Dynamics of Cardiovascular Disease Among South Asian Men and Women

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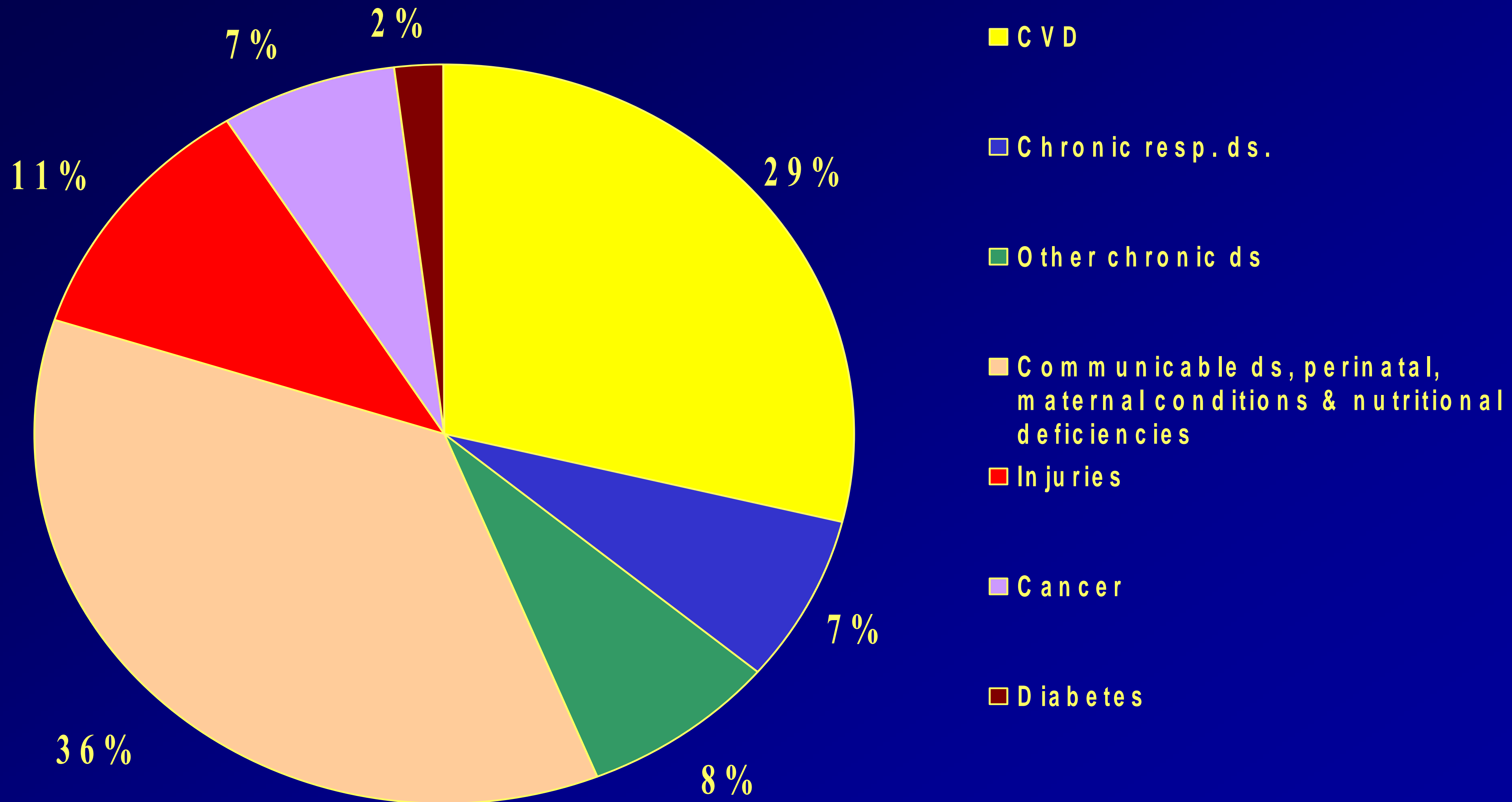
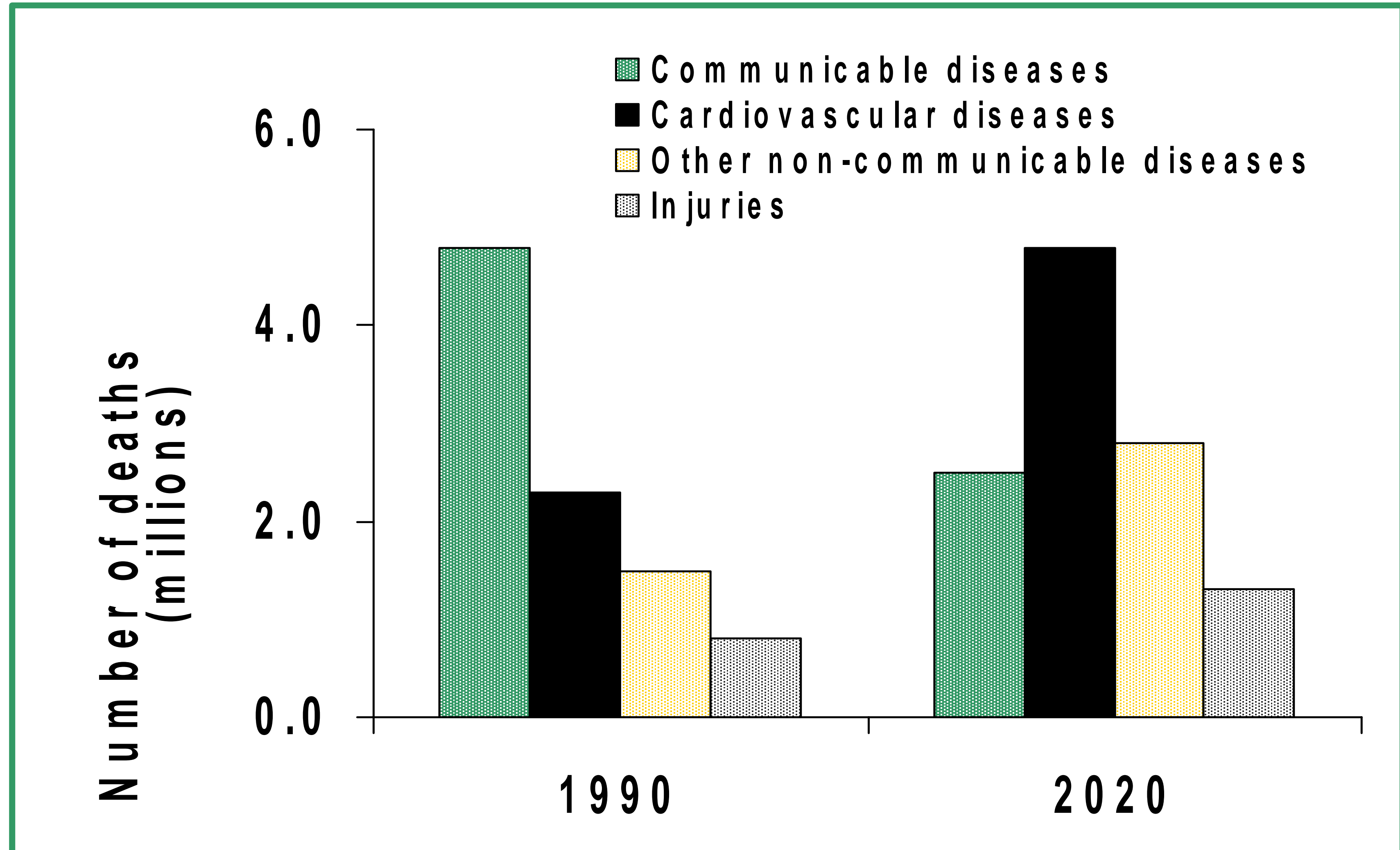
DEATHS IN INDIA (2005)



Source : WHO

ACTUAL AND PROJECTED NUMBERS OF DEATHS IN INDIA BY CAUSE 1990 AND 2020



ANDHRA PRADESH RURAL CAUSE OF DEATH STUDY (2004)

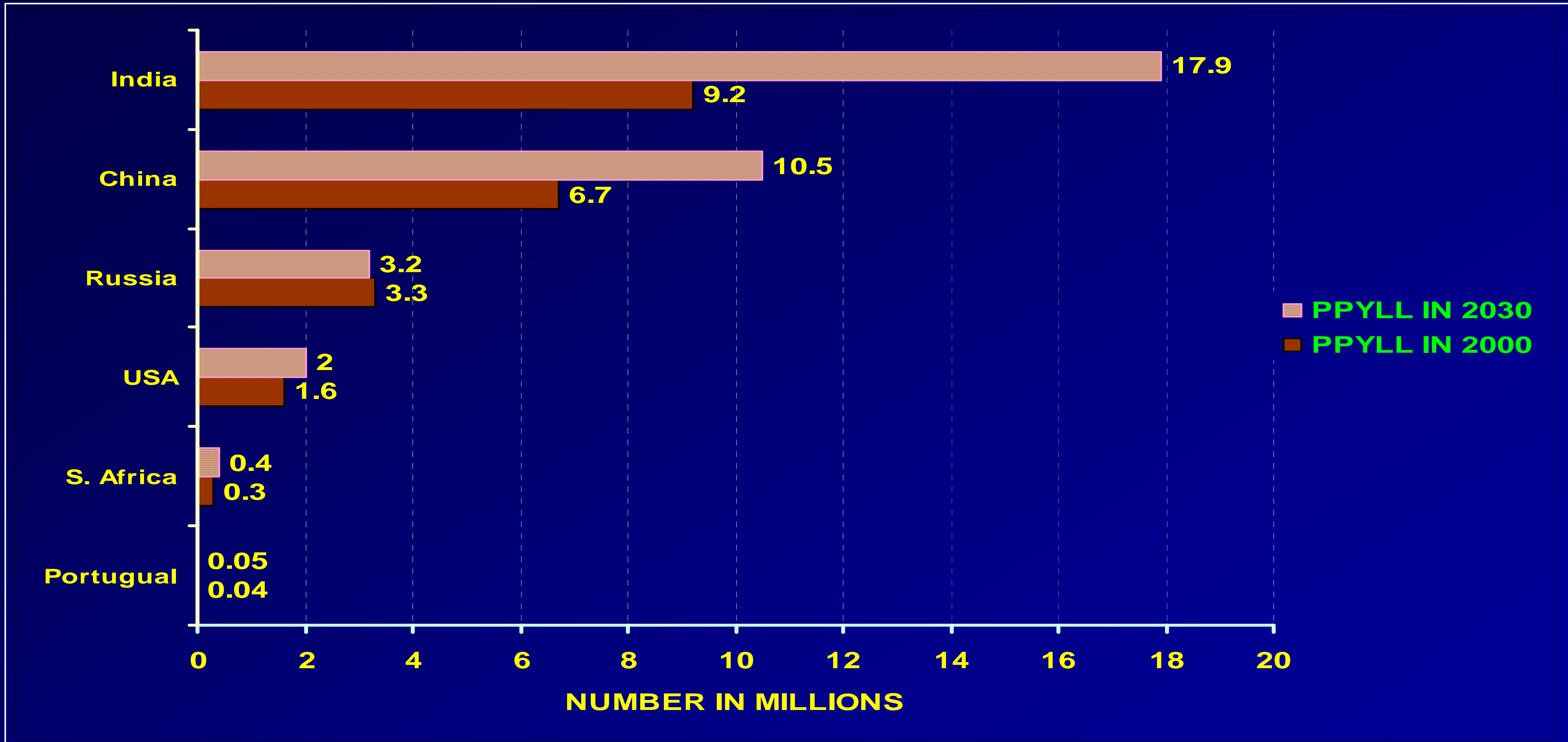
• Godavari Districts	:	45 villages
• Population	:	180, 162
• Deaths	:	1534 Deaths
• Cause of Death	:	Verbal Autopsy (MPWs)
		Assignment (Physicians)
• Response Rate for VA	:	98%
• Circulatory System Deaths	:	32%*

(CHD = 14%, stroke = 13%)

- Joshi R. et al (IJE 2006)

* 27% of these occurred below 60 years of age

YEARS OF LIFE LOST DUE TO CVD IN POPULATIONS Aged 35-64 Years: Leeder et al.2004



PPYLL= Potentially Productive Years of Life Lost

Five- year increase in life expectancy gives a country a 0.3-0.5 % higher annual GDP growth rate in subsequent years (Barro R 1996: Health and economic growth; PAHO)

Neglected Chronic Diseases Carry Economic Costs

- In **2005**, it is estimated that India lost **9 billion** USD in national income from premature deaths due to heart disease, stroke and diabetes.

- These losses are expected to cumulatively lead to **237 billion** USD over the **next 10 years**.

Source: World Health Organization

INDIANS : THE GROWING PROBLEM OF CHD

- Projections of rising mortality and disability
- Trends of increasing prevalence and hospitalization.
- Altered age profile; increasing urbanization; rising rates of diabetes, hypertension, overweight, tobacco consumption
- Experience of Indian migrants: adverse gene-environmental interactions
- Programmed susceptibility : Impact of small size at birth (Intrauterine nutrition : Barker effect)

Rising Chronic Disease Burdens

	2000	2025
No. of Persons with HYPERTENSION	118 Million	214 Million
No. of Persons with DIABETES	30 Million	60 Million +
No. of Persons Dying from TOBACCO	900,000	2 Million +

CHD IN INDIA: ABSOLUTE NUMBERS

- **Prevalence studies report CHD:**
  - **3-4% in rural areas; 8-10% in urban areas**
- **Conservative estimate: 29.8 million patients**
  - **(14.1 million urban; 15.7 million rural)**
- **Annual event + death rate (~10%):**
  - **2.9 million/year**
- **Mortality (~5% per year)**
  - **1.5 million/year**

Gupta R. BMJ 2004; 328;807-10. Electronic response.

Risk Factors

- Are they different?
- Do conventional risk factors matter?
- Are their levels high?
- Is there an SES gradient?

CVD RISK FACTORS IN 'SOUTH ASIANS' SUMMING UP THE EVIDENCE

MIGRANT STUDIES I	
McKeigue 1991, 1993	Central obesity; Hyperinsulinemia Glucose Intolerance (Diabetes+ IGT)
Enas 1995	Dyslipidemia (↓ HDL; ↑ TG) ↑ Lipoprotein 'a'
Anand 2000	↑ Homocysteine

MIGRANT STUDIES II	
Bhatnagar (London- Punjab)1995	Conventional Risk Factors are important and have been underestimated
Shoukat (Case- Control in UK)1995	
Bhopal (S. Asian groups) 1999	
Patel J et al 2005	

Contd..

CVD RISK FACTORS IN 'SOUTH ASIANS' SUMMING UP THE EVIDENCE

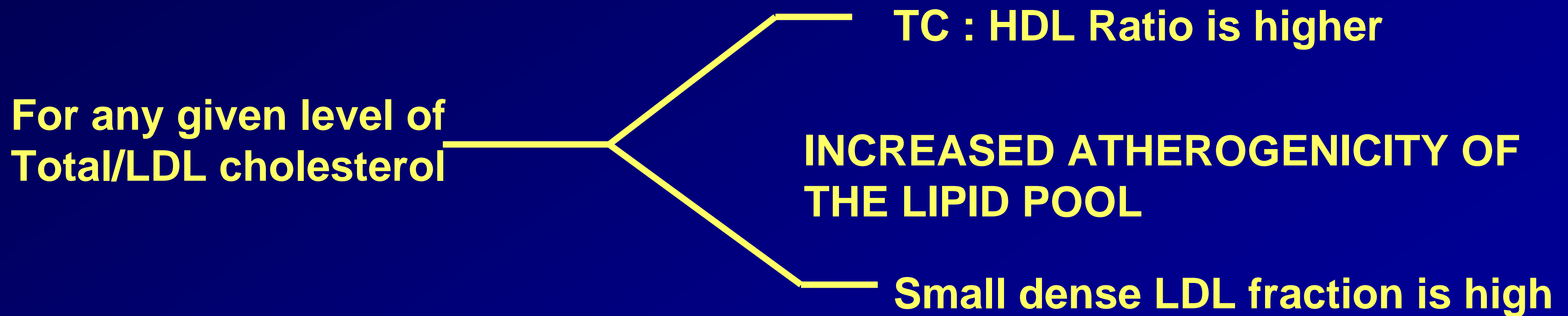
INDIAN STUDIES	
Pais 1996 (Case-Control)	Smoking; Hypertension
Reddy 1993, 99 (Urban-Rural: ICMR Study)	↑Total Cholesterol: HDL Ratio Waist-Hip Ratio + BMI Dysglycemia + Diabetes
Mohan et al. 2001 CUPS Study (Chennai)	Emphasis on conventional risk factors. High prevalence of IGT
Gupta R et al 2005	Dietary patterns and CHD mortality related across Indian states

CHD Risk Factors: A Comparison of Vellore & Delhi Male Population

	VELLORE (rural %)	DELHI (rural %)	VELLORE (urban %)	DELHI (urban %)
CHD Prevalence (per 1000)	31.5	44.8	59.2	87.2
Total Cholesterol ≥ 200	15.8	17.1	26.9	37.2
Triglycerides ≥ 200	11.1	14.1	19.3	16.5
TC:HDL ≥ 4.5	44.2	42.2	59.9	64.6
Hypertension *(BP ≥ 140/90)*	8.6	11.96	21.6	22.1
Diabetes *(FBS≥140 mg/dl)*	3.2	2.8	9.4	13.0
BMI ≥ 25	9.2	8.4	26.0	37.3

Data from ICMR Study (1990-1994)

INDIANS IN COMPARISON TO OTHER ETHNIC GROUPS



MIGRANT COMPARISONS
WITH OTHER ETHNIC GROUPS

SAME ENVIRONMENT
DIFFERENT GENE POOL

NON-CONVENTIONAL RISK FACTORS

CONVENTIONAL RISK FACTORS

URBAN-RURAL COMPARISONS
MIGRANT-NONMIGRANT COMPARISONS

SAME GENE POOL
DIFFERENT
ENVIRONMENTS

URBANIZATION: WEIGHT GAIN + BULGING BELLY

Category	Urban (Delhi) (% prevalence)		Rural (Haryana) (% prevalence)	
	Male	Female	Male	Female
Overweight (BMI ≥ 25)	35.2	47.6	7.8	11.27
“Overweight” (BMI ≥ 23)	54.4	64.9	17.3	18.8
Central Obesity	71.8	39.5	44.9	35.8

(Age Group = 35-64 years; Period = 1990-1994)

Reddy et al, Obesity Reviews (2002)

Prevalence of Metabolic Syndrome in India

	Prev.(%)	Age-gp	Remark	Location
Ramachandran (2003)	41	20-75	ATP III WC>90/85	Chennai
Gupta (2003)	13	20+	ATP III	Jaipur
Reddy (1992-94)	30 34 26 40	35-64	ATP III ATP III WC>94 WHO criteria Overall (either)	Urban Delhi
Reddy (1992-94)	11	35-64	ATP III and ATP III mod.	Rural Haryana
SSIIP	20	20-69	ATP III	All over India
Misra et al	30	38	Own definition	Delhi

Prevalence of Diabetes in adults above 20 yrs

- Rural: 4%
- Urban: 11.9 %

(Estimates of ICMR, 2004)

OR for Impaired Glucose Tolerance or Diabetes, according to BMI at 2 yrs and 12 yrs

BMI at 2 yrs of age	ODDs Ratio (CI)		
	BMI <14.7 at age 12	BMI =14.7-16.2 at age 12	BMI >16.2 at age 12
<15.0	2.2 (0.8-5.9)	2 (0.7-5.7)	4.5(1.6-12.8)
15.0-16.1	1.8 (0.6-5.0)	1.4 (0.5-4.1)	2.4 (0.9-6.8)
>16.1	1¥	1.5 (0.5-4.3)	2.1 (0.8-5.8)

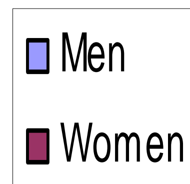
¥-reference category

Bhargava SK et al., NEJM 2004

Industrial Population Survey (2002-2003)

- Ten large/ medium industries across India, employing 1500-5000 people (public & private) twinned to medical colleges (public & private)
- Surveillance of CVD risk factors, with baseline survey
- Employees and their family members
- Age and sex stratified multi-stage random sampling
- Age Group: 20-69 years (Mean Age: 40yrs)
- n = 19 973 for the questionnaire survey,
- n = 10 442 for biochemical investigations

Age adjusted prevalence of risk factors 2002-2003



Prevalence %

0
10
20
30
40
50
60

Overweight 45.8 48.1

Central Obesity 25.5 30.3

Dyslipidemia 40.2 34.4

Diabetes 8.3 9.0

Hypertension 26.0 26.3

Tobacco Use 40.2 15.5

Metabolic Syndrome 18.4 35.0

Risk factors

KS Reddy et al WHO Bulletin 2006

SES GRADIENT:ORDER OF REVERSAL FOR CVD RISK FACTORS

Tobacco

Blood Pressure

Plasma Cholesterol

↓ Physical Activity

Obesity

Health Transition

CASE-CONTROL STUDY OF AMI (DELHI - BANGALORE, 1999)

350 cases under (75 years of age)

700 controls (matched for age, gender, hospital)

Variable	Age & Sex Adjusted RR	Multivariate RR
Education (none vs. highest level)	2.0	2.2
Household income (<3000 vs. > 10,000)	1.6	1.5

Source: Rastogi T. et al, Am J Clin Nutr, 2004

TOBACCO CONSUMPTION IN NORTH INDIAN MALES IS INVERSELY RELATED TO EDUCATIONAL LEVEL: RESULTS OF THREE CROSS SECTIONAL SURVEYS

Educational Level	Urban n=1456 Age: 34-65 years	Rural n=1070 Age: 35-64 years	Industrial n=2273 Age: 22-58 years
Illiterate	61.4%	83.3%	78.6%
Semi-Literate	48.6%	88.1%	73.7%
Undergraduate	41.3%	70.3%	52.8%
Graduates / Postgraduates	22.3%	44.2%	35.6%

Period of Surveys: 1990-1998

Reddy K S et al, 2000

CVD RISK FACTOR SURVEY IN 10 INDUSTRIES
Risk Factors by Educational Status in Women

Risk Factor	ES I (%) OR	ES II (%) OR	ES III (%) OR	ES IV (%) OR	P for trend
Tobacco Use*	0.2	0.6	2.7	42.1	*
Regular Physical Activity	33.3 1	22.5 0.9 (0.7-1.1)	21.2 0.6 (0.5-0.8)	16.1 0.3 (0.2-0.4)	<0.001
Diabetes	4.2 1	4.8 1.1 (0.6-1.8)	9.8 2.4 (1.5-3.8)	11.2 2.8 (1.8-4.4)	<0.001
Hypertension	15.3 1	18.4 1.2 (1.0-1.5)	23.8 1.7 (1.4-2.1)	34.7 2.9 (2.4-3.5)	<0.001
Metabolic Syndrome	29.0 1	30.7 1.1 (0.8-1.4)	40.8 1.7 (1.3-2.1)	39.4 1.6 (1.2-2.0)	<0.01

ES I: Post Graduate; ES II: Graduate; ES III: Secondary or High School;
ES IV : Primary or Illiterate

(Ongoing Indian Industrial Surveillance Study; Baseline Survey in 2002-03)

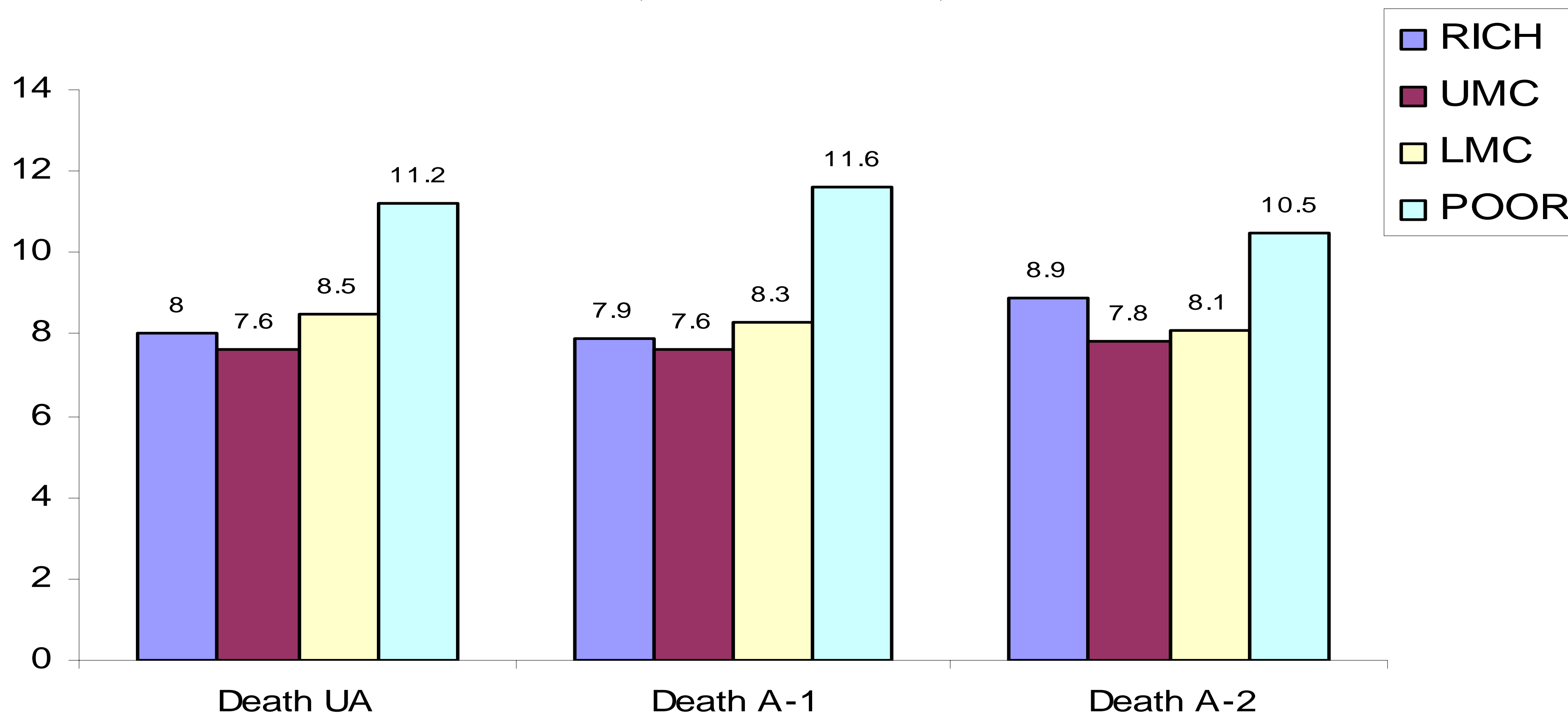
THE SOCIO-ECONOMICALLY DISADVANTAGED GROUPS ALSO FARE WORSE

IN

RECOGNITION OF RISK FACTORS AND ACCESS TO GOOD CLINICAL CARE

Create Registry India: Case-fatality

6,564 STEMI Subjects, 76 Hospitals



CREATE India Investigators. Indian Heart J 2003; 55:463

CVD SURVEILLANCE ACTIVITIES

Baseline survey: 2002-2003
Age group 20-69 (n=19973)

Health promotion interventions: 2003-2005

Intermediate intervention evaluation survey-2004-2005

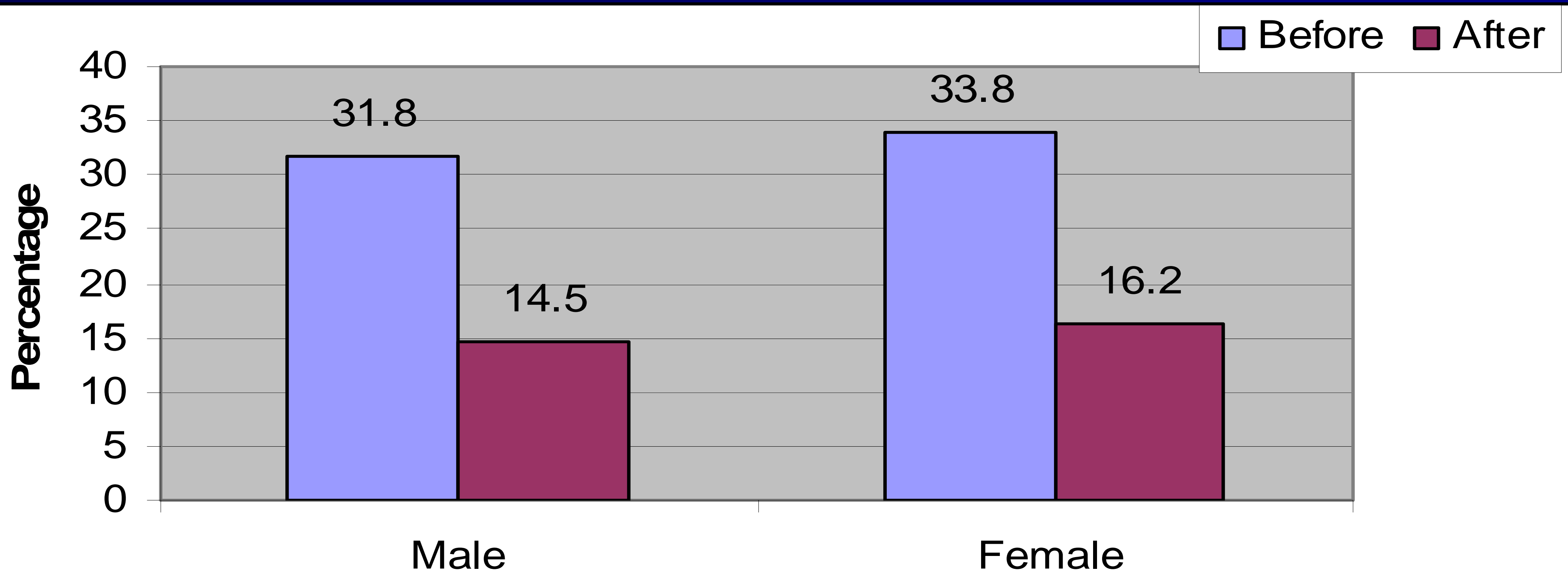
Final survey: 2005-06 (n=6172)

2223 Individuals attended both Surveys

Intermediate changes (2004-2005)

Behavioral changes	% changes
Physical activity levels	↑ 17.1%
Fruits and vegetable consumption	↑36.3%
Conscious effort to decrease oil/ghee/butter consumption	↑ 31.3%

Age Adjusted Prevalence of Use of Extra Salt (Before and After Intervention)



Trends in Mean Levels of Variables in Men (Six Centre Data)

Variable	Baseline:2002 n=6428	First Annual Surveillance: 2004 n=1236	Final Survey: 2006 n=4698
SBP	128.4 (16.7)	127.1 (16.8)	123.4 (16.7)
DBP	79.9 (10.8)	78.4 (10.5)	74.7 (10.5)
Weight	62.2 (12.6)	61.8 (12.3)	61.7 (11.8)
WC	84.0 (11.1)	81.8 (11.0)	81.0 (10.3)
PG	92.1 (29.0) n=2894	90.1 (30.5) n=1207	83.6 (31.8) n=4062
TC	176.5 (43.0)	173.1 (42.2)	165.7 (43.8)
TG	132.9 (76.1)	132.0 (80.1)	135.5 (80.9)
HDL	43.2 (11.6)	45.8 (11.5)	49.5 (10.3)

Same individuals before and after intervention

Variables	Baseline	After Intervention	Mean Difference & 95% C.I	P Value*
Mean Age (Years) (n=2223)	41.48	45.28	3.8 (3.7-3.9)	<0.001
Mean Weight (Kg) (n=2223)	62.64	60.47	-2.16 (1.9-2.3)	<0.001
Mean WC (Cm) (n=2221)	84.95	80.92	-4.02 (3.7-4.3)	<0.001
Mean BMI (n=2222)	23.44	22.65	-0.79 (0.7-0.9)	<0.001
Mean SBP (mm of Hg) (n=2218)	128.3	122.2	-6.1 (5.4-6.8)	<0.001
Mean DBP (mm of Hg) (n=2216)	79.9	73.9	-5.6 (5.2-6.1)	<0.001

*Two tailed significance (paired sample t test)

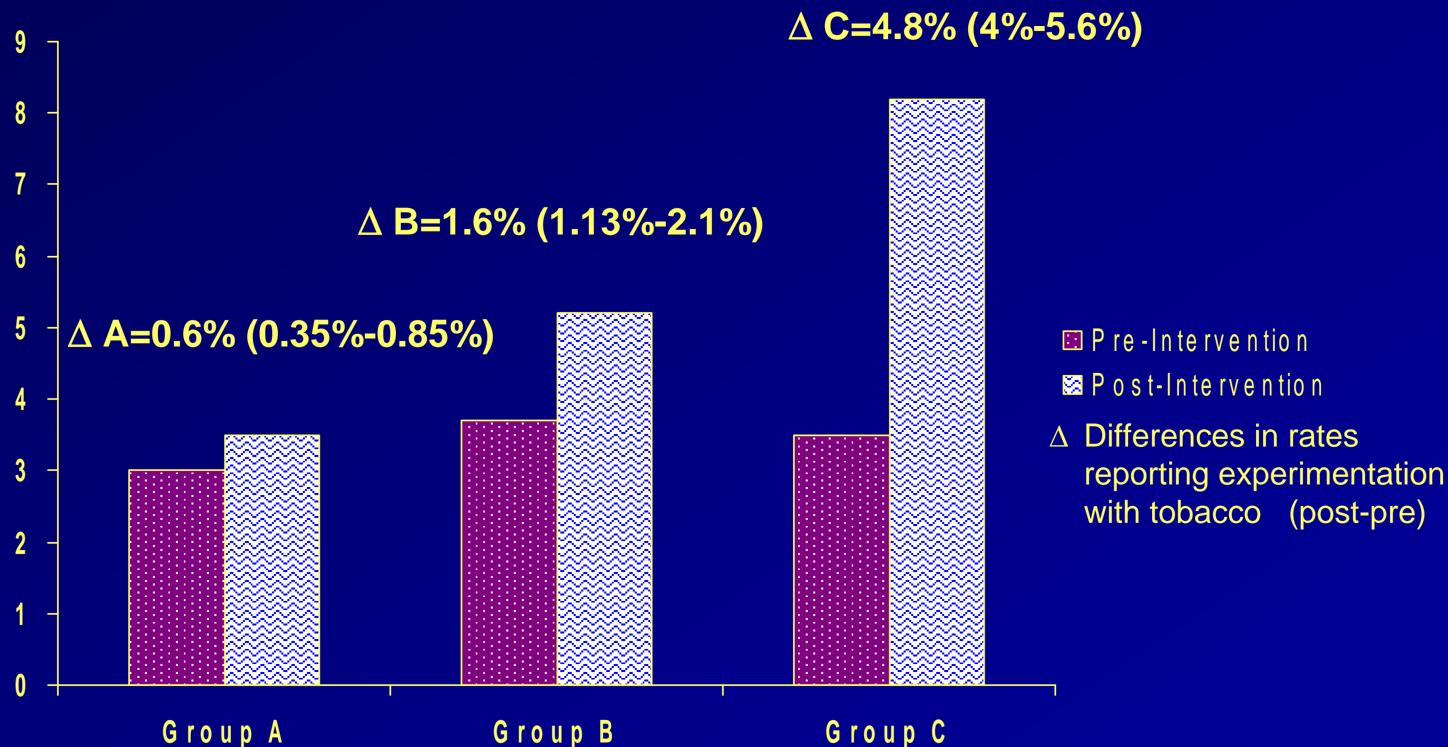
Same individuals before and after intervention

Variables	Baseline	After Intervention	Mean Difference & 95% C.I	P Value*
Mean Plasma Glucose (mg/dl) (n=989)	95.1	89.2	-5.9 (3.8-8.1)	<0.001
Mean Total Cholesterol (mg/dl) (n=990)	186.6	173.3	-13.4 (10.6-16.1)	<0.001
Mean High Density Lipoprotein (mg/dl) (n=975)	43.8	50.2	+6.4 (7.3-5.5)	<0.001
Mean Triglycerides (mg/dl) (n=988)	135.4	125.8	-9.6 (4.1-15.1)	<0.001

***Two tailed significance (paired sample t test)**

Result: 1996-98

Rates of Experimentation with Smoking among three groups during Pre and Post Intervention



Figures in Parentheses indicate 95% Confidence Intervals

Reddy KS et al., Am J Health Behavior 2002

WE NEED

AN EFFECTIVE PUBLIC HEALTH RESPONSE

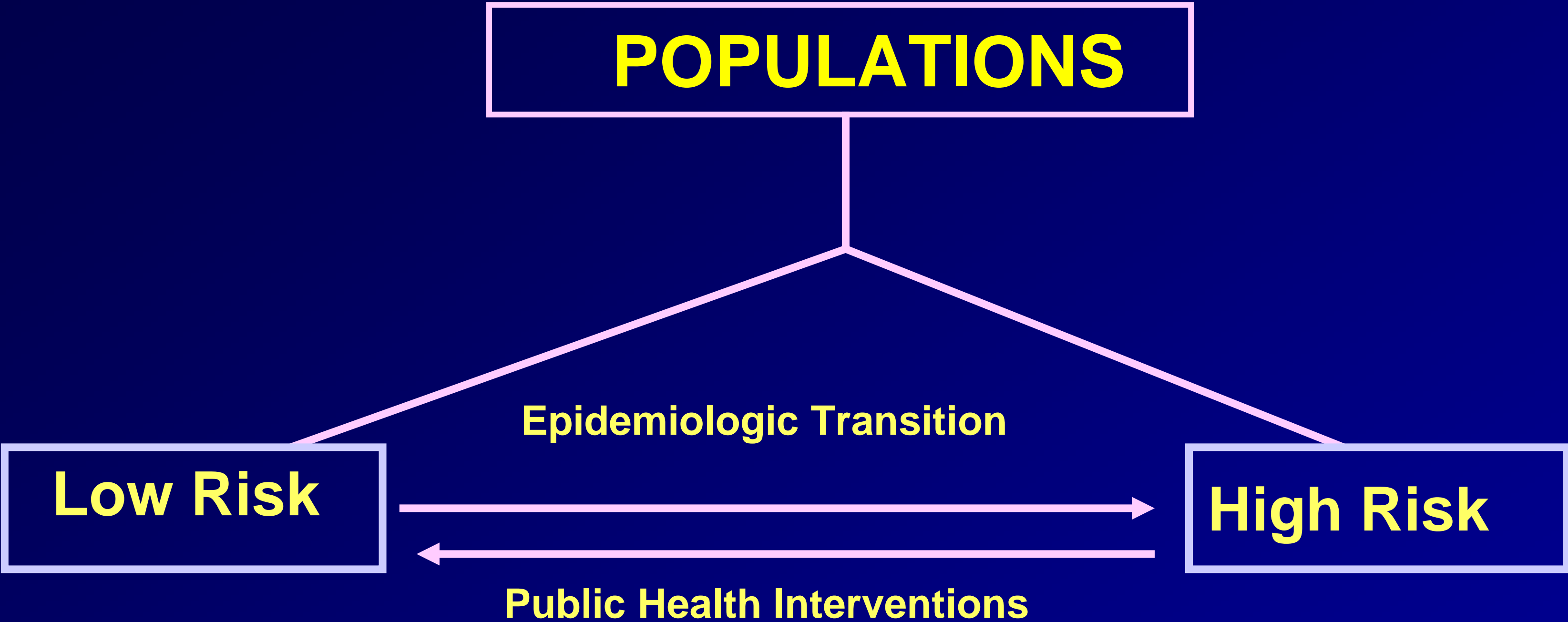
THAT CAN TELESCOPE THE HEALTH TRANSITION

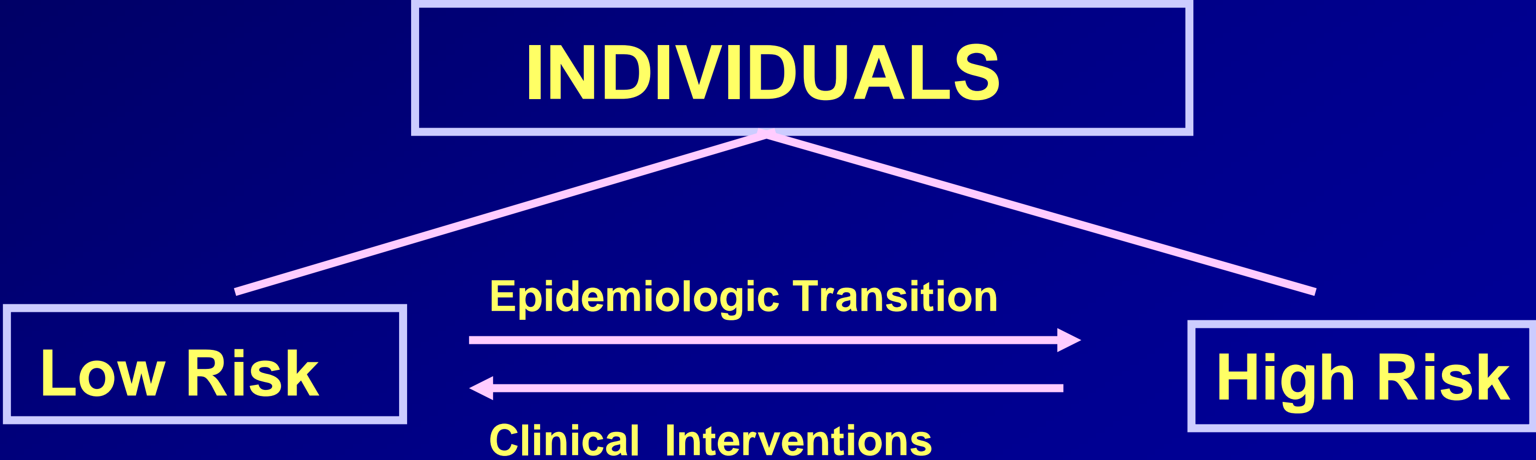
AND AVOID THE HUGE BURDENS

OF MID-LIFE DISEASE, DISABILITY & DEATH

IN LOW AND MIDDLE INCOME COUNTRIES

SPECIALLY IN SOCIO-ECONOMICALLY
DISADVANTAGED GROUPS


POPULATIONS
Low Risk
Epidemiologic Transition
High Risk
Public Health Interventions


INDIVIDUALS
Low Risk
Epidemiologic Transition
High Risk
Clinical Interventions

PUBLIC HEALTH INTERVENTIONS

Policy Interventions → Enabling Environment (Financial, Social, Physical)

Educational Interventions → Health Beliefs and Behaviours (Community; Individual)

Desired Change

Health leaps out of science and draws nourishment from the totality of society

- Gunnar Myrdal

POWER OF POLICY DEMONSTRATION

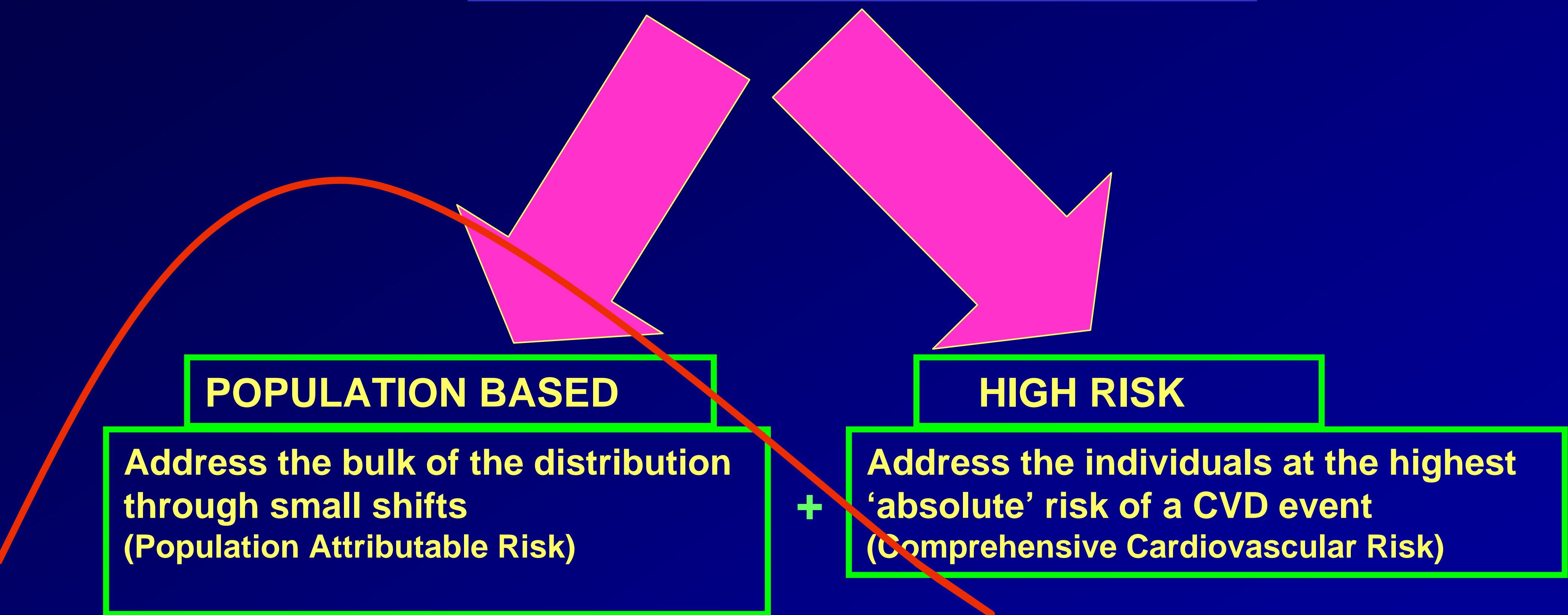
TOBACCO

- Taxes
- Advertisement Bans
- Ban on Public Smoking

DIET

- Finland
- Poland
- Mauritius

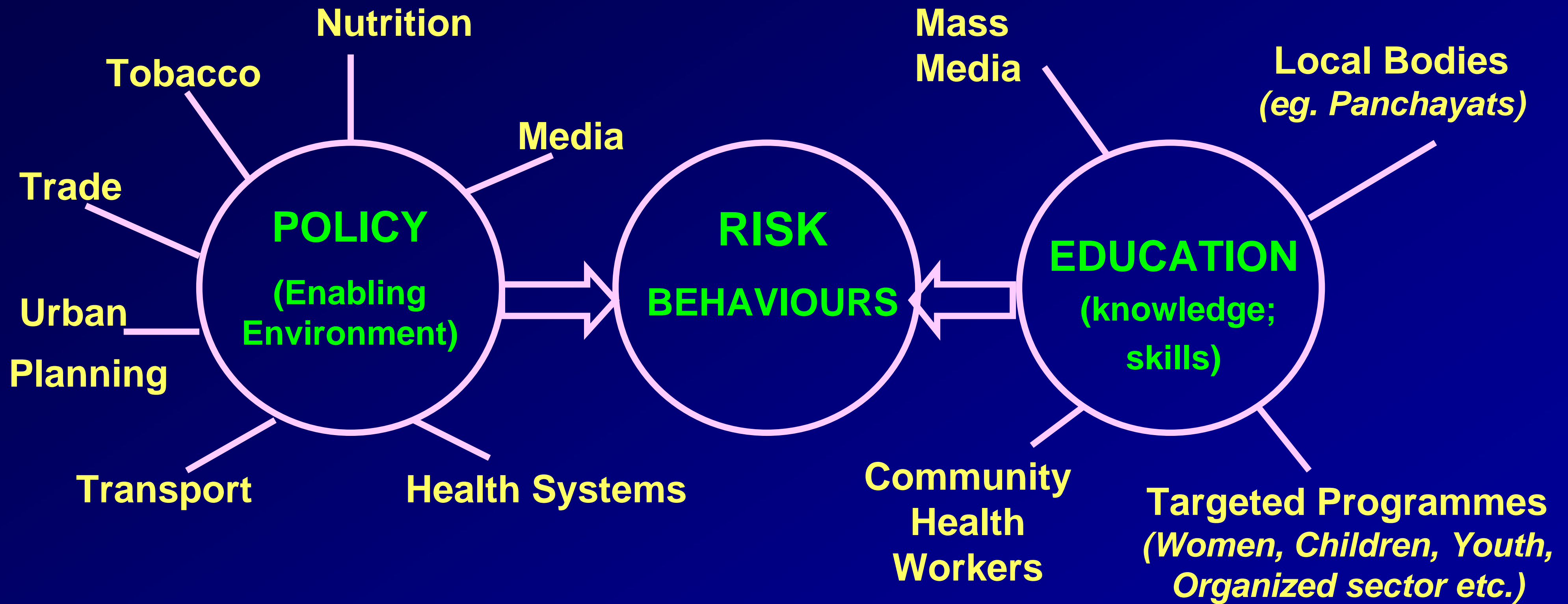
Food Labeling in USA, Canada
Australia, Norway


CVD PREVENTION
POPULATION BASED
Address the bulk of the distribution through small shifts
(Population Attributable Risk)
+
HIGH RISK
Address the individuals at the highest 'absolute' risk of a CVD event
(Comprehensive Cardiovascular Risk)
Widespread Effect = Large Benefits
High Impact = Cost-Effective use of resources

Estimated Stroke & IHD deaths averted in 2020

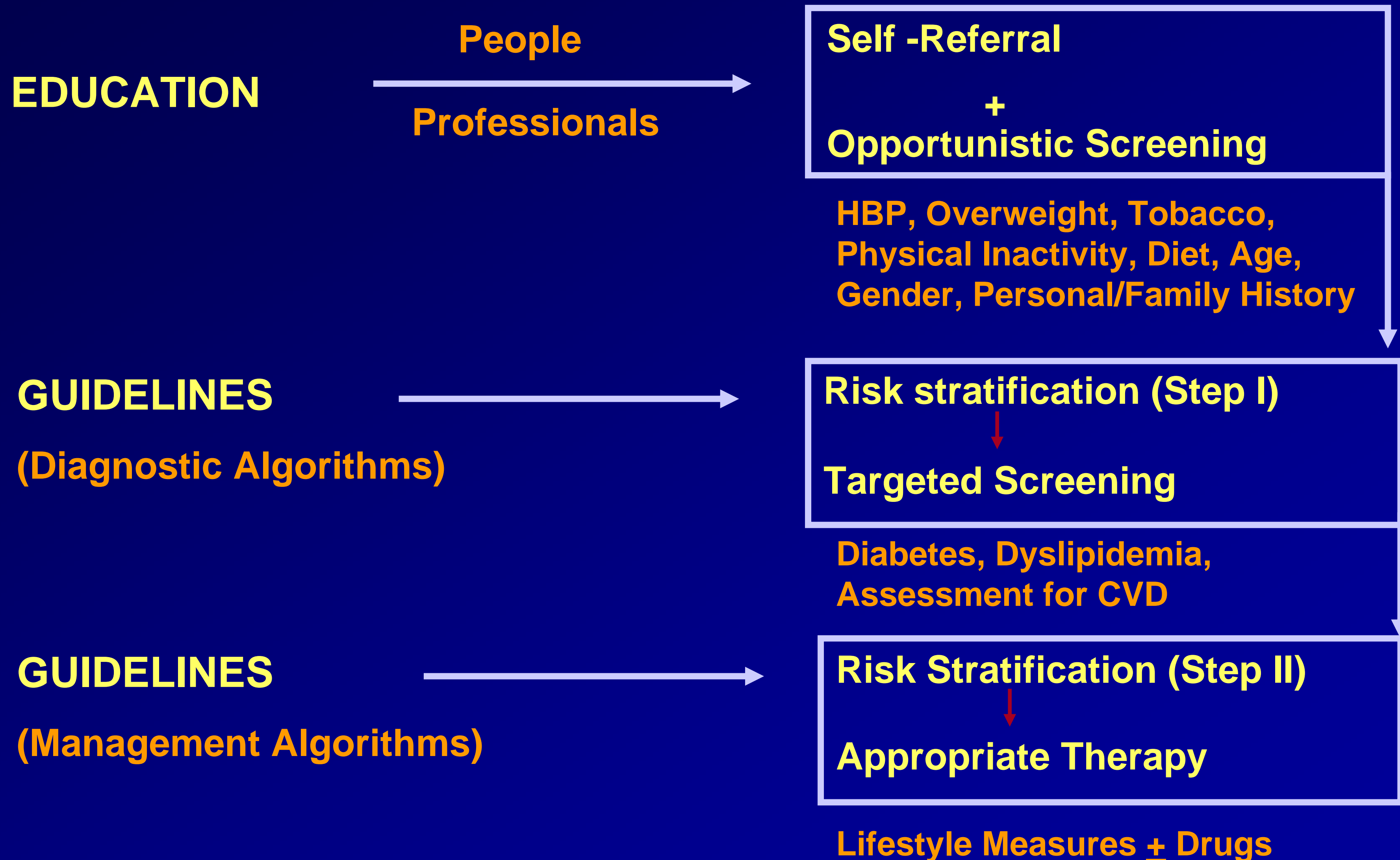
	2% ⇩ DBP popn-wide No.(000s)	%	7% DBP ≥ 95 mmHg No.(000s)	%
India	300	9%	380	11%
China	450	12%	530	15%
OAI	200	10%	220	11%
Asia	950	10%	1,100	12%

Combined approaches ~ 22%, 2 million deaths



* Government * Elected Bodies * NGOs * Professional Bodies * Private Sector * Media

PRIMARY PREVENTION OF CVD
Risk Detection + Risk Reduction in Individuals



Age<40 years & No Abd Obesity

LOW RISK
DM-2%, MS-4%

Age <40 years & Abd Obesity
OR
Age >39 years &
No HBP or Abd obesity

LOW- AVERAGE RISK
DM-8%, MS-7%

Age 40-49 years &
HBP or Abd Obesity

AVERAGE RISK
DM-13%, MS-40%

Age 40-49 years &
HBP AND Abd Obesity
OR
Age>49 years &
HBP OR Abd Obesity

HIGH RISK
DM-20%, MS-51%

Age>49 years &
HBP & Abd Obesity

VERY HIGH RISK
DM-28%, MS-85%

PREVENTION & CONTROL OF CVD & DIABETES

HEALTH PROMOTION

Health Education + Enabling Policy Measures

EARLY DETECTION OF PERSONS AT RISK

Opportunistic + Targeted screening; Technology for
Non-fasting Blood Chemistry (? Non-HDL cholesterol ? HbA1C)

EFFECTIVE THERAPIES FOR RISK REDUCTION

Diet; Physical Activity; Tobacco Avoidance; Aspirin;
BP and Cholesterol lowering medicines; Anti-Diabetics; ? PolyPill

Indian Tobacco Control Law 2003

Key Provisions

- Ban on smoking in public places
- Ban on direct and indirect advertising of tobacco products
  - Point-of-sale advertising is permitted
- Ban on sales to minors
  - Tobacco products cannot be sold to children <18 years
  - Tobacco products cannot be sold within a radius of 100 yards of educational institutions
- Pictorial health warnings
- English and one or more other Indian languages to be used for health warnings on tobacco packs
- Testing and Regulation: Ingredients to be declared on tobacco product packages (Tar and Nicotine)

Q. DO WE KNOW ENOUGH TO COMMENCE ACTION?

A. YES!

POLICY AND PROGRAMME RESPONSE

Q. DO WE NEED TO KNOW MORE TO ACT BETTER?

A. YES!

RESEARCH RESPONSE

THE RESEARCH RESPONSE

MUST PROVIDE

AN INTEGRATED EVALUATION OF THE MULTIPLE DETERMINANTS OF DISEASE AND IDENTIFY COST-EFFECTIVE PATHWAYS FOR HEALTH PROMOTION, DISEASE PREVENTION AND CLINICAL CARE

SUSCEPTIBILITY OF INDIANS TO CVD AND DIABETES

Needs Transdisciplinary Research

To study

Impact of Interactions among Social, Behavioral, Physiological and Genetic Factors

To identify

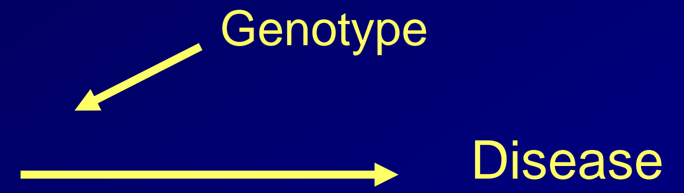
The determinants of susceptibility & develop effective public health & clinical interventions

For reducing risk

At both population & individual levels

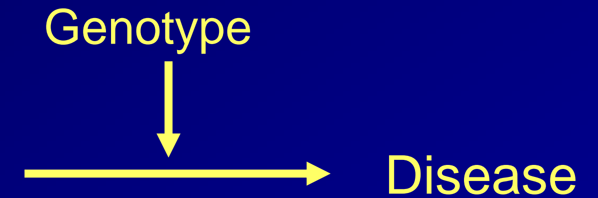
MODEL A:
The genotype increases expression of the risk factor

Social / behavioral risk factor



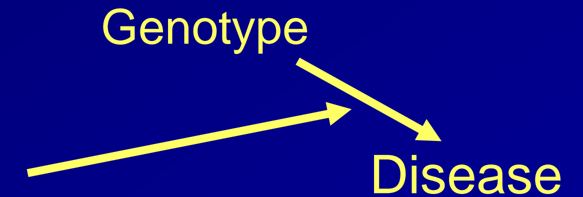
MODEL B:
The genotype exacerbates the effect of the genotype

Social / behavioral risk factor



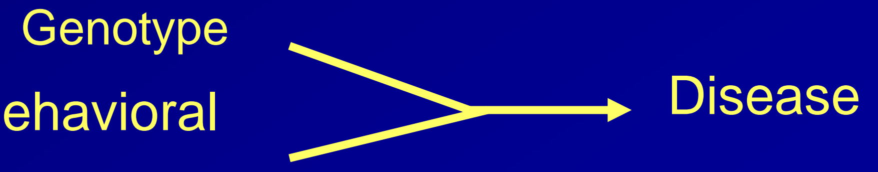
MODEL C:
The risk factor exacerbates the effect of the genotype

Social / behavioral risk factor



MODEL D:

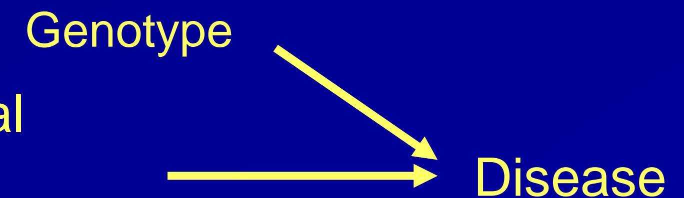
Both genotype & the risk factor are required to raise the risk



Social or behavioral risk factor

MODEL E:
The genotype & risk factor each affect risk; combined effect can be additive/non-additive

Social or behavioral risk factor



PROFILING APPROACHES

Researchers should use profiling approaches

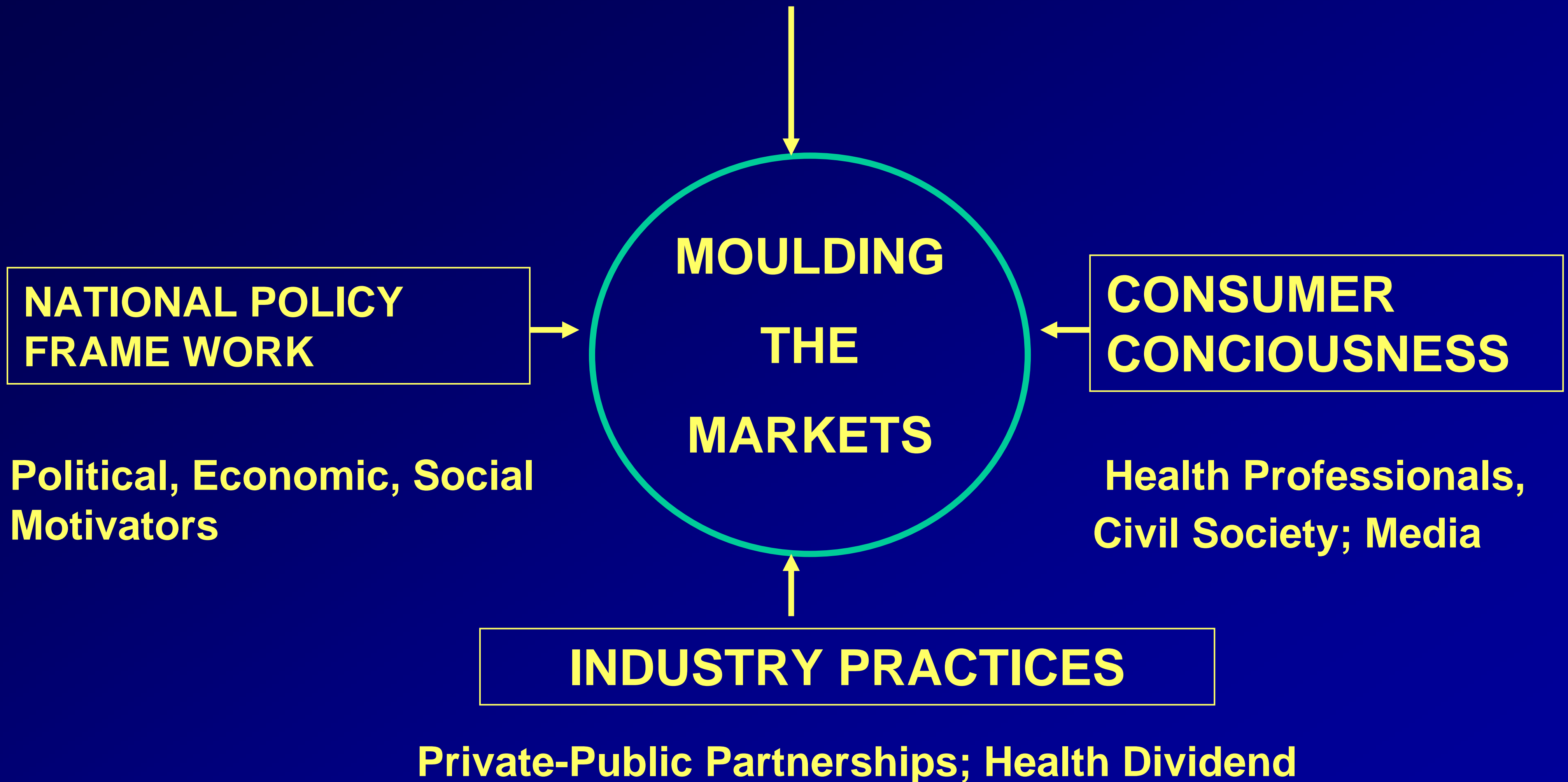
(genomic, transcriptomic, proteomic, metabonomic)

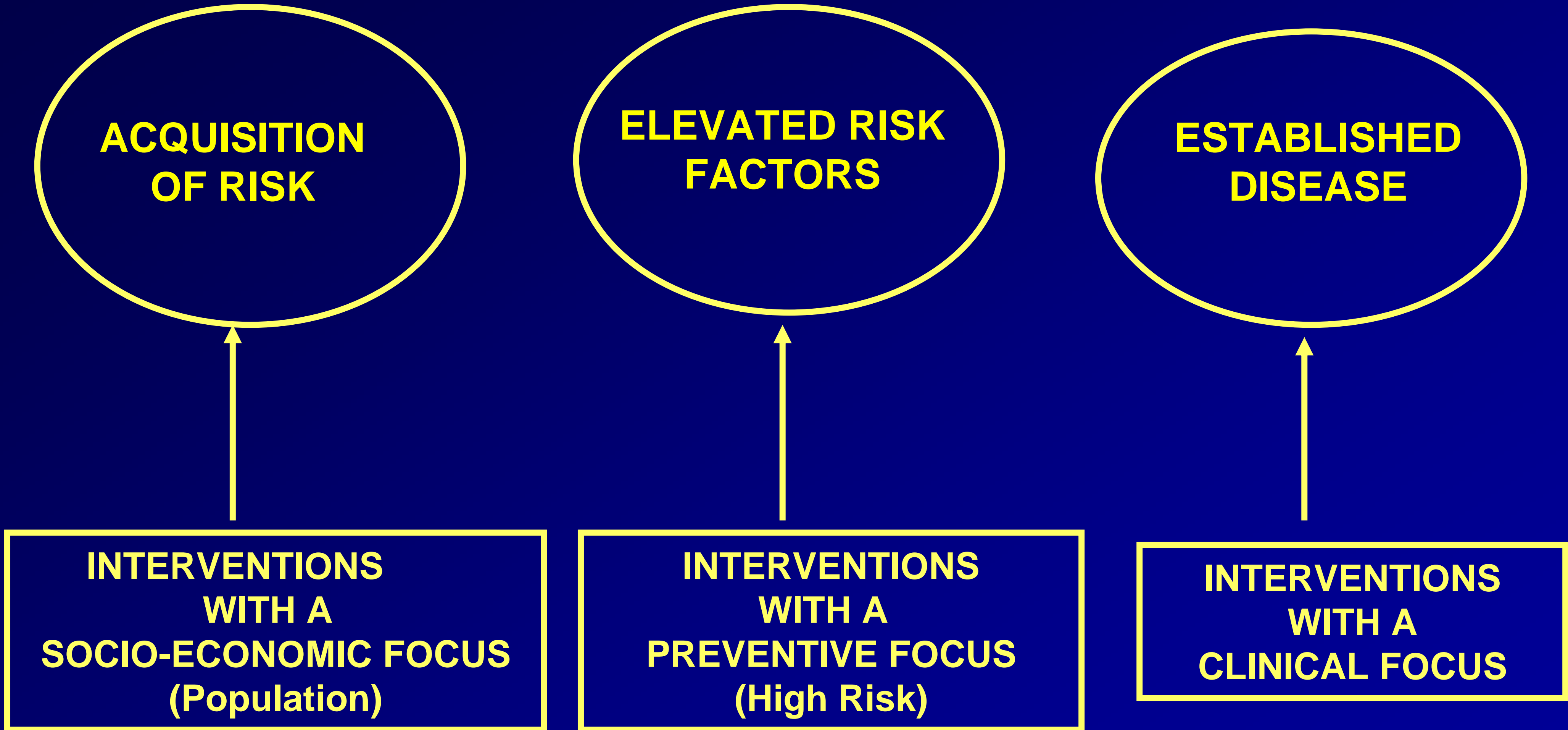
To discover

New genetic factors, biomarkers and mediating systems

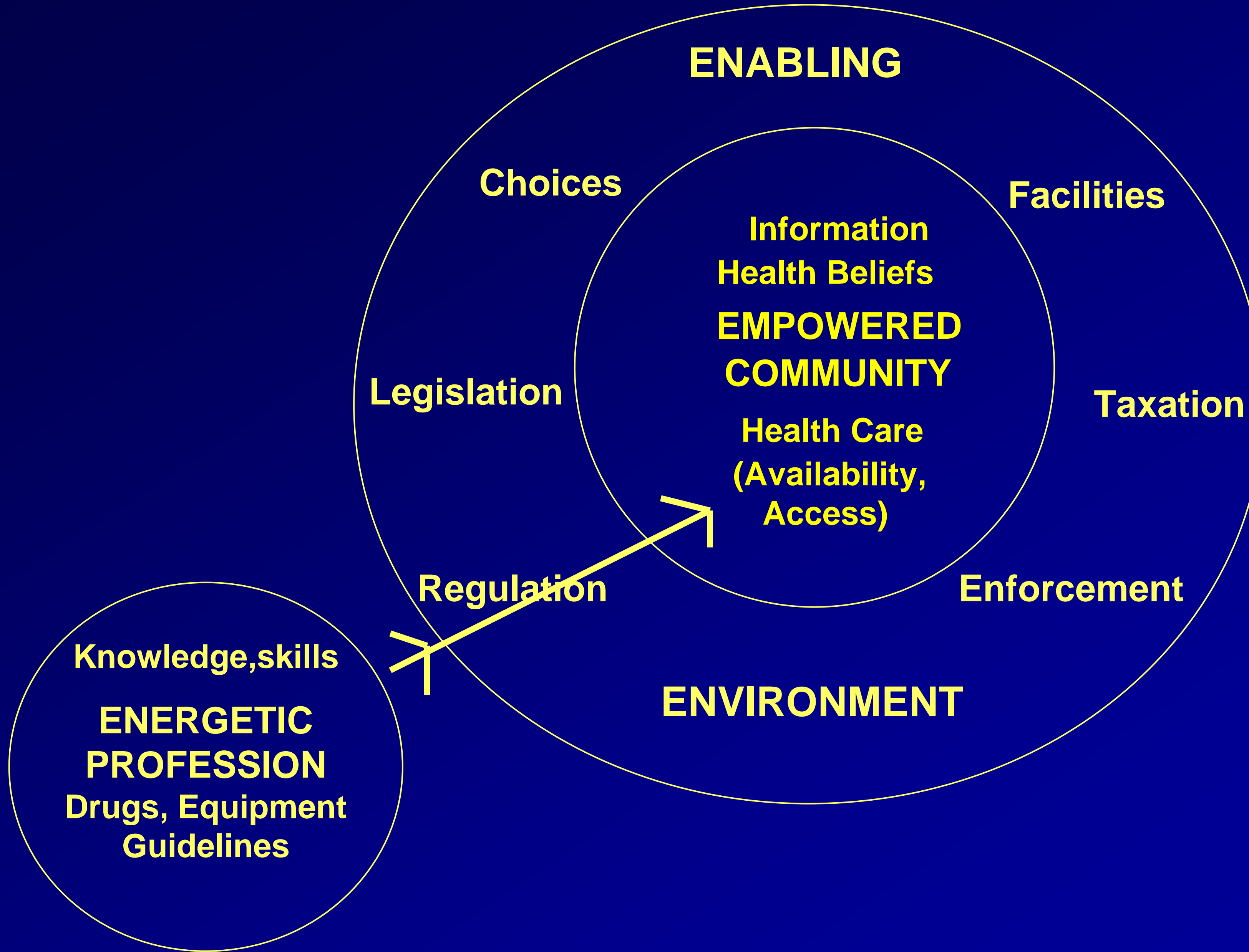
Through which interactions with social environment and behaviors influence health

GLOBAL → NATIONAL → COMMUNITY → FAMILY → INDIVIDUAL


International Agencies; Trans-National Trade and Media
GLOBAL COVENANTS, COMMERCE & COMMUNICATIONS
NATIONAL POLICY FRAME WORK
MOULDING THE MARKETS
CONSUMER CONCIOUSNESS
Political, Economic, Social Motivators
Health Professionals, Civil Society; Media
INDUSTRY PRACTICES
Private-Public Partnerships; Health Dividend


ACQUISITION
OF RISK
ELEVATED RISK
FACTORS
ESTABLISHED
DISEASE
INTERVENTIONS
WITH A
SOCIO-ECONOMIC FOCUS
(Population)
INTERVENTIONS
WITH A
PREVENTIVE FOCUS
(High Risk)
INTERVENTIONS
WITH A
CLINICAL FOCUS

CAPACITY FOR CONTROL OF CVD



To overcome the Epidemic of CVD the Developing Countries Must Provide a

Political Response

Based on

Scientific content

supported by

Scio-Economic Support Systems