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Review Article

Nutritional Adequacy in Teenage

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ABSTRACT

The period of transition from childhood to adulthood occurs between the ages of 13 to 19 and is termed as teenage or adolescence in case the upper age limit reaches upto 21. Numerous external and internal factors lay influence upon the food choices and dietary pattern of teenagers, which might lead to altered nutritional status in them, such as malnutrition. Malnutrition includes under as well as over nutrition both. It has long been affecting infants and pre-schoolers on a large scale in under-developed and developing countries, but now even teenagers are getting malnourished due to abnormal eating habits. Those belonging to developed nations, follow westernized eating habits, disorders like anorexia nervosa and bulimia nervosa, etc., while those belonging to comparatively lesser developed nations, burdens of food insecurity, nutritional unawareness, poverty and many such factors are responsible for leading the individual towards under nutrition. Thus this condition has become a matter of global health concern. It is therefore necessary to address the causative factors leading to malnourishment and understand its symptoms and dietary management. This review enlists the characteristics features, symptoms, and management of malnutrition from both, ancient and current perspectives. The risk factors have been categorised into *Ahar* janya factors (dietary factors) and *Vihar* janya factors (lifestyle factors).The paper also highlights the required amount of different nutrients for teenagers such as calories, carbohydrates, proteins, fats, fibre, and certain micronutrients. Description has been provided regarding the appropriate foods to be taken by under and over nourished individuals and certain behavioural modifications needed to be made by them.

Key words: Teenage, Adolescents, Malnutrition, Diet, Nutrition.

INTRODUCTION

Throughout the life cycle of an individual, teenage is one of the most crucial phases involved in the development since it is the transition phase from childhood to adulthood requiring the chief focus on wholesome dietary intake. The dietary patterns of Indian Adolescents' diets seem to be characterised by excessive intake of energy-rich, nutritionally deficient foods and sugar-sweetened drinks as well as small intake of fruits and vegetables. [1] The approximate age range altogether is 12 to 19 years. Teenagers are also called 'adolescents' whose age is given to be 13 to 18 years. Being a transition phase, these individuals undergo many physical and psychological changes which demand adequate supply of nutrients and regular physical activity. This supply has to be in accordance to the recommended dietary allowances and if not, it may lead to malnourishment. Malnutrition is not just restricted to deficiency or excess of one or more nutrient/s but it gives rise to various other associated complications. Therefore nutrition promotion strategies must be designed effectively so that healthy eating can be encouraged and food availability and accessibility can be targeted. [2]

The term malnutrition refers to both under-nutrition as well as over-nutrition and it is defined by low weight-for-age (underweight), length-for-age (stunting), or weight-for-length (wasting). Malnutrition can be correlated to *Karshya* disease in *Ayurveda* due to similarity in disease such as *Parigarbhika*, *Phakka*, *Balashosha*, and *ShuskaRevati* and their clinical features have been described in different *Ayurvedic* texts. [3]

Why Do These Changes Occur?

Approximately 50% of the weight and 20-25% of the height of an individual is built during adolescence, and nutrition at population level serves as a highly significant indicator of variability in this process. [4] Due to increased secretion of sex hormones rapid conversions take place in the body, making them mature for reproduction in a biological context. These changes are clearly characterised by the presence of external sexual characters, such as appearance of facial hairs in males and breast enlargement in females. In the previous studies, the potential consequences of psychosocial and physical transformations were considered to be the risk factors for abnormalities like eating disorders. However, human and animal data are increasingly concluding that genetics is greatly responsible for occurrence of eating disorders. [5] The increasing westernisation, urbanisation and mechanisation occurring in most countries around the world is associated with changes in the diet towards one of high fat, high energy-dense foods and a sedentary lifestyle. [6] Developing countries suffer from both over-nutrition and under-nutrition. The increase in number of over-weight individuals has tripled in last 30 years among the developing countries and reached more than 900 million by 2008. Whereas, rise in the rate of overweight in developed countries was 1.7 times during the same period. [7]

MATERIALS AND METHODS

The present review is based upon thorough study of nutritional requirements pertaining to teenage malnutrition. Relevant literature was collected from online databases like PubMed Central and Google scholar regarding age of teenage, malnutrition, its symptoms and management through dietary and lifestyle modifications. *Ayurvedic compendia* were studied for signs and risk factors leading to malnourishment of an individual.

Inappropriate Body Frame:

Acharya Charak has described following eight types of people to be of inappropriate health status, these are: over-tall, over-short, over-hairy, hairless, over-black, over-fair, over-obese, over-lean. Among these, he has enumerated the characteristic features and management of over and under nourished individuals. According to him, there are certain other distinct features also for over nourished and under nourished individuals, such as, shortened life span, hampered movement, difficulty in sexual intercourse, debility, foul smell, over-sweating, too much appetite, and excessive thirst characterize over-nourished people.

Whereas indulgence in rough (high residue) food and drinks, fasting, low appetite, excessive oppression to evacuative therapy, grief, suppression of natural urges including those of sleep, non-unctuous anointing in rough persons, indulgence in bath, type of body constitution, old age, continued disorder and anger, lead to under-nourishment of the person. [8]

Underlying Factors and Management: Since it is a transition phase leading to maturity, adolescents must possess adequate nutritional status and well-being. Adolescent girls are the vital bridge between the present and future generation. Therefore their well-being is a matter of major concern all over world. Many researchers claim that in South Asia, a high prevalence of under-nutrition among adolescents has been observed. Under-nutrition and overweight, both are world-wide problems, especially spreading to developing countries, where they an increasing threat to health. Out of all the

deaths globally, one third are the consequences of ailments accompanying either excessive weight or low food consumption. [9] Under nutrition lays a damaging effect on the minds and intellect of teenagers by affecting their capability to learn and work at utmost efficiency. Simultaneously, a mounting prevalence of obesity and its associated chronic diseases is also being experienced in these nations. [10] Teenage malnutrition has now been regarded as a global health issue because its long term complications of adverse health status are being known to mankind all over. [11]

Underlying Factors for Adolescent Malnutrition:

- **Maternal and Childhood Malnutrition**- Malnourished women, especially those suffering from micro-nutrient deficiency are more likely to be anaemic and fall prey to maternal mortality at comparatively greater rates. Ifin case they survive, poorly nourished teenage mothers have greater chances to deliver low birth-weight infants, disseminating a succession of health complications from one generation to the following. [12]
- **Parental Influence**- Several studies have explored primary and secondary parent influences within the same home environment in connection to teenage weight and health related conducts. A comparative study on adolescents residing with and without their parents suggests that resident and non-resident parents may affect the weight related behaviours of teenagers in a slightly different way. A significant correlation was observed between the body mass index (BMI) of parents living with their children and healthy behaviours like consumption of fruits and vegetables, and sugar sweetened beverage to that of similar behaviours of their adolescent children. Furthermore, a minimal relationship of physical activity of non-resident parent to physical activity of adolescent was observed which may prove to be a probable influence on adolescents involved in physical activity on their own. [13]
- **Pica-** Many attempts have been made to understand the relation between consumption of non-nutritive substances and micronutrient deficiency. Iron deficiency is related to pica, although the specific etiology is yet to be identified. A study undertaken on this found that adolescents who were engaged in pica had significantly lower iron status than the rest. [14]

Pica has also shown significant association to an increased risk for anaemia and low Hb, Hct, and plasma Zn. Even though the direction of the contributory association between pica and micronutrient deficiency remains unknown, the extent of these associations is comparable to other well documented causes of micronutrient deficiencies. [15]

- **Eating Disorders**- Eating disorders like anorexia nervosa and bulimia nervosa are emerging to be serious risk factors of teenage malnutrition world-wide. A positive correlation has been observed in between eating disorders and underweight status in teenage. [16] Indulgence in anorexia nervosa since long, may cause medical complications such as, neurologic, gastrointestinal, hematologic, dermatological, endocrine, problems of bone metabolism, pulmonary, and cardiac disorders. Concerning the medical status extremely starved male and female patients are similar in overall health with just one exclusion that weight loss in males begins with a lower reserve percentage of body fat and a high amount of lean muscle mass, due to which they undergo less weight loss before ketosis and breakdown of protein. In case of females, Amenorrhea occurs as a warning indication of consequences arising due to excessive weight loss, while there are no visible comparable signals for this in males. [17]

- **Physical Activity-** Not only diet but daily exercise and physical activity is also a determining factor for adolescent over and under nourished status. In a study performed by Aryeetey et al. it was observed that solely dietary and calorie restrictions are insufficient towards the goal of normalising the BMI of an obese individual. Physical activity plays a significant role in energy expenditure and prevention of excess fat deposition in the body. Diet and exercise complement each other in attaining and maintaining a decent health status. [18]
- **Poverty and Unawareness-** India is among the largest adolescent (253 million) and youth populated country in the world. It is evident that the youth population of India is so vast that it corresponds to the entire population of eighteen countries together in western Asia as reported by the United Nations estimates. [19]
- **Poverty and under-** nutrition are strongly associated to each other. Poverty lays down a restriction in access to food which is required to meet daily needs or safeguard dietary diversity and consequently ends up in malnutrition, where as malnutrition may have adverse effects on educational and financial accomplishments, thus continuing poverty. [20]

Unawareness regarding consumption of locally available nutritious foods, organic foods, substitutes of costly food items, as well health complications of packaged foods, snacks, and pre-cooked foods available in the market leads to unhealthy dietary practices and ultimately malnutrition. Brit to et al undertook a research work in Trichy district which examined the awareness regarding organic food in the people. It found that maximum population, i.e. 76% is aware of organic produce out of which the proportion of urban population is more. Here, the researchers have noted that credibility and availability are two main reasons for this. Bringing about more awareness and encouraging people to have their own garden for organically grown foods, can prove to be an aid in increasing its consumption. [21]

- **Inaccessibility-** India suffers from the burden of chronic hunger and inadequate health status at an enormous scale. In the current years, India contributes the maximum number of undernourished people of the world i.e. 212 million. In 1990-92, the total number of such people was 172.4 million and this number increased to 237.7 million in 2005-07 i.e. it showed nearly a 38% increase. The leading contributing factor for this is the absence of up gradation in agricultural yield due to scarce resources and agricultural stability desired by the markets. Overpopulation is often interrelated to competition for food and may end up in malnutrition, this holds true especially for rural areas where access to food is limited. Lack of satisfactory understanding among mothers about nutrition, breast-feeding and parenting is an additional area of concern. [22]
- **Pathological State-** Health conditions like myalgic encephalomyelitis or chronic fatigue syndrome are also among the causes of inappropriate health conditions. It is a condition with clearly distinguishable symptoms of chief complain of severe, restricting fatigue continued for 6 months or even more. [23] In sporadic ME/CFS, there are two peak ages of onset, 11–19 years in young patients and 30–39 years in adults.

Although adolescents are more prone to ME/CFS, yet it can develop in children as young as 2 years. Teenage girls have 3–4 times higher prevalence of ME/CFS than boys of same age group. Roughly around 60% of adolescents with ME/CFS suffer from joint hyper mobility, in contrast to 20% of healthy adolescents. Myalgic encephalomyelitis/chronic fatigue syndrome prior to puberty can influence both, the physical development and pubertal

fluctuations, and the emotive state and self-perception of a growing teen. Pubertal transformations can get delayed or accelerated, or there can also be alterations in physiological processes such as hypo-function or, less usually, hyper-function of neuroendocrine system.

The progression of ME/CFS succeeding puberty can be linked to an interruption in normal, psychological development nurtured by social segregation. It may also lead to cessation of menstruation which will be of major distress for the patient. [24]

Specific etiological factors for under-nutrition:

The ancient literature categorises etiological factors into:

1. *AharJanya* (dietary)
2. ViharJanya (lifestyle)

Ahar Janya factors include *Ruksha Annapana* (foods dry in nature), excessive intake of *Kashaya* (astringent), *Katu* (spicy) and *Tikta* (bitter) rasa in diet.

While, *ViharJanya* factors include *Alpa Bhojana* (inadequate food), *Langhana* (fasting), *Pramitashana* (intake of nutritionally deficient food), *Anashana* (absolute no food intake), *AtapaSevana* (excessive exposure to sunlight), *Ativyayam* (excessive exercise), *MalamutradiNigraha* (suppression of natural urges), *Vatasevana* (extreme exposure to wind), *Atibhargamana*, *Atichinta* (worry), *Atikrodha* (anger), and *Atibhaya* (fear) are contributory factors for malnutrition.

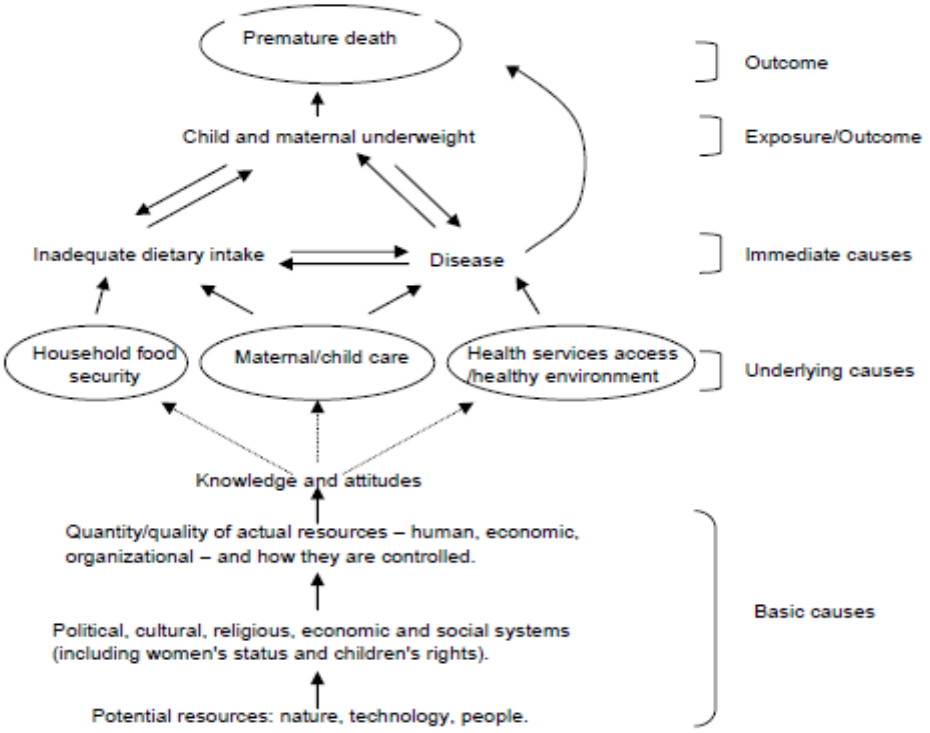

Figure 1: Causal framework for child malnutrition; adapted from UNICEF (1990)

Nutritional Needs of Teenagers: The overall health status of a teenager governs the health status in his/her adulthood. According to WHO estimates about 1.3 million adolescents died from avoidable or curable causes during 2012. Teenage obesity has shown and increasing trend in the recent years due to major shift in the pattern of diet and physical activity. [25] Approximately 35% of the global disease load is rooted in teenage. [26] Therefore to provide optimum levels of intake of different nutrients various institutions have given their own recommendation, such as DRIs. It uses the chronologic age and gender of teenagers and also contains a detailed assessment of the quantity of macro and micro-nutrients necessary to be

consumed daily by an individual. Yet there remains a great difference between actual requirement and recommended values. Hence, it is worthwhile for health professionals to consider clinical parameters and other outcome indicators for nutritional adequacy, body growth, and in overall development also, while considering DRIs. This will further simplify determining the exact nutrient requirement values per day.

1. **Energy-** In order to calculate the correct requirement of energy, the anticipated energy expenditure considering gender, age, height, weight, and physical activity level (PAL) are calculated and an additional 25 kcal are added which is required for growth and deposition. By this method, individual needs can be recognized. PAL is subdivided into following levels,

- Sedentary,
- Low active,
- Active,
- Very active

These levels must be assessed to define most precise values of required energy (in kilocalories).

However, BMI assessment can be very well regarded as an inexpensive and practically feasible technique to evaluate body size, which can be further used to check if or not the data is being under reported or over reported. [27] However, BMI is not the most appropriate technique for body fat assessment as it does not indicates the accumulation of fat in different sites of the body. [28]

According to the National Cancer Institute, fats and sugars are the main nutrients needed to be considered while talking of over-consumption of energy. Scientists have found that the mean daily consumption of extra sugars by 9 to 13 years old males is 29.2 tsp., amongst 14 to 18 years old males, it is 34.4 tsp., among 9 to 13 years old females this value is 25.2 tsp.

Pre-packed commercial foods fast foods, snacks, and bakery items are greatly contributing towards over-weight status in teenagers. In their diet, 16% of added fat is from potatoes, corn, and other fried items like, chips. Therefore, for such cases diet counselling has been proved to be a favourable method in behavioural modification towards obtaining healthy nutritional status. [29]

2. **Proteins-** Daily requirement for protein is appropriately calculated by per kilogram of body weight method owing to individual differences in growth and development rates. According to the reports published by World Health Organization/Food and Agriculture Organization (WHO/FAO), the reference values for protein intake are 0.9 g/kg/day from 3 to 18years of age for boys and from 3 to 15 years of age for girls. [24] From 15 to 18 years of age, this value decreases marginally for girls to 0.8 g/kg/day. [30] Many often the amount of protein consumed is less than its turn-over rate. This implies that protein metabolism undergoes a major feature of re utilisation of amino acids. However, certain other amino acids are also lost from the body by oxidative catabolism. Thus, dietary amino acids must be supplied continuously to replace above losses, even after body growth of the individual ceases. [31]

Proteins: Estimated Average Requirements and RDA for Adolescents

Age (years)	EAR (g/kg/day)	RDA(g/kg/day)
9-13	0.76	0.95 or 34g/day
14-18 (males)	0.73	0.85 or 52g/day
14-18 (females)	0.71	0.85 or 46g/day

3. **Carbohydrates and Fibre:** Carbohydrates constitute important part of dietary glucose and calories and also minor amounts of trace elements like, vitamins, minerals, or other essential nutrients. Fibre is that part of diet which is resistant to mechanical breakdown or enzymatic digestion and consists mainly of cellulose, non-cellulosic polysaccharide and lignin which is a non-carbohydrate component. [32]

The necessity for carbohydrates should be regarded as the primary need for

determining the accurate RDA (recommended dietary allowance) for a teenager. The calculated value of RDA of carbohydrate is 130g/day. To measure many different glycaemic responses brought by various carbohydrate rich foods, the theory of glycemic index GI) was established. [33]

The significance of fibre consumption is likely to be based on the chemical structure of fibre consumed. Fibre structure differs in many aspects such as chain length of fibre, branching present or not, side chains attached, type of binding in them, and composition, one or all of these factors may varying functioning in the human gut and their effects on disease. [34] Some other studies have also suggested that the type of fibre may affect an individual's response and potential for distress brought about by fermentation. [35] Furthermore, the particle size of fibre also contributes to this relationship. [36] If the intake of whole grains, fruits, and vegetables is very poor, then this may cause fibre deficiency in the body. The values of acceptable intake of fibre for adolescents are 31g/day for males of 9-13 years, 38g/day for males of 14-18 years, and 26g/day for 9-18 years old females.

4. **Fat:** The recommended percentage of fat, in total calorie intake for the whole day is 30-35%. Out of this, only 10% calories should be contributed by saturated fatty acids. Although, in order to confirm the acceptable consumption of essential fatty acids, definite recommendations are available for values of omega-3 and omega-6 fatty acids. A study performed on conjugated linoleic acid (CLA) states that, supplementing diet with CLA decreased body fat build-up and increased protein content in rats. [37] Recommended values for omega-6 PUFA, i.e. linoleic acid, are 12g/day for 9-13 years males and 10g/day for 9-13 years females, 16g/day for 14-18 years males and 11g/day for 14-18 years females.

The assessed requirements for omega-3 PUFA (alpha linolenic acid) for teens are 1.2g/day for 9-13 years males, 1g/day for 9-13 years females, 1.6g/day for 14-18 years males and 1.1g/day for 14-18 years females.

Researches undertaken previously have introduced weight loss programs which emphasize upon the intake of fatty fish to decrease lipid content. [38] Diets with restriction of energy consisting of serving fatty fish thrice weekly were shown responsible of raised levels of leptin in subjects who were obese. [39] Taking a hypo-caloric diet having salmon fish, was also shown to improve plasma lipid levels. [40] In a study performed by Ye J, 2009 supplementation of butyric acid has been shown as the responsible factor in reducing body fat by 10% in mice. It can also prevent diet induced insulin resistance as well as increase fat oxidation, hepatic energy expenditure, and PPARγ mediated PPAR α-expression. [41]

5. **Micronutrients:** The requirement for micronutrients gets elevated during teenage years, owing to rapid bodily development. Specifically, the ones involved in synthesis of lean body mass, bones, and red blood cells, are in greater demand. During growth spurt, vitamins and minerals needed for protein synthesis, and formation of DNA and RNA, are required in highest quantities. This requirement declines gradually after acquiring complete maturity, with just one exception of those required for the development of bones, since bone development continues till the end of puberty.

Except for one exception of iron, the demand for almost all the micronutrients is higher in males rather than females, in a comprehensive sense. In females after menarche, the dietary reference intake (DRI) for iron is 15mg/day, whereas a teenage male requires 11mg/day with higher levels essential for growth spurt.

During the pre-pubescent years, the requirement for folate is 300mg/day, which reaches to 400mg/day in later years of puberty.

In order to facilitate the absorption and metabolism of calcium and phosphorus, there is a need for vitamin D. The existing literature says the RDA for vitamin to be 600IU/day. Also, a reasonable increase in protein, less consumption of high GI foods and moderate intake of fat prevented regain of weight in obese patients, as concluded by a similar research. [42]

Importance of Fruits and Vegetables: The search of physical and spiritual well-being has led to wide-spread promotion of vegetarian based diets ever since 18th century. [43] Traditionally speaking, this was a belief that taking certain foods of plant origin, fruits, vegetables, and legumes could prevent or treat ailments right from headaches to heart diseases. [44] Weekly consumption of definite amounts from each vegetable subgroup is suggested for satisfactory nutrient intake.

Initially fruit was defined as "any plant used as food," and a vegetable was indicated as a "plant, as opposed to an animal or inanimate object". [45] Sugars and fibres are principal contents of fruits, just as pectin, which is extensively fermented in large intestine. The taste and sweetness of 55% high-fructose corn syrup are equivalent to those of sucrose. [46] There are descriptions of fruits and vegetables as part of phytochemical groups, e.g., carotenoids, etc. and are also rich in vitamin C and potassium. [47]

Apples hold 6% fructose and 3% sucrose in them, while pears are 6.5% fructose and 1.3% sucrose; although these values would be constant in their juices. Roots and tubers are other significant sources of energy as starch. Potatoes form staple vegetable worldwide. In contrast to green leafy vegetables, they have good content of starch and also supply high biological value protein. [48] Legumes are however better sources of protein as compared to vegetables, but they also have toxic plant metabolites, comprising of saponins and lectins.

There is wide diversity in carbohydrate content of foods and drinks. This also includes digestible carbohydrate and fibre. Epidemiologic studies advocate that there is a negative correlation between dietary fibre and CVD and it is also supposed to have a role in checking obesity. Different varieties of protein sources consumed daily can be helpful in controlling excessive levels of saturated fat and cholesterol. Therefore it would be ideal for schools if they offer a variety of fruits and vegetables along with foods rich in protein. Moreover serving size should also be considered to be appropriate. [49]

Management of over and under nutrition: Individuals, having balanced proportion of muscles, compactness, and firmness in different organs, do not easily suffer from nutritional disorders. These individuals show great tolerance to hunger, thirst, heat, cold, exercise, and they also have proper appetite, which means their *Agni* (digestive fire) is in balanced state. *Agni* is the *Ayurvedic* term for digestive and metabolic power of an individual. It implies more than just fire element and includes precise and powerful functioning of the gastro-intestinal tract. The digested nutrients get absorbed and are used to create body tissues. [50] Two separate theories have been propounded by *Ayurveda* masters, for both, under-nourished and over- nourished people. For increasing body weight, as in case of under-nourishment, light and saturating therapy is prescribed. While for lowering the bulk of body, as in case of obese or an over-weight individual, heavy and non-saturating diet is beneficial.

For over nourished individuals: To reduce weight, foods improving *Vata Dosha* and reducing *Kapha Dosha* and fat in the body, practising dry, hot, and sharp enema, rough anointing, use of *Guduchi*, *Musta*, *Devadaru*, *Takrarista*, *Triphala*, (a fermented preparation of butter milk) and honey can be taken. Some cereals of inferior quality like *Prasantika*, *Shyamaka*, *Kangu*, *Yava* (barley), *Yavaka*, *Jurna*, *Kodrava*, *Yava* (barley), green gram, *Makustha*, *Kulattha*, *Adhaki*a long with *Patola* and *Amalaki* fruits are also recommended to be

used. After meals honey water and *Arist* (a fermented product) is advised to be taken to improve *Meda*, *Mamsa*, and *Kapha*. Late sleeping, exercising, and continuous mental work can also be advised to reduce body fat.

More of fruits and vegetables that can be included in the diet:

Fruits: *Bilva (Aegle marmelos), Amalaki (Emblica officinalis), Bibhitaki (Terminalia bellirica), Haritaki (Terminalia chebula), Jambu (Syzygium cumini).*

Vegetables: *Patola (Trichosanthes dioica), Shigru (Moringa oleifera), Trapusha (Cucumis sativus), Vartaka (Solanum melongena), Granjanak (Daucus carota)*

An Ayurvedic compound called *Agnimanthadi*, has been shown to give beneficial effects in reduction of weight, BMI, and other related signs and symptoms of obesity. [51]

For under nourished individuals: In order to gain required weight by under-nourished individuals, the following lifestyle modifications are advised: taking proper sleep, staying happy, having comfortable bed, relaxed and calm mind; keeping away from mental work, physical exercise and being cheerful.

Acharya Charka has described the line of treatment of *Karshya* cases through dietary management e.g. light and nourishing diet is prescribed for the nourishment of the *Karshya* patients. Whereas consuming new cereals, meat-soup of domestic, marshy and aquatic animals, well-cooked meat, curd, ghee, milk, sugar-cane, rice, black gram, wheat, products of jaggery promote weight gain. Also, ingratiating and sweet enema, daily oil massage, ingratiating anointing, bath, use of fragrance, garlands, wearing white dress, timely drainage of *Doshas* and regular use of bulk-promoting and aphrodisiac formulations make-up a healthy body.

CONCLUSION

Earlier malnutrition was believed to be a frequently encountered case of infancy or childhood years. But now, data from all over the world specially, the under developed and developing nations, are sufficient to show that it is no longer restricted to that age. India is now suffering from double burden of over and under nourishment both. There is a drastic increase in the number of people who are obese or have type2 diabetes, and this can be attributed to the changes in dietary habits which are unhealthy. [52] Therefore, it becomes crucial to understand the importance of nutritiously rich meal and practising physical exercise regularly. Certain other components which are non-nutritive in nature, also aid in proper development of the body, such as dietary fibre, which helps in enhancing the food bulk and subsequently indigestion. It has role in preventing the individual from chronic diseases via other mechanisms involved. Diets with high GI starches have been shown responsible for weight gain, high visceral adiposity and lipogenesis compared to diets with low GI. [53] Current scientific thinking demands a more evidence-based review of research support. In the hierarchy of evidence, randomized controlled trails are considered the strongest support for studying dietary risk factors and disease. [54] However on the basis of present discussion, It can be concluded that nutritious meal is the fundamental factor to upkeep overall health status.

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