2.1 PHYSICAL GROWTH AND MALNUTRITION

Physical growth, nutrition and malnutrition are closely interrelated terms. Inadequate nutrition hamper normal growth and results in malnutrition. The word, 'malnutrition' refers to an imbalanced state of nutrition that includes both nutritional deficiencies and nutritional excess in children and adolescents reflected in the physical growth pattern, mainly height, weight and BMI of the individual. Malnutrition includesstate of nutritional deficiencies also called under-nutrition that include stunting, thinness and wasting and state of nutritional excess that include overweight and obesity. Malnutrition is a complex issue and the leading cause of death and disease in the world. As a global public health problem, malnutrition affects both children and adults across the world[1]. It has been estimated that 32% of the global disease burden can be removed by eliminating malnutrition[2]. Malnutrition is also considered as serious health issue that affects children in developing countries[3].

Stunting that represents a chronic form of malnutritioncan be assessed by approximately 2 years of age[4]. Stunting (height- for- age) below 2SD off the world health organization WHO/CDC reference standards in adolescence especially important consideration for adolescent girls[5].The effects of stunting are manifold. Studies have reported that stunting is associated with increased risk of cardio-metabolic disorders including obesity and cognitive developmental delay in adulthood. Stunting can also lead to increased mortality and poor recovery from disease[6-7]. Pre-pregnancy stunting has been reported as a risk factor for poor pregnancy outcome and preterm birth[8].

In the present world the coexistence of multiple forms of malnutrition is also a global phenomenon. This indicates that there is a coexistence of stunting with wasting. In Indian context the overall prevalence of stunting and wasting has been reported around 9%[9].

The global estimate of wasted children was around 52 million in 2016 among which 70% (36 million) were Asian. In Indian context a rise in the wasting form of malnutrition was also reported[10-11]. The global prevalence of thinness has been estimated to be 8.4% for girls and 12.4% in boys and there has not been much declined in these prevalence rate during the last three decades[12]. Underweight also termed as thinness is defined as less than 2SD from median for body mass index (BMI).

In the recent times it has been estimated that prevalence of stunting has declined from 199.5 million to 144.0 million between 2000 to 2019 and this accounts to a global decrease from 32.4% to 21.3% per decade. Wasting and severe wasting have been reported to be 6.9% (Percent) and 2.1% (Percent) globally whereas highest prevalence of wasting prevails in the countries of south Asia[13].

It has been reported that in many countries different forms of under nutrition (stunting, underweight, thinness) coupled with micronutrient deficiencies is common among adolescence which results mainly from inadequate nutrition during early childhood. This in terms fails to meet the high nutritional demand of rapid growth which is required during adolescence[14].

In India, under nutrition is the leading cause of childhood morbidity and mortality. It has been estimated that in India one third of the new born have low birth weight of is a major public health problem. This carries with it the risk of infant mortality and growth failure among survivors[15]. Studies have shown that childhood under nutrition affects physical growth & cognitive development, impair the immune system and increases the risk of morbidity & mortality[16-18].

Over nutrition is a state of nutritional excess is called and include overweight, obesity. Over nutrition include overweight condition and obesity. These are associated with physical inactivity coupled with consumption of energy dense foods.

The overnutrition state particularly obesity leads to different diet-related non-communicable disease (NCDs) like certain types of cancers, type 2 diabetes, hypertension, and diseases related to the cardiovascular system and arteriosclerosis[19-22].Obesity is also found to be associated with micronutrients deficiencies like zinc, iron and vitamins A, C, D and E[23-24].

It is now being observed that both under and over nutrition coexists among the populations of the developing countries and India is also not an exception. This is termed as a “Double Burden of Malnutrition” and is observed to occur comparatively at all levels, be it household, national and community levels[25-26].Studies have also reported that obesity is more prevalent among urban children while under-nutrition is more in children from rural and slum areas [27].

Adolescence is a time when the physiological need for nutrients increases and thus the consumption of a diet of high nutritional quantity is particularly important[28]. Studies

have revealed that a balanced & appropriate diet during childhood and adolescence likely to reduce the risk of both immediate and long-term health problems[29-32]. In India adolescent population comprise one fifth of total population and it has been reported that early detection of morbidity can help in prompt treatment and prevention of serious complication[33]. Because the prevalence of malnutrition in adolescent is considerably less than that in children, relatively few studies have been carried out on this topic with school-age population particularly in the context of a developing country[34]. However, studies focussing on Nutritional standards of school-age children and adolescents in India did not convey an impressive report. Various studies have indicated a high prevalence of underweight and stunted children in adolescent age group particularly from rural parts of India[35-38].

Agarwalet. al. (1992)[39] studied the physical growth pattern of affluent children from eight Indian states within the age group of 5 years age to 18 years age. Anthropometric analysis revealed that there is little variation in the mean height of the boys and girls from different zones of India. For boys the 50th percentile value varies from 128 cm to 170 cm from 9 to 17 years. Similarly, for the girls the 50th percentile value of height varies from 129 to 157 cm for 9 to 17 years. The mean weight ranged between 24.4 kg and 58.6 kg for boys between 9 to 17 years and for girls the weight ranged between 26.9 kg to 48.4 kg between 9 to 17 years.

Kapoor and Aneja[40] studied the nutritional profile and disorders of adolescent girls with in the age group of 11 to 18 years from a mixed socioeconomic group. Under nourishment in terms of low BMI was reported for higher percentage of girls from low socioeconomic group.

Thakur et. al.[41] recorded the height, weight and BMI of school going adolescent from Gujarat western India within the age group of 10 to 15 years. The study showed that the girls were having better nutritional status than boys in terms of BMI. At 10 years the mean height recorded for boys and girls were 133.7 and 132.2 respectively. Similarly, at 15 years respective heights for boys and girls were reported to be 153.6 cm and 150 cm. Weight of the boys varied between 25 kg to 36.2 kg between 10 to 15 years and for the girls the weight was 26.1 kg to 38.0 kg. For both sexes weight gain was more in a later age group. Similar trend was also found in BMI values.

It has been reported that for youth age 10 to 19 years in countries like Ethopia, Nigeria, Senegal, Bangladesh, Mayanmar, Cambodia and India have the lowest BMI.

While the lowest BMI for children ages 5 to 19 years is found in East Africa, the lowest mean BMI in adolescents is found in South Asia[12].

Venkaiahet. al (2002)[42] determine the diet and nutritional status of rural adolescents from different states of India within the age group of 10 to 18 years. The girl's height varied from 128 to 152 cm and weight from 23 to 43 kg. The height of the boys varied from 128 to 161 cm and weight between 23 to 46 kg. According to the study prevalence of stunting was reported between 35 to 60% in boys whereas higher prevalence of stunting (more than 50%) among 16 and 17 years. For the girls the prevalence of stunting varied between 32 to 37% from 10 to 17 years. The study also showed that the prevalence of wasting in terms of BMI for age was more among the boys.

Das and Biswas (2005)[43] conducted a community based, cross-sectional study among adolescent girls aged 10 to 19 years from West Bengal. Stunting was more prevalent than thinness. For the lower age group 10 to 14 years prevalence of stunting was more (25.6%) as compared to the thinness (17.9%). Among the higher age groups (15 to 19 years) the prevalence of stunting was more (52.3%) as compared to thinnest (10.8%). The overall prevalence of stunting was 37.8% and thinness was found to be statistically significantly associated with literacy level of mother.

Medhiet. al. (2006)[37] assessed the growth and nutritional status of school age children's between 6 to 14 years from Assam. These subjects belong to lower socioeconomic groups and their anthropometric parameters were lower as compared to affluent Indian children and WHO standards. The mean height of both sexes at 9 years were about 125 cm and the height attained at 14 years for both sexes were about 147 cm. The mean weight for boys and girls at 9 years of was about 21 kg and at 14 years for both the sexes it was around 36 kg. The overall prevalence of stunting for the males and females were 52 and 56% respectively. The overall prevalence of thinness for the males and a female subject was found to be 52 and 57% respectively. The mean height of girls was higher at the ages 10,11 and 12 years than boys.

Bisaiet. al. (2008)[44] studied the nutritional status of tribal children of West Bengal is 1 to 14 years. For children's about five years of age the prevalence rate of stunting and wasting were found to be 21 and 17% respectively.

Chakraborti and Bharti (2008)[45] conducted a study to assess the nutritional status of tribal adolescents of Orissa, India aged 10 to 18 years. Adolescent growth spurts representing an increased rate of growth for different anthropometric measurements was obtained between14 to 15 years among boys and 12 to 13 years among girls. The parameters were also significantly lower than the WHO standard. Mean height for boys ranged between 129.7 and 159.2 between 10 to 18 years and mean weight between 24.2 to 47 kg. For the girls the mean height was ranged between 131.6 to 148.3 cm and weight between 26 to 41 kg. The prevalence of undernutrition was 54% among boys and 36% among girls and this difference appeared to be statistically significant. The highest percentage (%) of under nutrition was observed among 12-years-old boys (77.8%) and 11-years-old girls (60%).

Chowdhury S D et.al. (2008)[46] studied the prevalence of under nutrition among tribal children of West Bengal with in the age group of 5 to 12 years. The overall prevalence of stunting was obtained to be 14% for boys and 22% for girls. Wasting was 23% for boys and 36% for girls.

Dambhareet. al. (2010)[38] assessed nutritional status of school going adolescents in the age group of 10 year to 16 years from peri urban area off Wardha District Maharashtra, India. The overall prevalence of stunting was 72% among boys and 27% among girls. Stunting was also found to be higher in early adolescent group (67.5%) as compared to late adolescent group (32.5%).

Shivrama Krishna et. al. (2011)[47] conducted a cross-sectional study to assess the nutritional status of rural adolescent girls from South India within the age group of 10 to 19 years. The prevalence of wasting and stunting was found to be 54.8% and 32.2% respectively which decline with age.

Airi and Edwin (2011)[48] conducted a cross-sectional survey to assess the nutritional status of 11 to 15 years old adolescents from Himachal Pradesh, North India. The overall prevalence of stunting was found to be 14% and boys were more stunted as compared to girls. 22.6% of the subjects appeared to be underweight and again the boy's percentage of underweight (26%) were more than the girls (19%). Over nutrition was found among 40% of the subjects. More boys in the overweight category (22%) and more girls were found in obese category (10%).

Manna P K et.al. (2011)[49] investigated the physical growth and nutritional status of 5 to 12 years old children from low socioeconomic group from Northern part of West Bangal, India. From 9 to 12 years of age a significant difference in the both mean height and weight of boys and girls were observed and girls were found to be taller and heavier than boys. The mean height of the boys from 9 to 12 years varied between 122cm to 132cm and that for girls was between 124cm to 135 cm. Mean weight ranged from 23 to 27 kg for boys and 23 to 28 kg for girls within the age group of 9 to 12 years. However, for all age groups the height and weight were lower than ICMR standard. Moderate and severe stunting ranges between 3% at nine years to 46% at 12 years. The prevalence of stunting was significantly higher among boys (12%) as compared to girls (7%).

Maiti S et.al. (2011)[50] studied the growth and nutritional status of rural adolescent school girls within the age group of 10 to 14 years from Medinipur district of West Bengal. Height, weight were the principal perimeters assessed. The study revealed that the mean weight was 24.5 to 35.7 kg which was lower as compared to affluent Indian children and NCH standard. The mean height at 10 years was 130.5 cm which increased up to 145.5 cm at age 14 years. 23.6 to 32.6% of the girls in the age group of 10 to 14 years were found to be mildly stunted and 0.8 to 3.2% of the girls were found to be severely stunted.

SrivastvaA et. al. (2012)[51] examined the height, weight and nutritional status of the school aged urban slump children of Uttar Pradesh, India. The mean height and weight of boys and girls was lower than the international CDC standard in all the age groups. About 33% of the children appeared to be wasted; girls(37.4%) more than boys (31%). Overall prevalence of stunting was 20%; girls more (22%) than the boys (18%).

Longkumar T (2013)[52] studied the physical growth and nutritional status of Naga children aged 8 years to 15 years from North East India, Nagaland. The study revealed that girls were taller than boys till 13 years after which the boy's height increases. The mean height of boys ranged between 124.7 to 161.1 cm and 125.9 to 151.9 cm for girls. The weight varied between 24.1% to 48.8 kg for boys and 23.8 to 46.8 kg for girls with in the age group of 9 to 15 years. 34.3% of the boys and 25.9% of the girls were underweight with an overall prevalence of underweight 30% was observed. Prevalence of overweight subjects varied from 2% for boys and 2.5% for

girls. The distribution of underweight and overweight subjects across the gender appeared to be non-significant.

Patilet. al. (2013)[53] examine in the height, weight and BMI of adolescent subjects is 10 to 15 years. A progressive increase in mean height with age was observed among the boys with the maximum increase in height was found between 14 to 15 years. For the girls the progressive increase in the mean height was observed up to 13 years which indicated that the adolescent growth spurt was earlier in the girls. At the age of 11 years the mean height of the girls was significantly higher than the boys, after which the boys tend to be taller than the girls. The study revealed that adolescent growth continues for longer period in the boys. The mean height at 10 years for boys and girls were 146 and 142.2 cm respectively. At 15 years the boy's height was 168.4 cm and girl's height were 156.2 cm. The weight among the boys from 10 to 15 years ranged between 31.8 and 52.2 kg and for the girls the mean body weight was 34.4 kg at 10 years and 44 kg at 15 years. For both the sexes the height and weight showed an increasing trend with age.

Singh JP et. al. (2014)[54]conducted a cross-sectional study among a rural adolescence of 10 to 19 years of age in Uttar Pradesh, India. Nutritional status was assessed from height for age and BMI for age. Overall prevalence of stunting and thinness were found to be 19.5% and 26.7% respectively. Thinness was more prevalent among golf (53.3%) as compared to boys (46.7%). While stunting was almost 50% among both the sexes. Stunting was more prevalent among mid- adolescent group (46.3%) and thinness was more prevalent in early adolescent group (37%).

Shivprakash and Joseph (2014)[55] assessed the nutritional status of rural school going South Indian children within the age group of 6 to 12 years. The overall prevalence of stunting was 27.9% and this was more in boys as compared to girls (29.1% versus 26.5%). For both sexes stunting was more in the age group of 11 to 12 years.

Shashank and Chetan (2016)[56] conducted a cross-sectional study among south Indian children between the age group of 6 to 12 years. In the age group of 9 to 10, 10 to 11, and 11 to 12 years the prevalence of stunting was reported to be 18.5%, 14.8%, and 16% among the boys and 20%, 14.6% and 17% among the girls.

Katoch and Sharma (2016)[57] studied the nutritional status of school going children aged 5 -14 years from Jammu and Kashmir, North India. 36% of the children were

stunted, 9% were underweight, and 2% were wasted. Stunting was prevalent among female children and wasting was prevalent among male children.

Chandrashekharappa (2018)[58] evaluated the nutritional state of adolescent girls aged 16 - 19 years from Karnataka, South India. Prevalence of malnutrition based on BMI was minimum (18%) among the 18-years-old girls and maximum among 16-years-old (35%).

Pal et.al. (2017)[59] investigated the prevalence of malnutrition among 10 - 17 years old adolescents and evaluated its association with socio-demographic factors. The height of boys varied between 128.3 cm to 158.6 cm and for the girls the height ranged between 130 cm to 143 cm. From 10 to 12 years girls were taller than the boys after which from 13 year onwards the height of boys was increases. Maximum rate of growth for girls observed between 11 to 12, 12 to 13 and 14 to 15 years. Weight of the boys varied from 23.6 kg to 47.2 kg where as for the girls the weight ranged from 25.5 kg to 41.3 kg. From 10 - 12 years girls were heavier than the boys. However, from 14 year onwards the weight of boys increases. Stunting was most prevalent among 17-year-old adolescents (63.6%) and raised from 32.3% at 10 years to 63.6% at 17 years. An increased prevalence of stunting was observed among the subject with the increase in age. Age-wise prevalence of thinness was maximum in 10 and 12 years (57%) and minimum at 17 years (39%) which indicated that thinness was more in early adolescent as compared to the late adolescent group.

Sharma et.al. (2017)[60] evaluated the nutritional standard of school children age 6 - 15 years in rural area of Moradabad, India. Almost 10% of the subjects were moderately malnourished, 2% were severely malnourished and 4% were overweight and less than 1% were obese. Girls were more overweight as compared to the boys and boys were comparatively more malnourished than the girls. However, the difference did not appear to be statistically significant.

Ahmed et. al. (2018)[61] studied the double burden of malnutrition among school-going adolescent girls (10 to 19 years) in North India. Underweight was found more among the early adolescent group and the proportion of underweight, overweight and obese girls were 47%, 6%, and 3% respectively.

Rani D et.al. (2018)[62] studied the nutritional status of adolescent girls age 13 - 19 years from urban slum of Varanasi, India. 60% were undernourished and 4% were overweight. Under nutrition was maximum among the age group of 13 to 14 years.

Kumar et.al. (2020)[63] studied the growth pattern of school going children of Jharkhand, eastern India within the age group of 6 - 14 years. The height for boys from 9 - 14 years varied between 127.7 cm to 146.7 cm and for girls also 127.7cm to 146.7 cm. The median weight of the boys from 9 to 10 years varied between 22 kg to 33.9 kg and for the girls 24.2 kg to 33.8 kg.

Dorjee et.al. (2020)[64]accessed the nutritional profile of children and adolescent boys and girls of age between 2 - 18 years belonging to Limboo community of Sikim, North India. Mean Z-score for height for age, BMI for age were obtained to be -1.75 and -0.16 indicating that the most of the children were within the normal category.

Kumar et. al. (2021)[65] utilizing the data from 2016 Udaya project conducted by Population Council under the guidance of Ministry of Health and Family Welfare from Uttar Pradesh and Bihar to assess the nutritional standard of adolescent boys and girls aged 10 to 19 years. The result showed that thinness was more prevalent among adolescent boys (25.8%) as compared to girls (13%) whereas stunting was more prevalent among girls (39%) as compared to boys (25.6%). Coexistence of stunting and thinness was also more among the boys (9.7%) as compared to girls (6%). Thinness was more in early adolescent group (10 to 14 years) while stunting was more prevalent in the late adolescent group and this trend was observed for both the sexes.

2.2 DIETARY PATTERN AND MALNUTRITION

Diet is an important component of nutrition and as well as a major determinant of nutritional status. Dietary patterns are influenced by food related beliefs, food preferences and availability of healthy foods. Adverse changes in dietary intake can cause different form of malnutrition which can affect systemic health as reported in various studies.[66-68].

The diet adequacy can be expressed in terms of quality and quantity. The protein quality of a diet often serves as an indicator of overall diet quality and expressed in terms of protein energy ratio. Inadequate diet has been considered as a major reason for high level of malnutrition.

Malnutrition is strongly related to nutrient intake. Issues related to nutrient intake that results in malnutrition, include inadequate consumption of healthy foods, unhealthy food habits, and non-availability of daily foods. In the last few decades, the global food habits have changed dramatically. A transition from healthy to junk food is observed across global populations and it is increasing at alarming rate. Unhealthy junk food consumption patterns result in micronutrient deficiency and lowers body's capacity to fight with various infections and diseases. This shift in food patterns results in malnutrition including both under and over nutrition.

School children are a vulnerable group deserving attention for improve their health and nutritional status for active performance, learning and achievement. This requires sufficient energy and nutrient intake from a balanced diet. In accordance healthy food and snacks should be provided for optimal growth and the acquisition of early healthy diet habits[69].

2.3 FOOD INTAKE PATTERNS

Food intake patterns are studied in terms of their adequacies and pervasive nature. Pervasive intake pattern may include excess consumption of energy dense and nutrient scarce fast foods and inadequacies indicates fewer servings per day less than the recommended levels.

In many situations, particularly, in developing countries it is not always possible to provide balanced and adequate food for various economic and geographical constraints. It has been reported that food quantity and quality consumed by children in these situations are often inadequate with a lower than desirable intakes of fruits vegetables, dairy products and whole grains, required for proper growth and good health (Results from National school health and nutrition programme baseline survey in Malawi). REF[70 – 74].

Studies conducted in western developed countries reported that food intake of adolescents do not meet dietary guidelines[75-77].Globally there is a trend of consumption of energy dense nutrient poor foods along with less consumption of fruits and vegetables by the adolescents[76,78].

In addition to the pervasive pattern of food consumption, adolescents also have unhealthy eating habits like skipping breakfast and other meals and snacking on fast foods which has been reported by another studies[79-80].

In Indian context, studies have reported not only nutritional deficiencies among urban adolescents[81], but also, excessive fast-food consumption which was found to be associated with obesity[82]. The over consumption of energy dense foods are often coupled with under consumption of vegetables and pulses[83].

It is now established that low-quality diets are the single biggest risk factor for the global burden of the disease[84]. Thus, consumption of healthy diet is presently a globally accepted scientific census[85]. A healthy diet must have adequate quantities and proportions of fruits, vegetables, legumes, nuts and whole grains[86]. According to the guidelines given by world health organization intake of free sugars must be limited along with limited intake of salt, saturated fat and elimination of trans fats of all kinds. [87-88]. Restrictions has also been imposed on consumption of sugar containing beverages[89] as it has been associated with increased body weight.

Sidiga A et al 2010[69]reported that poor diet quality and food habits are related to impaired nutritional status in 13-18 years-old adolescents in Jeddaah leading to over-weight and obesity among Saudi Arabian Adolescents.

Matthys et.al.(2006)[90]conducted a study on breakfast consumption pattern of Belgium adolescents aged 13 to 18 years. The study revealed that overweight girls were eating a low-quality breakfast. It was also obtained from the study that consuming a good quality breakfast provided all micronutrients. The study concluded that adolescents who consumes a good quality breakfast had better overall dietary pattern.

Food poverty is a factor which directly affect the food consumption pattern. Food poverty is found among the lower socioeconomic class status. Molcho M. et. al. (2006)[91] conducted a study to investigate the association between food intake and food poverty among Irish school children. The study revealed that experience of food poverty was associated with the less consumption of fruits, vegetables among the girls and more savoury snacking pattern among the boys, both of which were indicative of a poor diet. Both girls and boys reporting food poverty were more likely to miss breakfast on big days.

Lien L (2007)[92] conducted a study to examine the relationship between regular breakfast consumption and mental distress and academic performance among the Norwegian high school children. This study reported that breakfast skipping practice is common among 10th grade students. And the girls were skipping breakfast more

often than the boys. Breakfast skipping has more pronounced effect on mental distress and academic performance on boys as compared to girls.

In an attempt to investigate the nature of dietary intake and its association with health outcomes McNaughton, S.A., et.al. (2008)[93] conducted a study on Australian adolescents. The study revealed three main dietary patterns among the studied population. The fruit, salad, cereals diet pattern was mainly followed in rural region of residence. High fat and sugar containing diet were more consumed by the male subjects, and fish pattern was inversely associated with age. More consumption of fruits and vegetables were inversely associated with diastolic blood pressure and this association was found to be statistically significant.

Gretchen et. al. (2009)[94] conducted a longitudinal study over five years to identify the dietary intake pattern among the adolescent population of Minosta. The study revealed that dietary pattern in adolescents differ from adults and the emergence of fast food diet pattern among middle adolescent boys.

Storeyet. al.2009)[95]conducted a study on Canadian adolescents to examine the nutrient intake with meal related behaviours. The study revealed that higher frequencies of suboptimal meal behaviours like skipping meals and breakfast and consuming meals away from home resulted in poor diet quality.

Christine et.al. (2009)[96] in a study conducted among school children of Colombia found that overweight among the children had a positive correlation with snacking dietary pattern which was statistically significant. Overweight was also found to be associated with higher socio-economic status and maternal obesity.

Macferlane et.at. 2009)[97] conducted a cross-sectional prospective study over 3 years to examine the association of body weight and BMI with family food environment. Different aspects of family food environment were considered which include breakfast eating patterns, food consumption while watching television, provision of energy dense foods by parents and consumption of energy dense food at home and away from home by the children. It was obtained that more frequent dinner consumption while watching television was associated with higher BMI Z- score and less frequent breakfast consumption and more frequent fast-food consumption at home were associated with higher odds of overweight longitudinally and cross-sectionally respectively.

Priya et.al. 2010)[98]conducted a study among nationally representative sample of US children/adolescents to examine the relationship between breakfast skipping and type of breakfast consume with the nutrient intake, nutrient adequacy and anthropometric indicators of physical growth. Subjects were divided into 3 groups based on breakfast related patterns; breakfast skippers, ready-to-eat cereal consumers and other breakfast consumer. Obesity was more prevalent among breakfast skippers. Ready-to-eat cereal consumers had lower intake so fat and cholesterol, and higher intakes of carbohydrates, dietary fibres and several micro nutrients as compared to the other two groups. The overall nutrient intake profile and adiposity indexes were better in ready-to-eat cereal consumers.

(Richter A et.al. 2012)[99] in a study identified the dietary patterns and three associations with the nutrient intake and lifestyle factors. The study identified 3 dietary patterns namely the western pattern, the healthy pattern, and the traditional pattern. The study showed that higher consumption of take away food, meat, confectionery and soft drinks were associated with higher energy density in which higher percentage of energy were derived from unsaturated fatty acids. These dietary patterns were also associated with low carbohydrate and lower densities of several vitamins and minerals. This traditional and western pattern of diet statistically resulted with lower age, lower socioeconomic status and more television watching hours among the girls and higher age groups particularly 16 to 17 years old among the boys. The dietary patterns were not found to be statistically significant corelated with the overweight.

Alvira et.al. (2012)[100] assessed the relationship between parental education and consumption frequency of obesity-related foods in European children. Low and medium parental education level group of children had lower frequency of eating, low sugar, and low-fat foods that comprised of vegetables, fruits, rice and whole meal bread. This study reported that intakes of vegetables, fruits, rice and water increased with increased parental education level; while the intakes of savoury snacks, fried meat and fish, fast food and sweetened beverages increased with decreasing education level.

Lippevellde et.al. (2013)[101] investigated the association of family- related factors with children's breakfast consumption and BMI. The study was conducted in 8 European countries. 11 family factors related to breakfast were considered in the study. These

include automaticity, availability, attention allowing to skip breakfast, negotiation, health belief communications, praising, eating breakfast together and parental self-efficacy. The study concluded that some family factors were significantly associated with children breakfast consumption and shaping children breakfast behaviour.

Evans et.al. (2014)[102]conducted a study on American school children aged 9 - 15 years to examine the relationships between eating frequency, meal frequency and snacking frequency with the total energy intake and diet quality. The study reported meal and snack frequencies were statistically significantly and positively associated with total energy intake, and the diet quality deferred by age category. The study also reported that snacking is associated with the better diet quality in elementary school-age children and lower diet quality in adolescents.

Laska et.al. (2014)[103] conducted a survey to examine the association between meal routines and meal practices among American college students. It was concluded that the meal timing and the contextual characteristics of eating like regularity, meal preparation at home, eating on the run, using media while eating, purchasing food on the campus influence, the choice of food and the quality of dietary pattern. Meal regularity and a meal preparation at home were associated with healthy dietary pattern.

Alviraet.al.(2015)[104]studied the prospective associations between socioeconomic status and dietary pattern in European children's over 3 food clusters; snacks and fast food, sweet food and sweetened beverages and fruits, vegetables and whole meal. Children with a higher educated parent and higher household income relied on healthy food cluster overtime while the migrants and children from lower Socio's-economic status had persistent unhealthy dietary profile.

Alshmmariet. al. (2017)[105]studied the growth profile and its association with a nutrient intake of Saudi children aged 2 -18 years. The study reported that both stunting and overweight/obesity groups had statistically significantly lower male intakes for critical micro nutrients as compared to normal children.

The WHO European childhood obesity service surveillance (COSI) was conducted among a large population of European children from 23 Countries with an aim to describe their diets and frequency of consumption of different categories of foods. The study revealed that regular breakfast habit was observed for most children

(78.5%) and fewer than half (42.5%) consumed fruits about (22.6%) consumed fresh vegetables and one in ten (10%) consumed sweet snacks and soft drinks[106]

A cross- sectional study conducted on adolescents between 16 and 19 years in Kilimanjaro region of Tanzania reported the coexistence of under nutrition and over nutrition among the studied group. Boys had a significantly higher intake of protein and carbohydrates while girls had a significantly higher intake of fats, which could be related with their physical growth status. The groups reported to assess more snack food outside the school area. There was also a difference in portion size consumed between a male and female[107].

A study conducted on Egyptian children on their dietary pattern, growth and nutritional status revealed that most boys and girls had three or less than three meals per day and 64% were regularly eating breakfast. The study found no association between lifestyle practices and stunting. The prevalence of underweight and stunting was higher among boys while girls tend to be overweight and obese. Statistically significant factors which contributed for overweight/obese were being more than three meals per day, eating while screening, irregular breakfast pattern and not taking vegetables[108].

Goel S. et. al. (2013)[109] conducted a study on adolescent girls of north India to examine the relationship between dietary pattern and overweight/obesity. The data revealed highly significant and positive relation between the consumption of fried foods and weight and BMI. It was obtained that most of the adolescent girls were skipping meals 60% and prefer savoury and sweet snacks and fast food (almost 90%). Hence, they were consuming excess of energy, protein and fat. The daily diet was also found to be containing inadequate amount of micro nutrients.

Kotechaet. al. (2013)[110] studied the food habits, food preferences and dietary pattern of school going urban adolescents of western India. Regular home prepared food was consumed by 80% of the adolescents. Nearly 60% of the subjects had their breakfast daily. Nearly 50% of the subjects were reported consumption of chocolate, candies and other fast-food items.

Soni and Katoch (2014)[111] conducted a study on dietary adequacy of school going children of Kangra and Kullu district of Himachal Pradesh. Most of the subjects were non-vegetarian. Intake of healthy food groups like cereals, pulses, green leafy

vegetables, milk and milk products was lower than the daily recommended level. While intake of fat was significantly higher among all the subjects. Intake of protein and other vitamins were also found to be lower than the recommended daily allowances.

Omidver and Bagum (2014)[112] assessed the food habits of south Indian urban adolescent girls to explore the relationship between the socio-economic status, food preference and dietary behaviour of different age groups. Data on adolescents showed that majority of them were underweight and skip meals. Higher percentage of underweight subjects was obtained in the lower socio-economic status and high proportions of overweight girls belonged to high socio-economic status. 68.7% girls were reported to consume fast foods on a regular basis. Daily consumption of fast food was higher among the girls from low socio-economic group.

Shafiee et.al. (2015)[113] investigated the mean intake of nutrient by adolescent boys from an urban population of South India aged 10 - 19 years and compared the intakes with RDA values recommended by ICMR. The study also investigated the food intake pattern in relation to social class. The study found inadequate levels of protein, calories, iron, calcium and beta-carotene level for all the subjects in relation to RDA. Highest quantities of proteins were consumed by obese boys followed by the normal boys and lowest among the wasted, stunted and stunted /wasted group. The intake of different nutrients by the children from nuclear and extended families were higher than those in joint families. The authors opined that because of smaller number of children in families each child gets importance or attention from parents which might have accounted for higher intake of proteins and calories among these groups.

Das et.al. (2016)[114] studied the dietary pattern and intake of nutrients and vitamins by adolescents in Himachal Pradesh in the age group of 11 - 19 years. Preference for home cooked meal and three meals a day was reported by majority of the subjects. Majority of the girls were vegetarian and majority of boys were non-vegetarian. A statistically significant difference in the mean intake of essential nutrients was observed across gender and intake on most of the nutrients by both the sexes were below the recommended dietary allowances level as suggested by ICMR.

Rathi N et. al. (2017)[83] reported the food consumption patterns in a sample of urban adolescents aged 14 - 16 years from eastern India Kolkata. The dietary intake of adolescents appeared to be poor in quality with 30% reported no consumption of

vegetables, 45% of the respondents did not consume any fruit. Consumption of energy dense snacks 3 to 4 times was reported by 70% of the subjects and nearly half of the subjects (47%) reported drinking three or more servings of energy dense beverages. Girls had more nutritious dietary intake than boys.

Mukherjee and Chaturvedi (2017)[115] conducted a study on dietary pattern and food preference of school children aged 5 to 11 years from Pune India. The study reported that snacks processed foods and fast foods were mostly preferred foods by the children. The most preferred food include snacks and fast food, sweets and non-vegetarian food. While milk, green leafy vegetables were the least preferred food items.

Gupta et.al.(2018)[116] studied the pattern of fast-food consumption by school aged children in rural Himachal Pradesh, India. The study reported that majority of the children 78% consumed at least one junk food items in the last 24 hours and 22% of the children consume two or more junk food items in the last 24 hours of the survey. Savoury snacks like chips were the most preferred junk food item followed by chocolate, bakery products and soft drinks. The contribution of this junk food to the total amount of fat contained in diet varied from 9 to 20%.

Kumar and Mishra (2019)[117] studied the nutritional status and dietary pattern of adolescent girls from urban slums of Agra North India. Although most of the respondent were found to be vegetarian, the dietary pattern indicated poor consumption of milk, fruits and leafy vegetables.

Singh et. al. (2021)[118]conducted a cross-sectional study among adolescent girls from urban slums of Varanasi district of Uttar Pradesh, India. Anthropometric profile, sociodemographic and socio-economic variables and dietary behaviour were studied. Half of the teenage girls were under-weight which was statistically significantly related with the lower educational standard of father. Being underweight was also related with increase in the number of family members. The study reported that less intake of pulses, green leafy vegetables and other vegetables few times a week is associated with being underweight.

From these previous findings it appeared that dietary inadequacies with more inclination to fast -food consumption is prevalent among most of the children and adolescent population of India.

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