Paleolithic diets, A Prescriptive approach for Current Chronic Ailments ?

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Chronic Diseases – Fact File

1. Global burden of chronic diet related NCDs is a serious cause for concern (Mortality is twice that of infectious diseases)
2. It is continuously rising in developing countries and 66% of deaths are due to NCDs in developing countries
3. Obesity / over weight are precursors of NCDs and are high even in low income groups
4. NCDs impose a significant burden on health systems and inflict cost on society and impact national development
5. Nutrition transition/physical inactivity adds to the burden of NCDs
6. Demographic changes, Urbanization, industrialization, mechanization and globalization compound the scenario
7. 80% occur in low middle income countries & 50% are women
8. Tobacco/alcohol use complicates the issue

Life styles – Faulty diets and physical inactivity and adverse habits are important determinants of NCDs

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Deaths in millions due to Chronic diseases

- 7.5 - die as a result of raised BP
- 6.0 - die as a result of tobacco
- 3.2 - die as a result of physical inactivity
- 2.8 - die as a result of being overweight or obese
- 2.6 - die as a result of ↑ TC levels
- 2.3 - die as a result of harmful use of alcohol
- 1.7 - die as a result of low fruit and vegetable intake

Out of 57 million deaths-36 million (63%) in 2008 were due to NCD, With No action deaths would increase by 17% from 2005 to2015

WHO, 2005, 2011-WHR, 2010

Important Risk Factors

Over weight / obesity – Central adiposity

Inadequate intake of vegetable and fruits – MN, phytoN, fibre

High intakes of energy dense foods – fat / sugar

High intake of salt

Physical activity↓– home, school, work, transport, recreation

Excess use of Tobacco & alcohol

High blood pressure

High blood concentrations of lipids(↑ TC, LDLc, Oxidised LDL, small dense LDL, triglycerides, post prandial lipemia, ↓HDL cholesterol), ↑Homocysteinemia

Glucose intolerance (Insulin resistance)

Increased prothrombotic and proinflammatory state

Poor maternal / fetal / early infant / child nutrition

Metabolic or X syndrome –common in Asians

Ancestral Diets and Thrifty Genotype

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KEY EVENTS IN THE EVOLUTION OF THE HUMAN

Appearance of Homo habilis	2 million years
Appearance of anatomically modern Humans (Homo sapiens sapiens)	40-50,000 years
Emergence of agriculture	10,000 years
Industrial revolution	200 years
Modern society	< 100 years

HUMAN DIETS / GENES

Homoerectus (1.7 million years)	-	Non-cereal Hunter Gatherer Society
Homo sapien sapiens (50,000 years)	-	Animal food with uncultivated plants
Agricultural Era (Post pleistocene)	-	10,000 years ago
Agricultural revolution	-	< 500 generations
Nourishing plant species	-	Limited
Available	-	195,000 species
Utilized as food	-	0.1% or < 300
90% of food supply	-	17 species
8 Cereal grains	-	56% of Food energy 50% of Protein

Genetically we are programmed for non-cereal nutrition requirement and diets of Paleolithic period

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Ancestral Genes

- Evolution at the molecular level is highly conservative
- Genotype evolved to confer survival and reproductive advantage in stone age (IR) (Fasting & feasting periods)
- The genes of Finns and Australian aborigines living miles apart are similar
- The genes evolved are disadapted to current life styles (THRIFTY GENOTYPE)
- Physical activity of our ancestors was strenuous
- Foetal programming in uterus in response to under nutrition (THRIFTY PHENOTYPE)

IR-Evolutionary response –High Protein, Low CH Diets

Reconstruction of life of stone age humans- Data Sources

- Human / animal skeletal remains (anatomical, microscopic, biochemical)
- Radio isotope analysis
- Archeological (living sites)
- Botanical remains (electron microscopy of pollen, spores, seeds, husks)
- Implements
- Uncultivated plant analysis
- Proximate analysis of game animals, fish, shell fish
- Cave or rock wall paintings
- HG living in 20 /21st century (biochemical markers)

Stone age or Cave man's diets

Terrestrial wild animal meat
Internal organs and bone marrow
Fish / shell fish / other aquatic foods
Birds (wild game)
Wild plants
Certain tubers / roots

Nutritional requirements of man are shaped by foods of pre agriculture era

Humans were taller, muscular, robust and brain size was large (Encephalisation)

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Average Daily Macronutrient Intake For Late Paleolithic Human Beings

(3000 Kcal Diet – 35% Meat and 65% Vegetable Foods)

	INTAKE (g)
PROTEIN	251.1
Animal	190.7
Vegetables	60.4
FAT	71.3
Animal	29.7
Vegetables	41.6
CARBOHYDRATE	333.6
FIBER	45.7

Source :Eaton and Konner, NEJM, 312(5), 283.

	Paleolithic Diets	Current Diets
BMI	21.2 kg/m^2	>25 kg/m^2
Energy Intake	2800 kcal/day	>2500 kcal/day
Carbohydrates (TE%)	35%	>45-65%
Honey (TE%)	2-3%	Sugar $\leq$ 25%
Fibre	>100g	<25-40g
Cereals	Nil	40-70%
Dairy products	Nil	Plenty
Wild Veg & fruits	Plenty (70-90%)	23% of CH
Phytic Acid	Minimal	Large amounts
Mineral bioavailability	High	Low
Acid base(K/Na)	Alkaline	Acidic
Protein	35%	20%

Abstracted from Eaton SB, 2006; Cordain et al 2000

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	Paleolithic Diets	Current Diets
Fat	35%	>35%
Saturated Fat	7.5%	>10%
PUFA	High	Low
N6 : N3 ratio	2:1	>10:1
Trans fats	3-5%	>5%
Cholesterol(mg)	400-500	300
Serum cholesterol	3.2 mmol/l	5.3 mmol/l
Carcass fat content (Animals)	3.5%	25-30%

Abstracted from Eaton SB, 2006; Cordain et al 2000

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Nutrients of Cave men diet

↓Energy dense

↓ Sodium

↑ Complex carbohydrates

Cave men Diet

↑ Potassium

↑ Calcium

↑ Fibre

↑ In protein

↑ Phytonutrients

↓ Fat

Quality of fat

↓ Saturates

↑ Poly unsaturates

↑ Omega 3

Is Paleolithic prescription, a preventive solution?

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Usual vs Paleo diet intake (Mean S.D.)

Diet factors	*delta*	*P-value*
Energy (Kcal)	+329 ± 840	NS
Protein (g)	+91 ± 50	0.0006
Carbohydrates (g)	−5 ± 126	NS
Total fat (g)	−3 ± 53	NS
Saturated fat (g)	−16 ± 21	0.05
Monounsaturated fat (g)	+13 ± 20	NS
Polyunsaturated fat (g)	+20 ± 5	<0.0001
Cholesterol (mg)	−187 ± 275	NS
Calcium (mmol)	−2 ± 10	NS
Sodium (mmol)	−92 ± 82	0.01
Potassium (mmol)	+193 ± 42	<0.0001
Phosphate (mmol)	+22 ± 19	0.01
Magnesium (mmol)	+14 ± 6	<0.0001

PD : lean meat, fruit ,fish, leafy and cruciferous veg, eggs, nuts excluding dairy products, sugar, soft drinks, cereal grains, beans, refined fats

Source : LA Frassetto LA et al EJCN-2009

Resting blood pressure measurements and brachial artery reactivity data

Factor	Days –2 to 0 (usual diet)	Days 15 to 17 (Paleo diet)	P-value
Systolic BP (mmHg)	116±10	-2.6±5.1	NS
Diastolic BP (mmHg)	71±6	-3.4±2.7	0.006
MAP (mmHg)	86±7	-3.1±2.9	0.01
Brachial artery diameter at baseline (BAD; mm)	3.97±0.88	3.98±0.85	0.14
Peak brachial artery diameter during hyperemia (pkFMD; mm)	4.25±0.83	4.35±0.73	0.05
Absolute difference pkFMD-BAD; mm)	0.288±0.089	0.371±0.158	0.06

Abbreviations: BAD - brachial artery diameter
pkFMD- peak BAD during compensatory hyperemia following blood flow occlution

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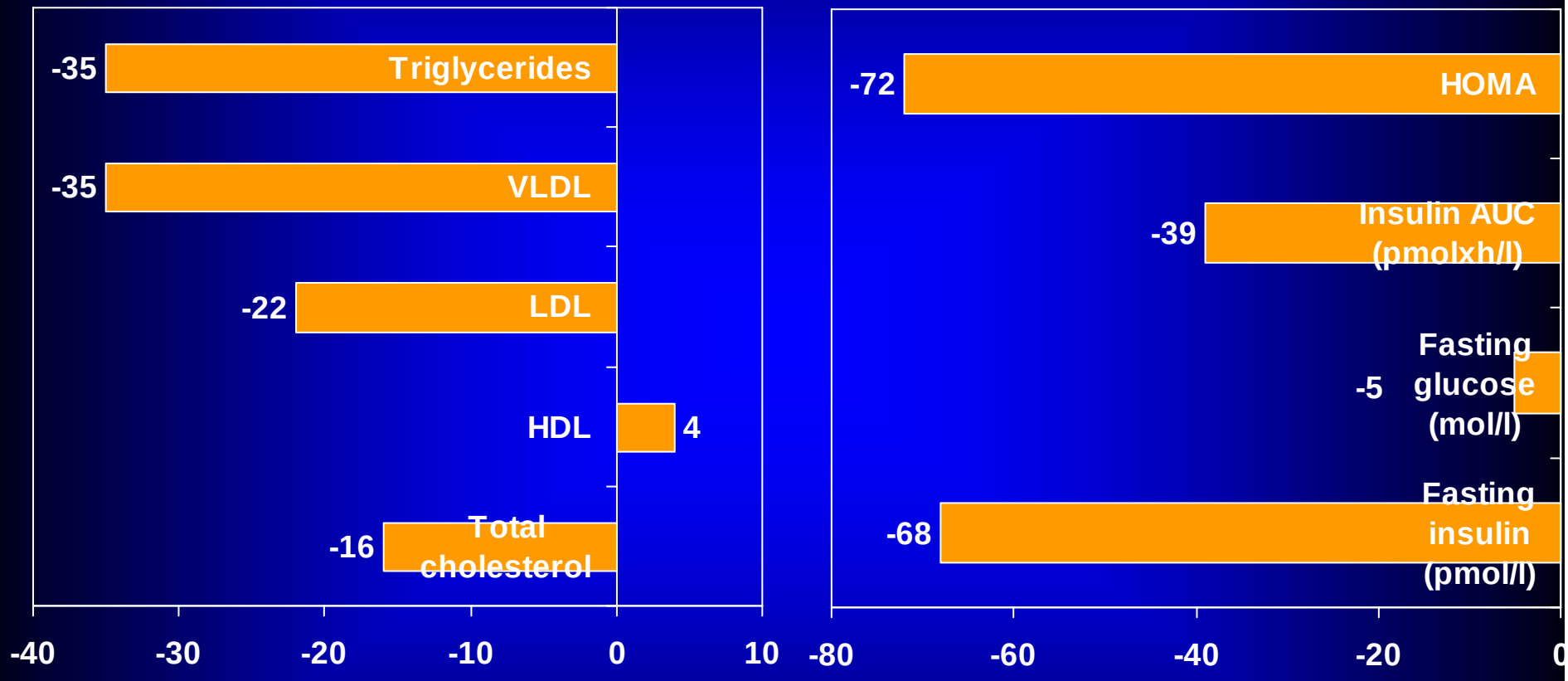
Effect of the paleolithic diet on metabolic variables
Delta values (mmoles/l)



Source : LA Frassetto LA et al EJCN-2009

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Usual vs Paleo diet intake and urine output comparisons (Mean S.D.)

Diet factors	*delta*	*P-value*
pH[a]	+0.34 ± 0.46	NS
UNaV (mmol)	−89 ± 73	0.007
UClV (mmol)	−76 ± 63	0.007
UKV (mmol)	+71 ± 56	0.004
UKV/UNaV (mmol)	+1.8 ± 0.6	<0.0001
CrCl (ml/min)	+4 ± 33	NS
UCa/CrV (mg/100 mg)	−40 ± 30	0.0009

Source : LA Frassetto LA et al EJCN-2009

Paleolithic diet vs Other Diets

On PD diet compared to Mediterranean diet or diabetic diet or original mixed diets

Either in normals, IH, diabetes, The following results were obtained

Duration : 3wks – 3 months

Results :

- **⬇ in glycemic load**
- **⬇ in BMI**
- **⬇ in waist circumference**
- **⬇ in systolic BP**
- **⬇ PAI - I**
- **⬇ fasting insulin and 2 hr blood glucose**

Sources : Several

PROBLEMS WITH CEREAL GRAINS

CONSUMPTION	-	HISTORICALLY REMOTE	-	BIOLOGICALLY RECENT
No vitamin A	-			Vit. A Deficiency
No β-carotene	-			Except yellow maize
No vitamin B12	-			Plant sources
Vitamins, Minerals Phytochemicals	-	wild Plants vegetables, fruits		Low
Processing No vitamin C Antinutrients Bioavailability	-	Scurvy Niacin B6, Biotin		B. Complex Deficiencies ↑ Pellagra Homocysteine ↑
Poor Metabolism		Biotin Biotin carboxylase		Linoleic to Arachidonic (Chain elongation) ↓

MINERALS ON CEREAL FOODS

Phytates	-	Iron, Zn, Cu absorption	↓
Poor sources	-	Calcium (bioavailability)	↓
Low Ca / P	-	Bone growth and metabolism	↓
Ca / Mg	-	Ca excretion	↑
1-25$(OH)_2D_3$	-	Secondary hyperparathyroidism	↑

OTHER MICRONUTRIENTS AND CEREALS

Fat	N3 fatty acids	Brain	↓
		Retinal function	↓
		Thrombosis	↑
		Inflammation	↑
		Lipid	↑
		LBW	↑
		LDL Oxidation	↑
Aminoacids (Imbalance)	Essential	Growth	↓
	Conditionally essential	Body mass	↓
		Immune function	↓
	Non-essential	Muscular strength	↓
Poor source	Taurine	Platelet aggregation	↑
		Free radical scavenger	↓
		anti-arrhythmic action	↓
		Retinal function	↓

Evolution of food system in India in the recent past

Post wars	↑ Poverty / hunger
Post independence	↓ Staples, PEM, MND
Import of foods	Mostly grains
Green revolution	↑ Cereals & Erosion of millets
Support prices	↓ Pulses and Diversity
Industrialization/ Processing	↓ fibre and MN
Dairy (White revolution)	↑ Saturated Fat
Vegetable oils(yellow revolution)	↑ N6/N3 ratio
Hydrogenation, baking	↑ Saturated, Trans fat
Large scale sugar prod.	↑ confectionary, SSB, fructose bevarages
Veg.,/fruits (rainbow revolution)	↑ farm losses, poor technology
Functional foods	lycopene, beta-carotene, sterols

Climax : Faulty Dietary Habits

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EVOLUTION AND EXERCISE

The upright bipedal gait	-	Standing / walking
Home sapiens	-	Vigorous exercise
TEE / RMR Hunter gatherer	-	1.8
Modern man	-	1.1
VO^2 max (Hunter gatherer)	-	52 ml/kg/min
Modern man	-	40.8 ml/kg/min

Source :Chen, World Rev. Nutr. Dietet. 84: 106, 1999

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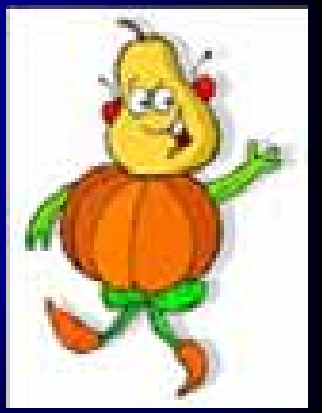
OBESITY / INSULIN RESISTANCE

TYPE	METABOLIC DISTURBANCES
Gluteofemoral	Moderate Insulin Resistance Low CHD Risk
Truncal / Abdominal	↑ Insulin Resistance ↑ TG ↑ LDL ↓ HDL Synthesis ↑ CHD Risk
Visceral Obesity	↑ Marked Insulin Resistance ↓ Glucose intolerance ↑ TriglycerideLipase ↑ VLDL Secretion ↓ HDL Synthesis ↑ Highest CHD Risk

Dietary Recommendations

- To achieve energy balance and appropriate weight for height
- To maintain weight (among adults) such that BMI is in the range of 18.5- 23 kg/m^2 and to avoid weight gain (>5 kg) during adult life & central adiposity
- To be aware of fattening trajectory (adiposity rebound) in children
- Exclusive breastfeeding and appropriate weaning foods
- To promote growth (0- 2 years)- linear growth and muscle mass
- To restrict total fat, shift fat consumption from saturated to unsaturated (proper fatty acids)
- To eliminate trans fatty acids
- Diets to provide low glycemic carbohydrates and fibre
- To increase fruits , vegetables, legumes, whole grains and nuts
- Limit intake of free sugars and salt
- Use beverages such as green tea and lime water liberally
- To be active and remain stress free



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Ranges of intake goals for long term health

Dietary factor	Goals
Total fat	15-35% energy
Saturated fatty acids	< 10% energy
Polyunsaturated fatty acids (PUFAs)	6-11% energy
n-6 Polyunsaturated fatty acids (PUFAs)	2.5-9% energy
n-3 Polyunsaturated fatty acids (PUFAs)	0.5-2% energy
DHA/EPA	250-2000mg/d
Trans fatty acids	< 1% energy
Monounsaturated fatty acids (MUFAs)	By difference
Total carbohydrates	55-70% energy
Free sugars	< 10 % energy
Protein	10-15% energy/d
Cholesterol	< 300 mg/day
Sodium chloride (sodium)	<5 g/day (< 2 g/day)
Fruits and vegetables	≥ 400 g/day
Total dietary fibre	From foods (25 – 30gms)

FAO / WHO,2010

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PHYSICAL ACTIVITY

Physical activity	Duration	Health benefits
Moderate intensity Brisk walking	30 min/ daily	Cardiovascular Metabolic health)
Moderate Intensity Brisk walking	60 min/ daily	Body wt. reduction
High intensity Resistance Training	Twice a week	Musculo skeletal health

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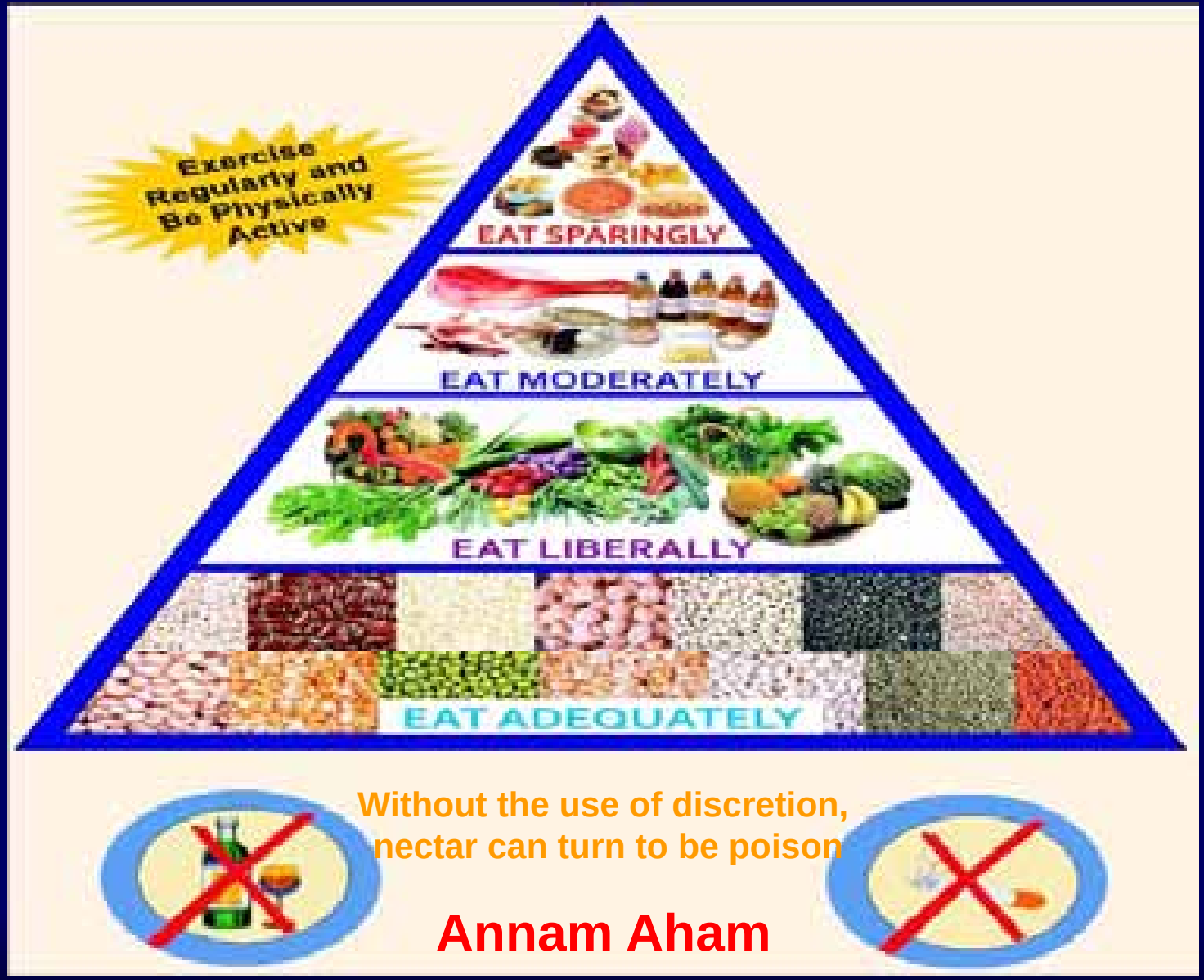
DIETARY PYRAMID FOR INDIANS



Dietary Guidelines for Indians- 2010

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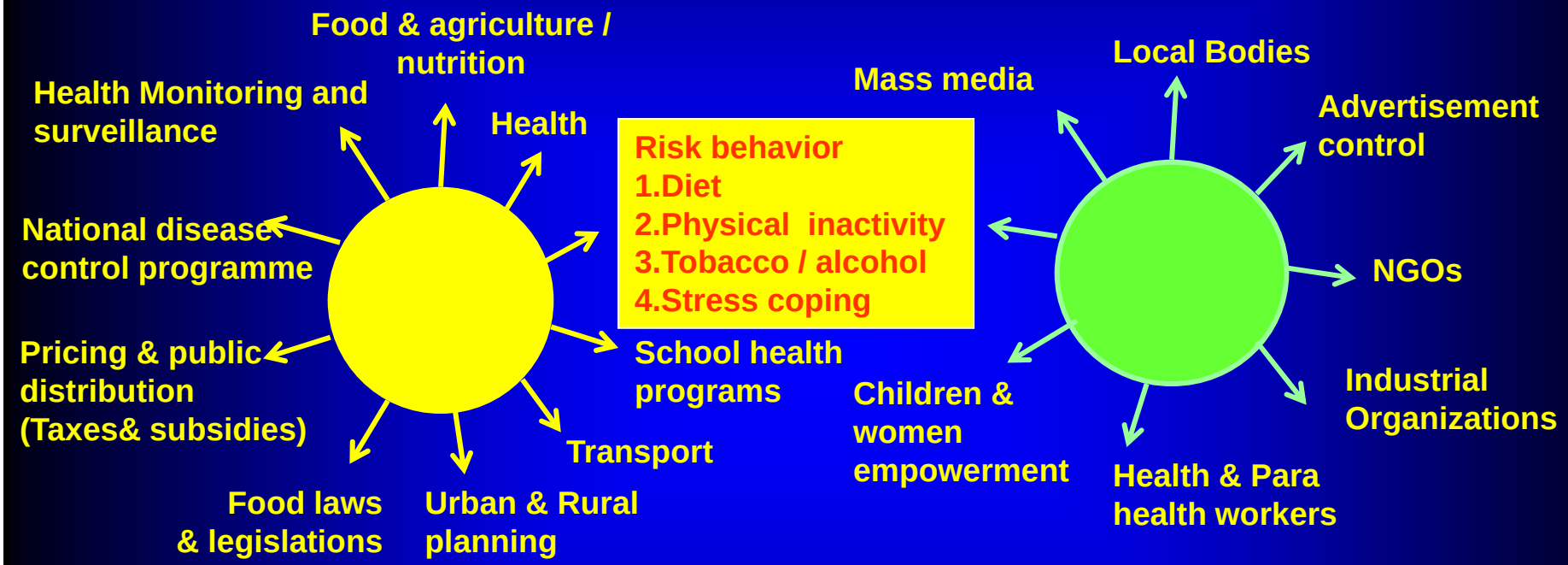
Public health Interventions

Taking Steps Towards a Healthy India



Enabling environment **Empowering people**

Multisectoral, multi disciplinary & multi level interventions
Interministerial & Interdepartmental convergence
Coordinated Policies (Consensus Building)
Flexible health system & Energetic profession

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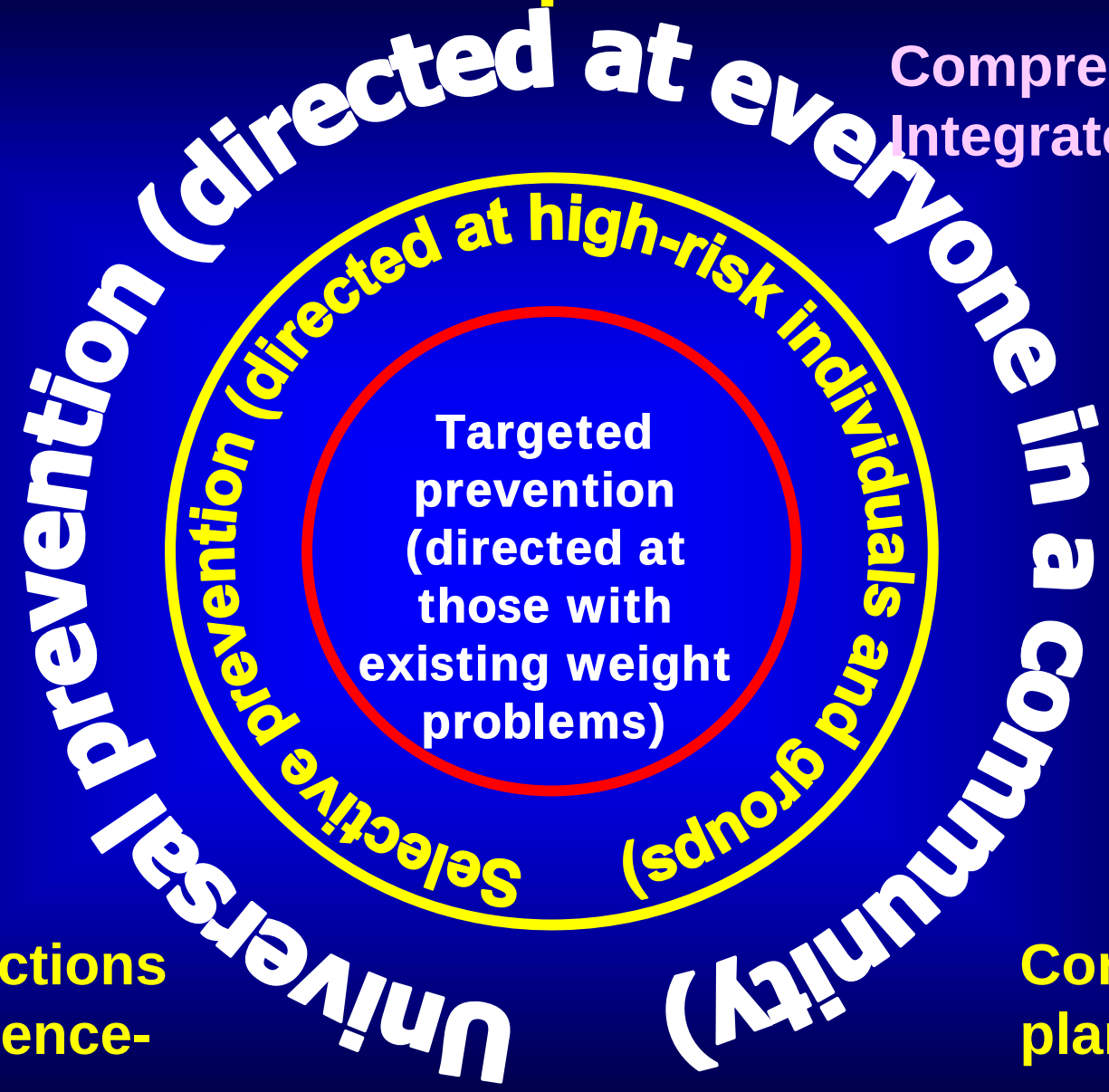
Levels of prevention

Cohesive Policies

Comprehensive Integrated Action



Affordable actions that are evidence-based

Convergent plans

Adapted from Obesity Report, WHO 2000.

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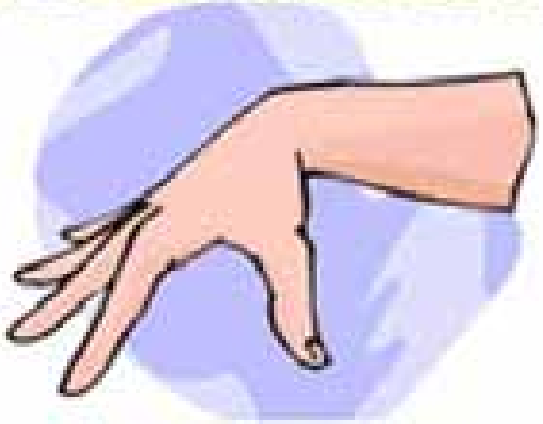
If you want one year of prosperity, grow grain.
If you want ten years of prosperity, grow trees.
If you want one hundred years of prosperity, grow people.

Chinese Proverb

Nutritional challenges for 21st Century

Solve pending problems

Prevention Is Better Than Cure



Early control and prevention Of NCDS

Preventing death & disability, promoting optimal health

THANK YOU FOR YOUR PATIENCE

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