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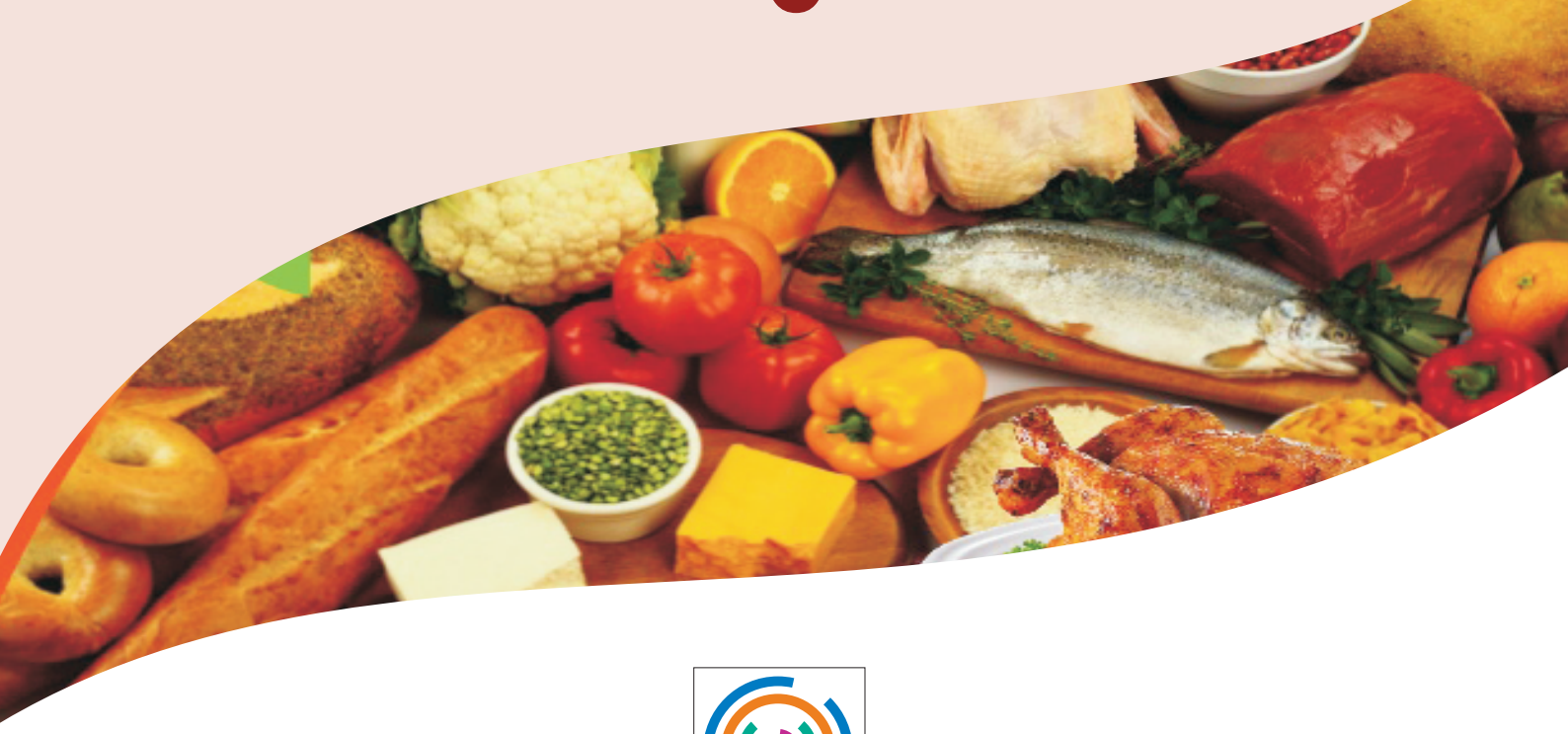
Role of Diet, Physical Activity & Lifestyle in Promoting Health



International Life Sciences Institute-South Asia
ILSI-India Regional Office

PREFACE

International Life Sciences Institute-South Asia, ILSI-India Regional Office and Ministry of Health, Nutrition and Indigenous Medicine, Government of Sri Lanka had organized an "International Conference on Role of Diet, Physical Activity and Lifestyle for Promoting Health". The need for such a conference was felt because the changes in lifestyles in many developing countries have resulted in accelerated incidence of non-communicable diseases (NCDs). These lifestyle related diseases are an avoidable threat to health and consequently to economic development. It is therefore essential to identify the risk factors and initiate preventive action.

The most common risk factor for NCDs is obesity resulting primarily from excess energy intake and lack of physical activity. The diets can also be unbalanced in respect of different nutrients required for health and wellbeing but can be rectified through food fortification.

The shift in diets from traditional to processed foods have been made necessary because of the transformation from agricultural to industrial societies. This shift cannot be reversed but diets can undoubtedly be made more healthy in respect of calories and nutrients. That really is the challenge.

The conference addressed the different implicit issues and the risk factors. What is called for is an informed approach to food choices. Industry provides information in nutrition labelling on processed foods and consumers can also gain information from the internet. With encouragement from Government and nutritious food choices offered by Industry, the consumer can be motivated to select healthy diets, including functional foods. These have to be complemented with physical activity to promote healthy living.

The conference drew up an action plan which if effectively implemented can make a huge improvement in public health and reduce early incidence of NCDs. This monograph sets out the common problems as also the practical solutions. Health conditions in Sri Lanka are no different from other countries and the monograph should be of interest to all stakeholders in public health issues.

I must express my gratitude to Dr P G Mahipala, Director General, Ministry of Health, Nutrition and Indigenous Medicine encouragement and cooperation in organizing the conference, Government of Sri Lanka for his cooperation.

D. H. Pai Panandiker

Chairman, ILSI-India

ACKNOWLEDGEMENTS

An **"International Conference on Role of Diet, Physical Activity and Lifestyle for Promoting Health"** was organized by International Life Sciences Institute-South Asia, ILSI-India Regional Office and Ministry of Health, Nutrition and Indigenous Medicine, Government of Sri Lanka on November 20-21, 2015 in Colombo, Sri Lanka. A number of national and international experts presented their views. ILSI-India appreciates their contribution as also the suggestions from experts who participated.

The conference was addressed by: Mr D H Pai Panandiker *(Chairman, ILSI South Asia Regional Office, ILSI-India)*; Dr P G Mahipala *(DG, DGHS, Ministry of Health, Nutrition & Indigenous Medicine, Government of Sri Lanka);* Mrs. Nirmali Samaratunga *(President, ILSI South Asia Sri Lanka Committee)*; Dr B Sesikeran *(Former Director, National Institute of Nutrition, India)*; Dr Michael Sagner *(M.D. President, European Society of Lifestyle Medicine, Paris);* Dr A. M. S. B. *Mahamithawa (Director, Estate and Urban Health, Former Director, Nutrition Division, Ministry of Health, Nutrition and Indigenous Medicine, Government of Sri Lanka);* Prof. Fred Brouns (*Chair "Health Food Innovation" Dept of Human Biology, Faculty of Health, Medicine and Life Sciences, Maastricht University, Netherlands*); Dr V. T. S. K. Siriwardana (*Director, Non-Communicable Diseases Unit, Ministry of Health, Nutrition and Indigenous Medicine, Government of Sri Lanka*); Dr V. Prakash (*Distinguished Scientist of CSIR-India, Vice President, IUNS, Director of Research, Innovation and Development at JSSMVP)*; Dr John Foreyt (*Professor, Department of Medicine and the Department of Psychiatry and Behavioral Sciences, Baylor College of Medicine, Houston, USA);* Dr Gargi Saha *(Research Officer, National Tea Research Foundation, India);* Dr G.N.V Brahmam *(Former HOD, Division of Community Studies, National Institute of Nutrition, India);* Dr K D Renuka Silva *(Senior Lecturer, Human Nutrition, Department of Applied Nutrition, Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka);* Ms Radhini De Costa *(AVP Marketing Services, Nestle Lanka Ltd);* Dr Grant Dubois *(Sweetness Technologies LLC, USA);* Ms Dilani Hettiarachchi *(Nutrition and Health Manager, Unilever Sri Lanka);* and Dr Laura Fernandez *(Director General, European Food Information Council, Brussels).*

This Monograph has been drafted by Dr Santosh Jain Passi, *Public Health Nutritionist, Former Director, Institute of Home Economics, University of Delhi in consultation with* Mr D H Pai Panandiker, *Chairman ILSI-India and* Ms Rekha Sinha, *Executive Director of ILSI-India.*

The Monograph include essence of the presentation and disscussions at the conference and further inputs and observations by Dr Passi. *ILSI-India acknowledges her contributions.*

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ABOUT INTERNATIONAL LIFE SCIENCES INSTITUTE-SOUTH ASIA ILSI-INDIA REGIONAL OFFICE

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International Life Sciences Institute-South Asia , ILSI-India Regional Office, ILSI-India is a branch of International Life Sciences Institute (ILSI) with Head Quarters in Washington D.C. ILSI strategy encourages global action on identifying and then resolving outstanding scientific questions in four thematic areas that capture the core of ILSI's work: Food and Water Safety, Toxicology and Risk Science, Nutrition, Health and Well-Being, and Sustainable Agriculture and Nutrition security.

ILSI-South Asia-Regional Office, ILSI-India has been working on scientific issues in the above areas since 1996. It works very closely with industry, R&D organizations, and government departments. It carries out its mission through sponsoring workshops, conferences, seminars, training programs and research. It also brings out publications and organizes educational programs. It covers India and South Asian Region.

ILSI branches include Argentina, Brazil, Europe, the Focal point in China, India, Japan, Korea, Mesoamerica, Mexico, Middle East, North America, North Andean, South Africa, South Andean, Southeast Asia Region, Taiwan, and the ILSI Health and Environmental Science Institute. ILSI also accomplishes its work through the ILSI Research Foundation (composed of Center for Environmental Risk Assessment of Genetically Modified Crops (CERA), Center for Risk Science Innovation and Application (RSIA), Center for Nutrition and Health Promotion and Center for Integrated Modelling of Sustainable Agriculture & Nutrition Security (CIMSANS). ILSI has a special consultative status with Food and Agriculture Organization of the United Nation.

INTRODUCTION

'Health is a state of complete physical, mental and social well-being; and not merely the absence of disease or infirmity'

World Health Organisation, (1948)[1]

"The worldwide increase of non-communicable diseases", Dr Margaret Chan said, "is a slow-motion disaster, as most of these diseases develop over time. But unhealthy lifestyles that fuel these diseases are spreading with a stunning speed and sweep"[2].

Non-communicable diseases (NCDs) pose major public health challenges undermining the socio-economic development. Foremost causes of this emerging pandemic are modernisation, urbanisation, sedentary lifestyles and longevity[3]. Major NCDs -cardiovascular diseases, diabetes mellitus, cancers and chronic respiratory diseases, share four common behavioural risk factors - tobacco usage, unhealthy diets, physical inactivity and harmful use of alcohol[4]. Even in developing world, the rapid shift from infectious diseases to NCDs is attributed to economic development coupled with transition from traditional healthy dietary patterns to refined/processed foods (high in total fat, trans fat, salt and simple sugars), physical inactivity, tobacco/alcohol abuse and changing socio-cultural norms[5]. More than 80% of the cardiovascular diseases (CVDs)/type 2 diabetes mellitus (T2DM) and 33% cancers can be prevented through lifestyle modifications[6]. The recently proposed Gross National Happiness[8] Index measures material well-being along with community, culture, governance, knowledge/wisdom, health, spiritual/psychological welfare, balanced use of time/other resources as well as harmony with the environment.

It is imperative that for reducing the NCD related disease burden as well as promoting health of the population, priority attention needs to be given to disease prevention strategies.In NCD prevention, the role of nutritionally balanced diet coupled with appropriate lifestyle practices is inevitable. For inculcating healthy food choices, robust policies need to be framed and evidence-based strategies addressing lifestyle modifications, need urgent implementation[9]. Further, it has been proposed that, since the term 'NCDs' does not properly communicate the association between diet, lifestyle, physical activity and the diseases, these be termed as *'lifestyle related diseases'*.

'Every human being is the author of his own health or disease'

- Lord Buddha

SECTION 1:
Impact of Socio-Economic Trends on Nutrition Transition

"Cancer, diabetes, and heart diseases are no longer the diseases of the wealthy. Today, they hamper the people and the economies of the poorest populations even more than infectious diseases. This represents a public health emergency in slow motion".

Ban Ki-Moon. UN Secretary-General (2009)[10]

Chronic lifestyle-related diseases are becoming the leading cause of mortality and disability on the planet. Of 56 million global deaths in 2012, nearly 68% (38 million) were attributable to NCDs [11]. Over the years, there has been a major shift in dietary patterns, physical activity and body composition of humans. In the coming decades, due to epidemiological transition, there will be dramatic changes in global health needs (Fig 1.1).

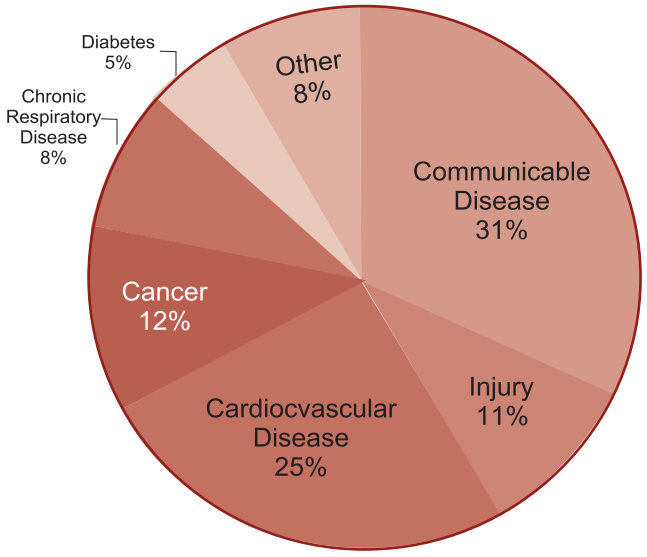


Fig 1.1: Causes of The Global Burden of Disease Study (2010) Death in Developing Countries[12]

The Global Burden of Disease Study[13] has systematically highlighted the epidemiological shift in morbidity and mortality resulting from infectious diseases and malnutrition, to NCDs. Since 1970s, although, nearly 10 years of life expectancy has been gained, a greater number of years are spent living with injury and illness.

In developing nations, the traditional plant-based diets are largely being replaced by energy-dense diets – high in animal protein and fat but low in dietary fibre. Such dietary patterns coupled with sedentary lifestyle and other risk factors are responsible for the escalating burden of chronic diseases.

Nutrition Transition:In developing nations, the current acceleration in nutrition transition is far different; the dietary shift which took nearly 1-2 centuries in the West has now occurred merely in a few decades in the developing world. From Paleolithic hunter-gather societies thriving on rather healthy diets, human beings have modified their diet and activity patterns resulting in the emergence of newer type of diseases and disabilities. Such a change subjugated by nutrition-related NCDs has rather been rapid in most of the low- to middle-income countries where the open market for fresh foods is gradually paving way for the large scale supermarkets [15].

Various socio-economic factors (income, education, physical environment and race),

directly or indirectly, contribute to the individual's nutritional status. Some of these may increase the risk of malnutrition including over-weight/obesity which in turn may cause progression of CVDs, hypertension, dyslipidaemia/ hypercholesterolemia and T2DM. In developing nations, chronic hunger and metabolic adaptations during gestation, predispose the individuals to NCD risk in their later life [16]. In high-income countries, consumption of processed foods laden with sugar, salt and fat has reached a plateau while it is rapidly escalating in the developing world. Behavioural change can, however, initiate reversal of various negative tendencies and facilitate successful aging [15].

Risk Transition: Low-income populations continue to be affected by the poverty linked *traditional risks* such as under nutrition, unsafe water, poor sanitation/hygiene, indoor smoke and unsafe sex. With increasing life expectancy as well as rising morbidity, mortality and disability due to NCDs, shift has been towards *modern risks* like physical inactivity, overweight/obesity, tobacco/alcohol abuse and numerous dietary risk factors (Figure 1.2). Consequently, many of the low- and middle-income countries are facing an enormously high dual burden of disease associated with modern risks while still struggling with the unfinished battle against traditional risks.

Increasing exposure to the emerging modern risks is inevitable but the adverse effects can be curtailed through effective public health interventions [17].

In the modern era, there is increased energy intake in the milieu of reduced energy expenditure. Lifestyle-related diseases are a complex challenge due to poorly defined and rather fewer policies, disconnect between public health and clinical systems as well as lack of commitment towards preventive strategies. Additionally, commercial pressures on one hand, and severe lack of investment in research on the other, exert a profound negative impact.

Various factors affecting food behaviour which in turn are responsible for nutrition transition include working parents, dwindling number of care givers and poor quality child-care, rapid shift towards commercially processed foods, increasing peer pressure and misleading advertising coupled with increased screen time leading to physical inactivity. The shift in activity patterns - though equally rapid, is rather poorly documented.

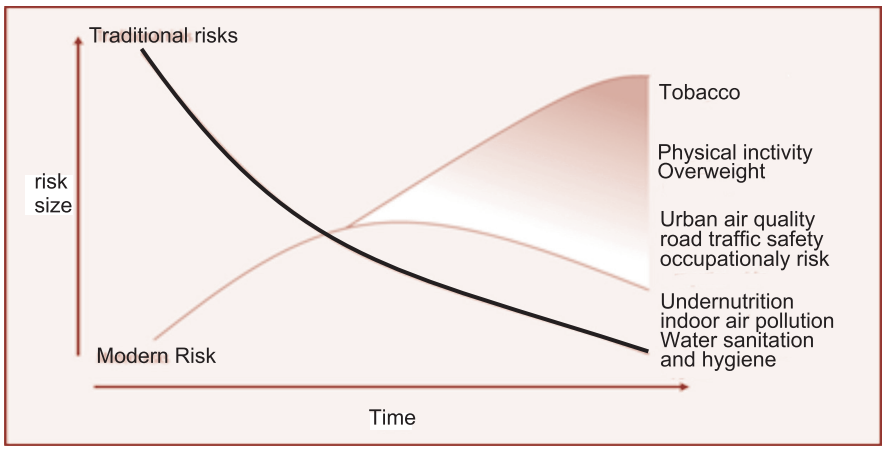


Fig. 1.2: Risk Transition - Traditional to Modern Risks (WHO, 2009)[17]

SECTION 2:
Risk Factors and the Determinants of NCDs

Most of the non-communicable diseases are the result of various behavioural risk factors resulting in undesirable metabolic/physiological changes such as hypertension, overweight/obesity, hyper-glycaemia and dyslipidaemia. There is overwhelming evidence that lifestyle factors are key proximal factors in the pathogenesis and incidence of NCDs[19](Table 2.1). The impact of poor lifestyle is not only limited to the diseases that are visible but it also increases the risk for mental disorders such as depression and anxiety, which are rather escalating worldwide. Lifestyle factors may also be more distal stressors impacting the economic and political scenario of the nation, particularly those with high population density. The economic burden of poor lifestyle choices is no longer sustainable and is impossible to be ignored. The United Nations have established that lifestyle-related diseases are a clear threat not only to human health but also to the national/global economic growth and development.

Table 2.1: Lifestyle Risk Factors: Country Specific Ranking

Country	Lifestyle Risk Factors Ranked within each Country						
	Stress	Lack of Physical Activity	Obesity	Poor Nutrition	Tobacco Use	Presenteeism	Substance Abuse
United States	1	3	2	4	5	6	7
Canada	1	2	3	4	6	5	7
Mexico	1	2	3	4	6	5	7
Brazil	1	2	3	5	7	6	4
Europe	1	3	4	7	2	5	6
Asia Pacific	1	2	3	6	4	5	7
China	2	1	4	7	3	6	5
India	1	2	3	6	4	5	7
Southeast Asia	1	2	3	6	5	4	7
Singapore	1	2	4	5	6	3	7

South Asia includes Malaysia, Phillippines and Singapore
Note: Rankings based on companies responding 5, 6 or 7-point extent scale.

Source: Paper presented by Dr John Foreyt, Professor, Departments of Medicine, Psychiatry and Behavioural Sciences, Baylor College of Medicine, Houston, USA, at the International Conference on Role of Diet, Physical Activity & Lifestyle in Promoting Health.

The 2014 data indicate that around 39% adults (aged >18 years) were overweight, 22% had high blood pressure and nearly 9% had elevated blood glucose levels [20]. Physical inactivity, low fruit/ vegetable intake, high fast food consumption and dyslipidemia are the major causative factors leading to cardiovascular disease and certain cancers; overweight/obesity can cause several metabolic changes that can elevate the risk of NCDs, including CHD and T2DM [21].

In Sri Lanka, the years of life lost due to NCDs have substantially increased. The WHO Survey (2010) has revealed that the years lost due to heart disease increased from 11.8 to 16.3 %, stroke5.5 to 6.6 % and diabetes 1.4 to 4.8 %; the highest risk factor being unbalanced diet.

NCDs impede socio-economic development which is driven by the underlying social, economic, political, environmental and cultural factors, broadly known as *social determinants* of NCDs[22]

> ***Social determinants of health*** *include conditions in which people are born, grow-up, live, work and age. They not only influence the individuals' opportunity to stay healthy but also the morbidity risk and life expectancy. Uneven distribution of social determinants results in social inequities – the unfair/avoidable variations in health across the groups. Social determinants and health inequities are amenable to change through policy and governance interventions*[23, 24].

Increasing incomes and shift towards western type of diets may lead to overweight/obesity as well as increase the risk of NCDs. Various systematic reviews and meta-analyses of cohort studies have revealed that increased sugar intake through food and beverages are closely associated with weight gain (mainly due to positive energy balance) and T2DM [25-27]. Additionally, large portion size/bulky meals and mindless eating during TV viewing are the contributory factors leading to an elevated risk of NCDs.

The nutrition-related non-communicable diseases (N-RNCDs) are driven by numerous factors such as ageing, rapid unplanned urbanisation and unhealthy lifestyles[28]. The ***first 1000 days of life*** (conception to two years postpartum) are most crucial; growing body of evidence documents that in-utero, infant and young child under-nutrition is directly linked to vulnerability to nutrition-related NCDs during adulthood. Therefore, appropriate health and nutrition interventions during this period can provide additional benefits beyond the immediate gains - by way of reducing the NCD incidence and mortality in later years [29, 30].

Low-nutrient dense diets may supply sufficient energy and may even lead to weight gain, yet these can result in micronutrient under-nutrition - a situation termed as 'hidden hunger'. Such situations early in life (first 1000 days) may lead to impaired growth/ development with significant impact on brain, cognitive functions as well as stature.

Thus, social determinants are important predictors of health and illness, yet very little recognition is accorded to this aspect while elaborating on the incidence, prevalence and management of NCDs – particularly CVDs and T2DM [31]. NCDs are a huge health and development challenge which is simply not a matter of personal responsibility!!

SECTION 3:
Role of Balanced Nutrition and Physical Activity

"The Current Epidemics of Chronic Diseases are a result of Discordance between our Ancient Genes and Modern Lifestyle."
Eaton et al., The Paleolithic Prescription. (1988)

Optimum nutrition and physical activity play a crucial role in maintaining good health. Poor dietary habits and physical inactivity not only lead to overweight and obesity but also cause numerous health hazards. For leading a healthy life, the need for nutritionally/quantitatively balanced diet is known for centuries across various regions and cultures. **Balanced diet** provides appropriate proportions of proteins, fats, carbohydrates, minerals, vitamins and water needed for maintaining good health. However, food insecurity has been the major cause of under nutrition leading to protein energy malnutrition, chronic energy deficiency, stunting and sub optimal growth as well as heightened infections and micronutrient deficiencies with myriad health consequences. Imbalanced energy intake has led to underweight/stunting at one end and over-weight/obesity/NCDs on the other. Therefore, sustained energy balance is critical in the maintenance of appropriate body weight andfor ensuring optimal nutrient intake.

Traditional diets had been much higher in nutrients thantoday's modern food supply. Over the last century, foods high in complex carbohydrates and dietary fibre have been replaced by high-fat low fibre foods which parallel the increased risk for numerous chronic diseases. Nutritionally, traditional diets are considered far healthier than their modern counterparts. In olden days, people ate food when they were hungry while now it is more so a matter of convenience. Certain highlighting characteristics of traditional and modern diets are listed below (Table 3.1).

Table 3.1: Characteristics of Traditional vs. Modern Diets

Traditional Diets	Modern Diets
Bulky	Palatable
Low energy density	Energy dense
Digested slowly	Digested rapidly
↑ Protein	↑ Protein
↓ Fat	↑ Fat
↑ Unsaturated fat	↑ Saturated Fat
↑Complex carbohydrates/ Dietary fibre	↓Complex carbohydrates/ Dietary fibre
↓ Refined/ processed foods	↑ Refined/ processed foods
↑ Vitamins/Minerals	↓ Vitamins/Minerals
↓ Na/K ratio	↑ Na/K ratio
↑ Phytonutrients	↓ Phytonutrients
↓ Glycaemic Index	↑ Glycaemic Index

(Source: Adapted from McKeigue, Shah and Marmot, 1991)

Carbohydrates contributing nearly 60 en%, present wide range of qualitative differences; highly refined carbohydrates forming major part of modern diet, need to be curtailed due to their high glycaemic index and thereby, elevating the NCD risk.Compared to poly/oligo-saccharides, intake of simple sugars needs to be curbed even for individuals with inadequate energy intake.It has been advocated to keep the free sugar intake below 10 en% but poor palatability acts as the biggest impediment to such compliance [33]. However, this widely accepted norm can be achieved by using safe sugar substitutes approved by Joint FAO/ WHO Expert Committee on Food Additives (JECFA) [34]. It is important to look at total energy consumption and not only sugar for evolving effective strategies.

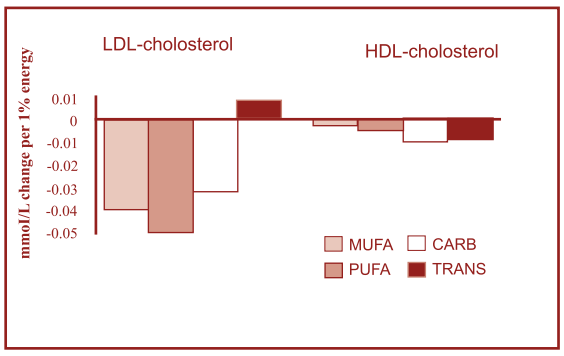
Low- and no-calorie sweeteners offer options to help the consumers with their lifestyle — whether to maintain energy balance for supporting healthy body weight/managing a diabetic diet or simply relishing sweetness without adding calories[35]. Data pertaining to more than 22,000 individuals who had participated in the U.S. National Health and Nutrition Examination Survey (NHANES) were analysed in the year 2013 which indicated that the subjects who consumed food/beverages with no and low-calorie sweeteners had better quality diets and were physically more active. This re-endorsed the findings by Sigman-Grant and Hsieh (2005) that the individuals regularly consuming low- and no-calorie sweeteners tend to choose healthier diets[36]. In 2014, a multidisciplinary group comprising leading international independent experts calorie sweeteners can play a beneficial role in diet and lifestyle choices[35]. Food Safety and Standards Authority of India (FSSAI, Government of India) amended the Food Safety and Standards (Food Product Standards and Food Additives) Regulations, 2011, and approved the artificial sweeteners, namely, Saccharin Sodium, Aspartame (methyl ester), Acesulfame Potassium, Sucralose, Neotame, and Steviol Glycoside. Isomaltulose has recently been added in the list of artificial sweeteners (Regulation No. 3.1 of Food Safety and Standards Regulations, 2011).

Dietary Fiber refers to *edible parts of plants or analogous carbohydrates that are resistant to digestion/absorption in the small intestine but undergo complete or partial fermentation in the large intestine*[37]. It includes celluloses, hemi-celluloses, lignins, pectins, gums, mucilages, arabinoxylan, inulin, â-glucan (oats), galactomannans (fenugreek) and resistant starches. Apart froms low digestion and high satiety, dietary fibre rich foods delay the absorption of sugar and cholesterol from other foods too leading to lowered glycaemic indexand reducing the serum cholesterol levels. Further, high fibre foods improve bowel movement and help in the growth of healthygut bacteria. Thus, dietary fibre confers the rapeutic effects against gastro-intestinal disturbances, obesity, diabetes, hypertension, CVDs, stroke and colon cancer. WHO has recommended 30g dietary fibre/day; however, a daily intake of 40g is considered reasonably safe (energy value:~ 2 kcals/g fermentable soluble fibre).

Fats and Oils requirement ranges between 15-30 en%. Researches document that specific dietary fatty acids play an important role in the causation or prevention of CHD *trans* Fatty acids generated during partial hydrogenation of vegetable oils pose a number of deleterious health effects and should, therefore, be eliminated or curtailed to the minimum. Modest reductions in CHD rates can be achieved by limiting saturated fats (SFA) or replacing SFAs by a combination of poly- and mono unsaturated fatty acids. Substituting SFAs by carbohydrates confers little/no benefit; however, it also depends on the type of carbohydrates. A meta-analysis of 60 controlled trials by *Mensink et al. (2003)*[38] indicates that the coronary artery disease risk is

reduced most effectively when *trans*fats/saturated fatty acids are replaced with *cis*unsaturated fatty acids; while replacement withcarbohydrates did not change the CAD risk (Fig 3.1).

Fig 3.1: Effect of Replacing SFAs/TFAs by *cis*-PUFA/MUFA or CHOs



Advantages of n-3 PUFA in cardiac health

- ? Reduces risk of cardiac arrhythmias
- ? Reduces platelet adherence and the risk of thrombosis
- ? Anti-inflammatory effect (reduces C-reactive proteins)
- ? Inhibits cardiovascular calcification

(Source: Mensink et al. 2003)[38]

The upper limit of SFA intake is 10 en% while dietary cholesterol should be kept <300 mg/day. Benefits of polyunsaturated fatty acids are well documented; n-6 and n-3 PUFA specifically aid in reducing the risk of heart disease. However, there is insufficient evidence to support that lowered dietary cholesterol reduces serum LDL–C[39].

Although, genetic patterns of human race were established for a diet providing equal proportions of ω-6 and ω-3 (1:1); however, the current diets are far deficient in omega-3 fatty acids (ω-6:ω-3 merely 15-16:1). Excessive intake of omega-6 and high ω-6:ω-3 promote pathogenicity of numerous diseases, including CVDs, cancer and inflammatory/autoimmune diseases; on the contrary, high omega-3 and lowered ω-6:ω-3 suppress the adverse effects. The desirable intake of omega-6 is between 4-10 en% and ω-6:ω-3 5-10:1; in secondary prevention of CVDs, ω-6: ω3 of 4:1 was found to reduce total mortality by 70%[40]. Following are the ω-6 and ω-3 intakes by different population groups (Table 3.2).

Table 3.2: ω-6 and ω-3 Intakes by Different Population Groups (g/day)

Country/Population	ω-6 PUFAs	ω-3 PUFAs	ω-6:ω-3
India	20	0.5	40
USA	14	1.4	10
UK	14	1.9	7
Japan	26	7.0	4
Eskimos	5	5	1

Source: *Paper presented by Dr B Sesikeran, Former Director, National Institute of Nutrition (ICMR), Hyderabad, at the International Conference on Role of Diet, Physical Activity & Lifestyle in Promoting Health.*

It is important that correct blends of 2 or more vegetable oils (e.g. sesame/groundnut/rice bran/ cottonseed oils blended with mustard/rapeseed/ canola/soybean oils) are used to achieve a desired ω-6:ω-3 ratio as well as SFA and MUFA content of the edible oils. In view of high *trans* fat content, it is good to avoid using partially hydrogenated oils (PHOs) for frying/cooking and limit the intake of TFA to less than 1-2 en%. Even increasing dietary carbohydrates beyond a certain limit elevates plasma palmitoleic acid concentrations – a biomarker of adverse health outcomes [41]. Reducing red meat and dairy products as well as increasing the intake of nuts, fish, soy products and non-hydrogenated vegetable oils confer beneficial effects on CHD by virtue of improved fatty acid composition of the diet. International Guidelines for fats are given below (Table 3.3).

Table 3.3: Recommended Dietary Intakes for Total Fat and Fatty Acids for Adults (FAO, 2010)[42]

Dietary Factor	Recommenended Amount (%Energy)
Total Fat	20-35%
Saturated Fatty Acids	<10%
Poly Unsaturated Fatty Acids (PUFA's)	6-11%
n-3 PUFAs	0,5-2%
n-6 PUFAs	2,5-9%
Trans Fatty Acids	<1%
Mono Unsaturated Fatty Acids	By difference

Proteins in a cereal based diet, lysine being the first limiting amino acid, cereal-pulse combinations improve protein quality of the diet. Proteins of animal origin not only have a higher digestibility but also an appropriate amino-acid profile; therefore, supplementation with animal proteins helps to improve overall protein quality of the diet. Since dietary fibre hampers digestibility, on a mixed vegetarian diet, protein digestibility is usually about 85%. The recommended protein intake for vegetarians is 0.8-1.0g/kg body weight/ day. Micronutrient deficiencies such as iron deficiency anaemia (IDA), vitamin A deficiency (VAD), iodine deficiency disorders (IDD), vitamin D deficiency (VDD) and deficiency of folic acid/ vitamin B_{12} (megaloblastic/pernicious anaemia) also pose major public health challenges.

Further, maternal nutritional status can alter epigenetic state of the foetal genome and gene expression, which in turn are, affected by the availability of amino acids and micronutrients (like pyridoxine, folate and vitamin B_{12}). Strong evidence indicates that low birth-weight (LBW) children are at a greater risk of CVD. Moreover, LBW coupled with rapid weight gain during childhood increase the risk of type 2 diabetes. Low maternal vitamin B_{12} status is predictive of high adiposity and insulin resistance among the children, especially in the case of folate replete mothers. Since maternal under-

nutrition during her own foetal life/childhood limits foetal growth, mother's current nutritional status is the outcome of her own past nutrition as well as that of the earlier generations. The size, morphology and nutrient transfer capacity of the placenta determine prenatal growth trajectory of the foetus and influence his/her birth weight [43]. In several developing countries, intervention studies have indicated that CVD risk factors in the offspring/s can be addressed by supplementing the diets of undernourished mothers during pregnancy. Compared to standard iron/folate tablets, multiple micronutrient supplementation during pregnancy can help to lower blood pressure of the offspring/s[44].

Since, a healthy diet helps to protect against all forms of malnutrition including NCDs, following are some of the diet related recommendations proposed by WHO (2015) [45]:

- Unhealthy diets and physical inactivity being the leading global health risks, healthy dietary practices need to be inculcated early in life.
- Energy intake (input) should balance the energy expenditure (output).
- Total fat intake should not exceed 30 en% coupled with a shift from saturated to unsaturated fats as well as elimination of industrial *trans* fats.
- High intake of free sugars being closely associated with obesity and elevated risk of NCDs, it is strongly recommended to reduce free sugar intake throughout life. As part of healthy diets, free sugars should be limited to less than 10 en% while suggesting a further reduction to less than 5 en% for additional health benefits.

Since **salt intake** at less than 5 g/day (~2g sodium) helps to prevent hypertension and reduces the risk of heart disease/stroke, WHO member States have agreed to achieve 30% relative reduction in salt intake along with a voluntary target for attaining 25% relative reduction in the prevalence of hypertension (SBP e"140 mmHg and/or DBP e"90 mmHg) by the year 2025 [46].

It is not only the **food composition but the quantity of food intake** is also equally important. A temptation to eat more often leads to excess energy accumulation as body fat, ultimately resulting in obesity. Once BMI exceeds 30, the domino effect comes into play.The risk of developing T2DM increases and so does that of hypertension, certain cancers, stroke, sleep apnoea, and the diseases of liver/gallbladder etc that consequently reduce the healthy years of life.Independent of BMI, waist circumference is an important indicator/risk factor for NCDs.

Evidence does not support *'single culprit'* theory for driving the obesity epidemic. Asians being at a greater risk of NCDs (owing to higher % body fat),even at a BMI of nearly 23.0 kg/m^2, the risk of T2DM, CVDs and metabolic syndrome is higher than the Caucasians. Further, South Asians are more susceptible to central obesity and insulin resistance [32]. Just like, there are multifarious sources of excess energy consumption multifarious causing inflammation, insulin resistance and ultimately diabetes.

Regular physical activity results in numerous health benefits, including prevention of NCDs. With increasing usage of modern energy saving devices, physical activity and consequently energy expenditure have significantly dropped - resulting in energy imbalance. Just for burning calories from a small sugar cube, two minutes brisk walk is needed. Considerable evidence supports the role of physical activity in maintaining caloric balance and improving overall health; the recommendations range from 150-300 minutes physical activity/week (~30-60 minutes/day) for most of the days. In case

the BMI is 30+, a much more vigorous exercise becomes mandatory. Therefore, balanced diet and regular physical activity should forman integral part of a healthy lifestyle.

Recommended levels of physical activity for adults (18-64 years) to improve cardiorespiratory/muscular fitness, bone health, reducing NCD riskand depression [47]***:***

- Adults should weekly perform at least 150 minutes of moderate-intensity aerobic physical activity or 75 minutes of vigorous-intensity aerobic or an equivalent of moderate- and vigorous-intensity activity; in bouts of at least 10 minutes duration.
- For additional health benefits, 300 minutes/ week of moderate-intensity aerobic or 150 minutes/week of vigorous-intensity aerobic or an equivalent of moderate- and vigorous-intensity activity.
- Muscle-strengthening activities should be carried out on ≥2 days/week.

While maintaining fitness, well-being, self-esteem and appropriate functional/recreational activity, 5-10% weight loss should be a realistic goal. Modest weight loss not only helps to reduce obesity-related comorbidities but also improves various risk factors like blood glucose, HDL-C, LDL-C, TAGs, HbA1cconcentrations as well as blood pressure and overall quality of life. The Finnish Diabetes Prevention Study reported that achieving a relatively conservative target of more than four hours of exercise/week was associated with a significant reduction in T2DM risk even in the event of no weight loss. It is likely that any kind of physical activity (sports, household work, gardening, or work-related physical activity) confers similar beneficial effects[48]. In the Look AHEAD Study covering 5145 overweight/obese adults with T2DM, intensive lifestyle interventions in 8 years produced significant weight loss (5%) in 50% subjects indicating that this approach can be employed for managing obesity-related co-morbidities[49]. For instance, in Sri Lanka, physical inactivity has demonstrated a significant negative association with obesity, diabetes, hypertension and metabolic syndrome.

Physical activity helps to minimize the loss of lean body mass, mobilizes abdominal fat, enhances psychological well-being and fitness capacity.

Ways to enhance physical activity and maintain energy balance:

- Lifestyle approach: 60 minute walk/brisk walk/day; aerobics and strength training; ensure not to skip breakfast; adequate sleep (~8 hours).
- Tools like pedometers, apps, etc. help inmotivating individuals to maintain energy balance.
- Keeping a record of dietary intake and activity pattern.
- Regular monitoring of body weight for self-motivation.

Nutritionally balanced diet as well as appropriate regular physical activity should be given due emphasis under the public health prophylactic measures so as to prevent and manage most of the cost intensive health problems.Maintenance of good health depends on wise management of energy from all the food/beverage sources along with a habit of regular physical activity. Given that very few individuals meet the physical activity recommendations, overall message regarding physical activity should likely be ***"the more the better."***

SECTION 4:
Food for Health

"Let food be thy medicine; and medicine be thy food"
Hippocrates (431 BC)

'We are what we eat' itself signifies that our body composition largely depends on our dietary intake. Since no single food can meet all our nutrient needs, importance of nutritionally balanced diet in general, and for preventing NCDs in particular, is inevitable. Recent advances establish the role of various functional dietary components for attaining good nutrition as well as in preventing NCDs. In the present era, consumers no longer weigh the foods only in the context of taste and immediate nutritional gains butalso in terms of their ability to provide specific health benefits. Therefore, functional foods have emerged as a rapidly expanding food market since food processing industry seeks to extend health benefits of their products.

Functional foods *refer to any food or modified ingredient that* confer potentially beneficial *effects* beyond basic nutrition.

Researches indicate that antioxidant vitamins protect the blood vessels against changes induced during atherosclerosis. Therefore, functional foods designed with health claims to curb CVDs primarily focus on reducing various risk factors like total cholesterol and homocysteine levels as well as hypertension. The major protective functional ingredients include soy/soy components, dietary fibre, antioxidants, omega-3 fatty acids, phytosterols and phytostanols. Other functional food components comprise numerous limonoids and ascorbic acid (citrus fruits), isoûavonoids(soy), tocotrienols (cereals, grains and vegetables), phenolic compounds (ginger and green/black tea), lycopenes (tomatoes, watermelon and guava),anthocyanins (beans, cherries, blackberry, black grapes and strawberry), quercetin (onion, broccoli, red grape wine, cherries, apple and certain cereals), resveratrol (grape peels) and antioxidants in various herbs - rosemary, sage, thyme and oregano [50]. However, it is imperative to identify the active components responsible for the proposed health benefits [51].

Tea the most popular calorie free, non-alcoholic, functional beverage, is consumed worldwide. Currently, this miracle beverage is gaining more and more importance in view of its immense health benefits. Numerous epidemiological studies have documented that tea plays an important role against several diseases. Potential health effects of green tea have already been known since long; black tea is now gaining attention owing to its ability to provide protection against a number of diseases. The major polyphenols –the aflavins and the arubigins as well as the anine and caffeine present in black tea not only contribute colour and unique flavour but also confer protection against heart disease and various types of cancers (breast, stomach, liver, colon, lung, pancreas, prostrate and skin). Researches indicate that tea possesses anti-inflammatory, antimicrobial and antimutagenic activity as well as prevents clastogenesis (*a process involving additions, deletions or rearrangements of parts of the chromosomes).* Several investigations have documented that regular tea intake provides protection against T2DM and gastrointestinal disorders as well as improves bone mineral density. Black tea has

been reported to enhance insulin sensitivity, retard cataract development, maintain fluid balance, improve dental health,provide protection against DNA/ protein damage, inhibit HIV and reduce the level of stress hormones. In addition, it not only plays a vital role in maintaining hydration and is effective against metabolic disorders including obesity, it also acts as a potent anti-aging agent. Further, tea intake enhances alertness, improves memory and cognition by modulating serotonin/ dopamine levels.Black tea polyphenols possess anti-neurodegenerative properties and prevent Parkinson's and Alzheimer's diseases– re-endorsing the age old perceptions relating to health benefits of tea[52].

Owing to economic development, there is a shift in the consumption patterns - today's consumer is concerned about preventive and curative aspects of diseases particularly weight management, heart health, bone health and mental well-being. Therefore, academia and industry need to keep the consumer's interest in forefront who is willing to pick up healthy foods at reasonable costs to curb the medical expenses.

Since time immemorial, the tested and tried **traditional foods** have evolved as a result of colossal cultural, social, economic and sensory experiences. Therefore, traditional knowledge needs to be amalgamated with modern science to establish and re-endorse the benefits of traditional wisdom through strong scientific knowledge base and help in re-introducing such foods in present lifestyle and dietary patterns.

In Ayurveda, traditional and ethnic foods are derived using herbs, spices/ condiments,fruits and vegetables in such a way that the final product is rich in bioactive/ bioavailable compounds. The knowledge backed by 5000 years of mammoth epidemiological experiences cannot be set aside rather it is a treasure house for evolving the so called functional foods!

The common health challenges of developing nations such as poverty linked under-nutrition/ malnutrition, poor hygiene/sanitation, infectious diseases, overweight/obesity and chronic diseasesrequire specialty functional foods/ beverages.

Nanoparticles – the attractive delivery systems for nutrients comprise micro-emulsions, liposomes and nano-emulsions; therefore, focus on health benefits of ingredients may pave way for novel nutrigenomicapproaches through functional foods.

Historically, the influence of gut microbiota on host health has focussed on pathogenesis/ symbiosis; however, various disease conditions are also influenced by the level of numerous gut bacteria. Chronic autoimmune inflammatory diseases - celiac disease, type 2diabetes and obesity may also be associated with an altered gut flora. Therefore, a symbiotic or beneficial relationship between various gut microbes is imperative for optimum health and well-being. Altered micro-biome balance can result in diarrhoea, constipation and cancers especially the colon cancer.

Human body is home to nearly 100 trillion microbes and quadrillion viruses. Due to the presence of health promoting bacteria, fermented foods have long been recognized to favour the gut environment.As per FAO/WHO (2001)[53] , **probiotics** are the live micro-organisms which, when administered in adequate amounts, confer health beneûts to the host. Probiotic bacteria should comprise identified strains with established safety, stability and efficacy etc. These confer immunity and the rapeutic benefits against several gastro intestinal disorders (traveller's diarrhoea, inflammatory bowel disease, chronic constipation etc.) as well as help in the management of metabolic syndrome and obesity [54]. **Prebiotics** are non-digestible carbohydrates/food components that act as substrates for the probiotics. **Synbiotics** refer to a combination of probiotics and prebiotics; fermented dairy products (yogurt and *kefir*) are considered synbiotics as they contain both the live bacteria and the food for them to thrive. Functional pre- and pro-biotics have a major role in changing the fingerprint of gastro-biota. In shaping the gut micro-biota, diet plays a dominant role over other variables such as ethnicity, sanitation, hygiene, geography and climate.

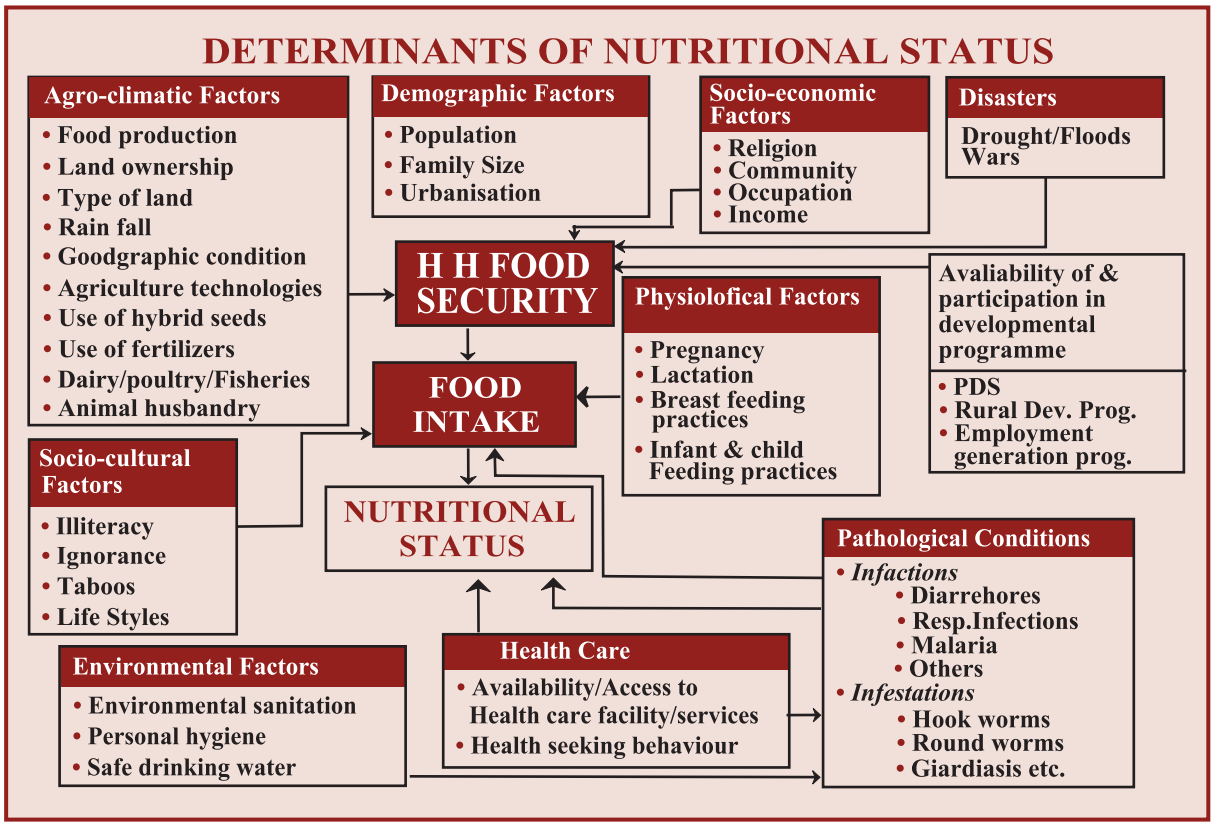
"Culture, science and habits with adequate physical/mental exercise play an important role in improving the quality of life, more so through global networking…….……

…….If the agenda of sustainable health through diet, lifestyle changes and gene nurturing matters to us, we ought to give due emphasis to safe functional foods/beverages in our daily diets !!"

SECTION 5:
Food Consumption Patterns and Physical Activity

Food consumption patterns have a direct bearing on food production and overall food security of the population. Owing to environmental, geographic and cultural differences, there is a wide variation in food consumption patterns of the masses across the nations. Thus, over the period, our diets have evolved under the influence of multiple factors such as income, availability, accessibility, individual preferences/beliefs, culture/traditions coupled with geographic, social and economic variations. Therefore, an insight into the food consumption patterns can contribute substantially in effective implementation of diet related strategies designed to curb the incidence of lifestyle related diseases. Modifications in dietary behaviour become easy and sustainable when the recommended foods are compatible with the existing food consumption patterns; and diet related interventions can be more effective when targeted towards specific socio-demographic subgroups [55].

Table 5.1: Determinants of Nutritional Status



Source: *Paper presented by Dr G.N.V Brahmam, Former HOD, Division of Community Studies, NIN, Hyderabad, at the International Conference on Role of Diet, Physical Activity & Lifestyle in Promoting Health.*

Economic growth is often accompanied by quantitative/qualitative improvements in the country's food supply resulting in a steady decline in nutritional deficiencies among its people. Further, it also brings about variations in food production, processing, distribution and marketing trends. In 2011, FAO had reported that, in aggregate, world was producing sufficient food for its people; however, there are profound discrepancies in its access at national/state/district/household level. It is well documented that there is a wide variation in the average daily per capita energy intake in least developed (2120 kcal), developing (2640 kcal) and developed (3430 kcal) nations [56]. In low-income countries, people spend major part of their income on necessities including food, and that too a substantial portion on low-cost staple foods. On the contrary, in economically advanced countries, they tend to spend a greater proportion of their budget on luxuries/recreation and much lesser on food– and there too high cost food items taking away a larger share of their food budget. On the whole, people in low-income countries are more receptive to the variations in income and food prices; and therefore, tend to make greater adjustments in their food consumption patterns with changing incomes/prices; albeit, such adjustments are not uniform – changes in staple consumption being the least and that of expensive foods the most [57]. To quote, dietary surveys in India have revealed that the average daily consumption of staples (cereals) is quite satisfactory; while the average consumption of protective foods such as pulses, green leafy vegetables and milk/milk products is grossly inadequate. Therefore, effective strategies should not be directed only at achieving food security for all, but these must ensure the consumption of adequate quantities of safe/good quality food as an integral part of healthy diet [58].

> In developing world, despite industrial growth and significant improvement in total food production, prevalence of sub-clinical forms of under-nutrition continues to be rather high.

There is an urgent need to improve and strengthen implementation of the existing short-term (supplementary nutrition programmes, immunization and health care services) and medium-term measures (micronutrient fortification of foods) as well as the long-term strategies such as dietary diversification and behaviour change communication – with special emphasis on quality of services with wider orpreferably universal coverage.

Dietary data – though limited, indicate a lack of compliance for the dietary guidelines/recommendations. Therefore, there is a dire need to conduct national level comprehensive nutrition surveys to generate valuable data on adequacy/inadequacy of nutrient intake and food consumption patterns of the individuals/households. This inclusive database will enable the policy makers to comprehend and specify the fundamental causes of health and nutrition problems so as to formulate,design and implement specific food/nutrition related intervention programes with greater efficacy.

Apart from changing dietary patterns, there has been a massive shift in **physical activity** of the people across the globe. Physical inactivity is one of the 10 leading causes of death and disability worldwide. Epidemiological data indicate an alarmingly high prevalence of major chronic diseases among physically inactive individuals. Globally, more than 2 milliondeaths/year and in a developed nation like US, nearly

334 thousand deaths/year are attributed to physical inactivity. Physical inactivity causes obesity associated with increased serum leptin (leptinresistance), in turn leading to greater physical inactivity. In fact, physical inactivity can be classified as a challenging ailment to draw the attention of one and all, specifically the concerned authorities, so that the lifestyle related diseases can be kept at bay (!). The irony is that the urban South Asians are at a risk of dysglycaemia at much lower levels of sedentary behaviour than the western populations, indicating the need for re-visiting the physical activity guidelines for South Asians. Even as late as in 20th century, common belief was that too much of exercise shortens life.

For addressing the downward trend in physical activity and associated fitness, public health strategies and necessary infrastructure is needed for children at an early age; and not doing so, invites chronic diseases/disabilities and premature deaths. Unequivocally, regular physical activity is among the key determinants of well-being, functional abilities, mood and perceived health status; thus, its preventive role can well be translated into clinical management.

Healthy habitats - conducive for regular physical activity are essential for community health; lack of such facilities is fuelling the so called eco-nutritional diseases (END). *Since the term 'chronic disease' is unable to describe aetiology or pathogenesis, it may be* logical to refer these as 'eco-nutritional diseases' to highlight:

- importance of food and the need for biodiversity;
- movement/activity in safe and sustainable settings;
- appropriate environmental buffer zones to minimize the risk of even the emerging transmissible pathogens.

A sustainable unifying strategy, therefore,needs to be urgently formulated and implemented for health advancement and optimization [59, 60].

SECTION 6:
Initiatives by Industry for Food Choices

There is burgeoning focus on the role of nutrition in the development of chronic diseases and impaired functional abilities of the populations. Numerous studies highlight that the *modern lifestyle* and *'industrialized nutrition'* have in some cases resulted in unhealthy foods comprising processed/refined foods loaded with sugars, salt and fats but low in plant foods, dietary fibre and micronutrients.

Diet plays a major role in maintaining our health and with changing pace of life, this becomes all the more important. In the event of current scenario, food industry plays a vital role in safeguarding the consumer's health and wellbeing.

For the past many years, food/beverage industry has been addressing nutrition and health as a priority which should continue to be a major driving force behind innovation and product development. The food and beverage industry has a long history of collaborating with public authorities (individual companies or through their federations) for promoting balanced diet, physical activity and healthy lifestyles, particularly through schools/colleges - and this is reflected in their corporate policies too. Many of these companies have taken steps to improve nutritional value of their existing food items - by curtailing *trans* fat, fortifying with vitamins/ minerals as well as by developing new range of products that encourage a healthy lifestyle and cater to diet-conscious consumers. In the last few years, food industry has been taking strides to meet the escalating consumer demands and producing low-calorie food products with restricted fats (particularly *trans*fat), sugar and salt content. Further, the industry has been contemplating on reducing the portion size too. Within the industry, nutrition and health have become a major driving force for their research and development (R&D); and in conjunction with health professionals, products have been developed for reducing the risk of various diseases.

Consumer willingness and acceptance are an important factor(!). There are many instances where public health concerns have been taken seriously by the industry and they reduced the salt/sugar content or increased the dietary fibre level in their products. But consumers should be ready to compromise with the taste of products having lowered sugar/salt or enhanced dietary fibre content.

Some industry level initiatives.....

- The 'Global Health & Wellness Initiative' comprising adaptation of their portfolio's nutritive value, revision of the marketing practices/policies, generating consumer awareness regarding healthy diet/lifestyle choices and advocating constructive public policy changes.
- Adoption of policies to ensure wide range of consumer choices for a variety of non-alcoholic beverages.
- Facilitating the consumers in making informed choices through appropriate nutrition labelling and other communication strategies. Optimising consumer food choices at every stage of life.

- Developingan array of innovative foods with adapted nutrient content; probiotics/prebiotics food products; low calorie-nutrient fortified foods and low sugar confectionary items in a wide range of portion sizes.
- Enhancing menu choices for promoting healthy lifestyles and collaborating with experts for improved consumer awareness.
- Curbing *trans*-fat content in the industrially produced food products by adopting technologies like inter-esterification, fractionation of tropical oils, blending etc.

In a nut shell, it is the multi-stakeholder responsibility to realize appropriate food reformulations; and these too will fail if the consumers are not willing to take necessary steps – very often they may jeopardise all the positive strides by adding extra table salt or sugar. An in-depth understanding of the industrial and consumer limitations can help in establishing effective guidelines and regulations[61].

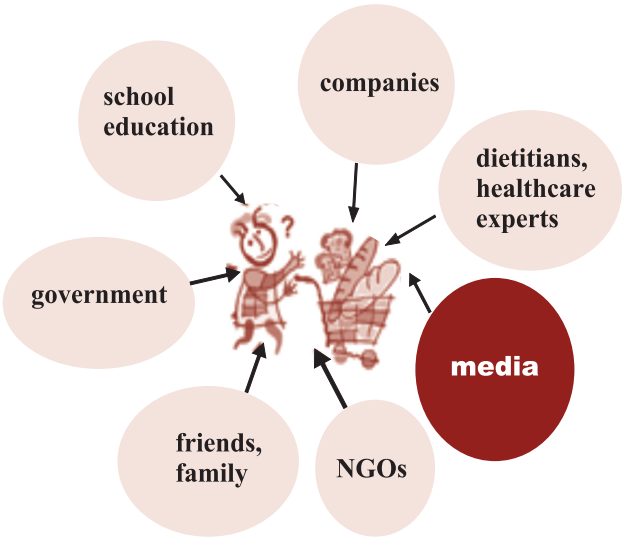
SECTION 7:
Consumer Education

In recent years, nutrition related awareness and the impact of diet on health have gained increasing importance in consumers' food choices; and the industry is cognizant of the significance of providing clear/accurate nutritional information to its consumers. In this direction, the industry has taken numerous steps including the extended and effective use of nutrition labelling which not only serves as an important communication tool but also provides fairly good information about the nutrient content of the particular food/ beverage on per cent/unit basis or per serving portion. The nutrition information on labels can help the consumers to know about the energy and nutrient content of the food they consider to buy and also learn about how the particular food/ beverage can fit into the balanced diet so that they can tailor their own diets for meeting the nutritional needs. Based on the nutrition label, the consumers can not only compare various products but are also guided to make healthier food choices.

Other consumer information/communication tools include websites, help lines, in-store leaflets and brochures which are increasingly being used all over. The industry and public authorities are continuously devising strategies for imparting effective consumer education. Advertisements are important communication instruments and play an important role in promoting appropriate dietary behaviours and lifestyle practices among the masses [61].

For imparting balanced communication, there are numerous information channels (Fig 7.1); however, media plays a significant rolesince it can reach a vast majority of the individuals in one go(!).

Fig 7.1: Information Channels for Nutrition Communication



Source: Paper presented by Dr Laura Fernandez Director General, European Food Information Council, Brussels, at the International Conference on Role of Diet, Physical Activity & Lifestyle in Promoting Health.

Amongst the individuals coming across media reports on unsafe or unhealthy food, majority tend to change their eating habits or avoid eating such foods, however, some of them still remain incognizant. The onus lies on the media to report accurately using simple and unambiguous terminologies from credible sources so that the general public gets across the right messages. Any misreporting of scientific information can lead to wrong perception that can adversely impact the public health ubiquitously. Trust in information sources is of great significance in imparting consumer education; and in this regard, consumer groups, physicians/doctors, teachers, researchers/scientists and public authorities are the most trustworthy.

To sum up, nutrition labelling permits but does not always lead to healthier food choices. Motivation among the consumers is a major bottleneck which needs to be addressed effectively; and with regard to nutrition labelling, consumer education is rather crucial. The countries with effective communication campaigns have documented greater nutrition knowledge, awareness, understanding and use of labelling systems. Therefore, effective communication, information and education channels are imperative forappropriate food choices leading to healthier lifestyle. With complementary involvement of multiple channels and proper sharing of responsibilities, a lot more can be achieved in this direction (!).

"Accuse not nature. She has done her part. Do Thou but Thine."
John Milton (1687), Paradise Lost

SECTION 8:
Strategies for Public Health Interventions

The major goal of public health intervention programmes is to carefully assess the community structures and processes so that they reflect perceptions and nature of the community. However, many of the problems around which community-based public health interventions are developed - diet, physical inactivity, tobacco/drug misuse, alcohol consumption etc. have profound individual and cultural influences. Most of the health related problems do not merely result from personal choices; rather society and the social structures have a great bearing. Whether it is the social class differences in lifestyle related morbidity and mortality or the access to health care services, public health is inherently linked to the burden of ill health and its distribution in the society [62].

It is important to effectively deal with the underlying issues of chronic diseases starting from 'cell to community'; understand how lifestyle factors inûuence the human health; how clinical medicine addresses the mechanisms involved in treating the various disease conditions; and how public health can help to create healthy environments and prevent chronic diseases. Thus, there is a dire need for an interdisciplinary, systems-based holistic approach to address the underlying mechanisms and factors associated with chronic diseases. In this regard, public-private collaborations as well as a state and industry level research linkages are of prime significance.

To deal with lifestyle related problems, the **major strategies** involve estimating the need and advocating action; developing national level policies, strategies and plans for their prevention, management and care; and promoting/implementing community level prevention and care strategies. Since most NCDs are preventable, unlike curative strategies, appropriate education of the masses for awareness generation and effective implementation of the prevention and management strategies can prove highly cost-effective [21].

Establishing surveillance systems for non-communicable diseases and their risk factors is an essential part of prevention strategies as well as periodically monitoring the impact of disease control programmes. With regard to surveillance for the risk factors, significant progress has been made during the past decade including generation of population-based data on various behavioural and biological risk factors. As part of the global strategy, WHO has developed an approach for Surveillance of NCD Risk Factors (STEPS) to document country-level trends in NCDs [63]. Further, WHO provides sound scientific evidence and options to policy-makers for strengthening their governance capacities so as to systematically act on the social determinants and reduce health inequities. In addition, urgent actions by the policy-makers are needed to prevent or mitigate processed food consumption along with comprehensive policies and regulatory approaches to effectively address this vital issue and help in achieving the desired goals [64].

Since the concerns for poverty and hunger dominate the attention of public and politicians, it is rather difficult to draw sufficient focus on NCDs. In view of co-existence of hunger related malnutrition, communicable and non-communicable diseases in many parts of the world must not adversely affect either of the conditions. It is imperative to inculcate healthy life style practices among children with ample emphasis on appropriate physical activity and

dietary behaviours so as to reduce the NCD burden in their later years of life.

Multi-sectoral actions for controlling NCDs involve:

- **Expanding delivery Platform** – Efficient screening program (mobile or at work places); health promotive villages, schools, institutions etc; inter- ministerial/ departmental programmes on NCD prevention; jogging tracks with low cost open space gymnasiums; and physical activity programmes at work places.
- **NCD-specific actions on social determinants**–Promoting programs for healthy life style which ensures energy balance.
- **NCD-sensitive actions on social determinants**–Education for all ages; cycling tracks along the roads; optimisation of resources; national level food and nutrition security programmes. Further, the health related issues need to be inducted in all other policies and programmes, wherever possible.

In addition, establishing an array of healthy lifestyle centres in close vicinity is highly recommended for improving physical activity and preventing the onset of lifestyle related diseases. Apart from focusing on healthy eating and physical activity, harmful effects and dangers of obesity as well as NCDs need to be glaringly highlighted at all forums including mass media.For vast majority of population – both in the developed and developing nations, role of diet being rather crucial in the genesis and management of lifestyle related diseases, various strategies for the prevention and control of nutritional deficiencies, communicable as well as non-communicable diseases can be grouped as short-term, medium-term and long-term strategies:

- **Short term strategies** include strengthening supplementary feeding programmes and specific nutrient supplementation programs with effective periodic monitoring.
- **Medium term strategies** comprise micronutrient fortification of foods - salt (iodine, iron), milk and cooking oils (vitamins A and D), wheat flour (iron, vitamin A, folic acid), rice (iron/array of micronutrients like in ultra-rice); supplementary foods under feeding programmes (e.g. ICDS/MDMS) as well as the ready to eat/convenience foods.
- **Long term strategies** encompass health and nutrition education; dietary diversification (behaviour change communication); development of kitchen gardens; agro-biodiversity, bio-fortification; genetically modified foods; environmental sanitation and personal hygiene; provision of safe drinking water; immunization; prompt treatment of infections; income generating activities; improvement in household food security; promotion of healthy lifestyle practices; and population control measures.

In most of the developing nations, community-based interventions and program need to address multiple risk factors with ample emphasis on dietary patterns and physical activity so that the menace of lifestyle disorders can be nipped in the bud. Prime endeavour should be to reduce the risk of these chronic diseases at every stage of life starting from childhood or rather the foetal life; and as a priority, the necessary actions/programs should be integrated with the existing health care system.

Ban Ki-moon (UN secretary-general)had emphatically remarked that the national level efforts for preventing lifestyle disorders remain 'insufficient and highly uneven'; and the crisis - a collective making, can only be reverted through urgent joint actions. Further, it has been commented that by preventing these diseases, the society will not only gain in terms of longevity and prosperity, but will also enjoy the pleasures of leading healthier and vigorous lives!!

The Conference held at Sri Lanka acknowledged that over the years, the Ministry of Health had taken several steps including lifestyle transition approach through behaviour change communication as the co-implementation strategy in minimizing the common risk factors for NCDs. In this endeavour, collaboration with the Ministries of Sports, Education, Youth Affairs and Mass Media proved rather useful. In addition, the Ministry of Health has also formulated a *'Strategic Plan in Health for 2009-2018'* aligned with development agenda of the Sri Lankan Government having 'Health Promotion' as an identified key strategic area. Keeping the recent developments and scientific evidence in view, experts at the Conference outlined the ***Action Plan*** for curbing/managing the lifestyle related diseases.

ACTION PLAN

Approach Towards Curbing/Managing NCDs

- All efforts should be directed to improve the health indicators and innovative approaches should be employed to achieve the same.
- It is multi-stakeholder's responsibility to help in promoting healthy living environment through appropriate measures at all levels - government, schools, colleges, offices, factories, households and the food supply chain.
- Multi-sectoral approach is required for preventing and combating NCDs. A coordinated approach involving all stakeholders will yield faster results. In addition to government, academia, private sector and international organizations should be involved in this endeavour.
- Policies should be scientifically sound; appropriate diet is not only important for maintaining health but it is also an effective way of checking the ever escalating incidence of NCDs.

Capacity Building

- Skill based short term training courses in nutrition, health and lifestyle modification should be organized for government officials, regulatory bodies, academia and industry.

Comprehensive Nutrition and Physical Activity Surveys

- National level comprehensive food consumption, nutrition and physical activity surveys should be conducted to generate valuable data on adequacy/inadequacy of food and nutrient intake, as well as food consumption and physical activity patterns of individuals/households. This information will enable the policy makers to comprehend, quantify and specify the causes of health/nutrition problems; and guide designing as well as effective implementation of specific food, nutrition and lifestyle related intervention programmes.
- Ministry of Health should set up National Nutrition Monitoring Bureau as an autonomous body to gather primary data on diet, physical activity and anthropometry once in every 5 years. It should also collect data on nutrient content of the crops. Such data will be helpful in monitoring health and evolving effective policies.

Dietary Changes

- Focus should be on wholesome, safe and nutritious foods designed on population based international guidelines (WHO/ Codex), aligned with the local regulations.
- All dietary recommendations should be based on the principles of variety, moderation and balance to bolster the concept of diversified balanced nutrition.
- If rice forms major proportion of the total energy intake then appropriate strategies may be devised either to reduce the intake of rice or introduce low calorie/ low glycaemic index rice rather than advocating the populations to stop eating rice. Hence,

low GI rice varieties may be grown/ imported and popularised.

- People should be encouraged to consume more fruits, vegetables (particularly green leafy vegetables), and pulses with meals. Simultaneously awareness about appropriate portion size should also be generated.
- Reducing sugar intake through all food and beverage sources should form an integral component of the intervention; however, other options should also be worked out.
- To reduce sugar consumption, obtaining data on per capita sugar intake from various foods/beverages is rather necessary.
- Different sugar sweetened foods/beverages should be identified for replacing sugar by sugar substitutes.
- Non-nutritive or low calorie sweeteners can be used in food and beverages since these provide the consumers a choice to satisfy their innate desire for sweet taste without adding the calories. Studies have shown that replacement of sugar with low calorie/ non-nutritive sweeteners may help to reduce calorie intake, and thus, aid in weight management. In this case, since the individuals are not deprived of "sweet foods", they may feel more satisfied with their eating plans, and thereby, achieve weight loss. With low calorie sweeteners, individuals with type 2 diabetes will have greater flexibility in meeting their dietary goals.
- Consumption of visible fat should be reduced from 35g to 25 g per day. Further, the individuals should be advised to consume variety of oils. The intake of fat should be in line with the calorie requirements; however, they should consume nearly 10 en% from saturated fat and not more than 1 en% from trans-fats.
- Reduce the total food and beverage intake by 20%, where necessary.
- Despite the free sugar content, a daily intake of 75ml-80ml of fruit juices can be consumed owing to their high antioxidant levels.
- An appropriate diet should contain a variety of foods in reasonable quantities.
- While proposing recommendations on diet, physical activity and lifestyle modifications, it is necessary to understand the existing diets as well as traditional food/beverages, culture and customs.

Functional Foods

- In view of high omega3 fatty acid content and functional properties, people can be advised to consume fish (especially fatty fish) for conferring better cognition and overall health.
- Tea is a wonder beverage -both green tea and black tea offer numerous health benefits and provide protection against gastrointestinal tract disturbances, metabolic disorders, obesity, type 2 diabetes, CVD and cancers. Information about evidence based health benefits should be disseminated to the consumers.
- Human body is home to about 100 trillion microbes and quadrillion viruses collectively referred as the microbiota and their genetic profiles as the microbiome. Colonization of microbes (number/type)

depends on the composition of diet, which in turn modify the gut health as well as several metabolic functions in the body. A disturbed balance of good and bad bacteria causes disease. Colonization of the gut with the good bacteria is protective. Foods and beverages containing probiotics and prebiotics improve the gut microbiome and, thus, will help in preventing/managing the NCDs.

Processed Foods

- Food Industry are equal partners in creating healthier food choices and developing responsible communication in supporting the global health initiatives for lowering the NCD rates and raising consumer awareness towards a healthier world. Responsible food companies can leverage their R&D and product development expertise to produce healthier foods in line with the dynamic health/nutrition guidelines provided by the concerned authorities.

Physical Activity

- Physical activity plays a key role in preventing and managing NCDs. It promotes health regardless of weight loss, builds physical fitness, helps in mobilizing the abdominal fat and enhances psychological well-being.
- Physical activities should be recommended for all age groups including children and elderly.
- People should be motivated to adopt lifestyle approach relating to physical activity. To start with, daily walk is a good endeavour; aerobics, yoga and other exercises help in maintaining calorie balance and reducing the risk of lifestyle related diseases.
- Many tools are available (pedometers, apps, etc.) for motivating individuals to achieve calorie balance.

R&D

All research organizations should be supported by government/regulatory authorities to strengthen the knowledge base related to nutritional intakes, dietary patterns etc. as a holistic approach.

Consumer Awareness

- Barriers to modifying the lifestyle and behavioural patterns need to be identified which could be rooted in cultural practices and traditional food habits.
- Focus should be on prevention of NCDs. This requires creating consumer awareness on diet, lifestyle and physical activity. Ministries of Health, Agriculture and Finance should formulate positive messages regarding safe/nutritious foods and physical activity.
- Media can be used for creating awareness; and to make dent, media campaigns should be continued at least for 3 months.
- Media should be rather careful about their reporting and should not publicize studies without prior expert verification. At times, misreporting orimproperly conducted studies may create a fear psychosis or biased opinions that can mar the efforts.
- Focus on school children can help in securing their future; therefore, nutrition should be inducted in school curriculum at least from 5th standard onwards.

- Brochures on diet and physical activities entitled – "Health For You" (in vernacular language) should be prepared and distributed in schools, colleges, offices and hospitals and uploaded on websites for wider dissemination. In this regard, mobile applications can also be designed and promoted.
- Mobile phones can be used for creating consumer awareness. For example mobile companies can be asked to install consumer awareness programs on diet and physical activity prepared by Ministry of Health. Thus, whenever the user switches on the mobile, nutrition health related message could be displayed/played.
- Nutrition labelling is an important tool providing food facts having profound potential to enable healthier food choices by the consumer. However, studies have shown that even in developed countries including Europe only a small percentage of population (16.8%) looks for nutrition information on the labels. This can perhaps be attributed to the fact that the consumers give low priority to nutrition labelling and its role in making healthy food choices. Communication campaigns and educational programmes can help in generating awareness and imparting nutrition knowledge regarding the importance of nutrition labelling.

Effective implementation of the Action Plan can greatly help in curbing the incidence and management of NCDs.

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