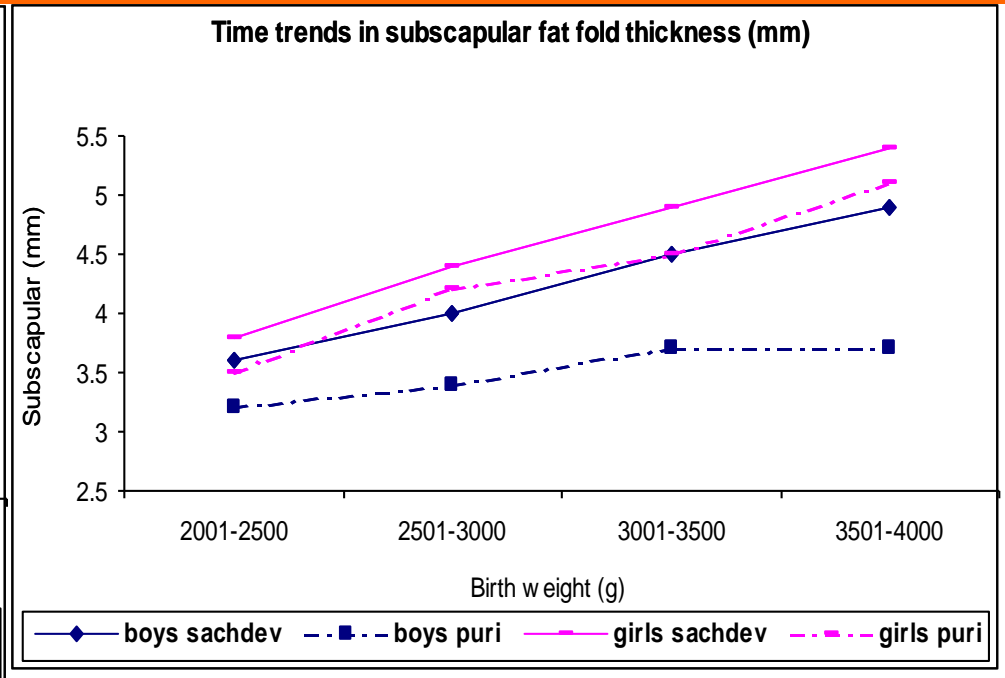
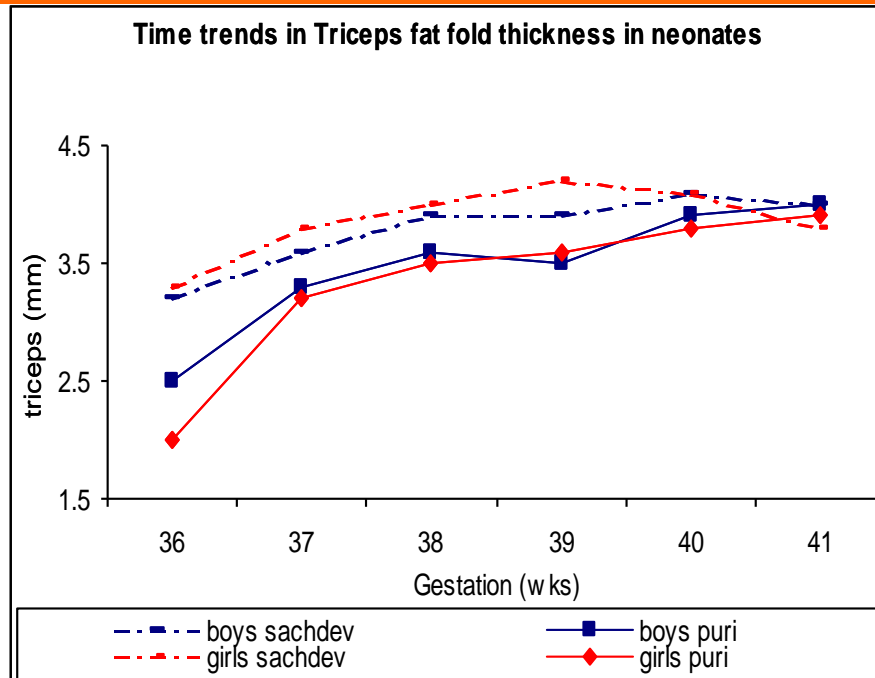
Low maternal height, low prepregnancy weight , low maternal weight gain and anaemia in pregnancy are major factors associated with low birthweight in India - **trans-generational impact of maternal undernutrition**

Gestational diabetes with maternal overnutrition predisposes to large for date babies – **trans-generational impact of maternal overnutrition**

Pregnancy induced hypertension with or without diabetes is emerging as an important obstetric factor predisposing to **LBW**

Effective antenatal care including treatment for anaemia , PIH & food supplements when needed can reduce **LBW** by about 5 % 

THE THIN -FAT INDIAN NEONATE



Indian neonates are short and wasted; they have low muscle mass but fat mass is spared.

Over the last two decades there has been no change in birth weight but there has been an increase in fat fold thickness of neonates - in boys and girls, in all gestational age and birth weight categories

Indians' proneness for adiposity begins in utero



RISK OF NCD IN DELHI COHORT

Age	Men	Wt (Kg)	Women	Wt (Kg)
At birth	803	2.89	561	2.79
2 yrs	834	10.3	609	9.8
12 yrs	867	30.9	625	32.2
30 yrs	886	71.8	640	59.2
BMI ≥ 25	886	47.4	638	45.5
Central Obesity (%)	886	65.5	639	31
Impaired GTT/diabetes	849	16	539	14

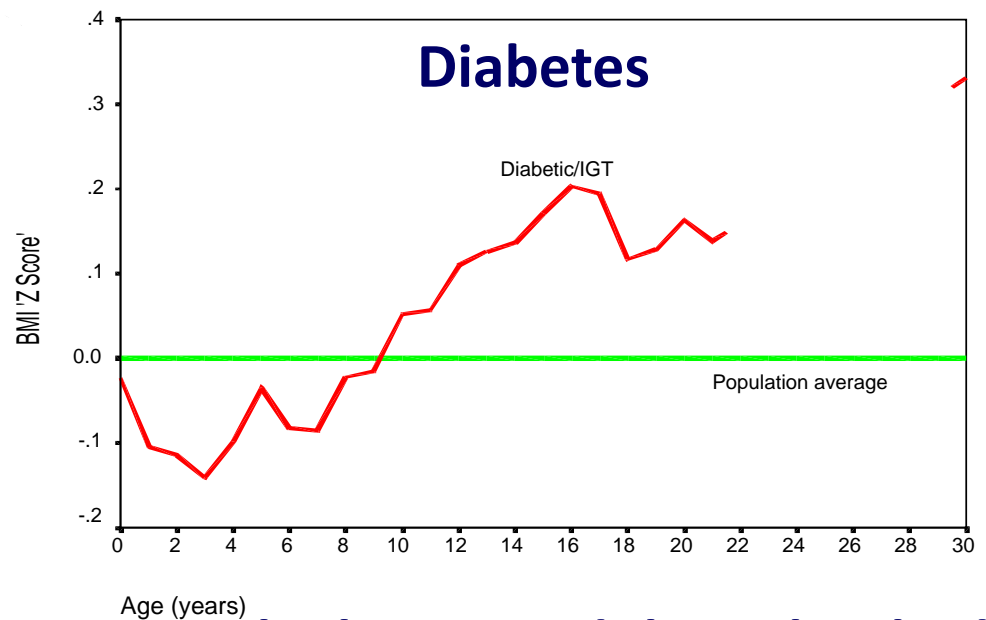
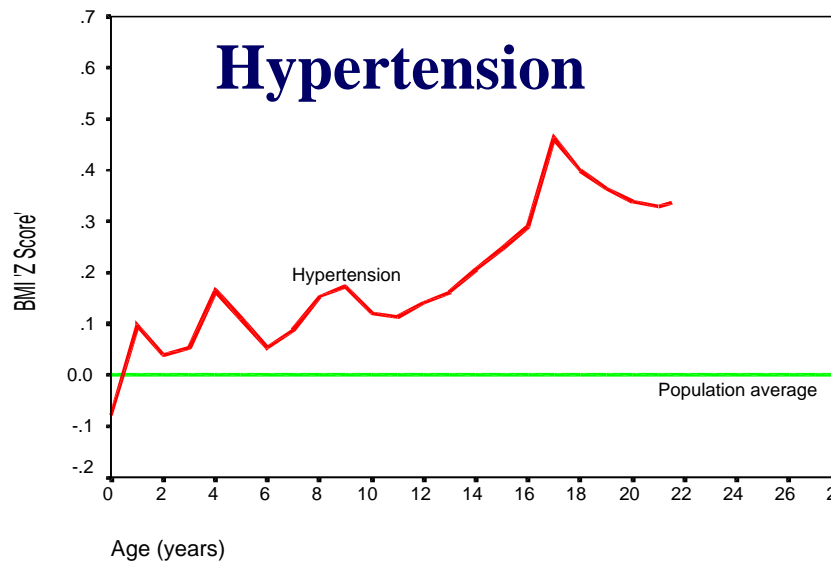
Source: Bhargava et al, 2004

**One-third of Delhi cohort children weighed <2.5kg at birth
They had low mean birth weight, were under-nourished
during infancy, childhood and early adolescence.**

**At 30 they were overweight, had abdominal adiposity and
high diabetes and hypertension rates.**



EARLIER GROWTH AND ADULT DISEASE



Risk of hypertension and diabetes was higher in adults who had gained more weight and BMI (mainly body fat) in childhood and adolescence.

Childhood under-nutrition may predispose to over-nutrition in adult life and also predispose to hypertension and diabetes.

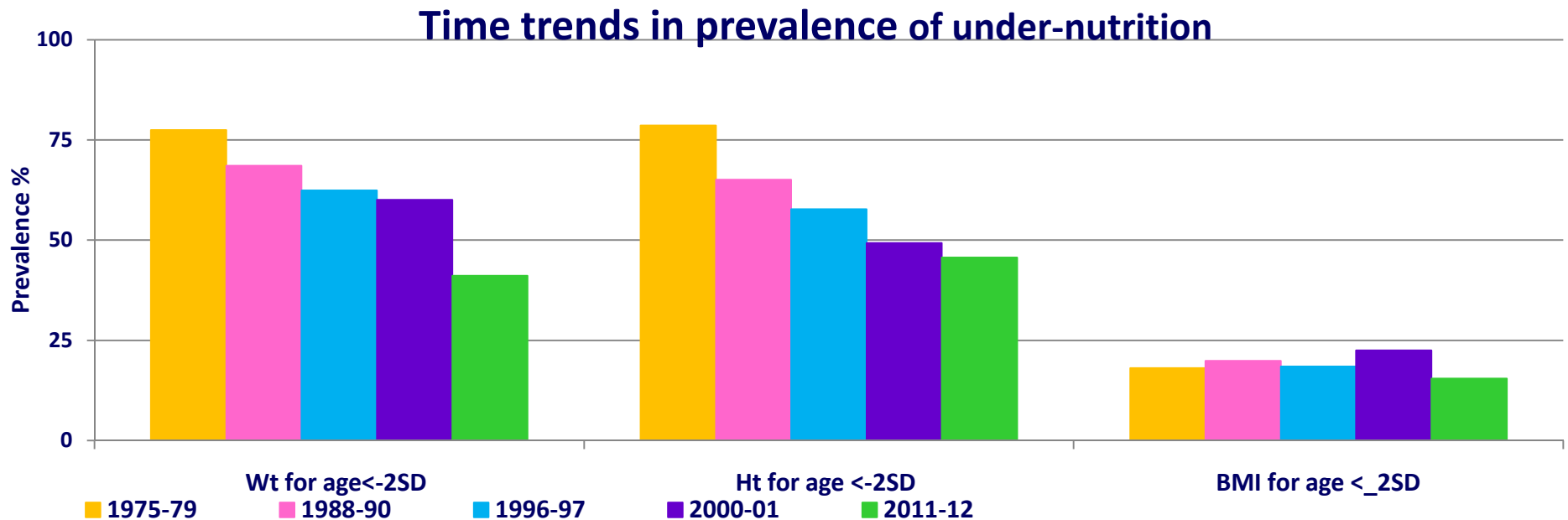
Bhargava SK, Sachdev HPS, *et al.* New Engl J Med 2004; 350: 865



NUTRITIONAL STATUS OF PRESCHOOL CHILDREN



TIME TRENDS IN PREVALENCE OF UNDER-NUTRITION IN UNDER FIVE CHILDREN IN INDIA (NNMB)

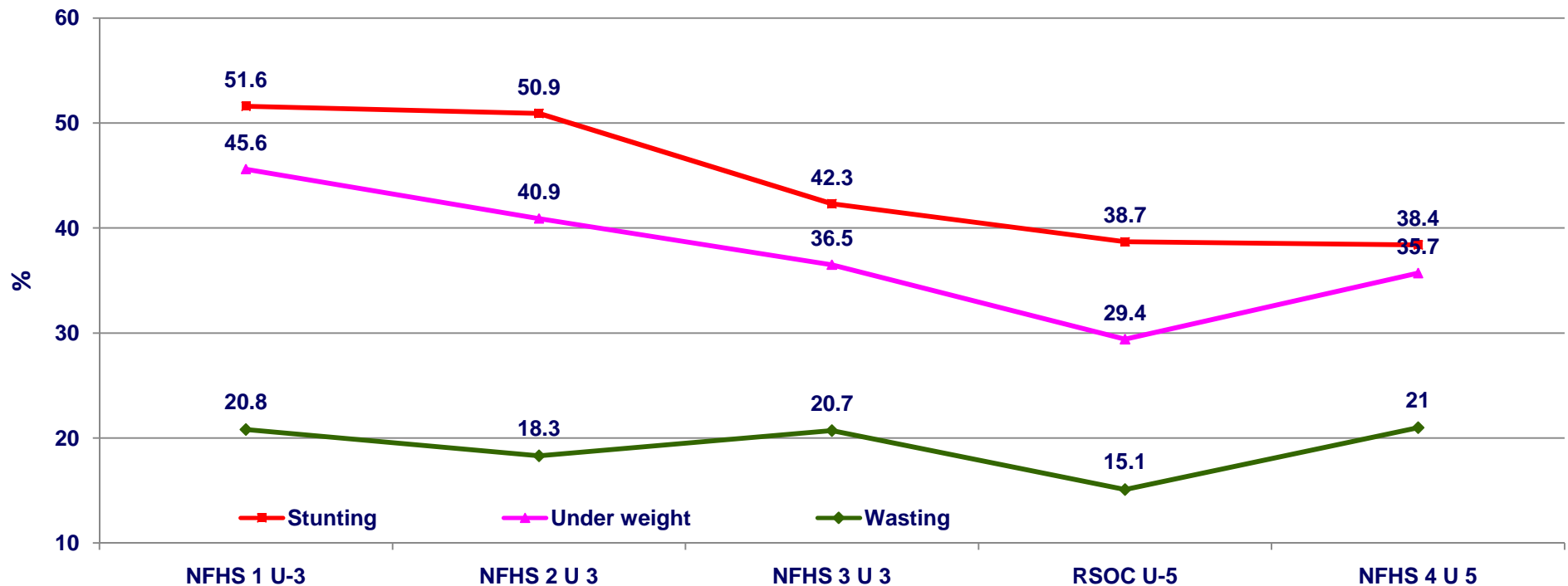


There has been a slow but steady decline in severe and moderate under nutrition (weight-for-age and height-for-age) in pre-school children, but wasting rates have remained unaltered

It was assumed that reduction in stunting will result in these children growing into taller adults.

But this did not happen because change in prevalence of stunting (<-2SD group) cannot result in increase in average adult height. 📢

TIME TRENDS IN PREVALENCE OF UNDER-NUTRITION IN INDIA



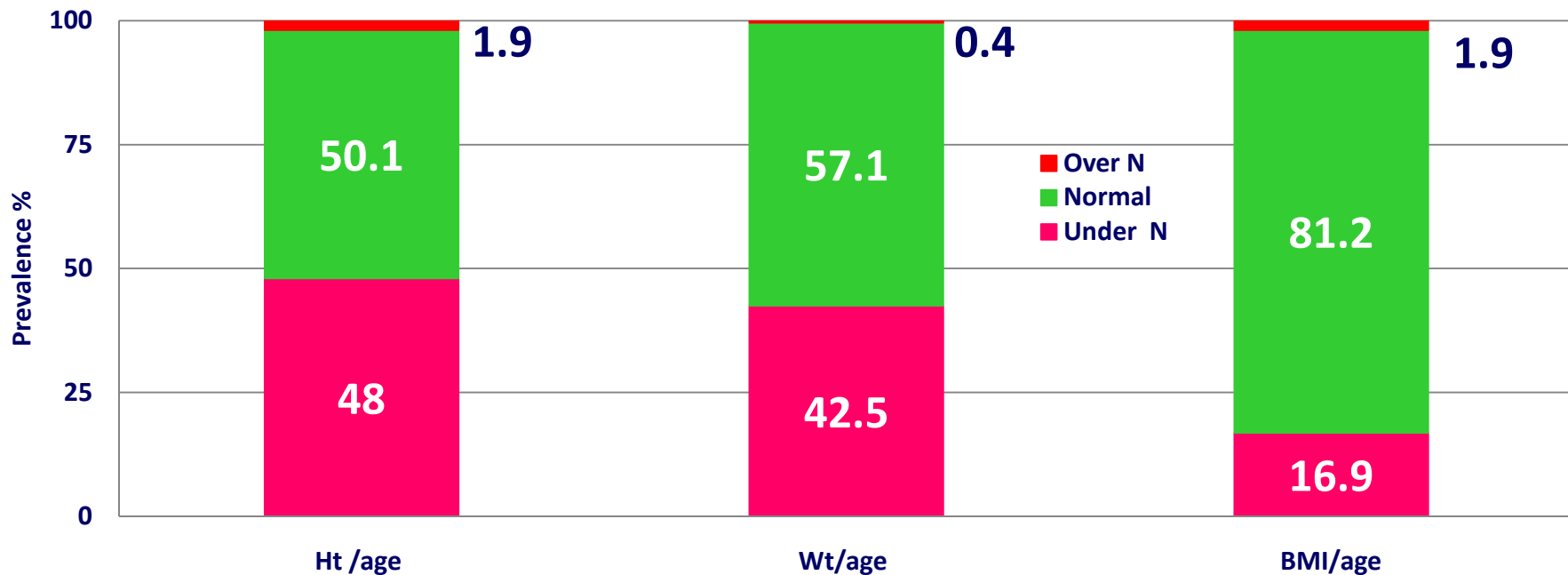
Over the last two decades there has been a slow but steady decline in stunting and under-weight rates

Over decades there has been very little reduction in the prevalence of wasting (a sign of current energy deficiency).

With emergence of dual nutrition burden, it has become essential to focus on nutritional status as assessed by BMI-for-age



NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN

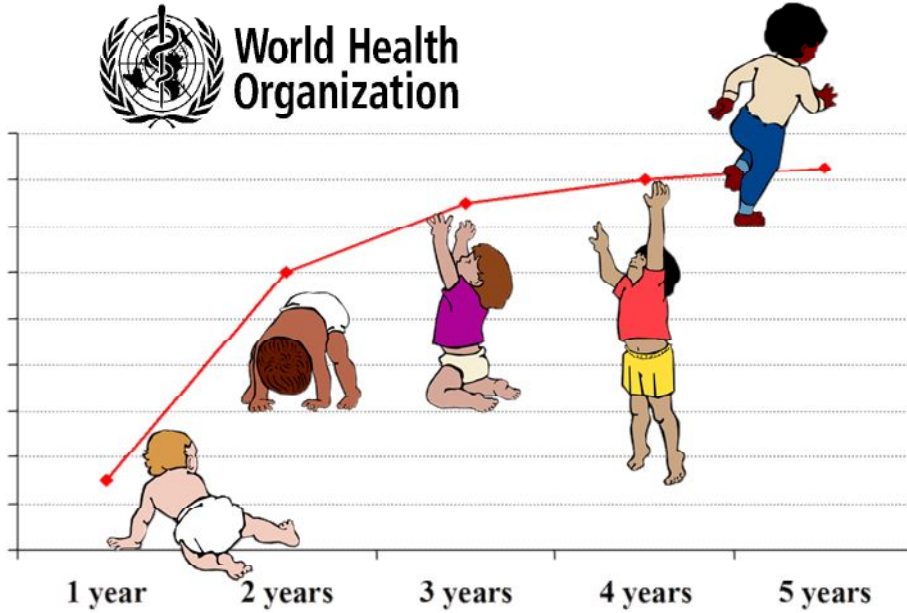


When BMI-for-age (weight for the current height and age) is used for assessing nutritional status of pre-school children, prevalence of under-nutrition (wasting) comes down to 17%. By improving dietary intake and treating infection, wasting can be rapidly reversed.

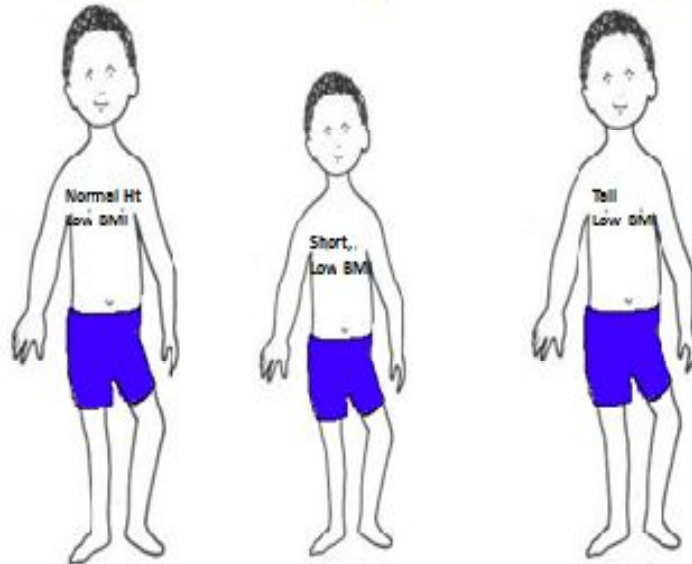
About 2 % of pre-school children are over-nourished.

It is important to use BMI-for-age for assessing nutritional status because short children with high BMI may be misclassified as stunted and under weight. They have to be classified as over-nourished and advised to become more physically active to become normally nourished. 📢

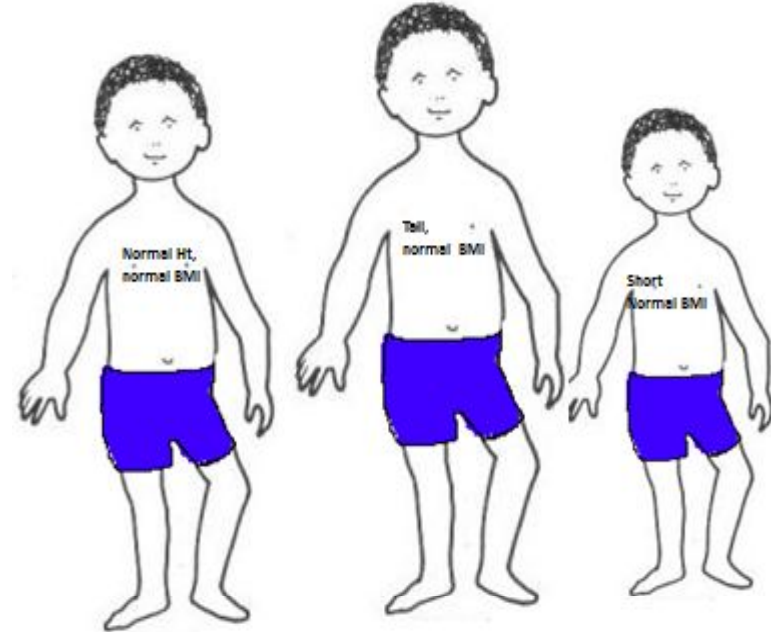
WHO Child Growth Standards 2006



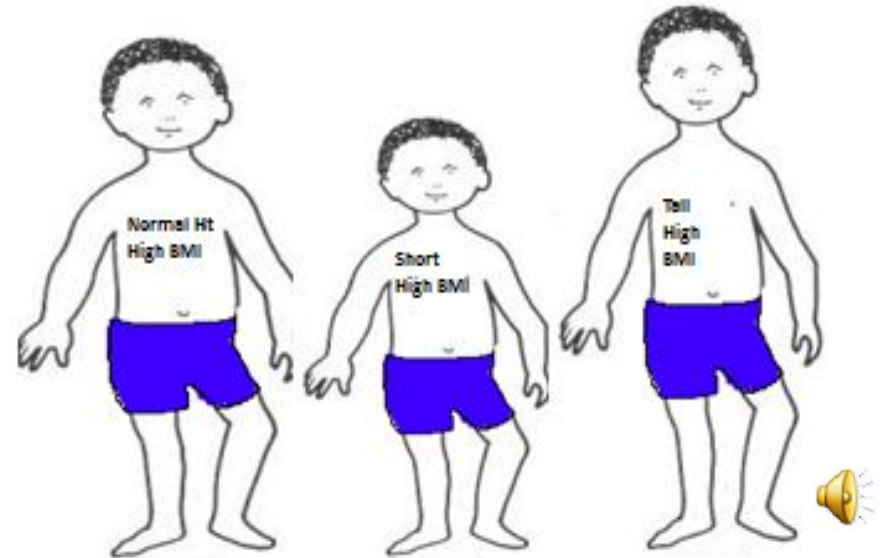
Children with low BMI can have normal height, be tall or short.
 They **all** require additional energy intake to ensure linear growth!



Children with normal BMI can be normal in height, tall or short.
 Children with normal BMI do not require nutritional interventions



Children with high BMI can have normal height, be tall or short.
 They **all** require adequate physical activity to reach normal BMI



NUTRITIONAL STATUS OF SCHOOL AGE CHILDREN



RDA FOR INDIAN CHILDREN

Group	Current mean wt	Requirement for current wt	Actual intake	Gap
Children				
1 – 3 y	10.5	840	714	-126
4 – 6 y	14.6	1095	978	-117
7 – 9 y	19.7	1379	1230	-149
Boys				
10 - 12 y	26.6	1729	1473	-256
13 – 15 y	36.8	2208	1645	-563
16 – 17 y	45.7	2514	1913	-601
Girls				
10 – 12 y	26.7	1469	1384	-85
13 – 15 y	36.9	2030	1566	-464
16 – 17 y	42.6	2130	1630	-500

The gap between the energy requirements needed for growth and actual energy intake was highest in in school age boys and girls
As a result undernutrition rates increase during this period



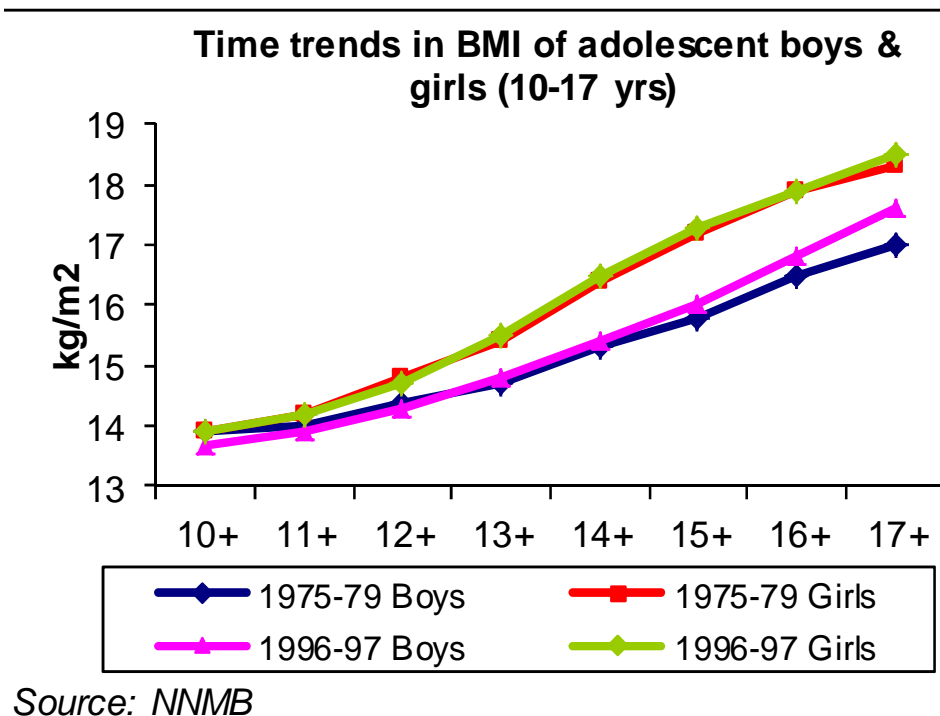
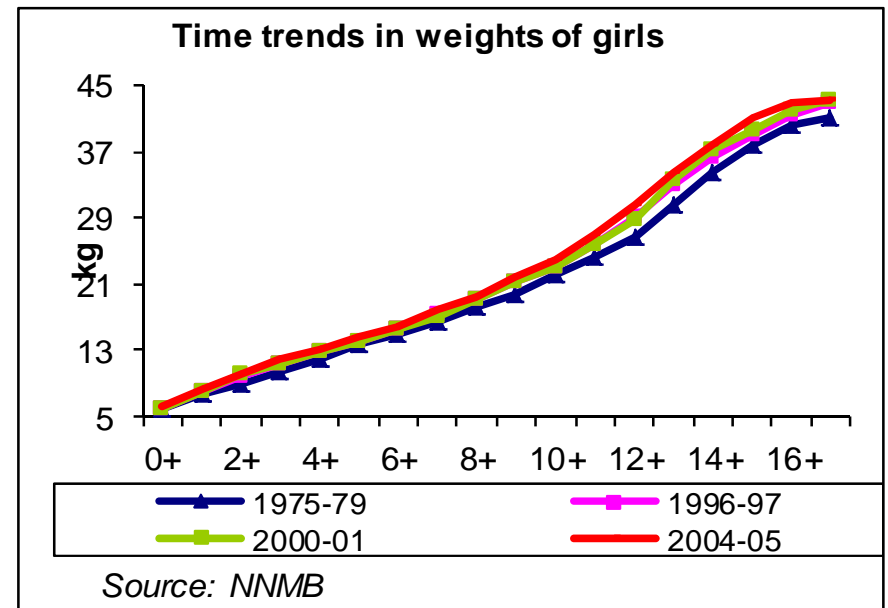
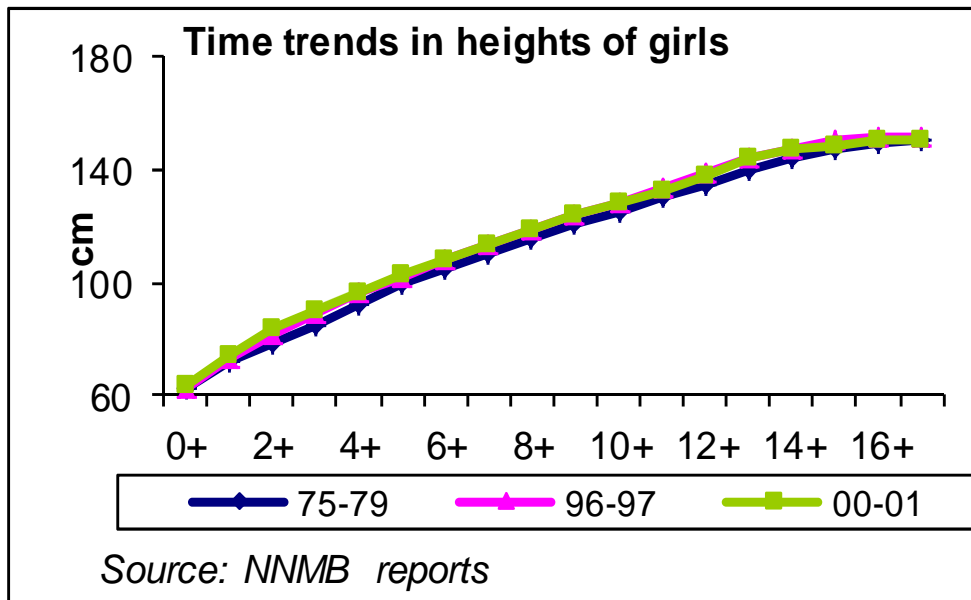
Sedentary life style

Excessive snacking Excessive time spent on T.V & computers



Increasing consumption of energy dense snacks, increasing time spent on TV watching/ computer games and reduction in physical activity/ play are some of the major factors responsible for the emerging problem of overnutrition in children and adolescents especially from urban affluent families

Nutrition and health education to combat these can prevent further escalation of overnutrition and later even reverse the trend 📢



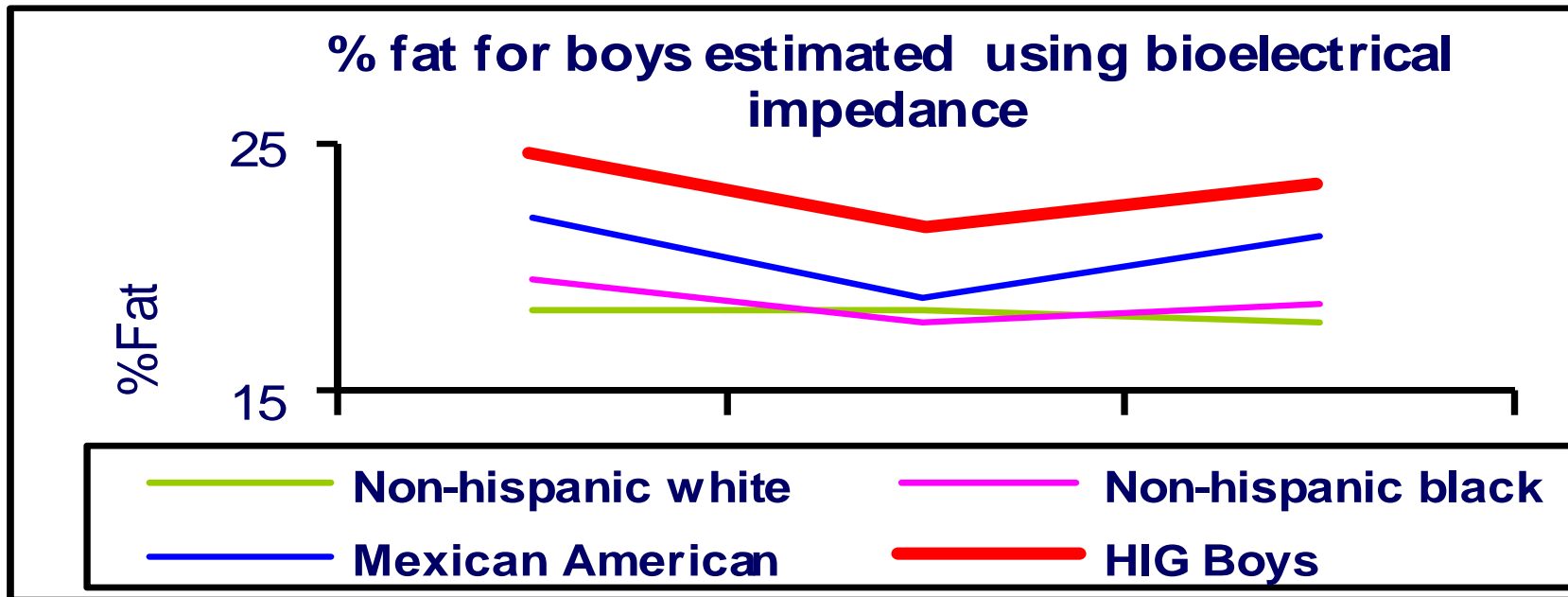
NUTRITIONAL STATUS OF CHILDREN

Over two decades there was very little increase in height but some increase in weight.

As a result there has been some rise in BMI in the 0-18 year age group

This is mainly due to increase in body fat





Over years there has been an increase in adiposity in school age children both in urban and rural areas

Data from Indian adolescents from urban high income group using bioelectrical impedance analysis have shown that they have high fat.

Comparison of data on % fat in Delhi urban high income group adolescent boys with Non-Hispanic white, Non-Hispanic black and Mexican Americans showed that % body fat was highest in Indian boys.

Adiposity in adolescents is associated with adiposity in adults.



NUTRITIONAL STATUS OF ADULTS



ENERGY REQUIREMENT OF ADULTS

MALE

FEMALE

Body Wt Kg.	BMR	PAL		Body Wt Kg.	BMR	PAL	
		1.53	1.4			1.53	1.4
45	1298	1986	1817	40	1031	1577	1443
50	1370	2096	1918	45	1101	1685	1541
55	1443	2208	2020	50	1171	1792	1639
60	1515	2318	2121	55	1241	1899	1737
65	1588	2430	2223	60	1311	2006	1835
70	1660	2540	2324	65	1318	2113	1933

Energy requirements depend on body weight.

Indian men and women are short; average weight of Indian woman is 46 Kg and that of men is 51 kg.


Energy requirements of sedentary Indians are low



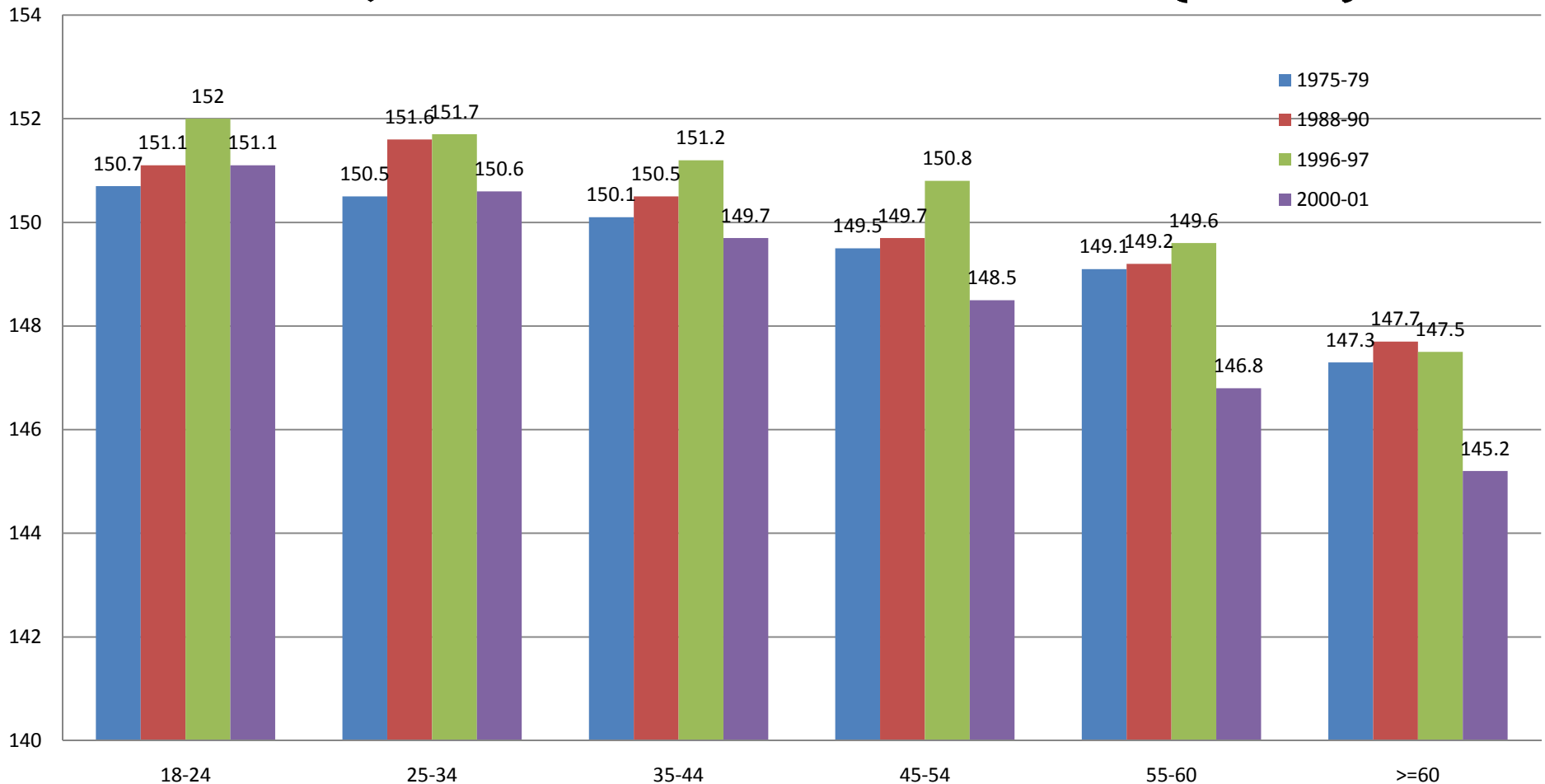
CHANGES IN BODY WEIGHT IN HIGH INCOME GROUP

Groups	Weight (Kg)	BMI	Energy Intake	Energy expenditure
30-39	59	24.8	2134	2056
40-49	64	26.4	2264	2191
50-59	69	28.6	2195	2146

Source : Wasuja and Siddhu

- Even in women from high income group, the energy intake is not high
- However energy expenditure is lower than intake by about 75- 100Kcal/day
- This positive energy balance leads to a progressive increase in body weight over decades
- This is the major factor responsible for increase in obesity and increased risk of CVD 

TIME TREND IN MEAN HEIGHT IN WOMEN (NNMB)

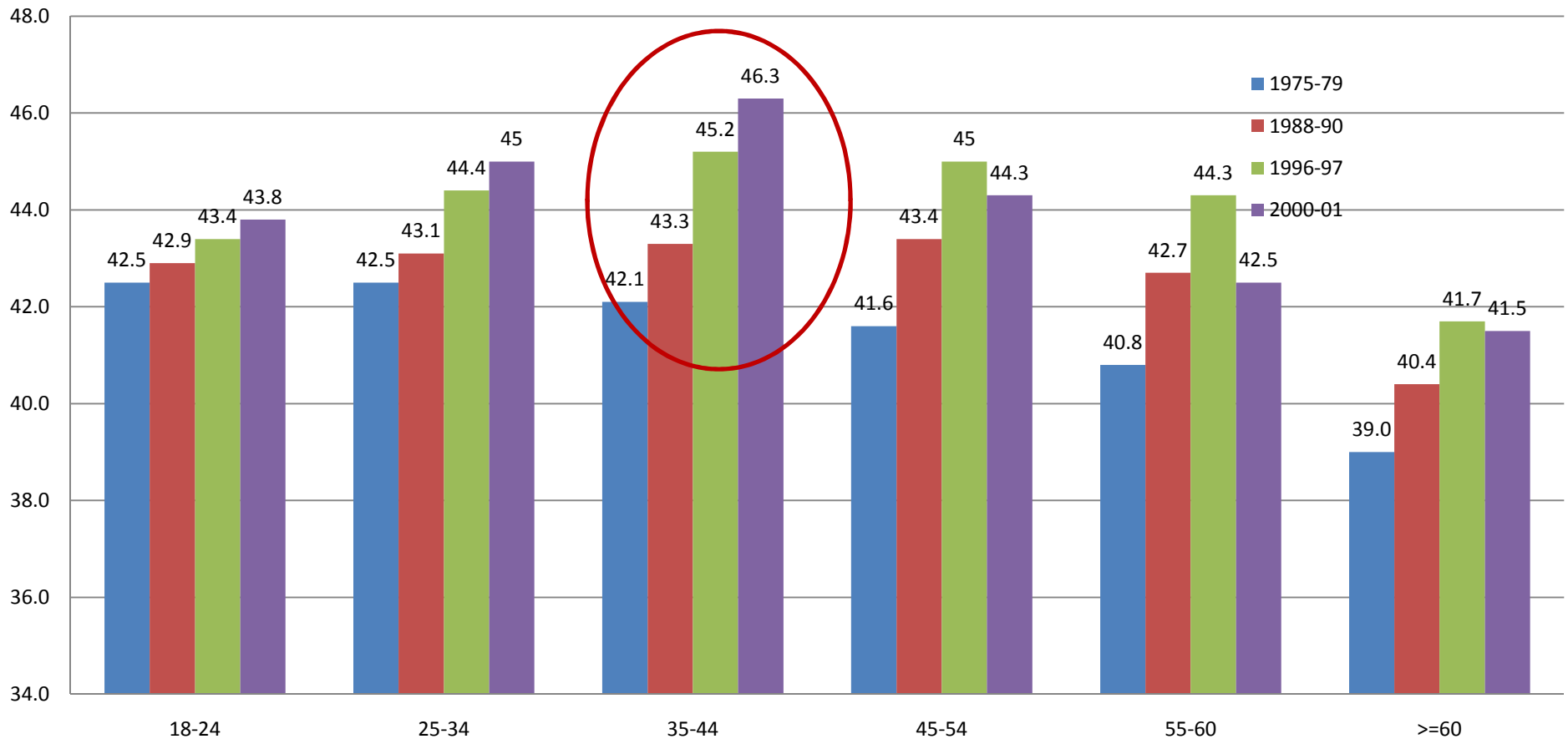


Increase in mean height in Indian women over three decades is less than 3 cms
Inter income group and interstate differences in height in Indian women is 5-6 cm.

**INDIAN WOMEN ARE SHORTER (151) THAN NCHS WOMEN (164) BY 13 CMS
THIS GAP CANNOT BE RAPIDLY BRIDGED**



TIME TRENDS IN MEAN WEIGHT IN WOMEN (NNMB)



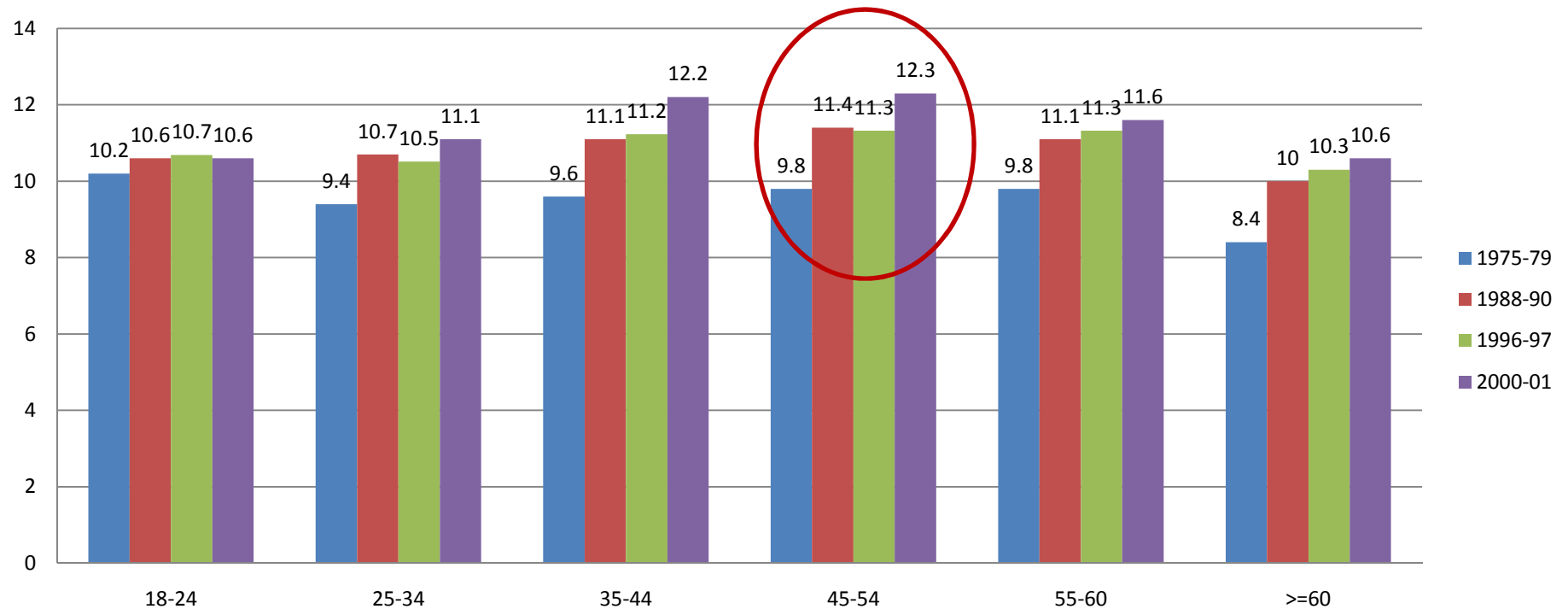
Mean weight is lowest in the <25 yr group.

Over years there has been increase in mean weight in women (2 kg in <25 and >4kg in 35-45 age group.

Inter income group and interstate differences in wt is about 5- 12 kg

INDIAN WOMEN ARE LIGHTER (42KG) THAN NCHS WOMEN BY (57KG) 15 KG THIS IS PARTLY DUE TO LOWER HEIGHT AND PARTLY DUE TO LOWER BMI

Time trends in FFT in women (NNMB)



Research studies have shown that for the same BMI Indians have greater adiposity and lower muscle mass.

There has been an increase in mean FFT in Indian women in the last four decades

It is lowest (<0.5mm) young women and highest in 45- 54 age group(>2.5 mm)

Inter income group and interstate differences in is about 2 mm

Adiposity is the major factor responsible for the rising non communicable disease burden.



ASSESSMENT OF NUTRITIONAL STATUS IN ADULTS

For adults, BMI has long been used as the indicator for assessment of both under- and over-nutrition.

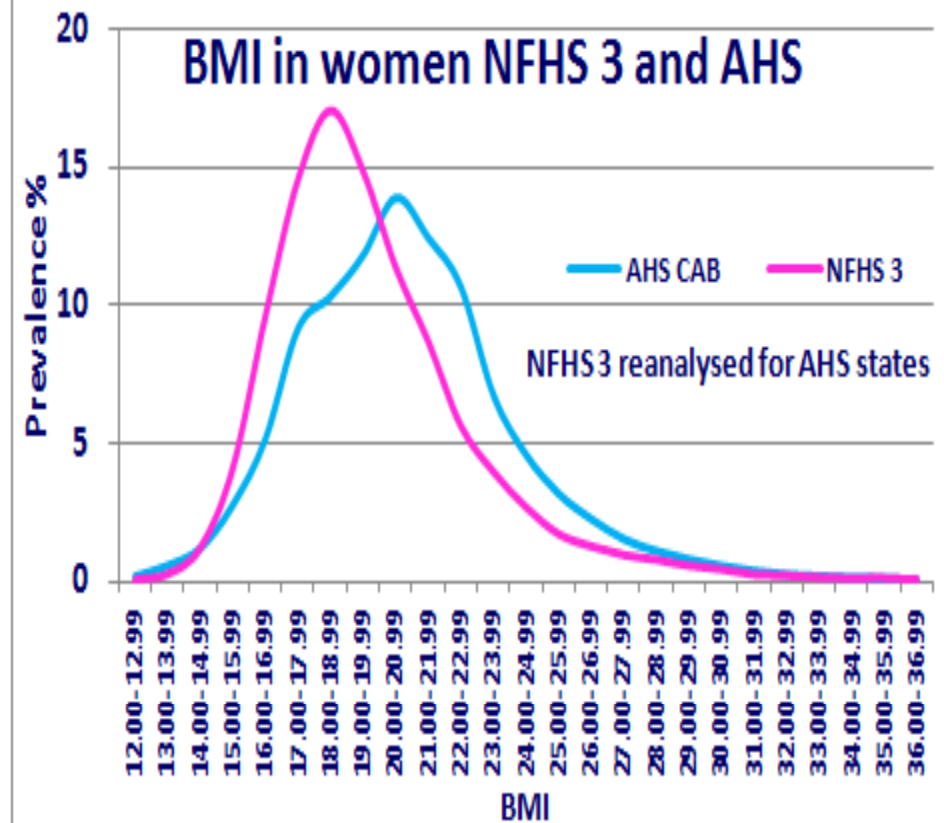
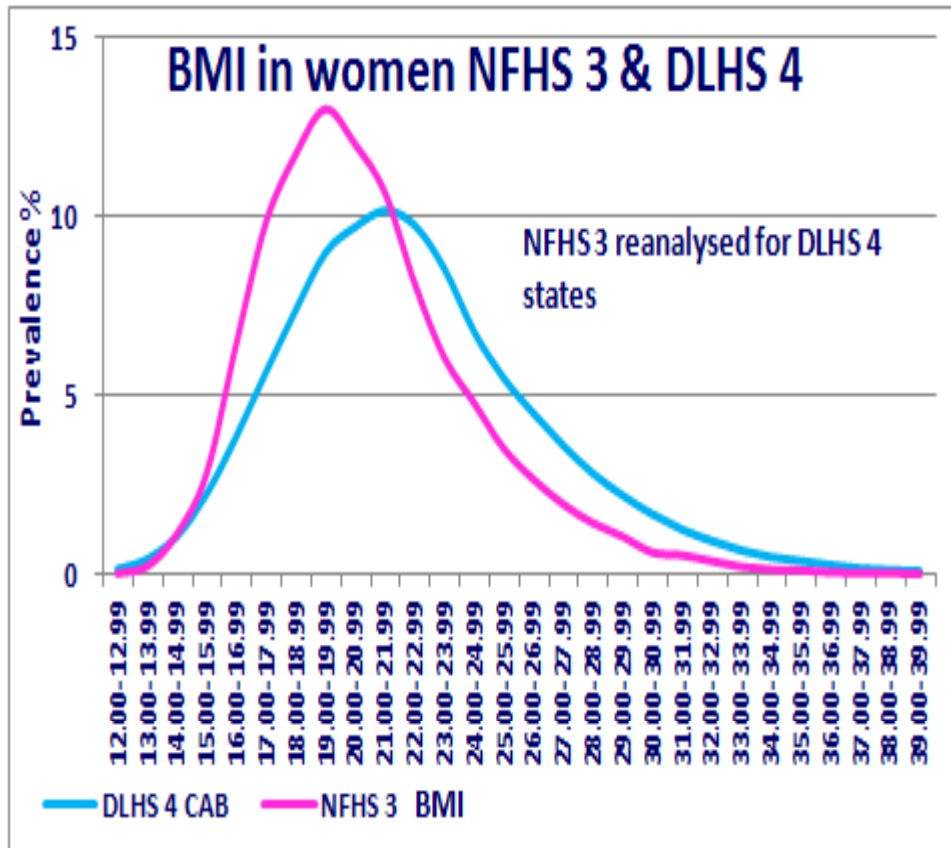
WHO had recommended that adults with BMI <18.5 should be classified as under-nourished, those with BMI between 18.5 and 24.9 classified as normal, between 25 and 29.9 should be classified as over-nourished and those with BMI ≥ 30 classified as obese.

Indians have higher body fat for any given BMI as compared to the Caucasians and the increase in CVD risk occurs even before BMI of 25 is reached.

It has therefore been suggested that Indians with BMI of ≥ 23 be classified as over-weight, those with BMI ≥ 27 as obese.

However currently all the national surveys continue to use BMI of 25 for classifying adults as over-nourished.





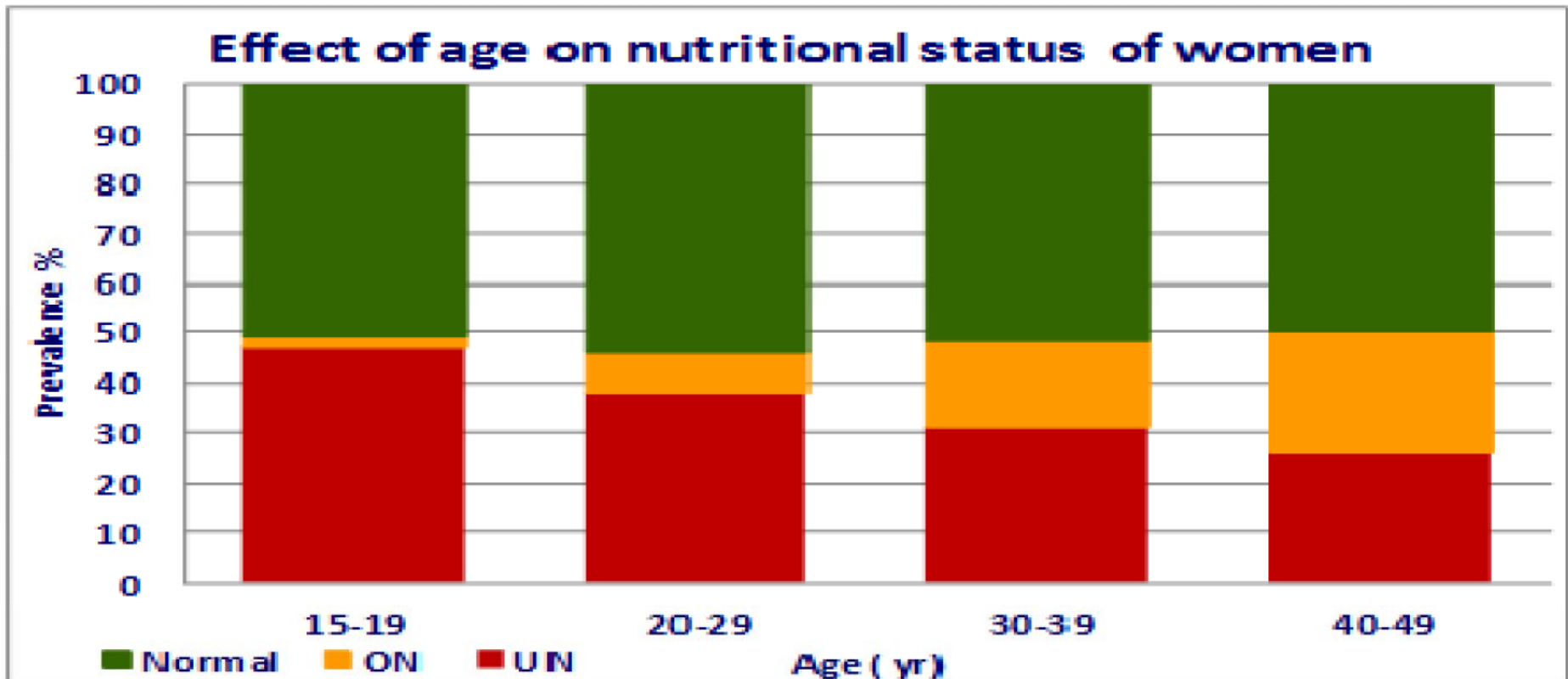
Over the last two decades there has been a shift to the right in the distribution of BMI - indicating that all women are gaining body fat.

While under-nutrition is still common in young women, over-nutrition is becoming a major problem in older women.

A similar trend is seen in men.

Measuring height and weight and computing BMI is essential therefore for assessing nutritional status of adults.





Most women complete child bearing by 30 years of age .

Under nutrition in women is higher in this age group and is associated higher low birth- weight rates in the offspring

Overnutrition rates are is high in women beyond 40 years of age . Over nutrition rates in women are higher than the over-nutrition rates in men

Women tend to ignore such weight gain because they believe that it is menopause related

They do not seek any nutrition or health advise and incur the risk of NCD and complications associated with NCD



**ASSESSMENT OF NUTRITIONAL STATUS IN
DUAL NUTRITION BURDEN ERA**



In the dual nutrition burden era accurate assessment of nutritional status has become essential.

➤ At individual level for

- early detection of under- and over-nutrition in persons**
- initiation of appropriate management on the basis of the findings during assessment and**
- monitoring the improvement in nutritional status over time**

➤ In community level surveys for assessment of

- magnitude and determinants of dual nutrition burden**
- impact of on-going public health interventions to combat the dual nutrition burden**



ASSESSMENT OF NUTRITIONAL STATUS IN DUAL NUTRITION BURDEN ERA

When under-nutrition was the public health problem parameters used for assessment of nutritional status were

- Household food security assessment
- dietary intake using 24 hour dietary recall
- clinical signs of nutritional deficiency and
- anthropometric measurements mainly weight and where possible height

Additional parameters used for assessment of nutritional status in dual nutrition burden era

- Physical activity measurements
- BMI
- Amount of body fat and its distribution



ASSESSMENT OF NUTRITIONAL STATUS IN DUAL NUTRITION BURDEN ERA

Measurements currently used for assessment of nutritional status are

- food and nutrient intake (food frequency questionnaire and 24 hour dietary recall) : to assess deficit or excess dietary intake
- physical activity pattern (using 24 hour physical activity questionnaire): to assess adequacy of the current physical activity levels
- height and weight and compute BMI: to assess under and overnutrition using BMI (for age in children) .
- Mid-arm, waist and hip circumferences and compute waist hip ratio: to assess adiposity and its distribution
- Fat-fold thickness measurement using Harpenden's calipers: to assess adiposity and its distribution
- fat mass and its distribution using bioelectrical impedance analysis: to assess adiposity and its distribution

