



PROCEEDINGS OF JAFFNA SCIENCE ASSOCIATION

**Presidential Address
Theme Seminar talks
Chairmen's Addresses
Review and Popular Lectures**

Volume: 15

No: 02

**15th Annual Sessions
7-9 May 2008
Jaffna, Sri Lanka**

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Editor's Note

This book contains the Proceedings of Jaffna Science Association, the Addresses and Talks delivered at the 15th Annual Sessions of the Jaffna Science Association held on 7, 8 & 9 May 2008.

I wish to thank the distinguished speakers for their work and cooperation for compiling this volume. I wish them success in their future endeavours and believe that they would continue their contributions to the region.

Hopefully this volume will be beneficial to the readers from students to researchers as well as to general public and will immensely facilitate to attain the objectives of JSA.

Dr. E. Y. A. Charles
Chief Editor

Department of Computer Science,
University of Jaffna

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Physical Needs of children

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Introduction

Life is a marvellous phenomenon. The infinite variety of living things the splendor and fecundity of the natural world astound us. Life is a continuous process whereby generation after generation of living things procreate and continue this process. The ability of DNA to replicate itself is a unique factor which ensures continuity of life.

Definition

Modern human beings, scientifically known as *Homo sapiens* is considered to be the ultimate triumph in evolution. The immortality of this species is ensured by procreation. The offspring of a human is denoted by the word "child". Children are precious gifts to their parents. The future prosperity of a country depends on them. The term 'child' is applicable to human offspring from birth to 12 years. From birth to one year the term 'infant' is used, from 2-5 years the term 'baby' is used and from 6-12 years the term 'child' is in usage. But these terms are not specific and denote children under twelve years.

This research is concerned mainly about the bodily needs of children. All children progressing from the helplessness of infancy to the independence of maturity have certain physiological needs without which life itself cannot continue and certain physiological needs without which an individual cannot attain contentment self reliance and good relationship with other people. Shelter and protective care, Food, Warmth and clothing, Fresh air and Sunlight prevention of illness and injury are some of the basic physical needs. The physical needs when fulfilled contributes towards growth which is increase in size and which can be measured in terms of height and weight.

Shelter and Protective care

The first lap of human life known as the antenatal period is spent within the confines of the mother's

womb where protection from harmful agents is provided. Birth is a hurdle which most babies clear without difficulty. The moment of birth and the period following it are unique. The baby has to adapt itself to the new environment. Mother's care and breast feeding give the baby a sense of security. As the baby grows it becomes a part of the household where shelter and care are provided. Father and the other family members extend their love and care. As the baby grows, attachments with parents, grand parents and siblings are established. When the child attains school going age, the circle of attachment includes teachers and friends who act as caretakers.

Food

Food is the most important physical need of a child. Growth is a process which needs nutrients which are supplied by food. Nutrients are essential for the promotion and maintenance of good health and for prevention of diseases. The fetus obtains the necessary nutrients for its growth from the mother's womb, hence the necessary for pregnant mothers to eat nourishing foods like egg, milk, fish, meat, fruits, vegetables and green leaves.

The four weeks after the birth of a child is known as the neonatal period and is very important. Mother's milk is the best food for the new born baby. The rich, thick milk called the colostrum provided by the breast during the first 2 -3 days after birth of a child contains extra nourishment. It also contains antibodies which have anti infective properties. It acts as a laxative and helps in the expulsion of meconium. It also contains vitamin A and many growth factors.

The composition of breast milk is ideally suited to the needs of the infant therefore babies will grow best on breast milk. It contains easily digestible whey protein which provides the baby with essential amino-acids. Breast feeding brings about

an overall improvement in the health of the infant, not only physical development but also adequate brain development. Thus it promotes higher intelligence quotient in infancy and later in childhood. It also promotes better emotional and social developments. Breast fed babies are less likely to develop ear infections or diarrhoea, have fewer childhood illness and do better at school. Breast milk gives protection against allergic disorders; it is also less expensive and clean. Breast feeding mothers must take nourishing food. When breast milk is insufficient infant milk formula can be given with doctor's advice. Babies must be entirely breast-fed up to four months. As there is universal awareness regarding the benefits of breast milk mothers must be encouraged to breast feed babies.

WHO studies in Sri Lanka indicate that problems related to nutrition in children start by the 4th month. This is due to improper weaning practise. Weaning indicates the introduction of food other than milk to the baby's diet. As the baby grows its nutritional requirements increase which must be supplemented by additional food. Weaning foods can be started by the 4th month but by the 6th month weaning must be started. Mashed rice, cungee, soup, boiled and mashed vegetables and cereals fish, meat, egg yolk, mashed papaw, banana and broth may be given as supplementary food. Initially the food must be given in a semi-solid form and little at a time about one teaspoon full. Gradually the consistency should be increased and by 7-8 months the food could be soft and lumpy. By one year the child must be able to partake of the house meals except hot spices. When the child reaches two years it must be able to eat by itself. Supplementary food must be prepared cleanly just before feeding. The babies diet must be sensibly organized to proper balanced diet of carbohydrates, proteins, fats, vitamins, minerals and water.

Warmth and clothing

As Sri Lanka is a tropical country and most parts are warm keeping a baby warm is easy. New born babies need warmth as they are newly subjected to environmental forces. Warmth is provided by

the mother's embrace when a baby is hugged close to the mother's body a sense of security body warmth and protection are provided. The baby must be covered with a cloth or thin blanket.

It is sensible to have a set of baby's clothing denoted as layette, ready a few weeks before baby is born. The main items of clothing in our country are baby shirts and nappies made of cotton cloth. Other items are few vests, baby linen such as cot sheets pillow cases towels and mosquito net. Metal press studs, hooks and eyes, and zip fasters must be avoided. As babies grow pampers could be used. It is best to keep the baby bare footed most of the time to help in formation of natural arches of baby's feet. When going out open sandals are best. As the baby grows dressing could be done according to prevailing trend.

Fresh air and Sunlight

Oxygen is the life giving component of the air, as such fresh air is an absolute necessity to maintain life. Metabolism depends on availability of oxygen. So houses must be airy and children must be kept in rooms with large windows through which air can circulate. Children living in crowded areas are apt to develop respiratory problems. Sunlight is necessary to provide warmth and light. Vitamin D is synthesized by the body in the presence of sunlight. It is essential for the development of bones and teeth. Atmospheric pollution is a hazard to living things. Due to depletion of the ozone layer many adverse effects are produced which are harmful to humans. In the urban areas and industrial sites we are exposed to polluted air containing hydro carbon fumes. In the rural areas pollution is due to spraying of insecticides and pesticides to vegetables crops and rice fields. Inhalation of polluted air is a health hazard as it predisposes to bronchial asthma, chronic cough or even cancer of the lung. Whenever possible children must be taken to parks and beach where they can breathe fresh air.

Prevention of illness and injury

The main cause of illness of children are micro organisms called germs which thrive on baby

tissues. There are larger parasites like worms and fungi also. the germs mainly bacteria and virus enter the body through contaminated food, air and water. Common infections of children are, common cold, sore throat, influenza, bronchitis, measles mumps, chicken pox, hepatitis, diarrhoea, pneumonia dysentery and whooping cough.

The body's immune system defend against invading germs. Antibodies are produced in the blood which acts against the germs. At times the defensive system is weakened and illness prevails. Children could be save guarded against certain diseases by giving vaccines or injections to develop immunization.

New born babies are given B.C.G vaccine against tuberculosis within 2-3 days of birth. Triple vaccine against diphtheria, tetanus and poliomyelitis is given at 3 months of age, 2nd doze is given 6-8 weeks later 3rd doze by 6-8 weeks later and 4th doze at 18 months. Injection is given against hepatitis. Besides these, vaccines for measles, typhoid, chicken pox and Japanese Encephalitis are also available. These vaccines are available free in the state health service.

Accidents can occur anywhere. They cause unnecessary human suffering. Accidents can be avoided if adequate precaution is taken. Parents should be alert, cautious and careful, take safety precautions and heighten the awareness of children regarding common hazards. As far as small children are concerned falls are dangerous and they could have serious consequences. Infants and young children should never be left sleeping unsupervised in beds. Sharp objects like knives, scissors kitchen knives cause injury and should be kept locked. Children are also prone to put foreign bodies like buttons beads seeds, pencils, wires etc in their ear nose and mouth, Parents must be always on the alert and keep the environment clear of injury causing articles.

The first indication of ill health is usually a change of mood and behaviour and loss of appetite. Most conditions that affect children are minor and self limiting. If illness persists doctors advice must be obtained. During illness energy and protein

requirements are increased so that additional food and liquid in take become necessary.

Malnutrition is a malady which is a fore runner to ill health specially anemia. Iron deficiency is the cause for this condition. Obesity is another condition which must be avoided. When a person takes more food than needed the body converts the excess food into fat and obesity results.

Conclusion

Each phase of growth and development of children has its own unique features with respect to physical, mental, emotional, social spiritual and various other dimensions. As much as children need good nutrition for their physical growth and development, they also need love a sense of security and good parental guidance for their emotional developments and well being. Children need to be shown that they are really wanted and loved especially in situations where they tend to feel that they are being neglected. Children are on a voyage of discovery, they may go astray and get into trouble if they lack proper guidance and training. It is the responsibility of the parents to assist and guide them by providing opportunities, facilities and encouragement. Children will then grow up to become adults with a sense of responsibility love and concern for others. Over protection is harmful as it will hinder them from becoming independent or develop self esteem.

As children grow their circle of attachment grows larger. All peoples who come in contact with them, by their words, actions and value systems will influence children for better or for worse. Parents must devote time to their children and have an eye on the company they keep.

Discipline is necessary for a successful life. Children must be disciplined with tact and patience. They must be trained to do what has to be done. It is the duty and responsibility of the parents to make provision for material, social and emotional needs of their children and direct them into proper channels for mental and spiritual growth and development so that they would develop into useful citizens.

பிள்ளைப்பராயத்தினருக்கான கல்வித்தேவைகள் (Educational Needs for the Childhood)

பா.தனபாலன்

யாழ்ப்பாணம் தேசிய கல்வியியற்கல்லூரி

பிள்ளைகளுக்காக நிலை பெற்றிருக்கும் கல்வியானது அவர்களை அறிவு மிகுந்தவர்களாகவும், கற்றல் தேர்ச்சியினூடு சமூகத்திற்குப் பயன்தரும் அங்கத்தவர்களாகவும் ஆக்குவதற்கு உதவ வேண்டும். குழந்தை பிறந்ததிலிருந்து பல்வேறு பருவங்களிலும் கல்வித்தேவைகள் பல்வேறு வகைப்படுகின்றன. இவற்றைச் சரியாக பெற்றோரும், ஆசிரியர்களும், சமூகமும், அரசும் நிறைவேற்றும் போது பூரண சமநிலை கொண்ட நற்பிரசைகளை உருவாக்கலாம். மனித வாழ்க்கைக் கால விருத்தியில் மிக முக்கியமான சிறப்பியல்பு வாய்ந்த பருவமாகப் பிள்ளைப்பருவம் உள்ளது.

இப்பருவம் தொடர்பாகப் பல்வேறு வகையான ஆய்வாளர்கள் பல்வேறு வயது வகைப்பாடுகளைத் தெரிவிக்கின்றார்கள். ஐ.நா.சாசனம் 5 வயதிற்கும் 18 வயதிற்கும் உட்பட்டோரைப் பிள்ளைகள் என்கிறது. இப்பிள்ளைப்பருவக் கல்வித்தேவைகள் தொடர்பாக மாஸ்லோ (Maslow), சிக்மன் புரொய்ட் (Sigmund Freud), ஜீன் பிஜாஜோ (Jean Piaget), பவ்லோ (Pavlov), ஸ்கின்னர் (Skinner), விகொற்கி (Vivgotsky), கொவ்கா (Kofka), எரிக்சன் (Erikson) போன்ற பலர் உளவியல் ஆய்வுக் கண்டுபிடிப்புகளை மேற்கொண்டுள்ளார்கள்.

எரிக்சனின் மனித வளர்ச்சிப் பருவங்களும் சமூகச்செல்வாக்கும்

இவ்வளர்ச்சிப் பருவங்களில் பிள்ளைப்பருவம் எனப் பெரும்பாலானவர்கள் கருதும் பாடசாலை செல்லும் பிள்ளைப்பருவம் (5-12), கட்டிளமைப்பருவம் (12-18 பெண், 12-21 ஆண்) என்பவை எதிர்கால மனித வாழ்வியலைத் தீர்மானித்து கற்றல் பேறுகளை எய்தும் காலமாக உள்ளது. இங்கு கற்றல் என்பது பயிற்சி, தேர்ச்சி, அனுபவங்களின் அடிப்படையில் ஒரு பிள்ளையிடம் ஏற்படக்கூடிய நிலையான நடத்தை மாற்றமாகும்.

கற்றலின் இயல்புகள்

- அனைத்து உயிர்களிடமும் காணப்பட்டாலும் மனிதனுக்கு விசேடமான தொடர்ச்சியானது (பிறப்பு முதல் இறப்பு வரை)
- கற்றலால் மனித நடத்தைச் செம்மையாகின்றது.
- கற்றல் நோக்கம் குறிக்கோளைக் கொண்டது.
- பன்முகத்தன்மை கொண்டது.
- அனுபவங்களால் விளைவது.

இவ்வாறான கற்றல் இயல்புகளைச் சுறுசுறுப்புடன் பின்பற்றும் துடிப்புள்ள பருவமாகப் பிள்ளைப்பருவம் உள்ளது. இப்பருவத்தினர் எதைப்பற்றியாவது கற்க ஆவல் மிகுந்து காணப்படுவார்கள். எனவே தான் இவர்களை உயிருள்ள கேள்விக்குறிகள் (Living

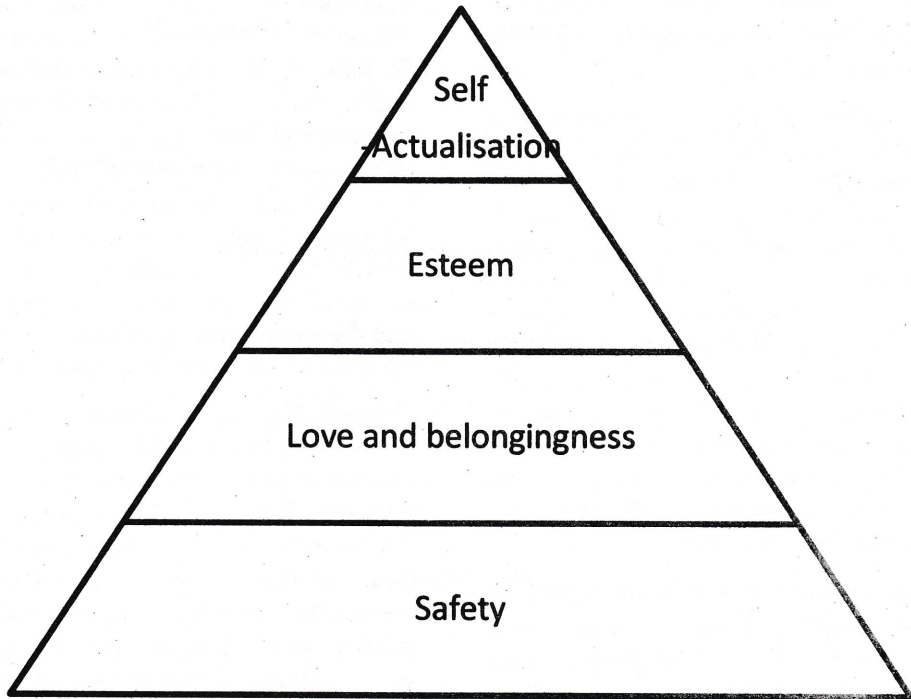
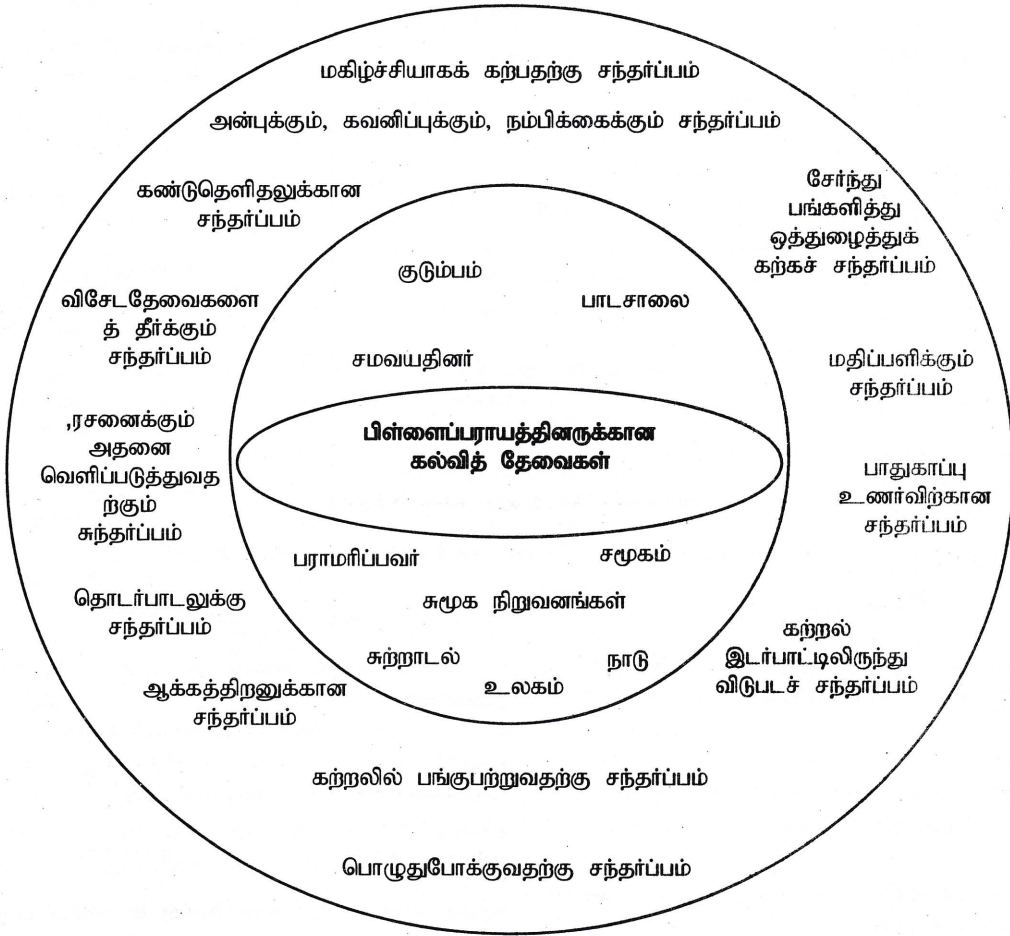
Question Marks) என கல்வி உளவியல் ஆய்வாளர்கள் தெரிவிக்கின்றனர். ஆராய்வுக்கம் மிகுந்து காணப்படும் இவர்களிடம் பலவற்றை அறியவும், கருவிகளின் துணை கொண்டு வேலை செய்யவும் ஆர்வம் காட்டுவர். செயல் மூலம் கற்கும் தேர்ச்சி கூடுதலாகக் காணப்படும். குழுவாகச் செயற்பட விரும்பும் இவர்களை கூட்டாளிக் குழுப்பருவம் (Gang Age) எனவும் விசேடமாக அழைப்பர். இவர்கள் தம் மதிப்பிற்குரிய தம்மை விட மூத்தோரிடம் வீரவணக்க மனப்பான்மையோடு (Hero worship) அவர்களைப் பின்பற்றி நடந்து கொள்வார்கள்.

பிள்ளைப்பருவத்தினரின் கற்றல் வகைகள்

புலக்காட்சிக் கற்றல் (Perceptual learning), எண்ணக்கருக் கற்றல் (Conceptual learning), பின்பற்றிக் கற்றல் (Imitational learning), உற்றுநோக்கிக் கற்றல் (Observational learning), பிரச்சினைகளைத் தீர்த்துக் கற்றல் (Problem solving), குழுவாகக் கற்றல் (Group learning), கண்டுபிடித்துக் கற்கும் முறை (Discovery learning), செயற்திட்டமுறை (Project method) போல அமைத்துக் கற்கும் முறை (Simulation), கற்பதற்குக் கற்றல் (Learning to learn) இவ்வாறான கற்றல் வகைகளைப் பொருத்தமான பாடத்துறைகளுக்கு ஏற்ப மாணவர்கள் பிரயோகித்து சிறந்த பயனைப் பெற முடியும்.

பிள்ளைப்பராய மாணவர்களின் கல்வித் தேவைகள்

1. பிள்ளைப்பராய மாணவர்களின் தனியான வேறுபாடுகளை மற்றும் விருப்பங்களுக்கான கல்வித்தேவைகள் (மனவெழுச்சி, கவர்ச்சிகள், எதிரான மனப்பாங்குகள், இரசனை, ஆக்கத்திறன், விருப்பமான பாடத்தெரிவுகள், இணைப்பாடவிதானம்)
2. பல்வேறு கல்விச் செயற்பாடுகளில் ஈடுபட உகந்த பொருளாதாரத் தேவைகள் (கற்றல் சாதனங்கள், வளங்களை வாங்க)
3. இப்பராய மாணவர்களின் கல்வித் தேவைகள், எதிர்பார்ப்புகளுக்கேற்ற குடும்ப சூழ்நிலைகள் (பிளவுபட்ட, பிரச்சினைகளுக்குரிய, பெற்றோர்கள் அற்ற, சிதைந்த நிலை)
4. இப்பராய மாணவர்களின் கல்வித் தேவைகளை முழுமையாகப் பூரணப்படுத்தும் பிள்ளைநேயப் பாடசாலை செயன்முறை
5. தமது கல்வித் தேவைகளை இனங்கண்டு ஊக்குவித்து வழிகாட்டலும், ஆலோசனையும் வழங்கக்கூடிய ஆசிரியர்களின் சேவை. கற்கும் போது ஏற்படும் பிரச்சினைகளைத் தீர்த்து ஆளுமைகளை வளர்க்கும் நண்பர்கள்- சம வயதுக்குழுவினரின் உதவிகள், சிறார் கேடுறுத்தலில்லிருந்து (Child Abuse) விடுபடும் தேவைகள்



இல	நிலை	சமூகச்செல்வாக்குகள்	பிரச்சினைகள்
01	பிறப்பு முதல் ஓராண்டு வரை	தூய்., செவிலியர்	நம்பிக்கை வைத்தல்., நம்பிக்கையின்மை
02	2ம் ஆண்டு	பேற்றோர்	சுதந்திரமாக இயங்குதல்., வெட்கப்படுதல்
03	3-5 ஆண்டுகள்	ஆதாரக்குடும்பம்	தானே முற்பட்டு செயலாற்றுதல்., குற்ற உணர்வு
04	6 முதல் பால் உறுப்புகள் முதிர்ச்சி பெறும் வரை	சுற்றுப்புறம், பள்ளி	உற்சாகமாக உழைத்தல்., தாழ்வுணர்வு
05	குமரப்பருவம் (11-18 வயது)	சமவயதுக் குழு, பிறகுழுக்கள் விரும்பும் தலைமை	தன்னைப்பற்றிய நிலையான கருத்து., தன்னைப்பற்றிய தெளிவற்ற குழப்பமான கருத்து
06	முன்முதிர் பருவம் (20-29 வயது)	நண்பர்கள், பால் தொடர்பு உறுப்பினர்கள், ஒத்துழைக்கும்., போட்டியிடும் குழுக்கள்	நெருக்கமான உறவும், ஒருமைப்பாட்டு உணர்வும்., தனிப்பட்ட நிலைமை
07	நடுமுதிர் பருவம் (30-50 வயது)	பொறுப்புக்களையும் குடும்பக் கடமைகளையும் தன்னுடன் பகிர்ந்து கொள்வோர்	தாராள மனப்பான்மை., தன்னுள் ஒடுங்கிச் செயற்படுதல்
08	பின்முதிர் பருவம் (50 வயதிற்குப் பின்)	மனித இனம்., நம் இனம்	நேர்மை., முழுமையான நம்பிக்கை இழப்பு

- குழு முறையில் கற்கக் கூடிய சந்தர்ப்பங்களும், நவீன தகவல் தொழில்நுட்ப வளங்களின் தேவைகள்
- பிள்ளைப்பராய மாணவர்களின் கல்வித் தேவைகளுக்கு உகந்த சமாதானமான யுத்தமற்ற - சமூக - பொருளாதார - சமய - பண்பாட்டுச் சூழல்
- தொடர்பு சாதனங்களின் பொருத்தமான கல்விச் சேவைகளின் தேவைகள்.
- முத்தோர்களின் சரியான விழுமிய வழிகாட்டல், பொது நிறுவனங்கள், அரசாங்கத்தின் உதவிகள், சமூக மயமாக்கல் தேவைகள்

இவ்வாறாகப் பிள்ளைப்பராய மாணவர்களின் கல்வித்தேவைகளை ஆராய்கின்ற போது அவர்களது கல்வித் தேவைகளில் பெரும்பாலானவை எமது பிரதேசத்தில் நிறைவேற்ற முடியாத சூழ்நிலைகள் உள்ளமை தெளிவாகத் தெரிகின்றது. இது சிறுவர் உரிமை மீறலாகும். எமது பிரதேச இப்பருவ மாணவர்களின் கல்வித்தேவைகள் தொடர்பாக முறையான ஆய்வொன்றை மேற்கொண்டால் அதிர்ச்சி தரும் பல உண்மைகள் வெளிவரும். எனவே இவ்விடயம் தொடர்பான கல்வி - சமூகவியல் ஆய்வுகள் எமது பல்கலைக்கழகம், தேசிய கல்விக் கல்லூரி, கல்வித் திணைக்களம், அரச சார்பற்ற நிறுவனங்கள் மேற்கொள்ள வேண்டும். ஏனெனில் எமது எதிர்காலப் பிரசைகள் இவர்களே ஆவர்.

எமது பிரதேச பிள்ளைப்பருவ மாணவர்களின் தேவைகள் முறையாக நிறைவேற்றப்படாததால் அவர்கள் மன அழுத்தங்களுக்கு உள்ளாகி மனமுறிவுக்கும், மனப் போராட்டங்களுக்கும் (Frustration and conflicts) உள்ளாகி நெறிபுரழ்வு நடத்தைகளில் ஈடுபடுகின்றார்கள். அவர்களது கற்றல் தடைப்படுகின்றது. வேலையில்லாமல் களவு கொள்ளைகளில் ஈடுபடவேண்டிய தூர்ப்பாக்கிய நிலை ஏற்பட்டுள்ளது. கட்டிளமைப்பருவத்தினர் மேலும் பல பாதிப்புகளுக்கு உள்ளாகியுள்ளார்கள். எமது

பிள்ளைகள் வாழவேண்டிய, தலை நிமிர வேண்டிய மண் இதுவாகும். அவர்களுக்கு வாழ வழி காட்டி வாழ்க்கைப்பாதையிலிருக்கும் தடைகளை அகற்றி ஏற்படுத்தும் அழகிய பாதையினூடாக எமது பிள்ளைப்பராய மாணவர்களைக் கல்வியினூடு அழைத்துச் செல்ல நாமனைவரும் ஒருங்கிணைந்து அர்ப்பண சேவையாற்ற வேண்டியுள்ளது.

கற்றல் தேவைகளை நிறைவேற்ற வேண்டிய பெற்றோர்:-

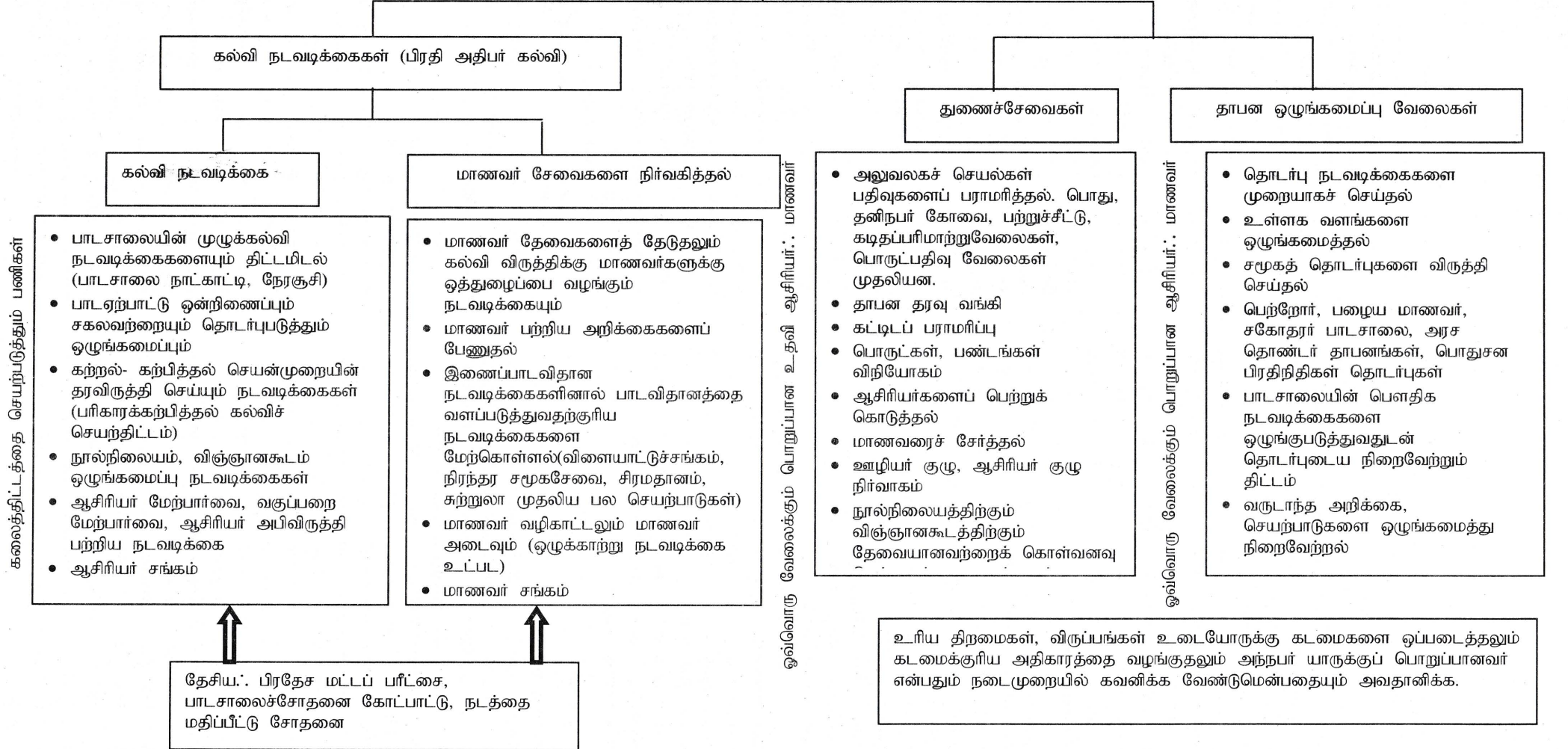
சமுதாயத்தில் குடும்ப அலகு மிகவும் முக்கிய அடிப்படை அலகாகும். பிள்ளைகளின் கற்றல் தேவைகளை நிறைவு செய்யும் பெற்றோரின் பங்குகளை பெற்றோரியம் (Parenting) என்று தற்போது அழைக்கப்படுகின்ற துறையாக வளர்ந்துள்ளது. இது பிள்ளைகளின் உளவியலோடும், நலவியலோடும் தொடர்புடையது. பிள்ளைகளின் வளர்ப்பு மற்றும் கல்வி தொடர்பாக எமது சமூகத்தில் நாம் பாரம்பரியமாகக் கடைப்பிடித்து வருகின்ற நடைமுறைகளையும், பண்பாட்டுக்கோலங்களையும், அணுகுமுறைகளையும் மறுபரிசீலனை செய்ய வேண்டிய நிலை இன்றைய காலத்தின் தேவையாக எழுந்துள்ளது.

பிள்ளைகளின் கல்வித்தேவைகள் எவை, நலன்கள் எவை எனத்தீர்மானிப்பதில் எமது பார்வைக்கோணமும், அபிலாசைகளும், கனவுகளுக்கும் முக்கிய இடம் கொடுக்கின்றோம். இவ்விடயங்கள் தொடர்பாகப் பிள்ளைகளுடனான தொடர்புகள், உறவுகள், இடைவினைகள், ஒத்த உணர்வுகள் (Empathy) என்பவற்றில் எதுவித அக்கறைகளையும் காட்டாத சூழ்நிலைகளே பெரிதும் பெரும்பாலும் நிலவுகின்றன. இதை நீக்கி பெற்றோர்கள் பிள்ளைகள் வீட்டில் கற்கக்கூடிய சூழ்நிலைகளைகளை ஏற்படுத்திக் கொடுக்க வேண்டும். பிள்ளைகளுடைய கல்வித்தேவைகளைப்பொறுத்தவரை அவர்களுடைய உரிமைகள், சிந்தனைகள் பற்றிய புரிதல்களும், மாற்றங்களும் இன்று ஏற்பட்டு வருகின்றன.

மாணவர் தேவை நிறைவேற்றும் பாடசாலை ஒழுங்கமைப்பு முறை

அதிபர்

பாடசாலை நடவடிக்கைகளை ஒழுங்குபடுத்துதல், கடமைகளை ஒப்படைத்தலும் சகல செயற்பாடுகளை மேற்பார்வை செய்தலும்



கடந்த இருபது ஆண்டுகளாக எமது பிள்ளைகளின் நிலை மிக மோசமான பாதிப்புகளுக்கு உள்ளாகிவிட்டது. இதன் தாக்கங்கள் பல சந்ததிகளுக்கு நீடிக்கலாம். போரும், வன்முறையும், பயங்கரங்களும், வறுமையும் பிள்ளைகளைப் பெரிதும் பாதித்துள்ளன. இவற்றின் தாக்கங்களால் பெற்றோர்- பிள்ளை உறவும் திருப்தியாக இல்லை. மேலும் பிளவுபட்ட குடும்பங்கள், மதுபாவனை, பாலியல் பிரச்சினைகள், சிறுவர் துஸ்பிரயோகம், குற்றச்செயல்களில் ஈடுபடும் பெற்றோர்களின் நடவடிக்கைகளால் பிள்ளைகளின் கல்வித்தேவைகள் பல சந்தர்ப்பங்களில் நிராகரிக்கப்படுகின்றன. இந்நிலையில் இருந்து ஐக்கிய நாடுகள் ஸ்தாபனத்தின் சிறுவர்-பிள்ளைகள் உரிமைச் சாசனத்தில் (UN Convention on the Right of Child) குறிப்பிட்டுள்ளவற்றை நோக்கவேண்டியுள்ளது.

- சிறுவர்களின் உள்- கல்வித் தேவைகள் பூரணமடைய முதலில் அவர்கள் அன்பும் ஆதரவும் தமக்குக் கிடைப்பதாக உணர்தல். பலம் வாய்ந்த ஒற்றுமையான குடும்பத்திலிருந்து கிடைக்கும் பாதுகாப்பு.
- நாளுக்கு நாள் மாறாத நிலையான சூழலில் வாழ்தல் (போர், இடப்பெயர்வு, இயற்கை அனர்த்தங்கள், வன்முறைகள்)
- உடலியல் தேவைகளான உணவு, நீர், சுத்தமான சுற்றாடல், மருத்துவம்.
- ஒரு சாதாரண சூழலில் கிடைக்கக்கூடிய வாழ்வின் அனுபவங்களைப் பெறக்கூடிய சந்தர்ப்பங்கள். (உதாரணமாக அவர்களுக்கு பார்த்து பின்பற்றுவதற்கு நல்ல மாதிரிகள் தேவைப்படுகின்றன.)
- கல்வித்தேவைகள் பெறக்கூடிய வசதிகள், கற்றல் மூலமாகத் தமது எதிர்காலம் பற்றிய நல்ல நம்பிக்கையைப் பெறல்.

பாடசாலைக்கல்வி:-

பிள்ளைப்பராயத்தினருக்கான கல்வித்தேவைகளை நிறைவேற்றும் முக்கிய அலகாகப்பாடசாலை உள்ளது. பாடசாலை மட்டக்கல்வி அபிவிருத்தி பாடசாலையிலுள்ள அதிபர், ஆசிரியர், மாணவர், பெற்றோர், முகாமைத்துவக்குழுவினரது ஒருங்கிணைந்த செயலாக்கம், சுறுசுறுப்பு, புரிந்துணர்வினாடாகவே முகிழ்கின்றது. மேற்குறிப்பிட்ட அனைவரும் ஒரே சமூகமாகி தொடர்ச்சியான முன்னேற்றத்திற்கு இட்டுச்செல்லும் ஓர் இடமே கற்கும் பாடசாலையாகும். இது மாணவர்களின் கற்றல் தேவைகளை நிறைவேற்றும் ஒரு சமூகமாகும். அட்டவணை 1ல் குறிப்பிட்டவாறு பிள்ளைகளின் தேவைகளை நிறைவேற்றும் பாடசாலை அமைப்பு முறைமையை ஒழுங்காக ஏற்படுத்த வேண்டியுள்ளது. ஏனெனில் எமது பெரும்பாலான பாடசாலைகள் மாணவர்களின் கல்வித்தேவைகளை முழுமையாக வழங்க முடியாத நிலையிலேயே உள்ளமையைப் பல ஆய்வுகள் எடுத்துக்காட்டுகின்றன. இவ்வகையில் ஆரம்பக்கல்விப் பாடசாலைகளையாவது மாணவர்களின் தேவைகளைப் பூர்த்தி செய்யும் பிள்ளை நேயப்பாடசாலைகளாக (Child Friendly School) மாற்றியமைக்கும் செயற்றிட்டத்தை இலங்கையில் UNICEF அமைப்பு ஆரம்பித்துள்ளது. இதன் நோக்கங்களாக,

1. சிறுவர் உரிமைகளைப் பாதுகாத்தல், கவர்ச்சிகரமான கற்றற் சூழல்
2. மாணவர் கல்வித்தேவைகளை நிறைவேற்றுதல், உள்- உடல் தேவைகளைப் பூர்த்தி செய்தல்
3. ஆசிரியர்- மாணவர் இடைத்தொடர்பை உயிர்ப்பித்தல்
4. பாடசாலை அதிபர், ஆசிரியர், மாணவர், பெற்றோர், நலன்விரும்பிகள், சமூகத்தவருக்கிடையேயான தொடர்புகளை விருத்தி செய்தல்.
5. பாதுகாப்பான சூழ்நிலையை வழங்குதல்.

எமது பிரதேசத்திலும் இலங்கையில் பெரும்பாலான பாடசாலைகளிலும் மேற்குறிப்பிட்ட நிலையை அடைய பல கட்டங்களைத் தாண்ட வேண்டியுள்ளது. பல விழிப்புணர்வு- நடத்தை மாற்றச் செயற்பாடுகளை மேற்கொள்ள வேண்டியும் உள்ளது. குடும்பம், பாடசாலை, சமூகம், நாடு என்ற வகையில் பிள்ளைகளின் கல்வித் தேவைகளைச் சரியாகப்பூரிந்து கொண்டு செயற்படுகின்ற பல்வேறு திறமுறைகளை உளவியல்- சமூகவியல் ரீதியாக மேம்படுத்த வேண்டியுள்ளது. பிள்ளைகளைக்கேடுறுத்தல் (Child Abuse) அல்லது துஸ்பிரயோகம் செய்தல் தற்போது பல்வேறு வகையில் அதிகரித்து வருகின்றது. உலகிலேயே மூன்றாவது இடத்தில் இவ்விடயமாக உள்ளதாக ருஜேஊருகு அறிவித்துள்ளது.

சிறார்களை உடல் சார்ந்த கேடுறுத்தல், உளம், மனவெழுச்சி சார்ந்த கேடுறுத்தல், சத்துணவு புறக்கணிப்பு, பாலியல் சார்ந்த கேடுறுத்தல், போதைப்பொருள் பாவனை, கடத்தல், கல்வித்தேவை நிராகரிப்பு, தொழில்களில் ஈடுபடுத்தல், வன்முறை, களவு நடவடிக்கைகளில் ஈடுபடுத்தல்களால் அவர்களுடைய உளவியல் கல்வித்தேவைகள் புறக்கணிக்கப்படுகின்றன. இவற்றிற்குத் தீர்வுகளைக்காண

- ஒன்றிணைந்த தேசிய ரீதியான நடவடிக்கைகளை மேற்கொள்ளல்
- பிள்ளைப்பராயத்தினருக்கான கல்வித்தேவைகள் தொடர்பான விழிப்புணர்வுச்செயற்திட்டங்களை முன்னெடுத்தல்
- குடும்பச்சூழலில் நெருக்குவாரங்களைத் தடுக்க குடும்ப- அயற்புற சமூகசேவைத்திட்டங்களை நடைமுறைப்படுத்தல்.
- வறுமையை ஒழித்தலும் குடும்பத்திட்டமிடல் ஆற்றுப்படுத்தல் சீர்மிய நடவடிக்கைகளை முனைப்பாக்கல்
- பாடசாலை மற்றும் சமூக ரீதியாகப் பிள்ளைகளின் உளவியல், கல்வியியல் தேவைகளை இனம் கண்டு அவர்களின் உணர்வுகளை வெளிக்காட்டக்கூடிய புரிந்துணர்வு செயற்பாடுகளை மேற்கொள்ளல்.

இவ்வாறாக உளவியல் ரீதியாகவும் சமூகவியல் ரீதியாகவும் பிள்ளைகளில் கல்வித்தேவைகளை சரியாக இனங்கண்டு அவர்களை கல்விமயமாகுதல் (Educationalisation) செயன்முறைகளில் எதிர்கால மனிதப்பெருமான்பை பொலிவுடன் மலரச்செய்தல் (Blossoming Human Excellency) என்ற கல்வியியலின் உயர்நோக்கியல் செயற்பாடுகளுக்கு உயிர்கொடுக்கும் அடிப்படைகள் பிள்ளைகளின் உடலியல், உளவியல், கல்வித்தேவைகளைப்பூர்த்தியாக்குகின்ற போதே சாத்தியமாகும். இதற்கான பல செயன்முறைகளை நாம் முன்னெடுக்க வேண்டியுள்ளது.

The Necessity for Herbal Treatment

P. Romaheswaran

Former Provincial Director of Ayurveda

The Chairperson Professor Vasanthi Arasaratnam, the Learned Dignitaries, Ladies and Gentlemen, on the outset let me thank the organisers of this meeting the Jaffna Science Association for providing me this rare opportunity to speak to you. This morning I feel I have very appropriately chosen a fruitful subject "THE NECESSITY FOR HERBAL TREATMENT".

In the 19th century Scotland a young mother observed her 3 year old son's inquisitive nature. It seemed he was curious about everything that moved or made a noise. James clerk Maxwell would carry his boyhood wonder with him into a remarkable career in science. He went on to do a groundbreaking work in electricity & magnetism. Years later, Albert Einstein would say of Maxwell's work that it was the most fruitful that Physics has experienced since the time of Newton.

All these years all the Scientific inventions have taken place through the dedicated application of the people involving themselves inwardly. Some people have involved themselves outwardly probing into the nature and thus succeeded in unravelling the mysteries of nature.

We have travelled a very long way from the days when nature filed the primitive mind of man with fear and terror. We have probed deep in to the mysteries of physical nature and harnessed its farces for our material comforts. We feel that we have conquered nature; through now and then we are reminded that we are still far from being its masters. The primitive man had however to use and even fight the element of nature in the struggle for existence and bow down to the forces over which he had not learnt to exercise any control. The human mind had not yet turned inwards but had to remain occupied with the appeasement and propitiation of external forces.

Well Ladies & Gentlemen, the plants or the flora is the greatest gift of God to mankind. Without plants nothing can exist in their world. The classifications of plants are many. Generally the plants are classified under three categories: herbs, shrubs and trees. Herbs are very small and annuals, shrubs are little big and biennials, but the trees are tall and perennials. The usages of plants are many and multi-folded.

Here I am going to deal with the subject "The Necessity for Herbal Treatment". So firstly, let me provide you with a proper definition for herb.

Usually all the plants are useful to man in many ways. But here when I say Herb, I do not mean the small trailing plants only. All the plants which have curative medicinal properties for diseases are generally termed Herbs. It can be herbs, shrubs, trees, climber, twiners, lians, epiphytes, parasites, halophytes, hydrophytes, xerophytes and it can also mean the usage of any part of the plants such as roots, stems, barks, leaves, buds, calyx, petals, stamens, seeds, fruits, nuts, gums, latex, etc. Or the whole plant itself. So any plant which is of medicinal value is termed as herb.

Our ancestors were completely dependent on nature for everything as I have pointed to you early. They obeyed the laws of nature and as such they were able to lead a peaceful life. Then they did not have curiosity to unravel the mysteries of nature. They were really contented with what they were possessing.

In the system of indigenous medicine the total number of diseases is limited to 4,448. They say there are 4,448 typical diseases and there are 4,448 typical Herbs to cure each disease. But all these valuable knowledge of Herbal treatments are extinct at present.

Evolution has affected the plant kingdom, the animal kingdom and the mineral kingdom as well. The man is also subject to evolution. His habit, habitat, and his illness also have undergone changes due to evolution.

For the modern evolved disease we prepare a medicine using the evolved herbs, shrubs, salts, animal product and minerals. When such medicine is prescribed to a patient he is cured fully rewarding success to our treatment.

This itself is a positive proof that herbal treatment is not only wholistic but also holistic. It is not subject to mutation. It is not affected by time space and causation. Thus the herbal treatment stands as a positive proof for its perfectness. When any domestic animal falls sick it begins to fast till it completely recovers from its illness. So it follows a medical maxim that fasting is the perfect medicine itself. “லங்கணம் பரம ஓளவுதம்”

Herbs are used in plenty by the indigenous medical practitioners in all their medicinal preparations. Medicine as everyone knows is not merely a science but an art as well. It consists of not merely compounding mixtures, preparing decoctions, oils, pills, plasters and drugs of all kinds: but it also deals with the different processes of life. The practice of medicine spoken of here deals not merely with the external body of man, but also with the inner man or the soul. The art of medicine is based on Truth and as such it is a Divine art not to be prostituted for base purposes for money. The employment of strong wills, benevolence, charity, patience etc are the important cornerstones in the practice of medicine. It is therefore a holy science and the practice of medicine and the curing of diseases are a sacred mission and as such cannot be understood by those who are undeveloped in their minds or who have made no study of the deeper causes and aims of life. There are countless remedies in nature which are marginalia die, i.e., the mysteries of curing and healing hidden from the

eyes, but open to the spiritual perception of the wife.

A medicine that will do good at one time will be useless at another according to the prevailing influence of plants and their forces; and therefore a system of medicine without the true knowledge and understanding of natural laws is likely to do more harm than good. Medical science may be mastered by learning, but medical wisdom be gained only by knowledge of nature or of the soul. Medical science in India as practiced by our ancestors has been purely associated with religion and philosophy and as such is evidently based on Truth.

A system of medicine without understanding and without a true knowledge of natural laws will therefore remain forever as a system of mere opinions superstitions and of passive observation and inactivity; and this is the fate of Indigenous systems of medicine in Sri Lanka.

Some may perhaps criticise this on the ground that these views are similar to those held by the Medical School of Dogmatic in the time of Hippocrates, that such knowledge is quite unnecessary because it is unavailable and impracticable and that the simple human experience should be the only guide to practice.

But the fact remains that unless these systems are thoroughly overhauled through appropriate literary research coupled with clinical and therapeutic researches our physicians will seldom cure a serious or chronic ailment.

The three systems that are adopted in practice here in Sri Lanka using herbs for treatment along with ingredients collected from various animal sources, minerals and metals are Ayurveda, Unani and Siddha; all of which are based on humoral pathology - or in other words on the same physiological doctrine that air, bile and phlegm are the three support of the body. They all advocate that without these three humours the individual could not exist and if they get deranged diseases or death will be the result.

Ayurveda is reckoned as a portion of the fourth Veda or the *Atharvana* as has been considered the oldest work in Hindu Medicine. Although this is claimed by the Aryans as theirs, neither its author nor the age is known and only fragments of it have come down to us embodied in certain commentaries of subsequent writers. The modern Hindus ascribe its authorship to their gods, Some to Brahma and others to Lord Shiva; but in their philosophical writings they are all attributed only to Siva; who in this aspect is known as (*vaidheesvara*) God of medicine.

It is not clear how the human race got access to it, as many and various are the legends current about it. It is said that in *kali-yuga*, the world became reprobate and the corruption of the human race was such as to necessitate a great curtailment of life and to leave the people embittered by numerous ailments. This legend is supposed to indicate the epoch of Ayurveda as inter mediate between the vedic and the Brahminical times which is about the 9th or the 10th century B.C. In the systems of Ayurveda the works of *Charaka* *Shusruta* on medicine and surgery respectively are regarded as a great authority.

The Arabians had cultivated the Science and Art of medicine at a very early period; but very little information is known regarding any of their physicians of repute. The Arabic writers of the 7th & 8th century A.D. were mostly natives of Syria who visited India on many occasions and took away with them many Hindu works which they got translated into Arabic and Persian languages. They were allowed borrowers of science and were also in the habit of looking forward to the increase of their stock of knowledge by translating into their own language some of the Medico-Theological compositions of the Indian Physicians. Professor Wilson is of the opinion that they followed the Hindu works on medicine more closely than the early Greeks and that is the Unani systems of medicine that is in existence at present.

The word Siddha comes from the word "siddhi" which means an object to be attained or perfections or Heavenly Bliss. Siddha, generally refers to Astama Siddhis, i.e., the right great supernatural powers Lahima etc. Those who attained or achieved the above said are known as *Siddhars* – Seers.

Siddhis are also construed powers which are attained by birth according to previous *karma*, by chemical means or power of words or by mortification or through concentration. Concentration on the element beginning with the gross ending with the simple forms enable to get mastery over the elements and this was practised by a sect of Buddhists who concentrated on a lump of clay with a view to see its fine ethereal particles.

In Dawson's classical Dictionary of Hindu mythology. They are described as belonging to a class of some divine beings of great parity and Holiness dwelling in the regions of the sky or between the sky and earth.

In Ayurveda such classes of performers were called *Rasayanans* on account of their ability, proficiency in the knowledge of Alchemy and rejuvenation. These Siddhars belong to a school of great knowledge which originally consisted of eighteen members known as *Moola varga siddhars*.

Plants have formed the basis of sophisticated traditional systems that have been in existence for thousand years. The first record, written on hundreds of clay tablets in cuneiform are from Mesopotamia and date about 2,600 B.C; amongst 1,000 plant derivatives which they were using were oils of cedars species (*cedar*) *Cupressus sempervirens* (Cypress), *Glycyrrhiza glabra* (licorice), *Commiphora* species (myrrh) and *Papaver somniferum* (Poppy juice). All of which are still in use today for treatment plants like *Achyranthus aspera* (நாயுருவி), *Aerva lanata* (சிறுபிளை) *Alternanthera sessilis* (பொன்னாங்காணி), *Amaranthus spinosa* (முள்ளுக்கீரை), *Amaranthus viridis* (அறுக்கீரை), *Hemidesmus indicus* (நன்னாரி), *Raphanus sativus*

(முள்ளங்கி) *Coccinia indica* (கொவ்வை) *Cucumis utilissima* (கெக்கரி) *Benincasa hispida* (நீற்றுப்பூசினி), *Lagenaria siceraria* (சுரைக்காய்), *Phyllanthus niruri* (கீழ்காய் நெல்லி), *Tribulus terrestris* (நெருஞ்சில்) are all used as diuretics preventing people from diseases affecting kidney.

In older days the traditional physicians widely used *Croton tiglium* (நேர்வாளம்) seeds in the preparations of *vatha pethy* commonly administered to patients as strong purgative twice a year one dose in mid January and the other in mid July to expel the collected Rheum from the descending colon which is understood as the cause for so many rheumatic ailments in the life of a person.

People used commonly the ripe old leaves of *Atrocarpus intergrifolia* (பலாப்பழுத்தல் இலை) as spoons to drink hot porridges thus controlling the blood sugar in their systems in the past.

For diabetes plants like *Cassia auriculata* (ஆவரசுப் பஞ்சாங்கம்), *Tinospora cordifolia* (அமுது சர்க்கரை சீந்தில் மா), *Solacia reticulata* (கடலிருஞ்சிப்பட்டை) are being used as successful herbal treatments especially for juvenile cases of diabetes.

The seeds of *Dolichos biflorus* (கெள்ளு) along with garlic if boiled and the boiled water is taken for 40 days continuously guarantees as a sure remedy for obesity.

Leishmaniasis: An Emerging Vector-Borne Disease in Sri Lanka

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Introduction

Leishmaniasis is a vector-borne disease known for centuries and is caused by a protozoan parasite called *Leishmania*. The disease is primarily zoonotic and responsible for nearly 1.5-2 million new infections annually with estimated 12 million people currently infected worldwide (<http://www.who.int/leishmaniasis/burden>).

The disease occurs mainly in 3 forms viz. cutaneous leishmaniasis (CL), visceral leishmaniasis (VL) and mucocutaneous leishmaniasis. The CL form is mainly associated with *L. tropica* and *L. major* (associated with animals) and the VL is generally caused by *L. donovani*. The causative agents are carried by tiny insects called sand flies and the disease is transmitted through the bites of female sand flies while taking blood meal.

The old world sand flies are called *Phlebotomine* and the new world are *Lutzomyia* species. The vectors are mainly confined to forested areas, shrub jungles, stones and caves. They feed on humans in the night and early morning. They hardly fly and hop around about 3 feet above ground level covering a distance of 450m. They undergo development through immature forms and takes more than 5 weeks to complete their life cycle.

Leishmaniasis in Sri Lanka

Despite the endemicity of VL in India, predominantly due to *L. donovani*, Sri Lanka has until recently remained free of any form of leishmaniasis, excepting cases in workers returning from overseas (Naotunne et al. 1990). The first autochthonous case of cutaneous leishmaniasis was reported in 1992 (Athukorale et al. 1992); a decade later, 65 cases, mainly from Northeast and North central provinces, were

documented by Siriwardena et al. (2003). Now the disease is wide spread and infected patients are reported from Jaffna, Vanni, Amparai, Mahiyangana, and Ambalantota. However, recently the first case of VL, based on liver biopsies of a female, reported from North Central Province (Abeygunasekara et al. 2007). The causal agent in CL patients was identified as *Leishmania donovani* zymodeme MON-37 (Karunaweera et al. 2003) which is typically associated with VL (kala-azar) in India.

Phlebotomus argentipes is the established vector of *L. donovani* in India (Illanko et al. 1994). The absence of Leishmaniasis in Sri Lanka was associated with the presence of zoophagic *P. argentipes*. However, presence of zoophagic and anthropophagic nature of *P. argentipes* in Sri Lanka was reported in 1990 (Lane et al. 1990; Lewis, 1978)

With the increasing incidence of cutaneous leishmaniasis in Sri Lanka, particularly in northern province, insecticide-mediated vector control will be under consideration. Optimising such a strategy requires the characterisation of sand fly populations in target areas with regard to species composition, vectorial status and extent of resistance, among other parameters.

Studies from northern Sri Lanka

Delft Island lies in the Palk strait 37 km from the coast of Tamil Nadu state in India where kala-azar (VL) is endemic. There was a request from the health officers in Delft to the Jaffna Health Services to take necessary action to control severe insect biting nuisance in early 2004. In mid May 2004 flies were collected in Delft using human landing catches (HLC) and cattle baited traps (CBT). Later the collected flies were identified as sandflies with *P. argentipes* as the predominant species (Surendran et al. 2005 a). In 2005, among

the 7 suspected cases (referred to Medical Faculty, University of Jaffna) 3 were identified positive for CL (unpublished data). All the diagnosed cases had prior exposure to Wanni main land.

These developments prompted the health authorities in Jaffna to carry out a single indoor residual spray (IRS) for Delft in June 2005. In this context several studies were carried out to study the bionomics of *P. argentipes* population and the public perception of sandflies and knowledge of leishmaniasis transmission.

Bionomics of *P. argentipes*

P. argentipes shows geographic variation in several morphological characteristics. The best-described of these is a difference in the length of the *sensilla chaetica* (Illanko 2000). The length of the *s. chaetica* appears to correlate with the VL distribution; sandflies from VL-endemic areas in India have short *s. chaetica* whereas sand flies from non-endemic areas have longer *s. chaetica*. Sympatric populations have also been recorded in India (Illanko et al. 1994; Illanko, 2000). As a result of these and other studies (e.g. variation in cuticular hydrocarbons) it has been suggested that *P. argentipes* exists as a species complex, with two morphological species of different vectorial capacity. The species which have shorter *s. chaetica* are referred as morpho species B and those with longer as morphospecies A (Illanko, 2000).

The analysis of *P. argentipes* population from Delft island revealed the presence of morphospecies B. As morphospecies B adults were collected using CBT and HLC techniques it suggests that morphospecies B is at least partially anthropophagy, supporting a link with leishmaniasis transmission (Surendran et al. 2005a)).

Molecular characterization

Perfect identification of vector is crucial in vector control programme. The sandfly identification is laborious as it is mainly confined to microscopic analysis. A molecular based technique is preferred

for its reliability and easy applicability. An attempt was made to develop a molecular based identification technique for *P. argentipes*. A simple 18S PCR-RFLP method was developed to distinguish *P. argentipes* population of Sri Lanka (Surendran et al. 2005b)

Insecticide resistance

Even though the IRS with lambdacyhalothrin carried out in 2005 proved to be effective (Surendran et al. 2007) studies were carried out to establish the current insecticide susceptibility status of sand flies from Delft Island. Surendran et al (2005b) analysed the activities of 4 enzyme systems involved in insecticide resistance (acetylcholinesterase, non-specific carboxylesterases, glutathione-S-transferases and cytochrome p450 monooxygenases), adapting procedures established for use with mosquitoes. There was preliminary evidence for elevated esterases and altered acetylcholinesterase in this population, which probably arose from the malathion based spraying regimes of the Anti-Malaria Campaign (Surendran et al. 2005b).

Public awareness

A structured questionnaire-based study was carried out among the residents of Delft to assess their perception of sandflies and knowledge of leishmaniasis transmission and also to determine factors that influence sandfly biting frequencies (Surendran et al. 2007b). No studies have been reported so far to assess local knowledge on CL and personal protective measures against sandfly bite by residents in areas of the country where CL can be transmitted. While most respondents perceived sandflies as a biting menace they did not suspect them as potential vectors of disease on Delft.

There was no awareness of leishmaniasis itself, and this ignorance is likely to be widespread in the Northeastern province. If sandflies are not recognized as important in the transmission of leishmaniasis, the villagers will not take sufficiently stringent measures to protect themselves against their bites. Although no cases

of CL have been reported from permanent Delft island residents, there is a serious risk of infecting the vector population on Delft Island with *L. donovani* arriving from mainland Sri Lanka.

Implications of Delft Studies

The potential for infection of the vector population on Delft Island with *L. donovani* arriving from mainland is thus relatively high. The way of life of the people and the environment in Delft are conducive for propagation and breeding of sandflies. The high humid and dry grey loam soil (suitable for extensive growth of pasture grass) with forests cover favours, in addition to the life style of the inhabitants, the high prevalence of *P. argentipes* on Delft. Sand fly populations present in forests (soil at base of trees, roots of large trees, caves) can spread to adjacent domestic dwelling made of mud floors and walls (Feliciangeli, 2004).

Although no cases of leishmaniasis have been reported from permanent Delft Island residents, the potential for infection of the vector population on Delft Island with *L. donovani* arriving from mainland Sri Lanka and Tamil Nadu is relatively high. The disease may also not be diagnosed among the residents since the medical community in Sri Lanka has become aware of local occurrence of the disease only recently. *Leishmania* species primarily infect animals and only secondarily human. The animals such as rodents and carnivores are considered as reservoir hosts of *Leishmania* parasites (Bray, 1974). The potential reservoirs such as dogs (as domestic animal) and squirrels (rodents) are present in Delft.

The unique lifestyle of the people also provides suitable environment for the propagation of sand fly populations in the island. Sand fly populations are said to be present in forest areas (soil at base of trees, roots of large trees, caves etc.) with adjacent domestic dwelling made up of mud floors and walls (Alexander and Maroli, 2003). Considerable proportion of the land cover in Delft island is of small forests. Many houses in the island are with mud floor and parapet wall, which is constructed using only coral stones. In addition,

the inhabitants of the island used to sleep in the open verandah of their houses. This provides a greater opportunity for them to expose themselves to sand fly bite. Medical facilities on the island are scanty. Sand flies are recognized as a biting nuisance, but not as disease vectors, and there is little, if any, awareness of leishmaniasis itself.

Given the many different combinations of vector, parasite, reservoir, ecological conditions, epidemiology and cultural practices that contribute to the transmission of leishmaniasis control measures should be carefully formulated. Community participation and education is required in addition to any control measures against leishmaniasis.

Conclusion

Leishmaniasis is emerging as an important vector-borne disease in Sri Lanka

Presence of both forms CL and VL has been reported. *P. argentipes*, the vector of *L. donovani*, is widely distributed in Sri Lanka with the presence of the vector morphospecies B. Studies from northern Sri Lanka reveal that the inadequate awareness among public is a major concern for disease control. Health authorities should be alerted of the emerging threat and to introduce a control programme with active participation of the public.

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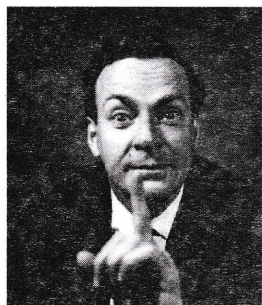
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Nanotechnology and its applications

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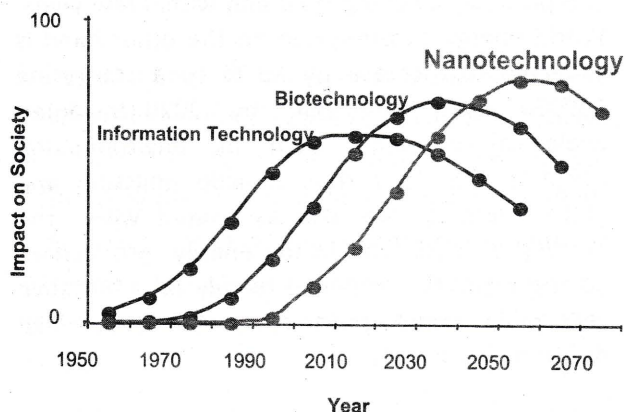
History



'There's plenty of room at the bottom'

Prof. Richard Feynman

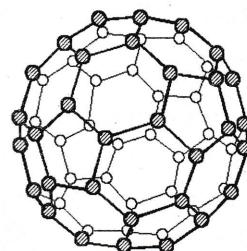
Nanotechnology first gained recognition after a Physicist and Nobel Laureate, Richard Feynman, presented his talk, "There's Plenty of Room at the Bottom" to the American Physical Society in 1959. In his talk, he predicted that enormous number of technical applications could be found by manipulating and controlling things on a tiny scale.



Although Feynman's prediction of the future of the nanotechnology came about fifty years ago, slow growth of this technology continued for more than three decades. The impact of Nanotechnology on the society really began to accelerate only very recently, whereas the other



Prof. Richard Smalley C60



leading technologies such as information and biotechnologies attained faster initial growth rate. In the last two decades over a dozen Nobel prizes have been awarded in nanotechnology. One of the major milestone was when Rice University Professor Richard Smalley won the 1996 Nobel Prize for discovering a new form of carbon: a molecule of sixty carbon atoms (referred to as C60) in 1985. Today C60 has become one of a growing number of building blocks for a new class of nanosized materials.

What is Nanotechnology?

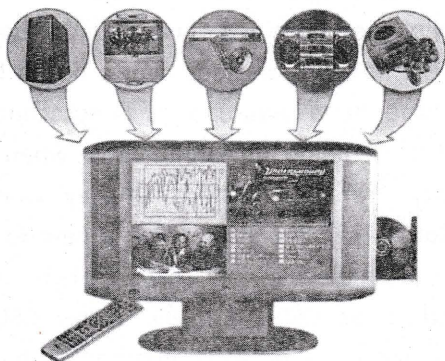
Nanotechnology is a highly multidisciplinary field and often has different meanings to people from different groups. In fact, it is fabrication technology in which objects are designed and built by the specification and placement of individual atoms or molecules or where at least one dimension is on a scale of nanometers ($\text{nm}=10^{-9} \text{ m}$). The essence of nanotechnology is the ability to work at the molecular level, atom by atom, or molecule by molecule, to create large structures with fundamentally new molecular organization. Nanotechnology is concerned with materials and systems whose structures and components exhibit novel and significantly

improved physical, chemical, and biological properties, phenomena, and processes because of their nanoscaled size.

Nanotechnology should let us make almost every manufactured product **faster, lighter, stronger, smarter, safer and cleaner.**

1. Electronic Applications: Computers of the future will use Atoms Instead of Chips for Memory

Computer chips are being made using lithography. If the computer hardware revolution is to continue at its current pace, in a decade or so we will have to move beyond lithography to some new post lithographic manufacturing technology. Ultimately, each logic element will be made from just a few atoms.

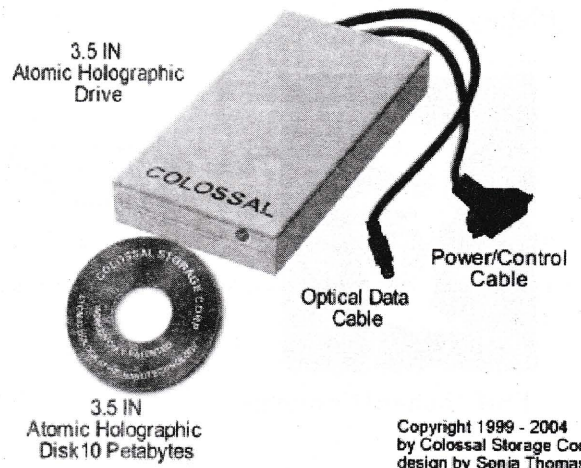


Convergence of IT, audio, video and graphics

Designs for computer gates with less than 1,000 atoms have already been proposed but each atom in such a small device has to be in exactly the right place. To economically build and interconnect trillions upon trillions of such small and precise devices in a complex three dimensional pattern will need a manufacturing technology well beyond today's lithography: we will need nanotechnology. With it, we should be able to build mass storage devices that can store more than a **hundred billion billion bytes in a volume the size of a sugar cube**; RAM that can store a mere billion billion bytes in such a volume; and massively parallel computers of the same size that can deliver a billion billion (10^{18}) instructions per

second. Nanotechnology may pave the way to have a device which incorporates several applications.

Nanotechnology will also bring 100 Terabyte (10^5 Giga Byte) 3.5-inch digital data storage disks soon.



Copyright 1999 - 2004
by Colossal Storage Corp.
design by Sonja Thomas

100 Terabyte 3½" Digital Data Storage Disk

2. Energy applications

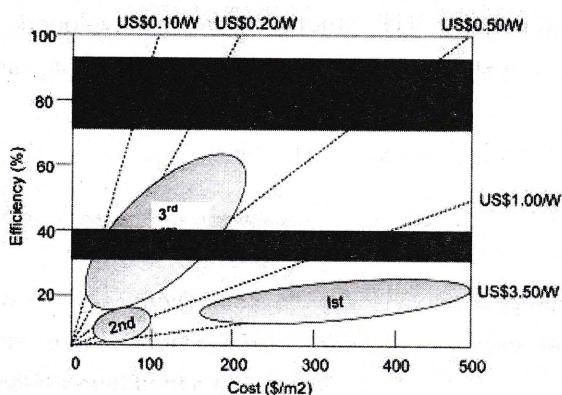
The energy crisis has nowadays become one of the most highlighted issues that threaten the world. The traditional fossil fuel used for the production of energy is declined at a terrific rate and probably awaiting their end within few years. World energy consumption on the other hand is expected to increase by 50 % to a staggering 180000 GWh per year by 2020. Unwanted ecological problems such as environmental pollution due to carbon dioxide emission and global warming are also associated with the burning of fossil fuels in the energy production. So the world is compelled to rely on alternative renewable energies to cover the substantial deficit by fossil fuels.

Nanotechnology has significant influence on several energy sources / storage devices such as fuel cells, batteries and solar cells.

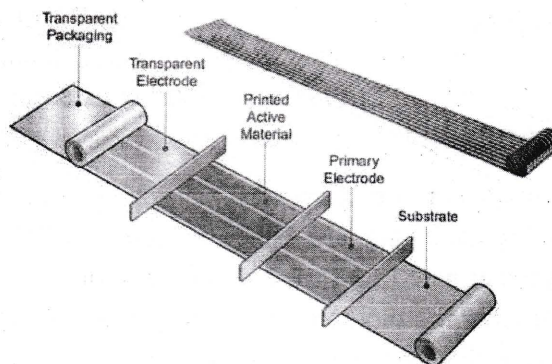
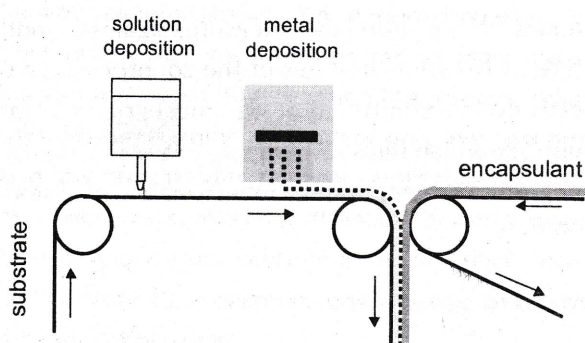
2.1 Solar Cells

Solar power is considered one of the better renewable energy platforms. Enough sunlight hits our region each day to meet our energy needs for

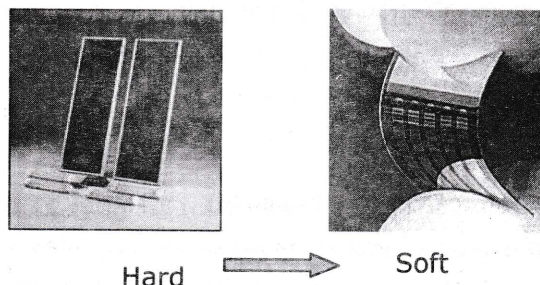
an entire year. On top of this, solar energy is a free power source, since nobody can corner the market on the sun.



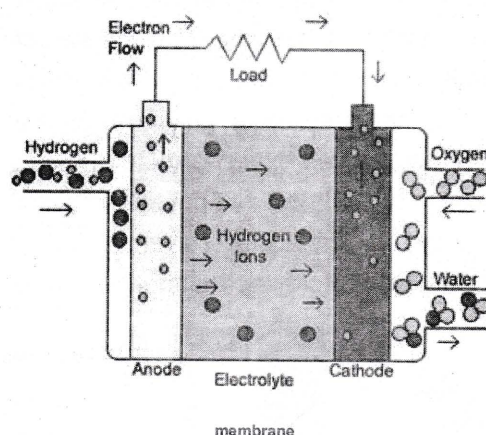
Several universities and companies have developed **nanotech solar cells** that can be manufactured at significantly lower cost than conventional solar cells. Nanotechnology will cut costs both of the solar cells and the equipment needed to deploy them, making solar power economical. The future generation solar cells that employ nanomaterials and nanotechnology for their production will be expected at least more than an order cost efficient than the present solar cells. Nanotechnology offers not only low cost but also low weight, low material requirements, ease of manufacture, mechanical flexibility and a large field of application. Fabrication of nanotech solar cell on large scale becomes possible due to roll to roll fabrication route.



In principle, nanotechnology can also be produced in several colours and even be transparent in the visible enabling semi-transparent windows, roof lighting or automobile sunroofs that generate electricity from solar light.



2.2 Fuel Cell



A fuel cell is an electrochemical conversion device. It produces electricity from fuel (on the anode side) and an oxidant (on the cathode side), which react in the presence of an electrolyte. Nanotechnology is being used to reduce the cost of **catalysts** used in fuel cells to produce hydrogen ions from fuel such as methanol and to improve the efficiency of **membranes** used in fuel cells to

separate hydrogen ions from other gases such as oxygen

2.3 Batteries

Companies are currently developing batteries using nanomaterials. One such battery will be as good as new after sitting on the shelf for decades. Another battery can be recharged significantly faster than conventional batteries.

2.4 Fuels

Nanotechnology can address the shortage of fossil fuels such as diesel and gasoline by making the production of fuels from low grade raw materials economical, increasing the mileage of engines, and making the production of fuels from normal raw materials more efficient.

3. Medical uses - Medicine can heal at the molecular or cellular level.

If we had surgical tools that were molecular both in their size and precision, we could develop a medical technology that for the first time would let us directly heal the injuries at the molecular and cellular level that are the root causes of disease and ill health. With the precision of drugs combined with the intelligent guidance of the surgeon's scalpel, we can expect a quantum leap in medical capabilities. Applications of nanotechnology in medicine currently being developed involve employing nanoparticles to

deliver drugs, heat, light or other substances to specific cells in the human body. Engineering particles to be used in this way allows detection and/or treatment of diseases or injuries within the targeted cells, thereby minimizing the damage to healthy cells in the body. When it's perfected, this method should greatly reduce the damage treatment such as chemotherapy does to a patient's healthy cells.

The longer range future of nanotechnology in medicine is referred to as nanomedicine. This refers to future developments in medicine that will be based on the ability to build nanorobots. In the future these nanorobots could actually be programmed to repair specific diseased cells, functioning in a similar way to antibodies in our natural healing processes.

While most applications of nanotechnology in medicine are still under development nanocrystalline silver is already being used as an antimicrobial agent in the treatment of wounds.

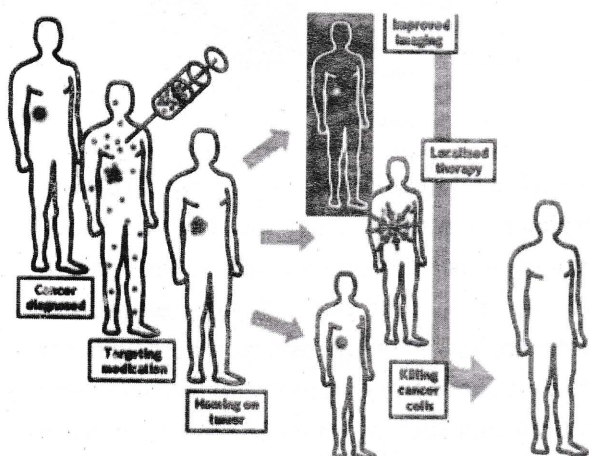
4. Health applications:

4.1 Cleaner Water

Nanotechnology is being used to develop solutions to three very different problems in water quality. One challenge is the removal of industrial wastes, such as a cleaning solvent called TCE, from groundwater. Nanoparticles can be used to convert the contaminating chemical through a chemical reaction to make it harmless. Studies have shown that this method can be used successfully to reach contaminants dispersed in underground ponds and at much lower cost than methods which require pumping the water out of the ground for treatment.

4.2 Chemical Sensors

Nanotechnology can enable sensors to detect very small amounts of chemical vapors. Various types of detecting elements, such as carbon nanotubes, zinc oxide nanowires or palladium nanoparticles can be used in nanotechnology-



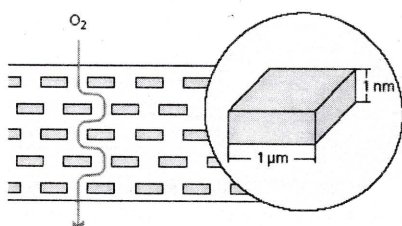
based sensors. Because of the small size of nanotubes, nanowires, or nanoparticles, a few gas molecules are sufficient to change the electrical properties of the sensing elements. This allows the detection of a very low concentration of chemical vapors.

4.3 Better Air Quality

Nanotechnology can improve the performance of catalysts used to transform vapors escaping from cars or industrial plants into harmless gasses. That's because catalysts made from nanoparticles have a greater surface area to interact with the reacting chemicals than catalysts made from larger particles. The larger surface area allows more chemicals to interact with the catalyst simultaneously, which makes the catalyst more effective.

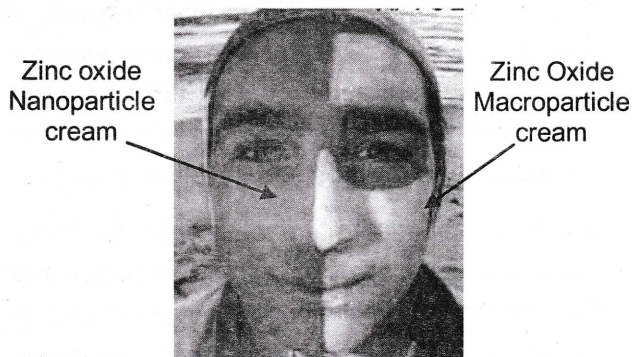
4.4 Food protection

Nanotechnology is having an impact on several aspects of food science, from how food is grown to how it is packaged. Companies are developing nanomaterials that will make a difference not only in the taste of food, but also in food safety, and the health benefits that food delivers.



4.5 Transparent sun cream

The sun cream serves to protect the skin from harmful radiations in the sunlight. If macroparticle cream is used, due to the opacity the natural look of the skin is lost. The transparent sun cream comprising nanoparticles allowed the visible light to pass through and thereby helps the skin not losing the natural nature.



5. Military applications - Weaponry can incorporate computer power but is this prudent?

In the future, even weapons as small as a single bullet could pack more computer power than the largest supercomputer in existence today, allowing them to perform real time image analysis of their surroundings and communicate with weapons tracking systems to acquire and navigate to targets with greater precision and control.

Military applications of nanotechnology raise a number of concerns that prudence suggests we begin to investigate before, rather than after, we develop this new technology.

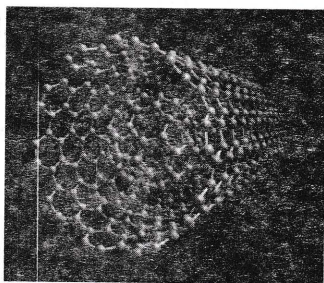
6. Economical air transportation: Lighter materials will make air and space travel more economical.

Transportation in space is very expensive and reserved for an elite few. Nanotechnology will dramatically reduce the costs and increase the capabilities of air and space vehicles. The strength-to-weight ratio and the cost of components are absolutely critical to the performance and economy of space vehicle: with nanotechnology, both of these parameters will be improved. Beyond inexpensively providing remarkably light and strong materials for space vehicle, nanotechnology will also provide extremely powerful computers with which to guide both those ships and a wide range of other activities in space. Nanotechnology may hold the key to making space-flight more practical.

Advancements in nanomaterials make lightweight solar sails and a cable for the space elevator possible. By significantly reducing the amount of rocket fuel required, these advances could lower the cost of reaching orbit and travelling in space.

Several nanomaterials are developed for these applications. Discovery of carbon nanotubes has the potential of revolutionising advancements in almost all realms because of their impressive structural, mechanical and electronic properties such as small size and mass, high strength, higher electrical and thermal conductivities.

These nanotubes are networks of carbon atoms approximately 1 nm in diameter and 1-100 μm in length and can be thought of as a layer of graphite rolled into a cylinder. One could just imagine these as flexible cylinders but with tensile strength even higher than that of diamond. Materials made of nanotubes are lighter and more durable because they have low density (1.3 gcm^{-3}). As they have very small diameters and large length carbon nanotube structures are susceptible to structural instability. The carbon nanotubes also allowed tuning their mechanical parameters to desired values.



Carbon nanotube

near-term applications, nanostructured molecular devices in practical applications may still need time to wait.

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Conclusion: Nanotechnology has very broad applications with economic and social impacts even greater than we can imagine it today. Nanotechnology is predicted to be developed by 2020 but much depends on our commitment to its research. Major challenges in nanotechnology are the tools and methods to fabricate nanostructured devices in an economically sound way. Although nanostructured materials find

Optimal Sample Sizes in Applied Research

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Chairman sir, executive committee members of the section, 'Applied Sciences', our professors, academic staff, students, and the distinguished gathering, it is my great pleasure to deliver this sectional chairman's address as I have lead the applied science section of the Jaffna Science Association during the past two years with various activities on behalf of the association. Aspects of applied sciences are part and parcel of our daily life and we are carrying out our daily activities with the scientific knowledge gathered from theories to applications of scientific concepts in all aspects.

I wish to take this opportunity to speak on 'Optimal Sample Sizes in Applied Research projects', as nowadays academics and scholars are engaged in various research projects mostly with sample surveys rather than population studies. Population studies are less popular in the current research world, and sample surveys and sample experiments are becoming frequent use for considering limited research funds and time constraints. Hence, I am hopeful that my talk today will be helpful to most of the young researchers to carry out their research work effectively. The specific emphasis in this talk is based mostly on applied social, biological and medical research processes.

A. Introduction

Why this topic at the JSA today?

During the past 23 years of my academic career at the University of Jaffna, I have observed in many under-graduate dissertations and in huge number of post-graduate studies that sampling approaches have been simply and carelessly applied in collecting information and data. Suitable sampling procedures were not properly adopted in most of the studies of our region.

Further, proper sample sizes have not been selected by most of these researchers. Hence, I decided to talk on this topic today for the improvements of the scientific research methods in the Jaffna region.

We shall now see why "Sampling Methods" in Applied Research Projects is an important topic. In majority of the Applied Research Studies, we have frequently encountered the terms "Sample Observations", "Sample Measurements", "Sample Experiments", "Sample Trials", "Sample Products", "Sample Outcomes" etc. Infact, these are most frequently heard key words in the research reports, papers, articles, dissertations etc.

Definition of Sampling

At this initial stage it is relevant to characterize the meaning and definition of "Sampling". We place three basic questions to explore the meaning or definition of "Sampling in Applied Research" or "Sample Survey".

1. What is meant by Sampling?
2. What do we do in Sampling?
3. Why do we perform Sampling?

Defining what is meant by "Enumeration" is appropriate. We place the question "What is Enumeration?" The answer is: Enumeration is 'Observing', 'Measuring', 'Counting' or 'Extracting' some data or information on the basis of "Quantitative variables" or "Qualitative Attributes" from a number of study materials or subjects. Sampling procedure in this context is defined to be a "Partial Enumeration". There are two types of enumerations in force: which are Complete Enumeration and Partial Enumeration. Complete enumeration is nothing but a Complete Study or Population Study or a Census, and on the other hand Partial enumeration is a Partial Study or a Fragment Study or a Sample Study.

Applied Research

It is now proper to characterize what is 'Applied Research' before talking about sample survey. Applied research is basically defined to be an action research. It aims at finding a solution to an immediate, pressing, current, and practical problem. It may also be treated as an **Empirical Research**. Sampling is the basic component of the Methodology in Applied Research.

We shall see what 'Empirical Research' is and why 'Sample Survey' is connected to. Empirical research relies on experience or observations alone. It is a data based approach coming up with results of processed data and conclusions. Empirical research is capable of being verified by repeated observations or experimental outcomes. Sampled observations or measurements are required in this context

Data and Information Gathering

Data and Information gathering in 'Empirical' or 'Applied' studies through 'Sample Survey' is now considered. Data are measured and recorded or observed and collected from Experiments or from Phenomena in any applied research studies such as:

- Biological Studies,
- Agricultural Studies,
- Engineering Studies,
- Health & Demographic Studies,
- Social & Psychological Studies,
- Economics & Business Studies,
- Cultural & Language Studies,
- Educational Studies etc

Before explaining about 'Sample Survey' the alternative approach of Complete Enumeration is explained. Complete enumeration is a study of whole exercise in a specified whole population. In experimental data collection, the study needs to be repeated for infinitely many times. In phenomenal data collection, all the study units be observed or measured.

B. Sample Surveys

We have earlier understood that a Partial Enumeration is a 'Fragment Study' or a 'Sample Study'. A study based on a scientifically selected sample which is constituted by a pre-determined number of experimental subjects or outcomes used to extract or gather data or any other relevant information is defined to be a 'Sample Survey'. In this regard we place the following facts for the justification of sample surveys for replacing population studies or whole and complete experiments.

- (1) Complete enumeration is unnecessary if a part of it can yield equally reliable results.
- (2) Complete enumeration may be impractical and hence we opt for partial enumeration
- (3) Well selected fragment may equally reflect the real characteristics of the whole lot of population and yield more accurate estimations.

What do we do in Sampling?

Coming to the three basic questions put-forwarded above, explaining the meaning of sampling above is being followed by the explanations to the second question, that is exploring the contents of sampling procedure. The contents of a sampling procedure are:

- (1) Collecting data and information from a study sample constituted,
- (2) Processing such collected data to study and describe the characteristics of the population or features of the experimental study,
- (3) Estimating such characteristics or features to arrive at conclusions for some specific objectives or inquiries of the study designed.

The characteristics of the population or features of an experimental study to be explored are said to be the parameters of the study population. The following parameters are defined for a characteristic or a study factor:

- Minimum / Maximum / Range
- Mean / Average

- Total
- Proportion
- Any located cut-off point
- Variance
- Standard Deviation etc.

Statistical Estimation Procedures

Once the study population is defined, parameters are characterized or defined, a sample of study objects is drawn, and the data or information are recorded an estimation procedure commences. Since statistical information or data are used this is mostly said to be a statistical estimation procedure. We consider the following:

- (1) Functions of Statistical observations are said to be estimators
- (2) Statistical estimators are the sample counterparts of population parameters
- (3) Estimating the population parameters through sample statistics is said to be the Sample Study.

The estimation procedure is essentially associated by exploring the '**Reliability**' of the constructed estimators. We consider the following in this context.

- (1) Any parameter of the population mentioned above could be estimated by sample statistics
- (2) Considering the same sample statistics, one can evaluate the variance of such estimators using standard formulas
- (3) The square root of the variance is defined to be the "Standard Error" of the estimate
- (4) Considering the value of the standard errors, researchers can justify the reliability of the estimator.

Why do we perform Sampling?

Coming to answer to the third question the reasons for performing sampling are thus explained. A specific question at this juncture is 'Why a complete enumeration is replaced by a sample enumeration?' There are valid reasons and advantages for employing a 'Sample Survey' over

complete enumeration. The very important reasons are:

- Reduced time and cost in sample surveys,
- Only method possible in specific studies or experiments,
- Detailed studies of the objectives are possible,
- More accurate results from the selected study subjects,
- Scientific explanations possible by eliminating unusual subjects,
- Suitable for hypothetical or imaginary studies or experiments,
- Administrative and other convenience in spatial distributions, etc.

Terminology of Sample Surveys

In executing a sample survey the planning and designing stages have a number of terminological issues. We may consider the following terms of sample survey and understand their practical meanings:

(1) Study Population / Universe

The maximum possible number of trials or the whole lot of study subjects is said to be a Population or Universe of a study. A universe could be:

- Finite / Infinite Population
- Existent / Hypothetical Population
- Static / Dynamic Population
- Organized / Unorganized Population etc

(2) Study Unit / Experimental Unit

A smallest entity defined in the study for possible data and information gathering is defined to be a study unit.

(3) Sampling Frame / Sampling Unit

A list of serially identified or organized study units is a sampling frame. In an experimental study the sampling frame could be of imaginary or virtual in nature. A unit possibly a study unit or study subject randomly drawn or randomly selected for

a treatment is said to be a sampling unit. A sampling unit could be differently defined for:

- Unit of Enumeration,
- Unit of Recording,
- Unit for Classification,
- Unit for Analysis,
- Unit for Reporting.

Sample Size

We shall now define what is meant by 'Sample Size', which is the key word of this talk.

A systematically or randomly and scientifically selected portion of the universe is defined to be the sample for the study on an objective. In a series of continuous trials, a scientifically fixed number of trials is said to be a study sample. The number of units or trials in these types of samples are said to be sample size.

Determination of sample size is a major problem to the applied researchers. Samples are like medicines. They can be harmful when they are taken carelessly with smaller or larger sizes. Adequate knowledge and skills are required to determine the sizes of the samples. Too large sized sample implies wastage of resources. Too small sample diminishes the utility of the information or data and reduce the reliability and validity of the results obtained from the sample.

We do not possess enough information to be sure or to confirm our choice of sample size is the best one. Sampling theory provides a frame work within which to think intelligently about the case

Some Practical Issues

Dear colleagues, as I highlighted at the commencement of this talk there are practical problems or issues encountered in sample studies. The following issues are frequently observed in a sample study:

- Improper sampling procedure adopted to draw a sample,
- Carelessly or improperly planned study before sampling,

- Skilled or trained persons are not involved to collect data from samples,
- Experienced persons are not involved in data collection process,
- Personal bias imposed by the experimenter or data collector,
- Prejudice of the investigator at different stages, etc.

Some Methodological Issues

Before considering the above said practical issues, we should also think about the possibility of being affected by some methodological issues. The following issues are frequently encountered in research methodology:

- Unsuitable sampling unit is defined,
- Irrelevant statistics or information are recorded or measured,
- Improper sample size is determined, larger or smaller size.

Hence, the basic dilemma encountered in our research problem is determining the proper sample size which is known as 'Optimal Sample Size' and employing the proper sampling procedure or technique for drawing the individuals to constitute the sample.

C. Determination of Optimal Sample Size

We shall now come to the key aspect of this talk which is known as the determination of optimal sample sizes in applied research studies. We have highlighted above on the three important methodological issues which are serious in nature in applied research studies. Every researcher performing his or her research by sample survey should consider these three issues at the commencement of the research.

Remedies in the Methodological Issues

The first two issues of 'Defining Sampling Unit' and 'Deciding on Statistical Information' could be simply corrected or revised by carefully

considering the specific objectives of the study. The third issue of 'Determining Correct Sample Size' is a major difficult task which is to be carefully handled. But, the researchers never consider this issue as a serious one and simply choose their sample size with some popular or magic numbers, which totally damages the whole study. A proper and suitable sample size chosen is said to be 'Optimal Sample Size' for the study.

Optimality Conditions

When we talk about optimal sample size, a basic question naturally arises here is 'What is meant by Optimal?' Hence the conditions or criterion of achieving optimality be clearly characterized. The optimality conditions are purely based on the estimation procedure to be adopted in a sample after its selection. That is we predetermine the optimality conditions which are actually characterized in the post sample selection scenario. In estimating the parameters of the population by sample information we should achieve:

- Reduced error and highest accuracy in the estimators,
- Unbiased estimation, means uniformity among different situations,
- Consistent estimation, means reduced distance with true parameter,
- Efficient estimation, means better selection with smaller estimation error,
- Sufficiency in estimation, means produced through sufficient statistics.

The determination of optimal sample size could be characterized by two different ways which are theoretical or conceptual approach and practical or empirical approach.

Error Estimation Approach

We shall first see what is known as conceptual approach. Optimal sample sizes are directly connected to the experimental errors occurred in

most of the sample studies. Previous information or a pilot study could yield various types of errors in this context. Measuring the errors of similar previous studies is helpful to determine the sample size in the present study. This approach is said to be error estimation approach. Two types of errors are observed in sample studies or in sampled experiments. Those are:

- (1) Sampling Errors
- (2) Non-Sampling Errors

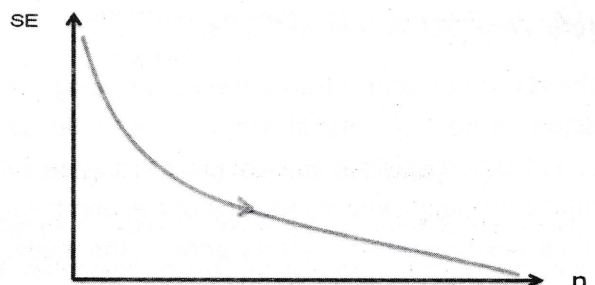
Sampling Errors

Sampling errors arise due to the non selection of whole population and studying the part of the population. This error mainly occurs during the following circumstances:

- Faulty demarcation of the sampling unit,
- Deliberate selection of the sampling unit,
- Substitution of convenient units in the sample,
- Improper choice of statistics in the sampling unit.

Sampling Error (SE) Vs Sample Size (n)

Sampling errors such as given above are inversely proportional to the sample size. That is when we increase the sample size, the errors of non-selection is reduced. This is shown in the figure given below:



Non-Sampling Errors

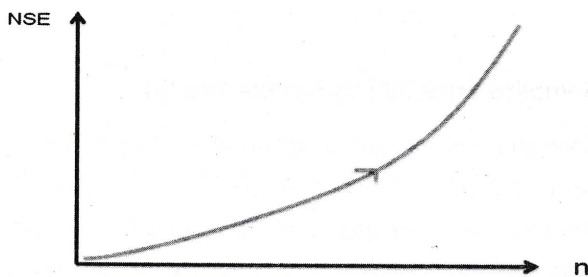
Non-sampling errors are not related to the individual sampling unit selection, but related to the information from all the selected units. These

errors arise at the stages of collecting, processing, and reporting data. The situations of such errors occurring are:

- Data inadequate in the sampling units,
- Data inconsistent in the sampling units,
- Response errors occur in the sampling units,
- Non-response errors seen in the sampling units,
- Coverage errors generated from the sampling units,
- Compiling errors generated from the sampling units,
- Reporting errors occurred from the sampling units.

Non-Sampling Error (NSE) Vs Sample Size (n)

Non-Sampling errors such as the above are directly proportional to sample size. This is shown below: That is when we increase the sample size, the errors of the above said circumstances also increase. This is shown in the figure given below:

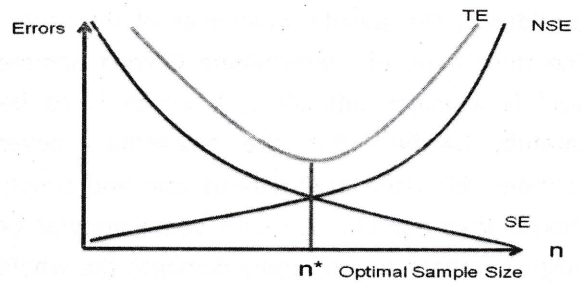


Total Error (TE) Vs Sample Size (n)

The above two contradictory trends regarding the determination of optimal sample size could be solved by considering the balanced situation of total errors in the entire sampling procedure. If we could measure all such errors prior to the study, the optimal size could be decided.

Feasibility of Error Approach

The feasibility of the application of the above approach is too cumbersome for the less-experienced researchers or those researchers



from the fields other than 'Statistics'. The transformation of the above described conceptual approach into the practical or empirical approach is difficult to the researchers other than statisticians. Furthermore, this approach is too general and difficult to exercise in practice.

Adopting a proper label with instructions about its use is not simply possible. If the errors are not properly measured, the sample size and results obtained from the sample data will be inaccurate and misleading the study. Serious complications may arise in the final results and conclusions, if this error estimation approach is not properly applied. Therefore, modified or simplified practical or empirical approaches are discussed in the following sections.

D. Sampling Procedure

It is important at this stage to elaborate various sampling procedures or techniques for the purpose of explaining simplified procedures for the determination of optimal sample sizes. This is because the simplified approaches are variably defined and described according to the sampling techniques, the researcher intends to formulate and apply. The researcher needs to undergo the following steps before such exercise.

- (1) Define the Population or Experiment of study with sampling or experimental unit,
- (2) Determine the Key variables of the study according to the specific objectives,
- (3) Characterize the 'Heterogeneity' of the Population or Experiment,
- (4) Construct the 'Sampling Frames' or 'Experimental Plans',

- (5) Select appropriate 'Sampling Procedure' or 'Sampling Techniques' to be adopted.

Sampling procedures or techniques usually adopted are of two types:

- (1) Subjective Sampling or Non-scientific Sampling
- (2) Objective Sampling or Scientific Sampling

Subjective Sampling

This is a non-scientific or non-probability or non-random sampling procedure for drawing sampling units to constitute a sample. No mathematical or any other scientific selection criteria are used to select study subjects in this procedure. Majority of the researchers, who do not like to use proper scientific research methodologies, but pretending that they are using a proper sample, usually adopt this method to avoid the explanation of a proper sampling technique.

Types of Subjective Sampling

Various types of procedures or methods are defined or selected in the respective studies according to the objectives, situations, and nature of their research problem. More frequently used procedures in this type are:

- Judgment Sampling
- Purposive Sampling
- Convenient Sampling
- Quota Sampling
- Expert Sampling etc.

Subjective Sampling and Sample Size

How does a researcher choose his sample size under subjective sampling procedure? Sample sizes in this situation are arbitrarily decided by the researcher. However, expert opinions are also incorporated most of the times.

Usually, 5% to 15% of the population size is considered as sample size in this procedure. This concept has never been theoretically derived, but

empirical evidences have been incorporated to confirm such results which are purely practical. The specific objectives are only considered for such determination, sometimes with suitable justification. The size may not be proper and may not be optimal in most of the situations.

Favoritism and Nepotism

There are two dangerous things in subjective sampling which are known as 'Favoritism' and 'Nepotism'. Favoritism refers to that the researchers can decide a sample size and the units to be included in the sample. Improper ways to achieve favorable results to them from the sample information could be a possibility. On the other hand, the researchers can also decide a sample size and the units to be included in the sample improper ways to arrive unfavorable results to the opponents from the sample information.

Researchers may also accidentally or purposely mislead the study if they arbitrarily determine the sample size in subjective sampling. They can manipulate or bias the results with a sample size with known sampling units to mislead the study to attain a conclusion already hypocritically decided. It can be favorably or unfavorably done with a predetermined purpose to hide the reality. Hence, proper justification of the sample size is required in these types of studies.

Objective Sampling

We shall now see what is 'Objective Sampling'? Contrary to the 'Subjective Sampling' described above 'Objective Samplings' are well defined procedures. This procedure is said to be 'Scientific', 'Probability' and 'Random' sampling procedure.

Scientific and mathematical procedures are adopted to select the study subjects and included in the study sample. Sampling frames are constructed and equal or weighted probabilities are assigned in the selection criteria. Unbiased and representative samples are constituted in objective samplings.

Types of Objective Sampling

Various types of objective sampling techniques are formulated and adopted in the study according to the specific objectives of the study and types of study population. The most popular objective sampling techniques are as follows:

- Simple Random Sampling (SRS)
- Probability Proportional to Size Sampling (PPS)
- Stratified Random Sampling (StRS)
- Cluster Sampling (CIS) / Area Sampling (ArS)
- Systematic Sampling (SyS)
- Multiphase Sampling (MPS) / Multistage Sampling (MSS) etc.

Some of the above given sampling techniques are characterized as 'Mixed Sampling' techniques. This is because part of the selection is random and the selection of the rest is non-random in the construction of the study sample.

Objective Sampling and Sample Size

In objective or probability sampling technique the determination of sample size is considered only after the background characteristics of the population are verified and the suitable sampling techniques are decided. That is Sample sizes are not predetermined. Sample sizes in these procedures or techniques could be appropriately calculated at a single stage. Whole sampling scheme could be folded with a number of multiple stages. Sampling techniques specified above could be variably adopted in each of the stages. Sample sizes could be calculated in each of the stages

My dear colleagues, considering the time constraints in this talk, I would like to discuss only some of the specific cases for determination of optimal sample sizes. That is we shall see how the optimal sample size for a homogeneous population and for a heterogeneous population are determined.

E. Optimal Sample Size in a Homogeneous Population

The most popular probability sampling technique for a homogeneous population is 'Simple Random

Sampling'. We shall see how the optimal size is determined in such a homogeneous population.

Simple Random Sampling (SRS)

A number of subjects, sample, in a homogeneous population is studied or a number of homogeneous or uniform trials adopted in an experiment are examined. Sampling frame is constructed and equal probabilities are assigned for the selection of units into the sample. Mechanical randomization or computer simulation methods are adopted to select the sampling units. Hence, a random sample with a number of random units is constituted.

Optimal Sample Size with SRS

There are various approaches to determine or calculate the optimal sample size in a homogeneous population to adopt simple random sampling. Those are as follows:

- Variance function approach
- Co-efficient of variation approach
- Confidence interval approach
- Cost function approach

The step by step procedures are discussed below for each of these approaches.

Variance Function Approach

- (1) Select a key variable of the study,
- (2) Use auxiliary information or previous literature to know about the population variance σ^2 of the key variable,
- (3) Conduct a pilot study and determine the sample variance V_0 ,
- (4) Use the relation $V(x) = \sigma^2/n = V_0$,
- (5) Hence, $n = \sigma^2/V_0$ is the optimal sample size.

Co-efficient of Variation Approach

- (1) Select a key variable of the study,

- (2) Use auxiliary information or previous literature to know about the population variance σ^2 of the key variable,
- (3) Conduct a pilot study and determine the coefficient of variation δ and sample mean \bar{x} ,
- (4) Use the relation

$$CV = \sqrt{\frac{\sigma^2/n}{\bar{x}}} = \delta$$

- (5) Hence, $n = \sigma^2/(\bar{x} \delta)^2$ is the optimal sample size.

Confidence Interval Approach

- (1) Select a key variable of the study,
- (2) Use auxiliary information or previous literature to know about population mean μ ,
- (3) Conduct a pilot study and determine the sample mean \bar{x} and sample standard deviation s ,
- (4) Fix a precision d for the maximum difference between the population mean and the sample mean,
- (5) Use the relationship

$$P(Abs(x - \mu) \leq d) = 1 - \alpha$$

Where $(1 - \alpha)100\%$ is the confidence level,

- (6) Further

$$P\left(\frac{x - \mu}{s\sqrt{1/n - 1/N}} \leq z\right) = 1 - \alpha$$

- (7) Comparing the relationships given in the steps (5) and (6) we could drive the result

$$n = \frac{Ns^2z^2}{Nd^2 + s^2z^2}$$

which is the optimal sample size.

Cost Function Approach

- (1) Get the total budget of the study C
- (2) Determine the fixed cost of the study C_0
- (3) Estimate the cost of an experimental trial or measuring a study unit C_s
- (4) Then $C = C_0 + nC_s$

- (5) Use $n = (C - C_0)/C_s$ to determine the optimal sample size.

F. Optimal Sample Size in Heterogeneous Population

The most popular probability sampling technique for a heterogeneous population is 'Stratified Random Sampling'. We shall see how the optimal sample size is determined in such a heterogeneous population.

Stratified Random Sampling (StRS)

In most of the applied research studies a heterogeneous population of multiple objects is studied or heterogeneous features or conditions are adopted in an experimental study. This type of complex population in a complicated experiment the population is stratified into a number of homogeneous sub-populations (Strata) or a number of homogeneous sub-trials or sub-experiments. Information on the size of the whole population (experiment), number of strata (sub-experiments), and sizes of the strata (sub-trials) is usually obtained or determined from the literature or from the objectives of the study.

Sub-samples from each of the strata (from homogeneous sub-populations) are initially drawn by SRS method. All the sub-samples are combined together to form a stratified random sample of the study. The total sample size of this complex population or phenomena or experiment is determined by considering the dominant key factor of the study which is common throughout the strata. This determination is similar to SRS, where the heterogeneity of the dominant factor is ignored or minimized or controlled by suitable scientific methods.

Optimal Sample Size with StRS

The optimal size of the heterogeneous population is determined first similar to the SRS method as stated above or by a suitable method adopted in a subjective sampling approach. The problem now is allocating or dividing the whole sample size into

the stratum or sub-populations or within the sub-experiments. Three methods are possible:

- (1) Proportional allocation
- (2) Optimal allocation by Variance
- (3) Optimal allocation by Variance and Cost

Proportional Allocation

The proportions of all the stratum on the whole heterogeneous population are considered for stratifying the total sample. We consider the following notations and procedures:

- (1) N – Size of the whole Population,
- (2) k – Number of stratum,
- (3) N_i – Size of the i^{th} stratum (Sub-population)
- (4) n – Size of the whole Sample,
- (5) n_i – Size of the i^{th} sample stratum
- (6) Then

$$N = \sum_{i=1}^k N_i \quad \text{and} \quad n = \sum_{i=1}^k n_i$$

- (7) Then the allocation is

$$n_i = \left(\frac{N_i}{N} \right) n$$

This allocation may not be optimal as only the sizes of the population components are considered and the statistical characteristics of the dominant factors are not considered. Further, the cost of the field survey or the experiment is not considered which is an important issue in this types of studies.

Optimal Allocation by Variance

The sample allocation is determined only on the basis of within stratum variations. Let S_i be the variance of the i^{th} stratum and let

$$NS = \sum_{i=1}^k N_i S_i$$

Then the allocation is

$$n_i = \left(\frac{N_i S_i}{NS} \right) n$$

Optimal Allocation by Variance and Cost

The sample allocation is determined on the basis of within stratum variations and field costs or experimental costs of the study. Let C_i be the cost of the study per study subject in the i^{th} stratum. If the total budget is C and the overhead cost is C_0 , then, the cost function of the study is defined to be,

- (1) Then

$$C = C_0 + \sum_{i=1}^k n_i C_i$$

- (2) Let

$$NCS = \sum_{i=1}^k \left(\frac{N_i S_i}{\sqrt{C_i}} \right)$$

- (3) Then the allocation is

$$n_i = \left(\frac{N_i S_i / \sqrt{C_i}}{NCS} \right) n$$

This is how we design the optimal sample and its sizes of the components in a stratified random sampling procedure that we adopt in the studies most of the times. Similar methodological procedures are available in the other sampling techniques, which are not covered in this talk, but I am sure that the methods I discussed here would help you to develop or improve, or search for the modified methods required in various researches.

G. Outcomes of the Talk

Conclusions and Suggestions

- ❖ The possible approaches of determining optimal sample sizes in the applied research studies under the basic situations have been described in detail in this talk,
- ❖ The majority of researchers of our region and in our university are reluctant to adopt the procedures on selecting optimal sample sizes, which is a major drawback,
- ❖ Improper sample selection will lead to hypocritical research and mislead the results and conclusions in our academic society,

- ❖ Consult your research supervisors regularly to perform efficient research with effective research methodologies,
- ❖ Consult competent research methodologist to adopt proper methods of research
- ❖ Consult statisticians to adopt proper sampling procedures and determine optimal sample sizes relevant to the study,
- ❖ அளவுக்கு மிஞ்சினால் அமுதமும் நஞ்சு அளவுக்கு குறைந்தாலும் உண்மைக்கு கேடு

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Sleep Well

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Introduction

"Sleep is an acquired habit. Cells don't sleep. Fish swim in the water all night. Even a horse doesn't sleep. A man doesn't need any sleep."

--- Thomas Edison, inventor

"I never use an alarm clock. I can hardly wait until five a.m. In the army I always woke before reveille. I hate sleeping. It wastes time."

--- Isaac Asimov, science fiction writer

"Dreaming of eating will not satisfy the hungry."

--- African Proverb

Sleep is the natural state of bodily rest observed throughout the animal kingdom, in all mammals and birds, and in many reptiles, amphibians, and fish. Until the 1950s, most people thought of sleep as a passive, dormant part of our daily lives. Neuroscientists now believe sleep is not only crucial to brain development, but is also necessary to help consolidate the effects of waking experience – by converting memory into more permanent and/or enhanced forms. We apparently spend one third of our lives in sleep. In Dolphins, whales and birds half brain sleep at a time.

Stages of sleep

During sleep, we usually pass through five phases of sleep: stages 1, 2, 3, 4, and REM (rapid eye movement) sleep. These stages progress in a cycle from stage 1 to REM sleep, then the cycle starts over again with stage 1.

Stage 1 is light sleep. We drift in and out of sleep and can be awakened easily. The eyes move very slowly and muscle activity slows. People

awakened from stage 1 sleep often remember fragmented visual images. Many also experience sudden muscle contractions often preceded by a sensation of starting to fall. These sudden movements are similar to the "jump" we make when startled.

In stage 2 eye movement stops and the waves in EEG become slower, with occasional bursts of rapid waves called sleep spindles.

Stage 3 shows extremely slow EEG waves called delta waves appear, interspersed with smaller, faster waves.

The brain produces delta waves almost exclusively in stage 4. It is very difficult to wake someone during stages 3 and 4, which together are called deep sleep. There is no eye movement or muscle activity. People awakened during deep sleep do not adjust immediately and often feel groggy and disoriented for several minutes after they wake up. Some children experience bedwetting, night terrors or sleepwalking during deep sleep.

In REM sleep breathing becomes more rapid, irregular, and shallow, eyes jerk rapidly in various directions, and the limb muscles become temporarily paralyzed. Heart rate increases, blood pressure rises, and males develop penile erections. When people awaken during REM sleep, they often describe bizarre and illogical tales – dreams. [3]

Distribution of Normal Sleep

In a typical sleep, the person passes through the stages 1, 2 and spends about 100 minutes in stage 3 and 4. Then REM follows and the cycle is repeated in about 90 minute intervals. Towards the morning, less stage 3,4 and more REM sleep. REM sleep: 80 % for preterm babies, 50 % for term babies, and 25 % in old age.

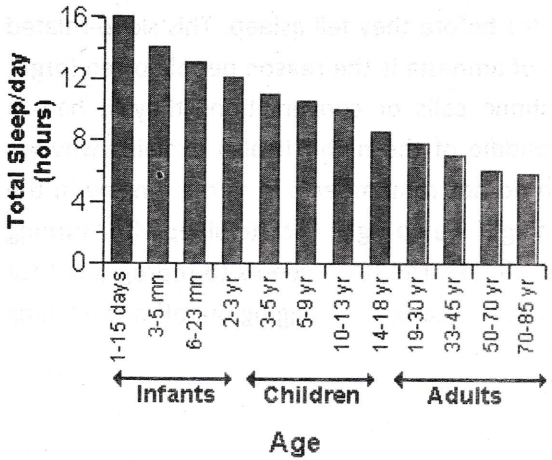


Fig.1: Total sleep needed

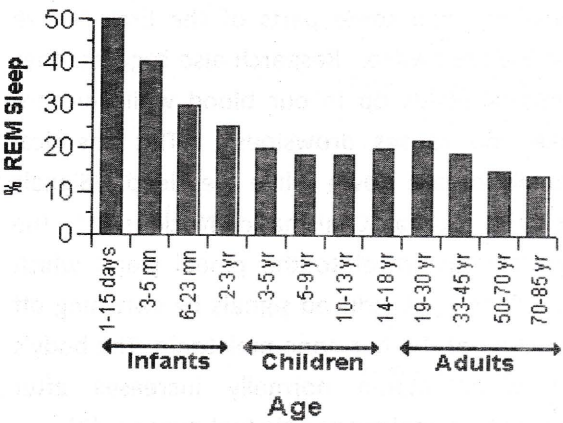


Fig. 2: Percentage of REM sleep

As shown in the two graphs above, infants spend more time sleeping and spend a greater percentage of sleep in REM sleep compared with the times of older children and adults. For example, newborn babies sleep about 16 hours per day and spend about 50% of that time in REM

sleep. Older people (50-85 years old) sleep only 6 hours per day and spend 15% of that time in REM sleep.

As children grow, they spend less time sleeping during the day. The graph below illustrates how nighttime and daytime sleep time changes with age. [2]

The amount of sleep each person needs depends on many factors, including age. Infants generally require about 16 hours a day, while teenagers need about 9 hours on average. For most adults, 7 to 8 hours a night appears to be the best amount of sleep, although some people may need as few as 5 hours or as many as 10 hours of sleep each day. Women in the first 3 months of pregnancy often need several more hours of sleep than usual. The amount of sleep a person needs also increases if he or she has been deprived of sleep in previous days. Getting too little sleep creates a "sleep debt," which is much like being overdrawn at a bank. We don't seem to adapt to getting less sleep than we need; while we may get used to a sleep-depriving schedule, the body and brain suffer. [3]. Homeostatic sleep propensity: the need for sleep as a function of the amount of time elapsed since the last adequate sleep episode, is also important and must be balanced against the circadian element for satisfactory sleep. Along with corresponding messages from

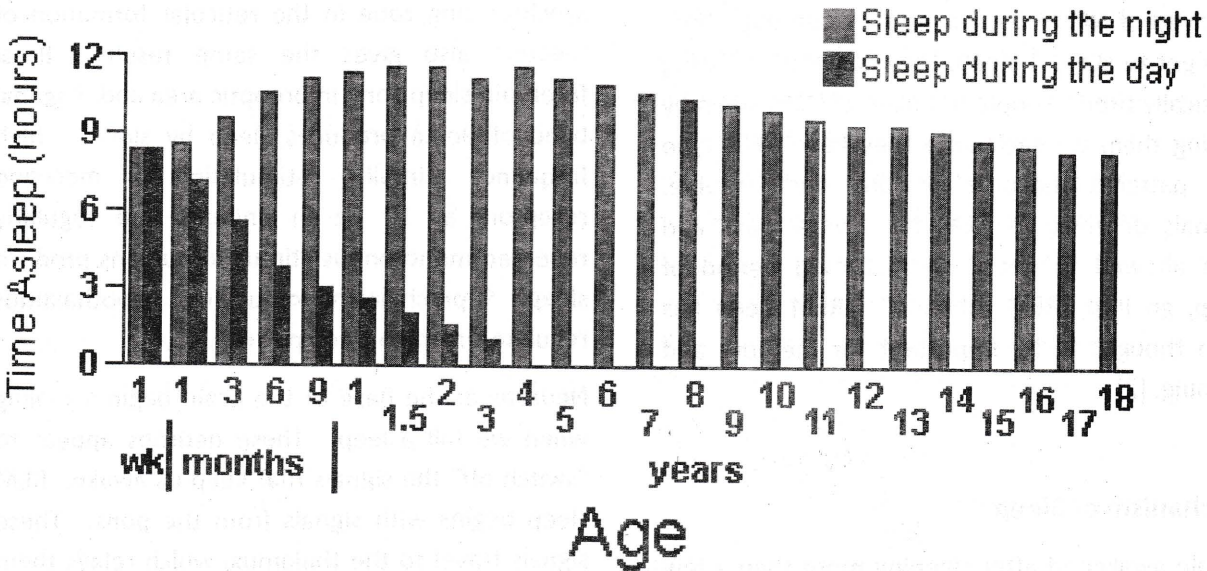


Fig. 3: Changes in Night and Day sleep time with age

the circadian clock, this tells the body it needs to sleep. [1]

Anesthesia and Coma

People who are under anesthesia or in a coma cannot be awakened and do not produce the complex, active brain wave patterns seen in normal sleep. Instead, their brain waves are very slow and weak, sometimes undetectable. [3].

Sleep as an Adaptive Process

Sleep may have developed because of a need of animals to protect themselves. For example, some animals search for food and water during the day because it is easier to see when the sun is out. When it is dark, it is best for these animals to save energy, avoid getting eaten, and avoid falling off a cliff that they cannot see. It is interesting to note *which animals sleep the most and which sleep the least*. In general, animals that serve as food for other animals sleep the least. [2].

Sleep as a Restorative Process

This theory of sleep suggests that sleep helps the body recover from all the work it did while an animal was awake. Experiments have shown that the more physical exercise an animal does, the more NREM an animal will have. Also, people deprived of NREM by waking them up each time they get to stage 4 sleep, they complain of being physically tired. People deprived of REM sleep by waking them up each time they have REM type EEG patterns, become anxious and irritable. Animals deprived of REM for several days and then allowed to get an undisturbed period of sleep, go into "REM rebound". REM sleep has been thought to be important for memory and learning. [2]

Mechanism of Sleep

People awakened after sleeping more than a few minutes are usually unable to recall the last few

minutes before they fell asleep. This sleep-related form of amnesia is the reason people often forget telephone calls or conversations they've had in the middle of the night. It also explains why we often do not remember our alarms ringing in the morning if we go right back to sleep after turning them off. [3]. The brain seems to reprogram it for sleep as in a computer logging on, off or switching user.

Chemicals associated with sleep

Neurotransmitters such as serotonin and adrenaline keep some parts of the brain active while we are awake. Research also suggests that adenosine builds up in our blood while we are awake and causes drowsiness. This chemical gradually breaks down while we sleep. Signals from the Supra Chiasmatic Nucleus of the Hypothalamus travel to the pineal gland which responds to light-induced signals by switching off production of the hormone melatonin. The body's level of melatonin normally increases after darkness falls, making people feel drowsy. [3]

Neural Basis of Sleep

The diencephalic sleep zone in posterior hypothalamus and related structures generate sleep if stimulated at 8 Hz. Faster stimuli produce arousal. Stimulation of the medullary synchronizing zone in the reticular formation of medulla also gives the same result. Basal forebrain sleep zone in preoptic area and diagonal band of Broca produces sleep by slow or high frequency stimuli. Stimulation of mechanoreceptors at 10 Hz in animals and regularly repeated monotonous stimuli in humans produce sleep. Suprachiasmatic nuclei of hypothalamus regulate circadian sleep pattern. [5,6]

Neurons at the base of the brain begin signaling when we fall asleep. These neurons appear to "switch off" the signals that keep us awake. REM sleep begins with signals from the pons. These signals travel to the thalamus, which relays them to the cerebral cortex – the outer layer of the

brain that is responsible for learning, thinking, and organizing information. The pons also sends signals that shut off neurons in the spinal cord, causing temporary paralysis of the limb muscles. If something interferes with this paralysis, people will begin to physically "act out" their dreams. A person dreaming about a ball game, for example, may run headlong into furniture or blindly strike someone sleeping nearby while trying to catch a ball in the dream. [3]

Disturbance to Sleep

Chemicals:

Since sleep and wakefulness are influenced by different neurotransmitter signals in the brain, foods and medicines that change the balance of these signals affect whether we feel alert or drowsy and how well we sleep. Caffeinated drinks such as coffee and drugs such as diet pills and decongestants can cause inability to sleep. Many antidepressants suppress REM sleep. Heavy smokers often sleep very lightly and have reduced amounts of REM sleep. They also tend to wake up after 3 or 4 hours of sleep due to nicotine withdrawal. [3]. According to a new study, Smokers are four times more likely to feel tired when they wake up and they spend less time in deep sleep than nonsmokers do. [6]

Many people use alcohol to facilitate sleeping—the so-called night cap. While alcohol does help people fall into light sleep, it also robs them of REM and the deeper, more restorative stages of sleep. Instead, it keeps them in the lighter stages of sleep, from which they can be awakened easily. [3]

Temperature:

People lose some of the ability to regulate their body temperature during REM, so abnormally hot or cold temperatures in the environment can disrupt this stage of sleep.

Jet lag and night shifts:

When travelers pass from one time zone to another, they suffer from disrupted circadian

rhythms, an uncomfortable feeling known as *jet lag*. It usually takes several days for the body's cycles to adjust to the new time. [3]. Symptoms much like jet lag are common in people who work nights or who perform shift work. Because these people's work schedules are at odds with powerful sleep-regulating cues like sunlight, they often become uncontrollably drowsy during work, and they may suffer insomnia or other problems when they try to sleep.

Traffic Noise and Cardiovascular Responses:

The participants in an experiment slept in the laboratory for 4 consecutive nights in each of 3 consecutive weeks and were exposed to aircraft, road, or rail traffic noise with weekly permutations. Cardiac responses did not habituate to traffic noise within the night and may therefore play a key role in promoting traffic noise induced cardiovascular disease. If so, these consequences are more likely for responses accompanied by awakenings than for situations without awakenings. [17]

Signs of Sleep deprivation

If one feels drowsy during the day, even during boring activities, that person haven't had enough sleep. If one routinely falls asleep within 5 minutes of lying down, that person probably has severe sleep deprivation, possibly even a sleep disorder. Microsleeps, or very brief episodes of sleep in an otherwise awake person, are another mark of sleep deprivation. In many cases, people are not aware that they are experiencing microsleeps. [3]

Dangers of Sleep deprivation

Accidents:

Sleep-deprived people perform as badly as or worse than those who are intoxicated when tested using a driving simulator or by performing a hand-eye coordination task. Sleep deprivation also magnifies alcohol's effects on the body, so a

fatigued person who drinks will become much more impaired than someone who is well-rested. Driver fatigue is responsible for an estimated 100,000 motor vehicle accidents and 1500 deaths each year, according to the National Highway Traffic Safety Administration in the USA. Since drowsiness is the brain's last step before falling asleep, driving while drowsy can – and often does – lead to disaster. Caffeine and other stimulants cannot overcome the effects of severe sleep deprivation. The National Sleep Foundation says that if one has trouble keeping the eyes focused, if one can't stop yawning, or if one can't remember driving the last few miles, that person is too drowsy to drive safely. [3]

The number and severity of workplace accidents also tend to increase during the night shift. Major industrial accidents attributed partly to errors made by fatigued night-shift workers include the Exxon Valdez oil spill and the Three Mile Island and Chernobyl nuclear power plant accidents. [3]

It may be possible to reduce shift-related fatigue by using bright lights in the workplace, minimizing shift changes, and taking scheduled naps.

Heart Problems and obesity:

Shift workers have an increased risk of heart problems, digestive disturbances, and emotional and mental problems, all of which may be related to their sleeping problems. Researchers from the University of Warwick, and University College London have found that lack of sleep can more than double the risk of death from cardiovascular disease. Too much sleep can also double the risk of death [1]. Changes in adiposity indices were compared between short- (5-6 hours), average- (7-8 hours), and long- (9-10 hours) duration sleeper groups. Both short and long sleeping times predict an increased risk of future body weight and fat gain in adults. Hence, these results emphasize the need to add sleep duration to the panel of determinants that contribute to weight gain and obesity [16]. In terms of prevention,

sleeping around 7 hours per night is optimal for health and a sustained reduction may predispose to ill-health.

Diabetes:

At the American Diabetes Association's annual meeting in June 2001, Eve Van Cauter, reported that people who regularly do not get enough sleep can become less sensitive to insulin. This increases their risk for diabetes and high blood pressure – both serious threats to the brain.

Previous work by Dr. Van Cauter, a professor of medicine at the University of Chicago, found that "metabolic and endocrine changes resulting from a significant sleep debt mimic many of the hallmarks of aging. We suspect that chronic sleep loss may not only hasten the onset but could also increase the severity of age-related ailments such as diabetes, hypertension, obesity, and memory loss. [7]

Brain function:

Sleep loss causes profound impairments in cognitive and behavioral performance. For example, in a prospective, randomized study looking at the effects of sleep deprivation in residency training, interns working a "traditional schedule" made 36% more serious medical errors compared with interns under an "intervention schedule" that included more sleep. Another study demonstrated that traditional-schedule interns had more than twice the rate of attentional failures when compared with the intervention-schedule interns. Taken together, these studies demonstrate that sleep-deprived house staffs make a significant amount of serious medical errors, largely the consequence of attentional failures from sleepiness. [8]. Humans deprived of sleep for long periods begin hallucinating and develop mental problems.

Life span and immunity:

In research studies, rats normally live two to three years, but if rats are totally deprived of sleep, they

only live about five weeks. They also develop sores, their immune systems do not work well and their body temperature drops [9]. In a survey done on African American and Caucasian American women and men without a sleep disorder, markers of inflammation and cardiovascular disease were associated with sleep deprivation [14].

Sleep and Behavior of Children

A Northwestern University study of 500 preschoolers found that those who slept less than 10 hours in a 24-hour period (including daytime naps) were 25% more likely to misbehave. They were consistently at greatest risk for "acting out" behavioral problems, such as aggression and oppositional or noncompliant behavior. Research shows that sleep disturbances in children are not only associated with medical problems (allergies, ear infections, hearing problems), but also with psychiatric and social issues. Children who were aggressive, anxious, or depressed had more trouble falling and staying asleep. Although sleep problems usually decline as children get older, these early patterns are the best indicator of future sleep troubles. [7]

Benefits of Sleep

Neurons:

Sleep appears necessary for our nervous systems to work properly. Some experts believe sleep gives neurons that are used while we are awake a chance to shut down and repair themselves. Without sleep, neurons may become so depleted in energy or so polluted with byproducts of normal cellular activities that they begin to malfunction. Sleep also may give the brain a chance to exercise important neuronal connections that might otherwise deteriorate from lack of activity. Too little sleep leaves us drowsy and unable to concentrate the next day. It also leads to impaired memory and physical performance and reduced ability to carry out

math calculations. If sleep deprivation continues, hallucinations and mood swings may develop.

Brain Connections in Early Development:

Animal studies show that sleep dramatically enhances changes in brain connections during a period of early development. Researchers at the University of California, San Francisco, examined the effect of sleep on brain plasticity in young cats that had just experienced an environmental challenge. The animals that were allowed to sleep for six hours after the stimulation developed twice the amount of brain change, compared to cats kept awake afterward.

This is the first direct evidence that sleep modifies the effect of environmental stimuli on the development of new brain connections. The finding has broader implications for plasticity in the brains of adult animals and people.

What's more, the amount of plasticity (connections between nerve cells) in the brain depends on the amount of deep sleep, which is indicated by large slow brain waves. This is precisely the time in life when the brain reorganizes its connections to attain the perfect precision it needs as an adult. [7]

Cellular Growth and Repair:

Deep sleep coincides with the release of growth hormone in children and young adults. Many of the body's cells also show increased production and reduced breakdown of proteins during deep sleep. Since proteins are the building blocks needed for cell growth and for repair of damage from factors like stress and ultraviolet rays, deep sleep may truly be "beauty sleep." Tissue repair occurs during sleep, including repair to the daily skin damage done by UV light. Getting enough deep sleep will help your skin repair itself. [9,10]

Learning:

REM sleep stimulates the brain regions used in learning. This may be important for normal brain development during infancy, which would explain why infants spend much more time in REM sleep than adults. Like deep sleep, REM sleep is associated with increased production of proteins.

One study found that REM sleep affects learning of certain mental skills. People taught a skill and then deprived of non-REM sleep could recall what they had learned after sleeping, while people deprived of REM sleep could not. [3].

Many of the brain areas activated when people performed the reaction time task were the same as those activated during REM sleep. During REM sleep, the visual cortex, premotor cortex, and some parts of the thalamus were more active in trained subjects than in untrained subjects. These were the same areas that showed significant activation during the reaction time task. [12].

Memory:

A study in rats also showed that certain nerve-signaling patterns which the rats generated during the day were repeated during deep sleep. This pattern repetition may help encode memories and improve learning. A napping study that involved 33 undergraduate students revealed that a nap resulted in waking up with shaper memory [3]. Some research findings support a hypothesis that REM sleep-associated processes facilitate proliferation of granule cells in the adult Hippocampal Dentate Gyrus [11].

Activating Memory Gene in Sleep:

Scientists at Rockefeller University showed that, in rats, certain brain cells that activate during daytime exploration tend to reactivate during sleep. Sidarta Ribeiro, Constantine Pavlides, and colleagues found that exposure to a "memorable" environment causes the brain to turn on a gene called zif-268 that is associated with strengthened communication between nerve cells.

The researchers exposed a group of rats to novel, enriched environments (labyrinths with toys), and another group of rats to their normal home cages. Then the rats went to sleep, passing through successive stages of slow wave and REM sleep.

During slow wave sleep, zif-268 turned off in all rats, regardless of which environment they had

experienced. But during REM sleep, zif-268 turned on in the cerebral cortex and hippocampus of only rats that had explored the labyrinths. The gene stayed off in rats that had not experienced the enriched environments.

This retrieval of zif-268 activity during REM sleep may couple with other reactivated brain mechanisms to "process" memories of novel experiences. Such processing may in turn prove important for cementing the memories acquired while awake. [7]

REM Sleep and Emotional Memory:

German scientists at the University of Bamberg Department of Physiological Psychology compared memory retention of emotional versus neutral text material. Participants were tested over intervals covering either early sleep (dominated by slow wave sleep) or late sleep when REM sleep is dominant. Sleep not only improved retention, but late sleep particularly enhanced memory for emotional texts. Results are consonant with a supportive function of REM sleep for the formation of emotional memory in humans. [7]

Activity in parts of the brain that control emotions, decision-making processes, and social interactions is drastically reduced during deep sleep, suggesting that this type of sleep may help people maintain optimal emotional and social functioning while they are awake.

A Better Way to Prepare for Exams

There is a saying that it is good to get a good night's sleep before a big test. That may be true. These new experiments suggest that it may be important to get a good night's sleep after you study or after you practice a skill such as shooting basketballs. [12]

Sleep could prove to be an important part of the strategy for preparing for challenges such as exams. The fact that sleep provoked slightly more plasticity (connections between nerve cells) than double the amount of exposure to experience

suggests that if you reviewed your notes thoroughly until you were tired and then slept, you'd achieve as much plasticity, or 'learning,' in the brain as if you'd pulled an all-nighter repeating your review of the material. [7]

Stress and Sleep Patterns

Why do some people lose sleep during periods of stress, while others seem to "sleep like a baby"? Research suggests that the difference may be explained by the ways people cope.

At Tel Aviv University, Dr. Avi Sadeh conducted a study of students. He found that those who tended to focus on their emotions and anxiety during the high-stress period were more likely to shorten their sleep, while those who tended to ignore emotions and focus on tasks extended their sleep and shut themselves off from stress. If you can't cope with it sleep on it. Sometimes sleep can help you regulate your nervousness and offer you an escape from stress, particularly when there's nothing you can do about it. [7]

Decision Making and Insight

Decision-making also appears to benefit from this overnight form of cogitation. During sleep, particularly the REM phase, the brain integrates information it took in during the day but couldn't process at the time. "Sleeping on it" is not necessary, however, for simple memory or learning tasks [7]. When Nobel laureate Otto Loewi discovered the chemical basis of neurotransmission in 1921, he attributed his experimental design to an insight he made during sleep [8].

Napping

Simply taking a nap may be one of the best things you can do to correct poor mental performance, especially after a stressful night of disrupted sleep, such as from sleep apnea or snoring. In a study of Japanese men, a mid-afternoon nap had positive

effects upon the maintenance of their daytime vigilance level. The 20-minute nap improved performance level and their self-confidence. [7]

Dreams

We typically spend more than 2 hours each night dreaming. Scientists do not know much about how or why we dream. Sigmund Freud, who greatly influenced the field of psychology, believed dreaming was a "safety valve" for unconscious desires. Only after 1953, when researchers first described REM in sleeping infants, did scientists begin to carefully study sleep and dreaming. They soon realized that the strange, illogical experiences we call dreams almost always occur during REM sleep. While most mammals and birds show signs of REM sleep, reptiles and other cold-blooded animals do not. [3]

Some scientists believe dreams are the cortex's attempt to find meaning in the random signals that it receives during REM sleep. The cortex is the part of the brain that interprets and organizes information from the environment during consciousness. It may be that, given random signals from the pons during REM sleep, the cortex tries to interpret these signals as well, creating a "story" out of fragmented brain activity. [3] Scientists also believe that sleep may be involved in "erasing memories from the immediate and distant past," and that dreaming is probably a piece of this process. [7]

Sleep and disease

Disease Disturbing Sleep:

Sleeping problems are common in many other disorders as well, including Alzheimer's disease, stroke, cancer, and head injury. These sleeping problems may arise from changes in the brain regions and neurotransmitters that control sleep, or from the drugs used to control symptoms of other disorders. In patients who are hospitalized or who receive round-the-clock care, treatment

schedules or hospital routines also may disrupt sleep. The old joke about a patient being awakened by a nurse so he could take a sleeping pill contains a grain of truth.

Sleep Precipitating Disease:

Sleep and sleep-related problems play a role in a large number of human disorders and affect almost every field of medicine. For example, problems like stroke and asthma attacks tend to occur more frequently during the night and early morning, perhaps due to changes in hormones, heart rate, and other characteristics associated with sleep. Sleep also affects some kinds of epilepsy in complex ways. REM sleep seems to help prevent seizures while deep sleep may promote the spread of these seizures. Sleep deprivation also triggers seizures in people with some types of epilepsy.

Sleep and Immune Reactions:

Neurons that control sleep interact closely with the immune system. As anyone who has had the flu knows, infectious diseases tend to make us feel sleepy. This probably happens because *cytokines*, chemicals our immune systems produce while fighting an infection, are powerful sleep-inducing chemicals. Sleep may help the body conserve energy and other resources that the immune system needs to mount an attack.

Sleep and Mental Disorders:

Sleeping problems occur in almost all people with mental disorders, including those with depression and schizophrenia. People with depression, for example, often awaken in the early hours of the morning and find themselves unable to get back to sleep. The amount of sleep a person gets also strongly influences the symptoms of mental disorders. Sleep deprivation is an effective therapy for people with certain types of depression, while it can actually cause depression in other people. Extreme sleep deprivation can

lead to a seemingly psychotic state of paranoia and hallucinations in otherwise healthy people, and disrupted sleep can trigger episodes of mania (agitation and hyperactivity) in people with manic depression.

Effect of Sleeping Problems:

Once sleeping problems develop, they can add to a person's impairment and cause confusion, frustration, or depression. Patients who are unable to sleep also notice pain more and may increase their requests for pain medication. Better management of sleeping problems in people who have other disorders could improve these patients' health and quality of life. [3]

Sleep Disorders

At least 40 million Americans each year suffer from chronic, long-term sleep disorders each year, and an additional 20 million experience occasional sleeping problems. These disorders and the resulting sleep deprivation interfere with work, driving, and social activities. They also account for an estimated \$16 billion in medical costs each year, while the indirect costs due to lost productivity and other factors are probably much greater. Doctors have described more than 70 sleep disorders, most of which can be managed effectively once they are correctly diagnosed. The most common sleep disorders include insomnia, sleep apnea, restless legs syndrome, and narcolepsy. [3]

Insomnia [Inability to Sleep]

People tend to sleep more lightly and for shorter time spans as they get older, although they generally need about the same amount of sleep as they needed in early adulthood. About half of all people over 65 have frequent sleeping problems, such as insomnia. Almost everyone occasionally suffers from short-term insomnia. This problem can result from stress, jet lag, diet, or many other factors. Insomnia almost always affects job

performance and well-being the next day. About 60 million Americans a year have insomnia frequently or for extended periods of time, which leads to even more serious sleep deficits. Insomnia tends to increase with age and affects about 40 percent of women and 30 percent of men. It is often the major disabling symptom of an underlying medical disorder. [3] In addition to being a risk factor for a depressive episode, persistent insomnia may serve to perpetuate the illness in some elderly patients and especially in those receiving standard care for depression in primary care settings [15]

Stress Hormones and Insomnia

That stress can affect proper sleep seems obvious. It appears to be due to increased vulnerability of sleep to stress hormones. As men age, it appears they become more sensitive to the stimulating effects of corticotropin-releasing hormone (CRH). When both young and middle-aged men were administered CRH, the older men remained awake longer and slept less deeply. In another study, the researchers compared patients with insomnia to those without sleep disturbances. They found that "insomniacs with the highest degree of sleep disturbance secreted the highest amount of cortisol, particularly in the evening and nighttime hours," suggesting that chronic insomnia is a disorder of sustained hyperarousal of the body's stress response system [7].

Sleep Apnea

Sleep apnea is a disorder of interrupted breathing during sleep. It usually occurs in association with fat buildup or loss of muscle tone with aging. These changes allow the windpipe to collapse during breathing when muscles relax during sleep. This problem, called obstructive sleep apnea, is usually associated with loud snoring. Sleep apnea also can occur if the neurons that control breathing malfunction during sleep.

During an episode of obstructive apnea, the person's effort to inhale air creates suction that

obliterates the airway. This blocks the air flow for 10 seconds to a minute while the sleeping person struggles to breathe. When the person's blood oxygen level falls, the brain responds by awakening the person enough to tighten the upper airway muscles and open the windpipe. The person may snort or gasp, then resume snoring. This cycle may be repeated hundreds of times a night. The frequent awakenings that sleep apnea patients experience leave them continually sleepy and may lead to personality changes such as irritability or depression. Sleep apnea also deprives the person of oxygen, which can lead to morning headaches, a loss of interest in sex, or a decline in mental functioning. It also is linked to high blood pressure, irregular heartbeats, and an increased risk of heart attacks and stroke. Patients with severe, untreated sleep apnea are two to three times more likely to have automobile accidents than the general population. In some high-risk individuals, sleep apnea may even lead to sudden death from respiratory arrest during sleep. [3,7].

Nasal continuous positive airway pressure therapy was effective in controlling obstructive sleep apnoea. [13]

Restless Legs Syndrome

Restless legs syndrome (RLS), a familial disorder causing unpleasant crawling, prickling, or tingling sensations in the legs and feet and an urge to move them for relief, is emerging as one of the most common sleep disorders, especially among older people. This disorder, which affects as many as 12 million Americans, leads to constant leg movement during the day and insomnia at night. Severe RLS is most common in elderly people, though symptoms may develop at any age. In some cases, it may be linked to other conditions such as anemia, pregnancy, or diabetes.

Many RLS patients also have a disorder known as periodic limb movement disorder or PLMD, which causes repetitive jerking movements of the limbs, especially the legs. These movements occur every 20 to 40 seconds and cause repeated awakening

and severely fragmented sleep. In one study, RLS and PLMD accounted for a third of the insomnia seen in patients older than age 60. RLS and PLMD often can be relieved by drugs that affect the dopamine, suggesting that dopamine abnormalities underlie these disorders' symptoms. [3]

Narcolepsy

Narcolepsy affects an estimated 250,000 Americans. People with narcolepsy have frequent "sleep attacks" at various times of the day, even if they have had a normal amount of sleep. These attacks last from several seconds to more than 30 minutes. People with narcolepsy also may experience cataplexy (loss of muscle control during emotional situations), hallucinations, and temporary paralysis when they awaken, and disrupted night-time sleep. These symptoms seem to be features of REM sleep that appears during waking, which suggests that narcolepsy is a disorder of sleep regulation. The symptoms of narcolepsy typically appear during adolescence, though it often takes years to obtain a correct diagnosis. The disorder (or at least a predisposition to it) is usually hereditary, but it occasionally is linked to brain damage from a head injury or neurological disease.

Once narcolepsy is diagnosed, stimulants, antidepressants, or other drugs can help control the symptoms and prevent the embarrassing and dangerous effects of falling asleep at improper times. Naps at certain times of the day also may reduce the excessive daytime sleepiness.

In 1999, a research team working with canine models identified a gene that causes narcolepsy—a breakthrough that brings a cure for this disabling condition within reach. The gene, hypocretin receptor 2, codes for a protein that allows brain cells to receive instructions from other cells. The defective versions of the gene encode proteins that cannot recognize these messages, perhaps cutting the cells off from messages that promote wakefulness. The researchers know that the same gene exists in humans, and they are currently

searching for defective versions in people with narcolepsy. [3]

Sleep Related Sexual Disorders

A broad range of sleep related disorders associated with abnormal sexual behaviors and experiences exists, with major clinical and forensic consequences. [13] They include sleep exacerbation of persistent sexual arousal syndrome, sleep related painful erections, and sleep related dissociative disorders.

A full range of sleep related sexual behaviors with self and/or bed partners or others were reported, including masturbation, sexual vocalizations, fondling, sexual intercourse with climax, sexual assault/rape. Adverse physical and/or psychosocial effects from the sleepsex were present in all parasomnia [sleep related dysfunction] and sleep related seizure cases. Confusional arousals were diagnosed as the cause of "sleepsex" in 26 cases (with obstructive sleep apnea).

Forensic consequences were common, occurring in 35.5% of parasomnia cases, with most involving minors. All parasomnias cases reported amnesia for the sleepsex, in contrast to 28.6% of sleep related seizure cases. [13]

Snoring

Obstructive Sleep Apnoea is one important cause. In an Italian study of more than 2,200 children, the group with the highest body mass index (BMI) was more than twice as likely to snore, compared to the group with the lowest BMI (a measurement of weight in relation to height). Snoring and attention-deficit/hyperactivity disorder (ADHD) are found to be associated in young children. After collecting data on more than 5,000 six-year-olds, and surveying the parents of 11,000 first-graders, a research team found that twice as many ADHD children experienced frequent loud snoring, compared to the general population of children. When the kids were treated for their snoring, their ADHD became much better or totally disappeared,

says Gozal. Even if it did not lead to complete resolution, there was some improvement in behavior and less need for medication. [7]

Gravity and Snoring

Because the respiratory system is greatly influenced by the force of gravity, the effect of weightlessness on sleep-related breathing problems was observed in five space shuttle astronauts. Without gravity, breathing problems were reduced by 55% – and snoring was nearly eliminated.

This report suggests that obstructed breathing might be alleviated by sleeping in a more upright position, instead of on the back. [7]

Optimal amount of Sleep in humans Adults

The optimal amount of sleep is not a meaningful concept unless the timing of that sleep is seen in relation to an individual's circadian rhythms. A person's major sleep episode is relatively inefficient and inadequate when it occurs at the "wrong" time of day. The timing is correct when the following two circadian markers occur after the middle of the sleep episode but before awakening: [1]

- maximum concentration of the hormone melatonin, and
- minimum core body temperature.

Tips for a Good Night's Sleep: [3]

Set a schedule:

Go to bed at a set time each night and get up at the same time each morning. Disrupting this schedule may lead to insomnia. "Sleeping in" on weekends also makes it harder to wake up early on Monday morning because it re-sets your sleep cycles for a later awakening.

Exercise:

Try to exercise 20 to 30 minutes a day. Daily exercise often helps people sleep, although a workout soon before bedtime may interfere with

Age	Hours
Newborn	18
3 months	15
6 months	14–15
1 year	13–14
2 years	13
3 years	12
4–6 years	11
7–8 years	10
9–17 years	9–11
Adults, Elderly	7–8
Pregnant women**	7–8(+)

** During pregnancy women may need more sleep per night. [1]

Table 1: Average total number of hours sleeping per day

sleep. For maximum benefit, try to get your exercise about 5 to 6 hours before going to bed.

Avoid caffeine, nicotine, and alcohol:

Avoid drinks that contain caffeine, which acts as a stimulant and keeps people awake. Sources of caffeine include coffee, chocolate, soft drinks, non-herbal teas, diet drugs, and some pain relievers. Smokers tend to sleep very lightly and often wake up in the early morning due to nicotine withdrawal. Alcohol robs people of deep sleep and REM sleep and keeps them in the lighter stages of sleep.

Relax before bed:

A warm bath, reading, or another relaxing routine can make it easier to fall sleep. You can train yourself to associate certain restful activities with sleep and make them part of your bedtime ritual.

Sleep until sunlight:

If possible, wake up with the sun, or use very bright lights in the morning. Sunlight helps the body's internal biological clock reset itself each day. Sleep experts recommend exposure to an

hour of morning sunlight for people having problems falling asleep.

Don't lie in bed awake:

If you can't get to sleep, don't just lie in bed. Do something else, like reading, watching television, or listening to music, until you feel tired. The anxiety of being unable to fall asleep can actually contribute to insomnia.

Control your room temperature:

Maintain a comfortable temperature in the bedroom. Extreme temperatures may disrupt sleep or prevent you from falling asleep.

See a doctor if your sleeping problem continues:

If you have trouble falling asleep night after night, or if you always feel tired the next day, then you may have a sleep disorder and should see a physician. Your primary care physician may be able to help you; if not, you can probably find a sleep specialist at a major hospital near you. Most sleep disorders can be treated effectively, so you can finally get that good night's sleep you need.

Summary

- Sleep is a restorative process
- It is initiated and terminated by brain mechanisms through transmitters
- Sleep is disturbed by, caffeine, nicotine, alcohol, jet lag, temperature, noise, and diseases
- Sleep deprivation can cause accidents, heart problems and obesity and worsen diabetes, brain function, behavior of children, immune system and reduce life span.
- Adequate sleep benefits, neurons and synapses, cellular growth and repair, learning and memory, reduction of stress, better decision making and erasing unwanted memories.
- Many disease processes interact with sleep.
- Sleep helps to recover from many diseases.

- Sleeping disorders must be treated.
- Good night's sleep is essential for good quality life.

"Sleep is better than medicine."

--- English Proverb

"The beginning of health is sleep."

--- Irish Proverb

"Disease and sleep keep far apart."

--- Welsh Proverb

Early to bed, and early to rise, makes a man healthy, wealthy, and wise."

--- Benjamin Franklin, 1758
(in *Poor Richard's Almanack*)

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Nutrition and Chronic Diseases

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1. Introduction

Hunger and malnutrition are the most devastating problems faced by the world's poorest nations and affect nearly 30% of humanity^{1,2}. Many developing countries are now facing persisting food insecurity and under-nutrition as well as emerging epidemics of chronic diseases (chronic diseases are diseases of long duration and generally slow progression), such as obesity, heart disease, hypertension, stroke, and diabetes³. Currently, 15.3 million people are estimated to die from cardiovascular diseases every year; that represents one-third of all global deaths from all causes. In the next two decades, the increasing burden of cardiovascular diseases will be borne mostly by developing countries⁴. The number of cases of diabetes worldwide is currently estimated to be around 150 million. In Jaffna with time the number of diabetics admitted to the hospital and attending the clinic is also increasing⁵. Most of the patients are affected with type 2 diabetes⁵. In 2000, over 6 million people died from cancer, and between 2000 and 2020, the total number of cases of cancer is predicted to increase by 73% in the developing world and by 29% in the developed world, largely as a result of an increase in the number of old people. Incidence of cancer is increasing in Sri Lanka and it is the fifth cause for the deaths in Sri Lanka⁶.

These recent data obtained also indicates that Jaffna is also not different from other developing countries in developing chronic diseases. Significant lifestyle changes in the second half of the 20th century have greatly contributed to the emerging epidemic of chronic diseases. Therefore it is very important to bring in the awareness on the relationship between nutrition and chronic diseases.

2. Illness or Wellness?

To become ill or leading a healthy life depends on an individual. Genetics, genetics & nutrition and genetics & environmental factors are likely to have effects on health and susceptibility to disease⁹.

3. How can genes and nutrition interact?

Genetic factors determine how susceptible a person is to develop a disease, whilst environmental factors determine which susceptible individuals will actually develop an illness. The genetic makeup of an individual coordinates their response to diet, and thus considers underlying genetic polymorphisms. Changes in dietary patterns may affect people in different ways because of genetic variations between individuals. While targeted dietary advice for susceptible populations or individuals is desirable, it is more practical to focus on overall environmental changes that might reduce the number of susceptible persons those who would go on to develop the diseases¹⁰.

There is good evidence that nutrients and physical activity influence gene expression and shape the genome. Gene-nutrient interactions also involve the environment. Genes define opportunities for health and susceptibility to disease, while environmental factors determine which susceptible individuals will develop illness. In view of changing socioeconomic conditions in developing countries, such added stress may result in exposure of underlying genetic predisposition to diseases.

4. How are chronic diseases linked to diet and nutrition?

Links have been established between dietary habits and degenerative diseases like cardiovascular diseases, diabetes type 2 and cancer. Unbalanced nutrient intakes are known to

be associated with the development of chronic diseases demonstrating that dietary chemicals have direct effects on molecular genetic processes. Therefore susceptible to chronic diseases is determined only 30% by genetic factors, while 70% is determined by other factors. Therefore keeping away from the chronic diseases is mainly in our hands.

There is dramatic increase in overall fat intake and refined foods, a corresponding reduction in the proportion of energy from starchy staple foods, accompanied by a shift from coarse grain and legumes towards more refined grains (mainly rice and wheat); greater intake of meat fish, dairy products and edible also¹¹. The general effect is to make diet less bulking and denser in energy. On an average, the amount of food consumed per person has increased by nearly 20% between the mid 1960s and date 1990s, reactively an estimated 2803 Kcal per day³. The increase in food consumption has been accompanied by a shift in dietary energy sources away from basic foods such as cereals and fruits and vegetables & towards animal products and vegetables oils¹².

5. How does diet affect health at different stages of life?

The risks of developing chronic diseases begin in foetal life and continue into old age. Thus, adult chronic diseases reflect the combined effects of prior exposure to damaging environments. Preventive measures can, therefore, be taken at all life stages.

5.1 Foetal and in early infancy

In the womb and in early infancy, several risk factors can influence susceptibility to the development of diet-related chronic diseases later in life. Slowed growth in the womb, which leads to low birth weight, affects nearly a quarter of all newborn babies¹³. It can profoundly influence childhood growth, survival, and physical and mental capacity, as well as increase the risk of developing diet-related chronic diseases such as

cardiovascular disease (CVD), obesity hypertension, and adult onset diabetes, stroke, later in life¹⁴⁻¹⁸. In developing countries low birth weight & stunting are accompanied by concurrent rapid shift in diets of mother, activity pattern & obesity^{11,19&20}. In Sri Lanka low birth weight observed in 1990 was 25% while stunting prevalence was 20.8%²¹.

Unusually large size at birth, possibly resulting from over-nutrition in the womb, has been linked to an increased risk of diseases such as diabetes and cardiovascular diseases.

5.2 Breastfeeding

Breastfeeding has lower risk of developing obesity in later life than those fed with other milk preparations for instance infants fed with formula milk may increase the risk of developing several chronic diseases, such as type 1 diabetes and cancer, in childhood and adolescence. The level of cholesterol and specific type of fatty acids present in the milk fed to babies are thought to affect the maintenance of cholesterol levels in later life²².

5.3 During infancy and childhood, both delayed growth and excessive weight or height gain has been shown to contribute to chronic disease in later life. For instance, infants with a low weight or short stature may experience an increased risk of coronary heart disease, stroke, or diabetes. Shorter children who gain height particularly quickly have an increased risk of stroke and certain cancers.

5.4 Childhood and adolescence

During childhood and adolescence, the adoption of habits such as unhealthy diets, low-levels of exercise, as well as alcohol and tobacco use has been shown to increase the risk of developing certain chronic diseases²³.

An unhealthy diet contributes to high blood pressure in children causing changes in the body

which are associated with the risk of developing cardiovascular disease and obesity. A high calorie intake in childhood is also linked to an increased risk of cancer in later life. Worryingly, not only do chronic diseases occur earlier and earlier in life, but they tend to persist throughout life.

5.5 Adulthood

Most chronic diseases are expressed in **adulthood**; therefore, it is a critical time for reducing risk factors and increasing effective treatment. Risk factors that prevail during adulthood have been strongly linked with cardiovascular disease and diabetes including tobacco use, obesity, physical inactivity, high cholesterol level, high blood pressure and alcohol consumption. An individual's ability to take control over his or her life and to make healthy lifestyle decisions appears to be an important determinant of health.

5.6 People older than 60

The main burden of chronic diseases is observed in **people older than 60**. Cardiovascular disease, type-2 diabetes and some cancers are most common at this stage in life. This is mainly due to multiple disease processes combining with age-related losses in physiological functions. As the risk of developing disease is generally believed to be reversible at any age there is an absolute benefit for ageing individuals to eat healthily, maintain their weight, and continue to exercise.

6. Diet induced chronic diseases

6.1 Excess weight gain and obesity

While over weight and obesity are most common in developed countries, almost all countries are now affected by this worldwide epidemic, as diets are becoming richer and people more inactive. The increase in the number of cases of excessive weight gain and obesity has been paralleled by an increase in some chronic diseases such as cardiovascular

disease and diabetes and some cancer^{11,24&25}. The energy dense diets increase the risk of overweight and obesity is does physical in activity^{11,26-29}. Due to the transition of the dietary pattern and life style over weight and obesity are affecting the developing countries.

Within a country, the occurrence of excess weight / obesity tends to vary between certain age groups and socioeconomic classes. For example, in the most affluent countries, obesity is now affecting not only middle aged people, but also increasingly young adults and children. A study made in Jaffna has shown that 50% of the overweight adults are between the age group of 41-60³⁰.

How can diet and physical activity affect obesity?

Certain types of foods and eating habits have been linked to weight gain and obesity, for instance snacking, binge-eating, and eating out^{27&28}. Physical activity and physical fitness are important factors in reducing the risk of unhealthy weight gain and related illnesses, such as heart diseases, and moderate to high fitness entails health benefits (independent of body weight).

With increasing overweight, as measured by the Body Mass Index (BMI), there is an increase in mortality rates and in the proportion of people with additional health conditions²⁹. In one study in the USA, over half of all deaths in women with a BMI greater than 29 kg/m² could be directly attributed to their obesity. Approaches in obesity reduction will reduce the risk of other pathologies such as adult onset diabetes cardiovascular disease and certain cancer³¹. A body mass index of 25 in an Asian adult appears to have a far greater adverse metabolic effect than it does in a Caucasian adult³². It has been proposed a lower BMI cut off 23 for overweight and 25 for obesity for Asians³³. Obesity levels are higher in urban than in rural areas. Obesity levels are not associated with wealth. Householders with both undernourished and overweight women represent 3-15% of households in developing countries²⁶.

The underweight child coexisting with an overweight non-elderly adult is a predominant poor combination/coexistence.

6.2 Cardiovascular diseases

Cardiovascular diseases include:

- ❖ **atherosclerosis**, which occurs when fatty deposits clog and harden arteries,
- ❖ **coronary heart disease**, caused by the reduced blood supply to the heart muscle,
- ❖ **stroke**, caused by inadequate blood flow to the brain leading to the death of brain cells,
- ❖ **hypertension**, occurs when blood pressure is higher than the normal range,
- ❖ **Cardiac arrhythmias**, which are irregular or abnormal heartbeats.

6.2.1 What nutrients are known to affect cardiovascular diseases?

A high intake of **dietary fats and refined foods** strongly influences the risk of developing cardiovascular disease (CVD)³⁴⁻³⁶. Restriction of calories shall reduce the risk of developing CVD⁴⁴. Saturated fatty acids commonly found in dairy products and meat raise cholesterol levels. Moreover, studies have also shown trans-fatty acids, found in industrially hardened oils, increase the risk of coronary heart disease. While they have been eliminated from spreads in many parts of the world, trans fatty acids are still found in deep-fried fast foods and baked goods. To promote cardiovascular health, intake of saturated fats should be limited to less than 10% of daily energy intake for most people, and to less than 7% for high-risk groups. Products commonly used for cooking, such as hydrogenated fats or coconut and palm oil, contain saturated fatty acids. Limiting the amount of saturated fatty acids consumed can be accomplished by restricting the intake of fat from dairy and meat sources, avoiding the use of hydrogenated oils in cooking, and ensuring a regular intake of fish (once or twice per week).

The most effective replacement for saturated

fatty acids in the diet is polyunsaturated fatty acids (PUFAs) which can lower the risk of developing cardiovascular disease. In particular, they are found in soybean³⁷ and sunflower oils as well as in fatty fish and plant foods. Polyunsaturated fatty acids have many positive effects, notably on blood pressure, heart function, blood clotting, and inflammatory mechanisms³⁸.

Cholesterol, which is an essential component of cell membranes and certain hormones, is produced by the liver, but it is also present in dairy products, meat and eggs. In the blood cholesterol is mainly transported by high density lipoprotein (HDL) and low density lipoprotein (LDL). The cholesterol carried by LDL can lead to its deposition in the arteries that can restrict blood flow and may cause heart problems. It is recommended to avoid excessive intake of cholesterol to prevent coronary heart diseases. Cholesterol is not, in fact, required in the diet because it is produced by the liver in sufficient amounts.

The studies in western population have proved that Fish consumption reduces the risk of coronary heart disease³⁸. In one particular study, a group of patients who survived a heart attack were given fish oils over several years. Compared to patients who did not receive fish oil, this group had a 20% reduction in total mortality, a 30% reduction in cardiovascular death and a 45% decrease in sudden death. Eskimos and Japanese have less risk of cardiovascular diseases due to their consumption of cold water fish which are rich in fish fat (heart diseases and fat)³⁹.

Fish consumption once or twice per week is protective against coronary heart disease and stroke. The benefits are most evident in high risk groups. For these groups, consuming 40-60g of fish per day would lead to a 50% reduction in the number of deaths from coronary heart disease. Vegetarians should ensure an adequate intake of the essential fatty acid alpha-linolenic acid which is also found in plant sources (such as canola and soybean oils, pumpkins, and walnuts).

Dietary fibre is also a major factor in reducing total cholesterol in the blood and LDL cholesterol in particular³⁷. Eating a diet high in fibre and wholegrain cereals can reduce the risk of coronary heart disease.

A high intake of **salt** (sodium chloride) has been linked to high blood pressure, a major risk factor for stroke and coronary heart disease^{40&41}. There is convincing evidence that a reduction in the daily intake of sodium (by 50 mmol, i.e about 1.2g across the world would lead to reduction in the number of deaths resulting from strokes and coronary heart disease (by about 22% and 16% respectively). Restricting **salt** intake to less than 5 g per day generally helps to reduce the risk of coronary heart disease and stroke. Restricting salt intake even more, to 1.7g of sodium per day may provide additional benefits such as helping to reduce blood pressure. However, precautions should be taken in special cases such as pregnant women who may be adversely affected by sodium reduction.

Taking potassium supplements has been shown to reduce blood pressure and the risk of CVD. However, the usual intake of fruit and vegetable consumption supplies an adequate intake of potassium and there is no evidence in favour of long term potassium supplementation to reduce the risk of CVD.

Thirty minutes of moderate **physical activity** every day may be sufficient to raise fitness of the heart and lungs which in turn may reduce the risk of CVD. A longer duration and a higher activity level would provide an even greater benefit. However, people who are generally inactive should avoid sudden and high-intensity bursts of physical activity.

6.3 Diabetes

Diabetes is a disease that develops when the body is unable to produce or respond to insulin in the normal way. There are two types of diabetes.

Type-1 diabetes is less common and associated

with a total lack of insulin. Previously known as insulin-dependent diabetes, it usually results from the destruction of the insulin-producing cells of the pancreas by the immune system. Both genetic and environmental factors seem to be involved in the onset of the disease.

Type-2 diabetes, previously known as non-insulin-dependent diabetes, accounts for most cases of diabetes worldwide. In this form of the disease, the body's failure to respond to insulin in the normal way leads to the overproduction of insulin, which may result in a partial failure of the insulin producing cells of the pancreas and consequently insufficient insulin production. Genetic and environmental factors determine the likelihood of developing type-2 diabetes⁵.

Serious complications that can result from diabetes include blindness, kidney failure, amputation, infections, coronary heart disease and stroke. In Jaffna during 2006 126 amputations and 557 surgical managements for diabetes mellitus wounds were carried out. About 63 diabetes nephropathy with chronic renal failure was also observed⁵. Lifestyle changes are key to both reducing the risk of developing and treating type-2 diabetes.

6.3.1 What factors are known to affect diabetes?

There is convincing evidence that excessive weight gain and excess fat in the abdomen increases the risk of developing type-2 diabetes⁴². Excess fat in the abdomen is an important factor in the development of insulin resistance, a condition that underlies most cases of type-2 diabetes.

Children of mothers who are affected by diabetes during pregnancy are also at high risk of developing obesity and type-2 diabetes in childhood. Delayed growth in the womb and low birth weight may also increase the risk of developing resistance to insulin.

Overall, studies on humans indicate a probable causal link between saturated fatty acids and type-2 diabetes, and a possible causal

association between total fat intake and type-2 diabetes.

6.3.2 How could diabetes be prevented?

Specific measures can be taken to reduce the risk for diabetes, especially efforts that focus on controlling weight and preventing obesity and cardiovascular disease. Measures include:

- ❖ Avoiding weight gain of more than 5 kg in adult life and treating excessive weight gain and obesity.
- ❖ Maintaining a mean Body Mass Index (BMI) in the range of 21-23 kg/m².
- ❖ Voluntary weight loss in overweight or obese people with higher than normal blood sugar levels.
- ❖ Engaging in at least a moderate level of physical activity for one hour or more in the course of the day on most days of the week. Exercising at 80 to 90% of maximum heart rate for at least 20 minutes five days per week may substantially improve insulin sensitivity
- ❖ Ensuring a low saturated fat intake.
- ❖ Consuming at least 20g of dietary fibre per day (i.e. whole grain cereals, fruit and vegetables).

In overweight people, voluntary weight loss enhances insulin sensitivity and reduces the risk of type-2 diabetes. Regular vigorous exercise may improve insulin sensitivity and thus reduce the risk of developing type-2 diabetes. The data collected in December 2007 indicated that 7788 adults and 11 children registered as diabetics in the medical clinics of Jaffna Teaching hospital⁵.

6.4 Cancer

Cancer is now a major cause of mortality. This is largely due to the fact that people tend to live longer, with fewer people dying from other causes such as infectious diseases. Cancer is caused by a variety of identified and unidentified factors. The most important proven cause of cancer is tobacco smoking. Other important factors include diet, alcohol consumption,

physical activity, infectious diseases, hormonal factors and exposure to radiation.

6.4.1 How can diet and physical activity affect the occurrence of cancer?

The likelihood of developing cancer may increase or decrease depending on what people eat how often they exercise. Dietary factors are estimated to account for approximately 30% of cancers in industrialized countries, making diet second only to tobacco as a theoretically preventable cause of cancer. Research to date has uncovered few definite relationships between specific dietary factors and cancer risk.

Factors for which there is evidence of an increased risk include:

- ❖ Obesity
- ❖ High intake of alcoholic beverages, aflatoxins (a toxic substance produced by certain molds), and preserved meat and salted or fermenting fish.
- ❖ Consuming drinks and food that are extremely hot (thermally)
- ❖ **Overall**, about 20-33% of cancers affecting the breasts, colon, uterus lining, kidney and oesophagus are attributable to unhealthy body weight and lack of physical activity.

Risk factors in developing **oral cavity, pharynx and oesophagus cancers** seem to vary between countries. In developed countries, alcohol and tobacco alone cause up to 75% of these cancers. In developing countries, 60% of these cancers are attributed to a diet low in fruits, vegetables and animal products. Throughout the world, consuming extremely hot (thermally) drinks and food increases the risk of these cancers. The observation made in Jaffna is very closer to what has been observed in the developed countries.

Studies have investigated the specific role of diet in the development of major cancers **Lung cancer** is the most common cancer in the world and over 80% of cases in developed countries are caused by tobacco smoking. The possible preventive effect of fruit and vegetables consumption

against lung cancer remains controversial. In Jaffna, water nitrate levels are very high. This may be due to the use of fertilizer in agriculture and improper sewerage system available in the North. Farmers too are not adhering to the regulations with regard to the use of pesticides and fertilizers. The farm products would be having pesticide residues, above permissible levels.

Changes in diet and nutrition may play an important role in the increasing frequency of specific cancers. Traditional and industrial food processing methods as well as microbiological and chemical food contaminants are factors that may contribute to the carcinogenicity of diets.

Although **stomach cancer** was once the most common cancer in the world⁴³. Dietary factors are thought to play an important role and substantial evidence suggests that a high intake of salty, preserved foods can increase the risk of stomach cancer, whilst a diet rich in fruits and vegetables may reduce the risk. A bacterial infection of the stomach (*Helicobacter pylori*) is known to contribute to an increased risk.

The risk of developing cancer of the uterus lining is greater in women who are obese, probably because of changes in hormone levels. Some studies suggest that a diet high in fruits and vegetables and low in fat might reduce the risk in developing **endometrial cancer**. Overweight and obesity may cause up to 30% of **kidney cancer** cases.

Liver cancer occurs much more frequently in developing regions. Southeast Asia liver cancer is closely linked to certain infections (hepatitis B or hepatitis C) and to eating foods that have been contaminated by a toxic substance produced by certain molds (aflatoxin).

Colorectal cancers are linked with the diet, such as a high intake of fat and preserved meat or overweight, seem to increase the risk of colorectal cancer. A high intake of dietary fiber, folate, calcium, and fruits and vegetables might decrease the risk of colorectal cancer. In addition, increased physical activity has been consistently associated with a reduced rate of colon cancer.

Cancer of the pancreas is more common in developed countries than in developing countries. Overweight might increase the risk of developing pancreatic cancer. Moreover, the risk might increase with a high intake of meat, and decrease with a high intake of vegetables.

Breast cancer is the second most common cancer in the world and the most common among women. It occurs much more frequently in developed countries than in less developed countries. This may reflect differences in risk factors linked to reproduction, such as age at the onset of menstruation, age of giving birth, number of children, and breastfeeding. Differences in dietary habits and physical activity may also contribute. Although obesity affects women of all ages, it only increases the risk of developing breast cancer in postmenopausal women. Many studies have shown a small increase in risk of breast cancer as alcohol consumption increases.

Mortality rates from **prostate cancer** are ten times higher in North America and Europe than in Asia, though figures are difficult to compare between countries because of different diagnostic practices. It is not yet clear if and how diet may influence the development of prostate cancer.

6.4.2 How could cancer be prevented?

The main diet and exercise-related recommendations for reducing the risk of cancers are as follows:

- ❖ *Primary Prevention*: The goal of primary prevention is to reduce or eliminate exposure to cancer causing factors, which include environmental carcinogens and life style factors related to nutrition and physical activity. This would include immunization against, or treatment of, infectious agents that cause certain cancers; use of tobacco control programmes; reduction of excessive alcohol consumption; dietary intervention and pharmacological intervention.
- ❖ Maintain a Body Mass Index (BMI) in the

range of 18.5 to 24.9 kg/m² and avoid weight gain of more than 5 kg in adult life.

- ❖ Maintain regular physical activity, such as one hour of fast walking most days of the week
- ❖ Consumption of alcoholic beverages should be avoided or limited to two glasses of either beer, wine or spirits per day
- ❖ Consumption of salt-preserved foods, preserved meats (such as sausages, salami, bacon, ham) and salt should be limited.
- ❖ Avoid eating foods that have been contaminated by aflatoxin, a toxic substance produced by certain molds.
- ❖ Eat at least 400 g of fruits and vegetables per day.
- ❖ Do not consume foods or drinks when they are at a very hot temperature.

7. What could be the dietary advice to the Jaffna population to avoid such chronic diseases?

Diet largely defines a person's health, growth, and development. A shift from relatively monotonous diets of varying nutritional quality, based on the indigenous staple grain or root, locally grammars legumes, vegetables & fruits and limited food of animal origin (except any prosperous sub populations) to a relatively industrialized diets, such as high in sugars and foods of animal origin, and hence animal fat, low in starches, dietary fibers, fruits and vegetables, more processed drinks and foods, and after more alcohol. The combination of energy dense diets with physically inactive life style is an underlying factor a rapid increase in number of overweight and obese peoples. This is the basis for the development of chronic diseases. Chronic diet related diseases vary in severity and significance. These include obesity, adult onset diabetes (Diabetes Type II, insulin independent diabetes), hypertension, peripheral vascular disease and stroke, hyper lipid angina, and coronary heart disease, and a number of cancers, including those of the mouth, throat, esophagus, lung, stomach, breast, prostate, colon and rectum. Most of the diseases also have non

dietary cause, e.g. use of tobacco and lung cancer. They are also often hereditary, but any inherited genetic predisposition to disease is usually unemotional only as a result of inappropriate environmental risk factors including diet.

To avoid the diet induced chronic diseases it is important to get the basic awareness of the principles of nutrition and modify the day to day food habits with healthy diets. The average energy requirements of adult male and female along with the proportions of the energy which has to be obtained from major nutrients are given in Table 1.

7.1 Nutrients

The essential nutrients include carbohydrates, proteins, fats, vitamins, minerals, fibers and water. The energy required is obtained by the oxidation of carbohydrates, proteins and fats. The vitamins and minerals are said to be accessory nutrients and are used for the metabolism of carbohydrates, proteins and fats. Fibers are indigestible substances but are beneficial to the body.

7.2 Energy

Energy requirement of adults are calculated based on their basal metabolic rate, sex, age, body weight and physical activity. The western values show that average energy requirements of a male and a female are 3000 (2400-4000) and 2200 (1600-3000) kcal respectively. The studies made in Sri Lankan show that the average energy requirements of a male and a female are 2340 and 1665kcal respectively. The energy obtained by the oxidation of 1g of carbohydrate, protein and fat is 4, 4 and 9 kilo calories. It is also advised that an adult has to obtain 65-70% of energy from carbohydrates, 8-10% of the energy from proteins and 15-30% of the energy from fats. Also an adult has to consume a minimum amount of 50g of mixed proteins. Based on these values the amounts of carbohydrates, proteins and fats an adult woman and man can consume are given in table. Reduction in energy consumption can

Sex	Energy requirement (Kcal)		Carbohydrate	Protein	Fat
Male	2340	Amount (g)	380	60	65
		Energy (Kcal)	1521	234	585
		Proportion (%)	65	10	25
Female	1665	Amount (g)	270	50	43
		Energy (Kcal)	1080	200	385
		Proportion (%)	65	12	23

Table 1: The average energy requirements of adult male and female along with the proportions of the energy which has to be obtained from major nutrients.

reduce the development of chronic diseases and increase the life span⁴⁴.

If this energy intake by an individual exceeds these values, fat accumulation shall take place leading to increase in body weight and cause the above said chronic diseases.

For a person to reduce the body weight, consumption of the energy nutrients has to be restricted. To do this and to satisfy the appetite of an individual the food has less energy density has to be consumed.

$$\text{Energy density} = \frac{\text{Energy (kcal)}}{\text{Mass of food (g)}}$$

Calorie restriction has shown to increase the life span of individuals.

7.3 Carbohydrate based food

Consumption of cereals and tubers, which are mainly starch based are consumed in refined form. The carbohydrates are divided into simple and complex. The simple carbohydrates are the ones which can be immediately absorbed without digestion (such as glucose or fructose-which is found in ripped fruits) or easily digested like disaccharides (table sugar or sucrose, the milk sugar-lactose). The complex carbohydrates are the products which needs time to get digested or which cannot be digested at all in human digestive system. The simple carbohydrates elevate the glucose in blood immediately and hence, leading to increased insulin secretion in the normal individual and causing easy conversion into fat

and cholesterol. But the complex carbohydrates need time to elevate the blood glucose level and they are not harmful as the simple carbohydrates. Consumption of simple carbohydrates can lead to more alarming chronic diseases when compared to complex carbohydrates. Urbanization and changes in the dietary style and introducing modern or western recopies into the day to day diets increase the chances of getting chronic diseases. Thus it is essential to avoid the simple carbohydrates as much as possible. Taking beverages and soft drinks with simple sugars are harmful. Taking Pepsi cola, Miranda, Coco Cola, etc are fashionable nowadays and can lead to bad effects. In addition these drinks also contain caffeine. Eating sweet food is another tradition and drinking coffee or tea with a large amount of sugar is also bad.

7.3.1 Glycemic index

The carbohydrates which can release glucose quickly are said to cause immediate increase in blood glucose level. These foods items are said to have high glycemic index values and they have to be avoided. Further over eating of the low glycemic index foods also is not good because they can lead to high glycemic load. This means that the food with low glycemic index in large amount also can increase the blood glucose level to larger extent. Eating low glycemic index foods would be good for CVD^{45&46} and diabetic patients⁴⁷.

Any foods which have GI values less than 55 are

low GI foods, those with 55-70 are medium GI foods and with GI above 70 are high GI foods. From our recent studies the GI values obtained for the locally available foods are given in Table 2a and b⁴⁸⁻⁵¹.

From the research findings it could be concluded that among the starch sources 'atta flour' pittu was the best followed by parboiled rice. Even though we have had a believe that kurakan and its flour are good starch based diets for diabetics and CVD patients, and obese and overweight persons. The results indicated that the foods made out of 'kurakan flour should not be recommended.

Boiled green gram and chick pea increased the blood glucose level to maximum at 1h while all the other foods considered in these studies have increased the blood glucose level to its maximum at half an hour. Further boiled green gram and chick pea showed lower GI values than all the other foods considered. Thus these two can be recommended for coronary heart disease, diabetes patients⁵¹ and obese people who want to follow weight reduction programme and those have the potential to develop chronic disease.

Thus among the different types of plantain varieties, ripped 'ithari' is best followed by kappal. However among the fruits, papya is the best followed by 'ithari' variety of plantain.

7.3.2 Uses of dietary fiber in chronic diseases

Fiber is also considered to be as an important nutrient. **Dietary fibers** are the edible, indigestible portion of carbohydrate and non-carbohydrate substances. Fiber is the major constituent of plant cell wall. Fiber is the part of whole grains, fruits, vegetables, beans, nuts and. Fiber in food provides non-calorie containing bulk. Since human digestive systems contain no enzymes that can hydrolyze fibres they remain almost unchanged during their passage in the alimentary canal. Further fibre-rich foods require more chewing than do those depleted of their fibre and so put brake on the intake of energy⁵³.

In humans, a high fiber diet aids water retention during passage of food along the gut, producing larger softer feces. Some fibers attract water into the digestive tract, thus softening the stools. Softer stools make elimination easier and reduce the pressure in the lower bowel. Some fibers speed up the passage of food materials through the digestive tract, thus shortening the time they are in the intestinal tract. This shorter time helps prevent exposure to cancer-causing agents.

In the small and the large intestine, fiber interacts with cholesterol and bile salts, and carries them out of the body with the solid wastes so that the blood lipid concentrations, such as blood cholesterol (LDL) level, are lowered. Thus the risk of gallstones and coronary heart disease is reduced.

Monosaccharides obtained by the digestion of some complex carbohydrates in the presence of fiber, produce a moderate insulin response and an even rise in blood glucose level.

Bran and whole-grain cereals and cereal products are excellent sources of insoluble fibre. Water insoluble fibre is also concentrated in stalks, seeds and skins or peelings of fruits and vegetables that we can eat. Examples of stalks, seeds and peelings of fruits include skins of apples, pumpkin, green leafy vegetables, etc.

Fibre also fights against the diseases threatening the gastrointestinal health, such as colon cancer, dumping syndrome, constipation, haemorrhoids, and even useful in the management of renal stones.

Most fiber-rich plant foods include legumes (15-19 grams of fiber per serving, including several types of beans, lentils and peas) and Asian pear (10 grams each, 3.6% by weight)

The fibre rich diets are green leafy vegetables like 'murungai leaves (which can also provide iron, β -carotene-precursor of vitamin A and folic acid), 'mulai keerai', 'chandi illai', ponnagkani, vallari, thavasi murungai, cabbage, sirukurncha

Foods		Glycemic Index (%)	Foods		Glycemic Index (%)	Foods		Glycemic Index (%)
Parboiled rice	Green leafy curry	47.5	Pittu (Kurakkan flour)	Green leafy curry	57.5	Pittu (Atta flour)	Green leafy curry	44.4
	Gravy	56.3		Gravy	63.3		Gravy	50.8
	Green leafy curry and gravy	54.7		Green leafy curry and gravy	59.3		Green leafy curry and gravy	46.3
	Nil	56.0						
Sampa rice		66.6	Pittu (Rice flour and wheat flour-1:2 ratio)		43.7	String Hoppers (Rice flour and wheat flour-1:2 ratio)		50.0
Polished Rice (At-402)		60.2						
Cassava		78.7	Potato		75.2			
Chick pea		33.3	Boiled green gram		31.4			

Table 2a: Glycemic Index values of different foods commonly eaten.

Foods	Glycemic Index (%)	Foods	Glycemic Index (%)	Foods	Glycemic Index (%)
'Kappal' Plantain	54.5	'Kathali' Plantain	50.4	'Itharai' Plantain	48.5
Papaya fruit	34.8	Jack fruit	64.4		

Table 2b: Glycemic Index values of different commonly eaten fruits.

(*Gymnema sylvestre*) etc., ladies figure, snake gourd, string bean (they can also provide proteins), winged beans (very good source of protein), brinjal, etc, could be consumed. Papaya is the best fruit rich in soluble fibre.

7.4 Proteins in the food

Protein sources eaten by the vegetarians can provide all the essential amino acids and hence eating only vegetarian diet can satisfy the protein requirement of an individual. However the biological values of the animal proteins are higher than the plant proteins. That is the animal proteins could be efficiently utilized by the human system than the plant proteins. Hence the amount of plant proteins need to be taken equivalent to the animal protein is higher.

Another important fact about proteins is that they all do not have all the essential amino acids, except egg protein. The essential amino acids are the amino acids which cannot be synthesized by the human body. Hence taking foods which would provide mixed proteins shall reduce the essential amino acid deficiencies. For example, eating cereals & legumes or cereals & meat or cereals & fish.

In the diet of the Jaffna population, cereals provide substantial amount of proteins. Adding legumes such as dhal, cow pea, chick pea, string bean, beans, soy meat, etc. shall satisfy the protein requirements.

Among the non-vegetarian dietary sources consumed by the Jaffna population, fish and country chicken are better choices than the broilers (or the birds grown in organized farms), beef and mutton. This is because the fat content is higher in broilers than in country chicken. Meat contains 22% protein. Thus consumption of beef, pork and mutton shall incorporate a high proportion of fat into the diet. Among mutton and beef, the fat removed mutton would be a better choice than beef.

Animal proteins, (even though they have high biological value) they also contribute to

homocysteine which is a non-fatty cardiovascular risk factor), and hence animal proteins have to be consumed in reduced amounts⁵⁴⁻⁵⁸.

The livestock in addition to protein provide essential micronutrients such as iron, zinc and vitamin A, pyridoxine, thiamin and riboflavin, etc. In developing countries like Sri Lanka livestock products remain a desired food for nutritional value and taste. However consumption of animal products can lead to excessive intakes of fats.

Consumption of fish is usually higher in areas that are near the coast, where alternative protein sources are lacking or where there is strong preference for fish. In Jaffna the fish and crustacean intake is more than the intake of livestock products. The amount of fish and fishing products consumption is doubled over 40 years. Fish has protein contents from 9.0 to 26% while crustaceans contain proteins from 9.8 to 25%⁵⁹. Fish provides most of the essential amino acids especially lysine and methionine in high amounts.

Egg is said to contain ideal protein and have all the essential amino acids. However each egg contains 250mg of cholesterol. Therefore for a normal person, it is advised to consume two eggs per week.

7.5 Fats in the food

Dietary fats include many different types of fatty acids and cholesterol. Fat contents of diets depend on the food sources. A growing proportion of fats are acquired from animal products which tend to be particularly high in saturated fats.

- ❖ Saturated fatty acids are often found in animal fats and, eaten in high quantities, can raise cholesterol levels.
- ❖ Monounsaturated and polyunsaturated fatty acids are found in nuts, seafood and certain vegetable oils and can lower cholesterol levels. Among the unsaturated fatty acids, linoleic acid and linolenic acids belong to $\omega 6$ and $\omega 3$ families of fatty acids and are said to be essential fatty acids.

- ❖ Trans-fatty acids are unsaturated fatty acids that behave in a similar way to saturated fatty acids. They are found in hydrogenated oils, such as margarines, and some animal-based foods and can raise cholesterol levels.
- ❖ The consumption of certain types of vegetable oils is increasing in parts of the world. In particular, in developing countries, the intake of hardened margarines (that are rich in trans-fatty acids) is increasing because they do not need to be refrigerated.

The coconut oil consumed contains 92% of saturated fatty acids and has the tendency to increase the blood cholesterol level. Gingili oil contains 47% of linoleic acid. It is one of the most unsaturated fatty acids containing oil in the world. It is also important to note that the oils/fats from plant do not contain cholesterol. Thus coconut oil, gingili oil, vegetable oil, sunflower oil, corn oil and soy oil do not contain cholesterol. However as coconut oil contains high amount of saturated fatty acid and saturated fatty acids have the tendency to increase the serum cholesterol level, coconut fat has to be avoided or reduced depending on the disease condition.

Fish oil is a good source of $\omega 3$ and $\omega 6$ series fatty acids. The $\omega 3$ and $\omega 6$ series fatty acid contents of some of the tropical fish are given in the Table 3.⁵⁹ Among the crustacean foods consumed, crabs and prawns (400-600 mg/100g) have high contents of cholesterol and thus have to be avoided or minimized.

Fish type		$\omega 6$ (mg/100g)	$\omega 3$ (mg/100g)
English Name	Tamil name		
Sardine	Soodai	127	1775
Indian Mackerel	Kanagnkelluthi	132	1010
Yellow fin tuna	Keerai Meen	116	699
Spanish Mackerel	Arukkula	88	431
Trevally	Paarai	30	234
Gray dog shark	Sura Meen	73	200
Skate	Thirukai	56	202
Thilapia	Kari	144	312

Table 3: The $\omega 3$ and $\omega 6$ series fatty acid contents of some of the tropical fish.

7.6 Other foods and nutrients

An intake of 0.8 mg of folic acid (from uncooked green leafy vegetables) could possibly reduce the risk of coronary heart disease (reduced blood supply to the heart muscle) by 16% and the risk of stroke by 24%.

There is insufficient evidence to support the theory that antioxidants such as Vitamin E (from corn or wheat germ oils), Vitamin C (from goose berry, guava, etc.) or β -carotene (from carrot, yellow pumpkin, mangoes) might reduce the risk of cardiovascular diseases (CVD).

Flavonoids, compounds that occur in a variety of foods such as tea, onions and apples, could also possibly reduce the risk of coronary heart disease.

Isoflavones, present in **soy products**, may provide protection against coronary heart disease.

Tea contains 30% of total dry weight green tea consumption reduced breast cancer risk.

Coffee beans contain a substance called cafestol, which can raise the level of cholesterol in the blood and may increase the risk of coronary heart disease.

Oat has cholesterol lowering effect due to soluble fiber β -glucan.

Soy plays preventive and therapeutic roles in cardiovascular diseases, cancer, osteoporosis and the alleviation of menopausal symptoms³⁷.

Tomatoes contain lycopene, the primary caroteniod found in the fruits. Lycopene could act

as an antioxidant and reduce cancer risk.

Garlic contains an odorless amino acid, alliin, which is converted by allinase into allicin⁶⁰. Allicin decomposes to form numerous sulfur – containing compounds, some of which have chemopreventive, inhibit tumorigenesis- (human cancer gene) antihypertensive property and cholesterol lowering effect.

Citrus fruits have protective effect against cancer.

7. Conclusion

The developing countries are facing a big challenge of increasing the risk of chronic diseases among its population, mainly due to transition in their food habits. Development of the chronic diseases could be due to genetic set up of an individual or due to the poor dietary habit or due to genetic set up, poor dietary habit and environment. Even, if a person has the hereditary tendency to develop the above said chronic diseases, the severity and complications arising from these diseases could be minimized by choosing correct nutrition. Awareness about the basic concepts about the nutrition and nutrients present in the food and cooking methods shall improve the nutritional status of an individual.

Food items which have simple carbohydrates, saturated fats, animal fats, cholesterol, should be avoided or the intake should be restricted. A diet comprising of a total fat intake of up to 35% does not increase the risk of unhealthy weight gain in physically active people who consume a lot of fruits, vegetables, legumes and wholegrain cereals.

A daily intake of 400 to 500 g of **fruits and vegetables** such as papaya, green leafy vegetables and legumes is recommended to reduce the risk of coronary heart disease, stroke and high blood pressure. This daily consumption of fruits and vegetables provides an adequate amount of potassium, which lowers blood pressure and is protective against stroke and cardiac arrhythmias. Indeed, fiber that is also found in wholegrain cereals helps to protect

against coronary heart disease and lowers blood pressure.

Eat more fish than meat. Restrict egg to two per week. Eat food with low glycemic index.

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