

Consensus of Medical Nutrition Therapy in Pediatric Clinical Practice (2 to 18 Years Old) of South Asian Perspective

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Abstract

South Asia, one of the economically fastest growing regions in the world, faces the dual paradox of malnutrition in children and adolescents. More than half of all stunted and more than two-thirds of all wasted children under age of five in the world live in Asia. Of the 49.5 million under five wasted children in Asia, 16.6 were severely wasted in 2018. Paradoxically, Asia also had almost half of all the under-five overweight children in the world. While this region is still battling with under-nutrition, has seen a rise in non-communicable diseases over nutrition related conditions such as obesity, metabolic disorders, increased cardiovascular risk etc. in the pediatric and adolescent population. In a region that is growing economically, these numbers are alarming and point towards a need to take nutrition seriously. Food is available, but is either being underused by economically poor or overused by those economically better off. Most often the care givers are ignorant of giving the balanced diet to children which results in malnutrition. Malnutrition can be easily corrected. There are many cheap locally available food resources that can be built into a child's diet to correct under-nutrition. Similarly, the right nutrition practices in the rich can curb over nutrition. Spreading this awareness is a monumental task and needs joint efforts of pediatricians, clinicians, parents, dietitians, psychologists and policy makers of the countries of this region. The experts reviewed the various recommendations and guidelines from various published articles and nutritional committees. These practice expert opinion recommendations from the experts from South Asia is an endeavor to move from a therapeutic to a preventive approach of tackling malnutrition. The experts hope that by following these practical recommendations malnutrition in South Asia will be tackled in a significant way.

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Figure 2: Wasting in the world and South Asia.

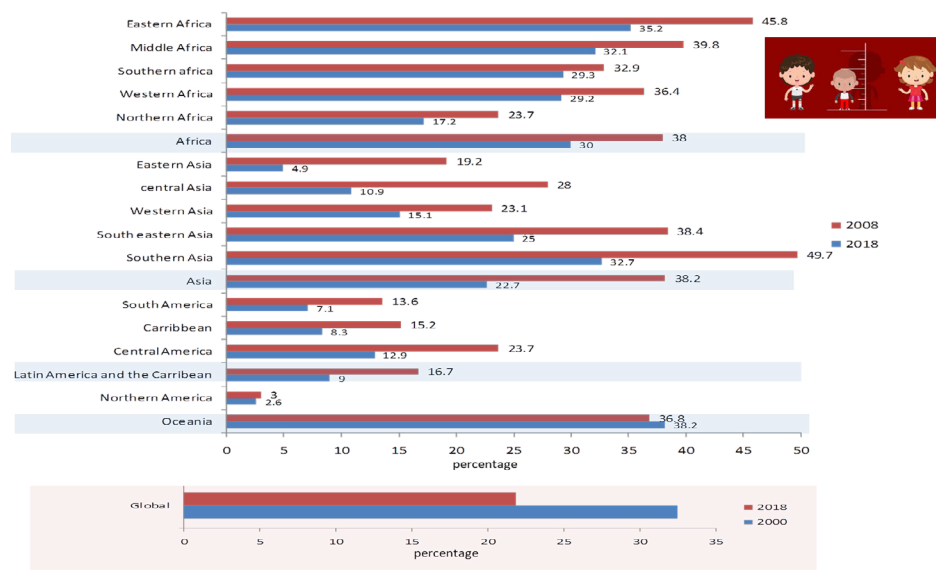


Figure 3: Decrease in under 5 stunting in Asia and South Asia between 2000 and 2018.

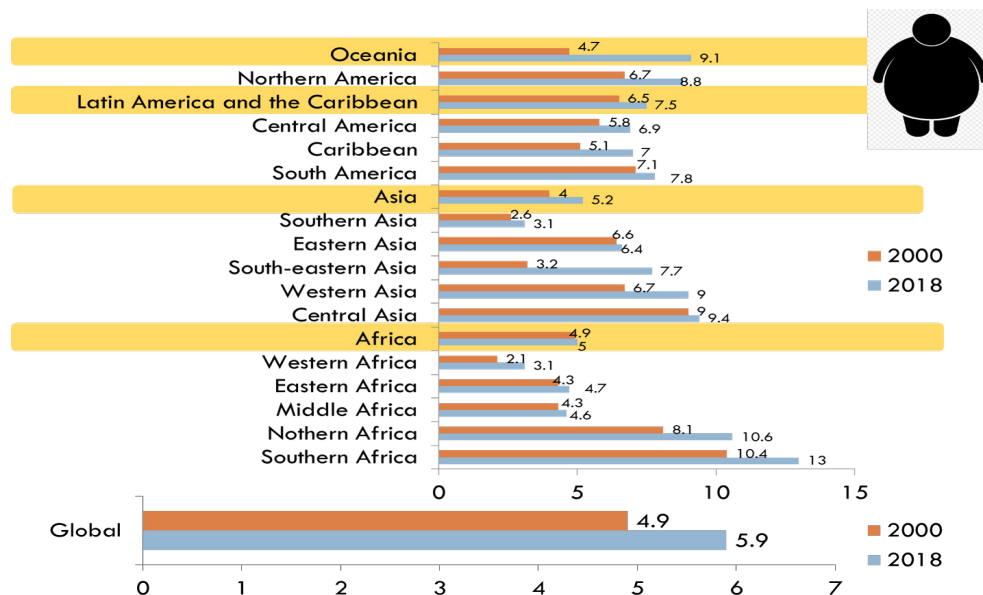


Figure 4: Increase in under 5 overweight in Asia and South Asia between 2000 and 2018.

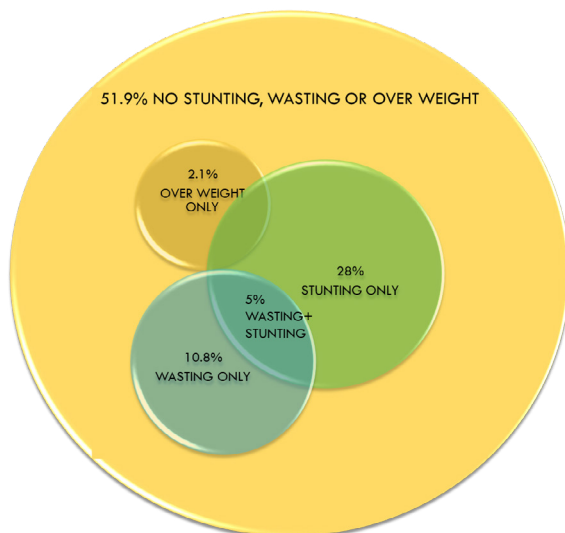


Figure 5: Wasting, stunting and overweight co-exist in under 5 in Asia as per UNICEF data.

Family Health Survey-4 (NHFS-4) data from India shows that stunting under five is highest in the poorest wealth quintile and lowest in the richest wealth quintile (51% vs. 22% of children). Underweight followed a similar trend 49% vs. 20%.^[3]

Though stunting in under-five in Asia and South Asia decreased between 2000 and 2018 [Figure 3], there has been an increase in overweight in under five children in these regions during this time period [Figure 4]. Thus, wasting and stunting coexist with overweight and obesity in children under the age of 5 years in South Asian countries [Figure 5].^[4]

Childhood obesity is a known precursor of adult obesity and linked to diet related non-communicable diseases like T2DM, metabolic syndrome and to cardiovascular complications.^[5] An Indian study found a trend towards increasing waist circumference in children 2 to 18 years old and the 70th waist circumference percentile was found to be most sensitive and specific in predicting metabolic syndrome in later life.

[6] Another study found that Indian children with diabetes mellitus had higher central adiposity and thin limbs (the thin-fat child) and higher insulin resistance than children from United Kingdom. [7] However, the UNICEF/WHO/World Bank 2019 report shows that no efforts have been made in the last 15 years to curb childhood obesity.

The nutritional requirements of 0 to <2 year olds are special and different from older children and depend mainly on breast feeding, milk and timely introduction of correct complementary feeding, it is usually dealt with separately as first 1000 days of life. [8,9] This age group is not dealt with in this recommendation.

However, in children 2 years and older, factors like poor dietary quality and economic disparities leading to inadequate food security contribute to under or over-nutrition in Low-Middle-Income Countries (LMIC) countries of South Asia. [10,11] Cultural preferences of when to start breast-feeding and complementary food (e.g. when to start foods such as egg) along with faulty feeding practices also impact the choice of diet, which in turn can cause under or over-nutrition. [12-14] A study from Dhaka showed that despite good knowledge of nutrition, extremely poor working mothers could not provide adequate nutrition to their children because of poor child support, buying capacity, access to cooking facilities and civic amenities. [15]

The Lower Middle Income Countries (LMICs) are thus facing a double burden of malnutrition characterized by child under-nutrition and obesity. These inequalities in nutritional status also necessitate an immediate and effective intervention to combat the progressively growing burden of nutritional disparities. [16] Given that advice on nutrition is often not routinely given to children and adolescents, counseling children and parents during clinic visits for routine immunizations or when children are brought for other illnesses may go a long way in improving their nutritional status. Hence, nutritional recommendations for children (2 to 18 years of age) in clinical practice in South-Asia region are presented here.

Process

A group of experts from the various fields of pediatrics from South Asian countries, Bangladesh, India, Nepal, and Sri Lanka met on August 17 and 18, 2019 to deliberate on literary evidence and clinical practice experiences for framing clinical practice recommendations for optimal nutrition in 2 to 18 years of age.

The first draft of the recommendations was prepared prior to the meet after a detailed literature review of global and South Asian data. Recent pediatric guidelines from the European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), National Institute of Nutrition (NIN), WHO, American Academy of Pediatrics (AAP), American Society for Parenteral and Enteral Nutrition (ASPEN) were also reviewed for formulating the nutritional clinical practice recommendations in 2-18 years of age in South Asia. [9, 17-20]

This was circulated amongst the experts for their detailed review prior to the meet. During the meet, the background and need for nutritional recommendations for pediatric clinical practice in South Asian region was discussed. Four sub-committees were formed with one expert each from general pediatrics, pediatric

gastroenterology, neonatology, and pediatric endocrinology. The experts discussed the draft and provided suggestions, comments and modifications to the draft.

A revised draft based on the discussions during the meet was prepared and circulated among the experts via e-mail for the formulation of the final recommendations. The draft was finalized for publication post-approval from all the attending experts.

Clinical Practice Recommendations for Monitoring Growth in 2 to 18 Years Old

Considering the high prevalence of stunting, wasting and overweight in children in South Asia, it is very important to monitor growth of children. Under-nutrition is detrimental to the growth and development of children. Malnourished children may have delayed motor and cognitive development along with behavioral problems and learning disabilities. [21] Also, children who become stunted before the age of five fail to reach their adult height potential. [22]

It is however important to choose the right growth charts to monitor growth. WHO has developed growth charts for children under five and for children five years and older. Up to the age of 5 years the height distribution is somewhat similar across most ethnic groups and geographical areas. Hence, the WHO charts for 0 to 5 years were constructed with data collected from six affluent populations of all continents. This growth chart is considered the gold standard for monitoring growth in children under five, across the world. [23]

However, the WHO growth charts for 5 years and above were constructed using data from National Health and Nutrition Examination Survey (NHANES). The final height achieved in older children, and the characteristics of the growth curve in 5 to 18 years old are dependent on nutritional, genetic, and environmental factors and the age at which puberty is achieved. [24,25]

These factors differ with the geographical area and ethnic group studied. Growth data from Asian countries such as China, Japan and Saudi Arabia show that the pubertal growth spurt is more attenuated in these children than their European counterparts. [26,27] In another study Wilde et al., showed that the height-for-age chart of South Asian children in Netherlands was very similar to charts of affluent children from India. However, South Asian children in Netherlands were shorter than Netherlands at all ages between 0 to 20 years (all P-values>0.001).

Hence the applicability of the WHO growth charts for monitoring growth in South Asian children 5 years and above is questionable. [28]

Recommendations for monitoring growth

- The panel recommends that the WHO growth standard may be used to monitor growth in children under 5 years (Appendix I (boys) and Appendix II (girls)).
- Countries having their own growth charts may follow the same for children between 5 and 18 years of age.
- The revised Indian Association of Pediatrics (IAP) growth

charts (Appendix III (boys) and Appendix IV (girls)) may be used to monitor growth in all countries of South Asia as per the discretion of the pediatrician, in case local growth charts are not available. Growth status may be monitored using IAP recommended cutoffs [Table 1].

Nutritional Requirements of Children and Adolescents (2 to 18 years Old)

General recommendations

- The diet of children should contain the right balance of macro- and micro-nutrients along with fluids to fulfill their growth and developmental needs.

- The panel agrees with ESPGHAN Committee on Nutrition (CoN) recommendation of at least four daily meals in children including breakfast. [29] Children under five may be given additional healthy snacks in between these four main meals to meet their additional need of growth.
- The National Institute of Nutrition (NIN), Hyderabad, India provides major nutrient (carbohydrate, fats, proteins, vitamins and minerals) and food groups (cereals, pulses, milk and milk products, meat and meat products, fruits and vegetables, oils and fats) and the portion sizes of different food groups for age specific balanced diet in children and adolescents [Tables 2 and 3]. The panel recommends these should follow the cultural patterns and tastes of the

Table 1: IAP recommended cut-offs.

Age	Growth Status	Indicator	Percentile	Z score
0-5 years (WHO-IAP Simplified)	Underweight	Weight for age	<3rd	<-2
	Severe Underweight	Weight for age	<0.1st	<-3
	Stunting	Length/Height for age	<3rd	<-2
	Severe Stunting	Length/Height for age	<0.1st	<-3
	Wasting	Weight for height	<3rd	<-2
	Severe Wasting	Weight for height	<0.1st	<-3
5-18 years (Revised IAP)	Underweight	BMI for age	<3rd	
	Stunting	Height for age	<3rd	
	Overweight	BMI for age	23rd adult equivalent	
	Obese	BMI for age	>27th adult equivalent	

Table 2: Major nutrient and food groups of a balanced diet.

Major nutrients	Other nutrients	Nutrients obtained
Energy Rich Foods	Carbohydrates & fats Whole grain cereals, millets Vegetable oils, ghee, butter Nuts and oilseeds Sugars	Protein, fiber, minerals, calcium, iron & B-complex vitamins Fat soluble vitamins, essential fatty acids Proteins, vitamins, minerals Nil
Body Building Foods	Proteins Pulses, nuts and oilseeds Milk and Milk products Meat, fish, poultry	B-complex vitamins, invisible fat, fiber Calcium, vitamin A, riboflavin, vitamin B12 B-complex vitamins, iron, iodine, fat
Protective Foods	Vitamins and Minerals Green leafy vegetables Other vegetables and fruits Eggs, milk and milk products and flesh foods	Antioxidants, fiber and other carotenoids Fiber, sugar and antioxidants Protein and fat

Table 3: Portion sizes of food groups of a balanced diet according to age.

Food groups	g/portion	Infants 6-12 months	1-3	4-6	7-9	Years					
						12-10		13-15		16-18	
						Girls	Boys	Girls	Boys	Girls	Boys
Cereals and millets	30	0.5	2	4	6	8	10	11	14	11	15
Pulses	30	0.25	1	1	2	2	2	2	2.5	2.5	3
Milk (ml) and milk products	100	4°	5	5	5	5	5	5	5	5	5
Roots and tubers	100	0.5	0.5	1	1	1	1	1	1.5	2	2
Green leafy vegetables	100	0.25	0.5	0.5	1	1	1	1	1	1	1
Other vegetables	100	0.25	0.5	1	1	2	2	2	2	2	2
Fruits	100	1	1	1	1	1	1	1	1	1	1
Sugar	5	2	3	4	4	6	6	5	4	5	6
Fat/ oil (visible)	5	4	5	5	6	7	7	8	9	7	10

ethnic groups in the South Asian countries and maintain the required food diversity for optimal growth and development of children.

- Indian Council of Medical Research-National Institute of Nutrition (ICMR-NIN) has also introduced the plate concept for easy understanding of portion size [Figure 6]. Common home measures and their measurements that can be used to follow portion sizes are also provided. This should be followed to consume right proportion of each food group.

Recommendations for macronutrients

Carbohydrates, fats, and proteins are the macronutrients essential for energy and growth in children. Additionally, proteins and essential fatty acids are important for appropriate development of brain.

Carbohydrates

Carbohydrates are mainly of two types, simple or complex, and each gram provides 4 Kcal of energy. The simple carbohydrates are glucose, fructose, sucrose and lactose and are found in fruits, vegetables and honey (glucose and fructose), sugar (sucrose) and milk (lactose). Complex carbohydrates can be in form of starches seen mainly in plant sources (cereals, pulses, millets, and root vegetables) and glycogen from animal foods.

Dietary fibers are also a type of complex carbohydrate that help in reducing absorption of fats and carbohydrates, increasing satiety and stool bulk. These are mainly classified as soluble and insoluble fibers depending on their water solubility. [30,31] Cellulose in vegetables and whole grains are the main types of soluble dietary fibers; and pectin and gums in vegetables, fruits and cereals are the main sources of soluble dietary fibers. [18,31,32] Increased intake of soluble fibers is associated with decreased risk of adiposity. [33] The recommended minimum daily intake of fiber, in children ≥ 3 years, can be estimated by age of the child *i.e.* grams of fiber required is equal to age of the child in years +5. [34] The Total Dietary Fiber (TDF) by food group and common food items is illustrated in [Table 4].

However, the consumption of simple sugars may be high in children in the higher socioeconomic strata; this can be attributable to the consumption of both natural (lactose and fructose) as well as added or free sugars. WHO defines free sugar as “all monosaccharides and disaccharides which have been added to foods and beverages by the manufacturer, cook or consumer, plus sugar naturally present in honey, syrups, fruit juices and fruit juice concentrates.”

Recently, Asia has seen a dramatic rise in the consumption of Sugar-Sweetened Beverages (SSBs) or beverages which contain added calories in the form of sugars such as high-fructose corn

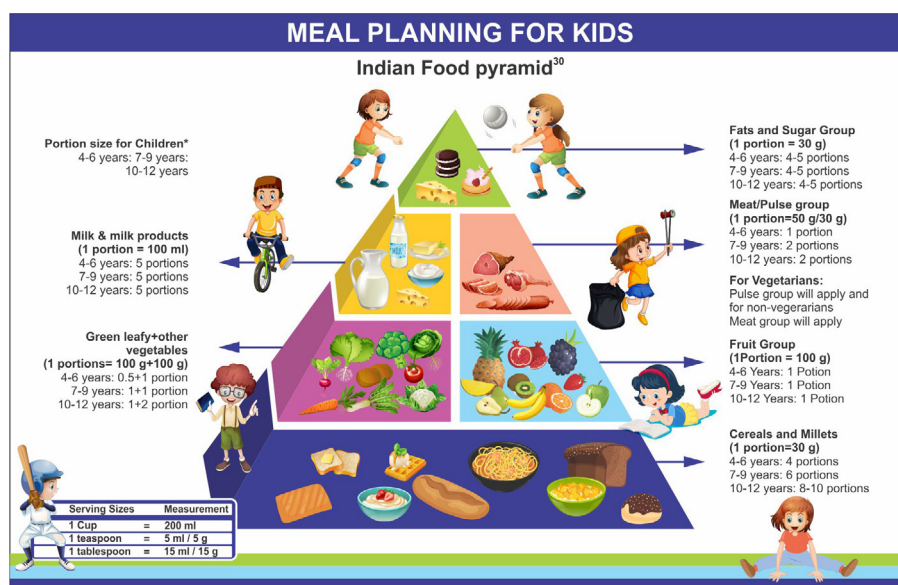


Figure 6: Portion sizes of food groups in the plate of a child or adolescent to combat hidden hunger.

Table 4: Total Dietary Fiber (TDF) by food group and common food items.

Food group	Food item	Fibre content g/100g edible portions			Soluble (%TDF*)
		Crude fibre	TDF*	Soluble	
Cereals	Rice	0.2	4.11	0.92	22.4
	Wheat	0.3	12.48	2.84	22.7
	Bajra	1.2	11.33	2.19	19.3
	Maize	2.7	11.54	1.65	14.2
	Jowar	1.6	9.67	1.64	17
	Ragi	3.6	11.85	0.89	7.5
	Lentil	0.7	10.31	2.04	19.8
	Chick pea	1.2	15.3	2.56	16.7
Pulses, dhals	Pigeon Pea	0.9	9.14	2.33	25.4
	Green gram	0.8	8.23	1.69	20.5

Vegetables	Cluster/beans	3.2	5.7	1.6	28
	Brinjal	1.3	6.3	1.7	27
	Cabbage		2.8	0.8	28.6
	Cauliflower	1.2	3.7	1.1	30.3
	Bhendi	1.2	3.6	1	26.9
Roots and tubers	Potato	0.4	1.7	0.6	33.5
	Carrot	1.2	4.4	1.4	30.6
	Onion	0.6	2.5	0.8	32
Green leafy vegetables	Spinach	0.6	2.5	0.7	28
	Amaranth	1	4	0.9	22.5
	Orange	0.3	1.1	0.5	45.5
Fruits	Banana	0.4	1.8	0.7	38.9
	Apple	1	3.2	0.9	28.1
	Tomato	0.8	1.7	0.5	28.5

symp, fructose, sucrose, etc. [35-37] Sugar content per 500 ml of commonly used drinks varies from five to eight teaspoons in sports drinks to 14-16 teaspoons in energy drinks to 11-17 teaspoons in carbonated drinks/soda and 6-22 teaspoons in fruit juices. [37] This is much higher than the age specific maximum recommended free sugar intake at medium activity level [Figure 7]. Increased intake of canned fruit juices and caffeinated and carbonated drinks among children is leading to an increased risk of childhood obesity and dental caries. [35,38-40] Further there is an increased risk of T2DM, obesity, and cardiovascular diseases during adolescence and adulthood.

Recommendations for carbohydrates

- In South Asia, 70%-80% of total dietary calories are in form of carbohydrates derived from plant sources such as cereals, pulses and millets. The panel recommends that a balanced diet should provide only 50%-60% of total calories from carbohydrates which should preferably be complex carbohydrates.
- Use of complex carbohydrates and whole grains should be encouraged. Use of refined and processed food should be discouraged.
- The use of sugar-sweetened beverages should be reduced to the minimum in children as this is the single most identifiable factor that is linked to increased morbidity and mortality in later years due to T2DM, obesity and associated metabolic and cardiovascular risks. [41]
- Free sugar intake should be below 5% of the total energy intake per day. This can help to check adiposity and dental caries.
- Lactose intolerant children may still tolerate cheese, curd, paneer and should be fed these instead of milk.

Fats

Oils and fats in the diet can be in the form of visible fat (cooking oil, butter, and ghee) or can be invisible fat present in animal and plant foods. Fats are of two types, saturated and unsaturated of which the Polyunsaturated Fats (PUFA) are more essential for proper bodily functioning. The energy needs of infants and children are almost double that of adults, and hence they need adequate amounts of fat in their diet. However, excess fat in diet can increase the risk of obesity, diabetes mellitus, and

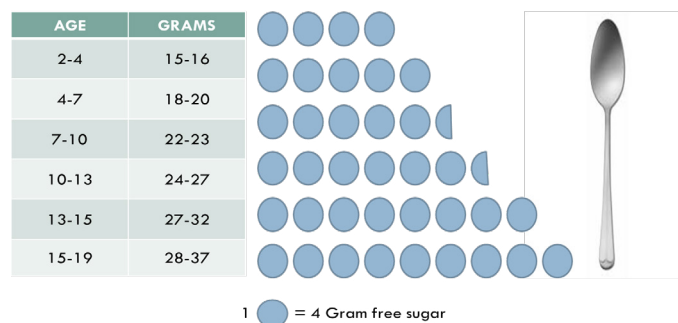


Figure 7: Recommended age-specific maximum daily free sugar 1 intake (<5% of energy intake) at medium physical activity level.

cardiovascular disease in later life. American Heart Association (AHA) recommends that fat should constitute 30%–35% kcal of total energy for 2-3 years old and 25%–35% kcal of total energy for 4-8 years, 9-13 years and 14-18 years old. [42,43] AHA recommends that saturated fat in diet should be limited to <7% of energy and trans fat to <1% of total energy intake. This means that 22%-27% kcal of total energy for 2-3 years old and 17%-27% kcal of total energy for 4-8 years, 9-13 years and 14-18 years old should come from PUFA. AHA however recommends that the fat intake may be adjusted according to physical activity level.

However, a study noted that the intake of fatty acids especially PUFA in children aged 4-8 years was significantly low as compared to the recommended levels. This difference could be compensated by consuming foods such as eggs, dairy products, breads, etc. and nutritional supplements rich in omega-3 fatty acids like Docosa Hexaenoic Acid (DHA). [44]

In another study, the association of DHA and brain activity was noted. They observed that a dosage of 0.4 g/day and 1.2 g/day of DHA provided an improved activation of the dorsolateral prefrontal cortex during sustained attention tasks in children (boys) aged 8-10 years. The study showed that eight weeks of DHA supplementation enhances the brain activation but longer duration is needed for improvement of cognitive performance in children. Individuals who had a DHA depleted diet at baseline were found to express improvement in the cognitive function with supplements. [45]

Recommendations for fats

- The total dietary fat (visible+invisible) should provide between 20%-30% of total calories [Table 5] required for age.

- The panel recommends that only 15% of the fat in diet should be visible fat, with 25 mg of DHA.
- Polyunsaturated fat should be preferred over saturated [Tables 6 and 7].

Proteins

Proteins can be obtained from both animal and plant sources and each gram of protein provide 4 Kcal of energy. Proteins are made up of two types of amino acids, amino acids synthesized inside the body and essential amino acids or Indispensable Amino Acids (IAAs) that cannot be synthesized in the body and need to be taken from food sources. The quality of protein is also important and is determined by the 'Protein Digestibility–Corrected Amino Acid Score' (PDCAAS). A protein is said to have PDCAAS=1 if the consumed amount of protein is equivalent to the Estimated Average Requirement (EAR) for that protein in meeting the minimal requirements for IAA intake. [46,47] Animal proteins have all the essential amino acids in the

right quantities and are considered high quality proteins. [48,49] Of the plant sources of protein a combination of pulses, cereals and millets makes up for most of the essential amino acids. Soy protein has a PDCAAS of 0.91 to 1. [50] Asian diet includes soy in many forms and soy protein consumption during childhood can have beneficial metabolic and cardio protective effects later in life. Some children are allergic to soy protein but majority of them usually outgrow this allergy by 10 years of age. [51,52]

Children and adolescents require more protein to fulfill their growth and developmental needs. [53,54] Also, compared to adults, children are more susceptible to high quality protein malnutrition. However, protein consumption of more than 15% of diet in childhood is associated with an increased risk of obesity in adult life.

Recommendations for proteins

Avoid diets with excess of proteins and to include sufficient amounts of high quality proteins with the right balance of amino

Table 5: Total dietary fat (visible and invisible).

Age/gender/ physiological groups	Physical activity	Minimum level of total fat (% energy)	Fat from foods other than visible fats % energy	Visible fat (cooking oil, butter, ghee, margarine) % Energy	gram/per/day
Children	3-6 Years				25
	7-9 Years				30
	10-12 Years				35
Boys	13-15 Years	25	10	15	45
	16-18 Years				50
	10-12 Years				35
Girls	13-15 Years				40
	16-18 Years				35

Table 6: Recommendation for type of visible fat.

1.	Use correct combination/blend of 2 or more vegetable oils (1:1) Oil containing LA+oil, containing both LA and ALA Groundnut/sesame/rice bran/cottonseed+mustard/rapeseed** Groundnut/sesame/rice bran/cottonseed+canola Groundnut/sesame/ricebran/cottonseed+soybean Palmolein+soybean Safflower/sunflower+palm oil/palmolein+mustard/rapeseed (oil containing high LA+oil containing moderate or low LA) Safflower/sunflower+palmolein/palmoil/olive Safflower/sunflower+groundnut/sesame/rice bran/cottonseed
2.	Re Limit use of butter/ghee
3.	Avoid use of PHVO as medium for cooking/frying
4.	Replacement for PHVO

ALA: Alpha Linoleic Acid; LA: Linoleic Acid; PHVO: Partially Hydrogenated Vegetable Oils

Table 7: Recommendations for optimizing quality of fat from foods other than visible fats [46].

- **To- increase n-3 PUFAs**
 - Consume foods which have a high content of ALA and/LC n-3 PUFAs
- Individuals/population who does not consume fish should achieve higher intake of ALA
- **To minimize TFAs**
 - Avoid food prepared in PHVO (processed, premix, ready to eat and fast foods)
 - Consume low fat milk and dairy foods
- **To limit SFAs**
 - Consume low fat milk and dairy foods
 - Moderate consumption of beef, mutton
- **To increase MUFAs and PUFAs, Antioxidants, Vitamins and Minerals**
 - Consume whole nuts but total energy and fat calories should be within the recommended limits.

ALA: Alpha Linoleic Acid; LC: Long Chain; MUFA: Monounsaturated Fatty Acids; PHVO: Partially Hydrogenated Vegetable Oils; PUFA: Polyunsaturated Fats; SFA: Saturated Fatty Acid; TFA: Total Fatty Acid

acids for the growth and development of children.

A balanced diet should provide about 10%-15% of total calories from proteins. Total protein consumption in children 2-3 years of age should be 5%-20% of the total daily calories and 10%-30% of the total daily calories in children aged 4-18 years. The RDA for energy and protein recommended by the panel for South Asian children is listed in Table 8 and energy calculation of commonly used cooked food items is given in Appendix V.

Recommendations for Micronutrients

Micronutrients in diet mainly consist of vitamins and minerals. Micronutrients can be obtained from both primary (plant and animal) and secondary sources (fortified food and food that enhance absorption). Micronutrients like iron, iodine, zinc, vitamins-B, C and D, and choline are essential for optimum brain development in infants and children. Micronutrient deficiency also known as ‘hidden-hunger’ is widely prevalent in Asian countries. Deficiencies in iron, iodine, zinc and vitamin A and D were found to be a major health concern in children in South Asia. [55-60]

The WHO has given suggestions for the use of multiple micronutrient food fortification powders in children aged 2-12 years. The micronutrient powders, to be administered as 90 sachets over 6 months, are recommended in areas where $\geq 20\%$ children under the age of 5 years have anemia. In addition to elemental iron, these sachets have 300 μg retinol and 5 mg elemental zinc. Other micronutrients may be added according to the dietary needs and composition of home foods. The

ESPGHAN CoN does not recommend the routine use of ‘young children formulae’, milk-based drinks or plant protein-based formulae, to partly meet the nutritional requirements in children aged 1-3 years. According to the CoN committee, the nutritional requirements of children can be met through locally available food items and these should be added to the diet of children who do not receive the right nutrition. [61]

- Diet should be planned so as to include foods that provide essential micronutrients such as copper, selenium, phosphorus, molybdenum, fluorine, cobalt, chromium and iodine. Foods rich in various micronutrients are enumerated in Table 9.
- Fortified foods and supplements may be used only if required. Formula-based diets should be discouraged.
- The age-specific dietary allowances for calcium, iron, phosphorus, magnesium, selenium, iodine and zinc recommended by the panel are listed in Table 10.
- Iron absorption is hampered in presence of milk, tea and milk products and hence iron should not be taken with these.

Recommendations for Vitamins

Since recommendations for vitamin intakes were not available for Bangladesh, Nepal and Sri Lanka, the panel considered recommendations for vitamin intakes in the US and by WHO and Indian Council of Medical Research (ICMR) (Appendix VI) to formulate the recommendations for South Asia [Table 11].

Table 8: RDA for energy and protein in South Asia [54].

Population groups (years)	Weight (Kg)	Energy (kilocalories/day)	Protein grams/day		
			High quality	Adjusted for 80% quality	Adjusted for 70% quality
2-3	14	1180	16	20	23
4-6	20	1470	21	26	29
7-9	27	1825	27	34	39
Boys					
10-12	34	2110	34	42	48
13-15	47	2650	45	56	64
16-18	56	2980	49	62	71
Girls					
10-12	36	2010	35	44	50
13-15	45	2205	41	51	58
16-18	49	2240	40	50	57

Table 9: Food source of micronutrients [62,63].

Micronutrient	Food source
Copper	Dried fruits, milk and milk products, seeds of sunflower and sesame, whole grains, potato, tahini, sun dried tomatoes, dark green leafy vegetables, yeast, organ meat (liver and kidney), and sea food such as shellfish and oysters
Zinc	Mainly animal food-meat, fish; milk Vegetarian diet is low on zinc
Chromium	Rich sources: processed meats, whole grains, pulses, Small amounts present in: dairy products, most fruits and vegetables
Cobalt	Rich sources: sea fishes and sea vegetables Small amounts present in: spinach, cabbage, legumes, broccoli, lettuce, oats, beet greens, and figs
Manganese	Rich sources: nuts, grains, cereals, tea, coffee Small amounts present in: meat, poultry, fish, dairy products, and seafood
Molybdenum	Organ meat (liver); lentils, oats, barley, dried peas, kidney beans, and soybeans
Selenium	organ meat (liver and kidney), muscle meat, seafood, cereal, cereal products, dairy products, fruits, and vegetables
Fluorine	Drinking water, tea, sea fish
Iodine	Rich sources: seafood and cod liver oil Small amounts: milk, vegetables, and cereals

Vitamin D

Deficiency of vitamin D is a major cause for nutritional rickets which is a worldwide problem. More than half of the adult peak bone mass is acquired during adolescence. [62-64] Adequate exposure to sun and dietary intake of vitamin D is essential in children to prevent rickets and osteomalacia. The US Endocrine Society has suggested daily vitamin D intakes of 600-1000 IU in children <1-18 years of age. [65] However, Indian children may require higher doses of vitamin D to maintain levels adequate for musculoskeletal health. [66]

Recommendations for vitamin D

- The panel agrees with the global consensus for daily intake of 600 IU of vitamin D in children aged >1 year.
- Children and adolescents should be exposed to sunlight between 11 AM and 3 PM for at least 30 minutes daily. [67,68]
- In the absence of food fortification, children with symptomatic vitamin D deficiency should receive supplements [Table 12]. Vitamin D supplementation should be part of primary healthcare programs for children. [69]
- Daily intake of 2000 IU is recommended for at least 3 months to treat nutritional rickets. In addition, these children should receive 500 mg/day of calcium regardless of age or weight.

- Routine calcium supplementation should be discouraged as it can increase the risk of constipation and calcium stones. [70] Children should get their calcium requirement from 200 ml to 400 ml of milk. Those who cannot afford milk may get their calcium requirement from legumes and other vegetarian sources of calcium such as ragi.

Vitamin A

Recommendations for vitamin A

Vitamin A in diet is mainly in two forms, retinol from animal sources and carotenes (which are converted to retinols in the gut) from plant sources. Vitamin A deficiency is a huge concern in South Asia. Deficiency of vitamin A may manifest as night blindness, Bitot's spots, xerophthalmia and keratomalacia. Adequate supplementation with vitamin A can help prevent blindness in children. [71]

Vitamin A supplementation of 200,000 IU in every 6 months to children under-5 has shown promise to control vitamin A deficiency in many developing countries in South Asia.

The panel recommends the vitamin A supplementation as per Table 11.

Salt

A newborn's kidney is too immature to handle the burden of

Table 10: RDA for micronutrients in South Asia. 1: Non-menstruating; 2: Menstruating.

Population groups (yrs)	Weight (Kg)	Calcium (mg/day)	Iron (mg/day)		Zinc (mg/day)	Phosphorus (mg/day)	Magnesium (mg/day)	Iodine (µg/day)	Selenium (mg/day)
			7.5% bioavailability	10% bioavailability					
2-3	14	500	7.7	5.8	4.8	600	50	90	17
4-6	20	600	8.4	6.3	5.7	600	70	90	22
7-9	27	700	11.9	8.9	6.0	600	100	120	21
Boys									
10-12	34	1000	19.5	14.6	6.8	800	120	120	32
13-14	47	1000	19.5	14.6	8.9	800	165	150	32
15-18	56	1000	25.1	18.8	8.9 (15 years) 8.6 (16-18 years)	800	165 (15 years) 195 (16-18 years)	150	32
Girls									
10-12	36	1000	18.71; 43.62	14.0; 32.7	6.1	800	160	120	26
13-14	45	1000	18.71; 43.62	14.0; 32.7	7.2	800	210	150	26
15-18	49	1000	41.3	31.0	7.2 (15 years) 6.8 (16-18 years)	800	210 (15 years) 235 (16-18 years)	150	26

Table 11: RDA for vitamins in South Asia.

Population groups (years)	Weight (Kg)	Vitamin A (µg/day)	Vitamin D (µg/day)	Vitamin C (mg/day)	Thiamin (mg/day)	Riboflavin (mg/day)	Niacin (mg/day)	Folate (µg/day)
2-3	14	400	5	30	0.5	0.5	6	160
4-6	20	450	5	30	0.6	0.6	8	200
7-9	27	500	5	35	0.9	0.9	12	300
Boys								
10-12	34	600	5	65	12	13	16	400
13-14	47	600	5	65	12	13	16	400
15-18	56	600	5	65	12	13	16	400
Girls								
10-12	36	600	5	65	11	10	16	400
13-14	45	600	5	65	11	10	16	400
15-18	49	600	5	65	11	10	16	400

Table 12: Vitamin D and calcium recommendations (therapeutic and preventive).

Age	Vitamin D				Calcium		
	Prevention	*Tolerable upper limit	Treatment	Treatment with large dose (oral route preferred)	Prevention	*Tolerable upper limit	Treatment
1-18 years	600 IU/day	3000 IU day till 9 years, 4000 IU/day from 9-18 years	3000/-6000 IU/day \$	60000 IU wkly for 6 weeks	600-800 mg/day	2500 mg/day till 8 years and 3000 mg/day for 9-18 years	600-800 mg/day
At-risk groups	400-1000 IU/day	as per age group	As per age group	as per age group	As per age group	as per age group	as per age group

\$: For ≥ 3 months; daily maintenance doses need to be continued after treatment; *: Tolerable Upper Limit—a nutrient's maximum total daily intake from all sources unlikely to cause adverse health effects in humans.

additional salt added to diet. [72,73] The panel recommends that no additional salt should be added to diet of children under one year of age. For children older than a year, salt may be added to meals as required.

Recommendations for salt

- The panel recommends that salt should not be added from outside to the infant's diet before one year of age.
- The panel recommends salt intake for children 1 year or older as: [74,75]
 - 1 to 3 years—2 g of salt a day (0.8 g sodium)
 - 4 to 6 years—3 g of salt a day (1.2 g sodium)
 - 7 to 10 years—5 g of salt a day (2 g sodium)
 - 11 years and over—6 g of salt a day (2.4 g sodium)

Dietary Fluids

Fluids in diet can be hidden water content in fruits and vegetables and in the form of drinking water. Tea, coffee, carbonated beverages and sweetened beverages are not considered as fluids.

Water is necessary for normal functioning of all cells of the body and for digestion, absorption and metabolism of food.

Recommendations for fluids

The panel recommends 60 ml-80 ml water per kg body weight in children between 0 to 10 years and 41 ml-55 ml water per kg body weight in adolescents between 11 and 18 years.

Obesity

Childhood obesity is a growing problem with serious health consequences. Globally, about 170 million children <18 years of age are said to be overweight. No single nutrient has been explicitly associated with the development of obesity in children.

The WHO has described the ANGELO (Analysis Grid for Elements Linked to Obesity) process to determine the multiple and varied causes of obesity in children and defining targeted solutions to combat the problem. Based on this the panel recommends country-wide standards for healthy eating practices and initiatives to be adopted at community-level. The panel also feels that legislative reforms to check the marketing and access to unhealthy foods should be made if possible. Schools need to introduce policies on healthy food habits and options and issue guidance to parents for preparing healthier lunch boxes for children. [76]

Recommendations for preventing obesity

- The panel agreed with the recommendations provided by WHO, AHA, and NASPGHAN for preventing obesity. These practices should be adopted in South Asia to foster the evaluation of and introduction of early interventions for over-nourished children.
- The panel gave the following recommendations to curb obesity in children and adolescents:
 - Increase physical activity
 - Lay emphasis on increased consumption of fruits, vegetables, whole grains, and water. Reduce/avoid sugary drinks, fast foods, and high fat consumption.
 - Avoid excess consumption of salt. Follow AHA recommendation of a daily intake of sodium of <1500, <1900, <2200 mg in children aged 1-3, 4-8, and 9-13 years. [77]
 - Follow WHO recommendation of daily breakfast, improvement in lunchbox content, and low-fat dinners.
 - Depending on physical activity, discretionary calories may be added to match energy demands and growth. [78]
 - Follow the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) guidelines to include assessment of growth and nutrition in children as part of patient care. [79]

Catch-Up Growth

Catch-up growth is characterized by height velocity growth above the limits of normal for age for at least 1 year after a transient period of growth inhibition; it can be complete or incomplete. Although catch-up growth can be expressed in terms of height velocity, the change in height standard deviation score is more appropriate. Adequate and balanced energy, macronutrient and micronutrient intakes are vital for the physical and mental development of infants and children. Studies have shown that in nutritionally at-risk children, dietary counseling and oral nutritional supplementation (that can provide 450 kcal energy, 13.5 g of high protein, 17.7 g easily digested fat and 28 minerals and vitamins) can sustain normal growth. In such children, it was observed that height steadily increased over the study period with an average rate of 0.5 cm every 4 weeks. [80]

Pediatric Intensive Care Unit Nutrition

Various studies shown that the children admitted to PICU lose significant proportion of their weight during ICU stay. [81,82] Hence, it's very important to take care of nutrition during PICU stay.

Recommendations for PICU

Achievement of optimal nutrition in PICU is associated with better outcome in PICU

Therefor the panel recommends the following for planning nutrition in PICU:

- Starting enteral nutrition early
- Both bolus and continuous feeds can be used as bolus feeds are same as continuous feeds although continuous feed is tolerated better in certain special situations
- Feed level can be escalated fast as this is well tolerated and leads to early achievement of full feeds (Full feeds corresponds to tolerating more than 50% of feeds).
- Frequent interruption of feeds should be avoided in PICU as feed interruption is the most common cause of not being able to achieve full nutrition in PICU.
- Maintain desired caloric intake of around 60-70 Kcal/kg/day and proteins is 2-2.5 gm/kg/day, as calories less than this leads to negative protein balance. In certain conditions you may have to give higher calories and proteins than recommended for example in burns, Toxic Epidermal Necrolysis (TEN) etc.
- Can give multi-vitamin and multi-mineral supplement as required. There are multiple studies showing role of

multivitamin and multi mineral in improving outcome in PICU. Few of them are thiamine, vitamin C, selenium, vitamin D and vitamin A

- There is no role of total parenteral nutrition in early PICU stay as it is detrimental in first 2 weeks of PICU also there is no role of partial parenteral nutrition in PICU like high dextrose containing fluids.

Child Psychology for Healthy Eating

Even though initially the child's food environment follows that of family, as the child grows this food environment is influenced by peers, social media, and advertisements and by child's own perceptions of food and feeding practices. Advertising is directly linked to child's diet and translates into an increase in energy dense snacks and overall calories and a reduction in intake of fruits and vegetables. [83] Increased screen time and snacking while viewing a screen reduces physical activity and significantly increases the risk of obesity.

The 'Identification and Prevention of Dietary-and Lifestyle-induced Health Effects in Children and Infants Study' (IDEFICS) found that obese children are less likely to adhere to healthy food and physical activity recommendations than normal weight and thin children. The study also found that adherence to food and physical activity recommendations decreased the risk of obesity. [84] One of the main findings of IDEFICS was that having the right knowledge about food was not directly linked to children adopting healthier food preferences. [85]

Hence, the child psychology towards adapting the correct behavior towards eating and physical activity has to be shaped early as dietary habits from childhood tend to track over time

Table 13: Recommendations for healthy feeding practices.

Strategy	Implementation
Be a role model	Children follow parents and adults in the family; inculcate the right food environment at home for all to follow Dislike for healthy food should not be practiced Help child build taste for fruits, vegetables, whole grains, dietary fibers by consuming these with appreciation
Availability and hidden control	Purchase and store only healthy foods at home Avoid regular trips to unhealthy stores and fast food restaurants Keep healthy snacks and food options like fruits, sprouts etc. at home
Accessibility	For small children, keep food out of reach Keep small portions of healthy foods within easy reach Increase child's access to information on recommended dietary allowances of various nutrients Increase child access to information on food pyramid; food plate; healthy living
Avoid food as a reward	Food should not be used as a reward for inculcating good behavior, or for completing studies or any task Can coax child to eat healthy and try and show how healthy eating is rewarding in terms of school performance, sports, and extra-curricular activities Cheat days or unhealthy food may be allowed once a week, but not as reward Use smaller food packages of energy dense snacks and convenience foods with right energy labels instead of large family packs; several studies have shown that families using larger packs consumed more total energy which reduces drastically on introduction of portion or package size.
Promote self-regulation	Serve moderate portions Help child recognize the sense of fullness Take child's help in organizing the right feeding environment at home
Creating the right environment for family meals	Share as many meals with children as possible Expose the child to maximum food groups in every meal Try variations of the same food to understand child's taste Take child's help in meal planning and give the child the option to choose e.g. choose a green vegetable Make family meal times fun times of shared experiences and laughter Discourage TV viewing at meals No TV viewing during meals
Reinforcing healthy habits	Set total screen time (TV, mobile, computer, laptop etc.) Encourage child to pursue sports, dance, swimming, or any physical activity of interest. Set meal times and meal portions and teach child to fill the plate accordingly*

*: Give a printout of the food plate and food measurements

and are maintained in adulthood too. Since it may be difficult to directly modify the feeding habits of the child, parental feeding practices should be targeted. ^[86] Children mimic parents and therefore parents can influence their child's food consumption behavior by promoting healthy eating practices and by preventing unhealthy ones. ^[87]

Recommendations to improve child's eating behaviour

The panel recommends that child psychology and child's eating behavior should be propelled in the right direction to inculcate life-long healthy eating practices. Listed in Table 13 are some recommendations from the panel which parents can follow to build healthy feeding practices for their children. Pediatricians or dieticians can reinforce these practices with parents. Printed copies of information on nutrition may be given to parents and on each visit a feedback can be taken regarding what is being followed. ^[88-93]

Conclusion

Prevention is better than cure and hence all parents and caregivers should be routinely counseled about nutrition. The poor doctor to patient ratio in South Asia forces this region to adopt a more therapeutic than preventive approach. Thus, this panel strongly advocates the need to follow these recommendations in routine practice to ensure optimal growth and development of children and adolescents. Routine growth and nutrition assessment should be done in children as part of patient care. Growth charts should be routinely used in practice and parents counseled about their child's growth status using these charts. Clinical psychologists, dieticians, and educators may also be trained to impart correct diet counseling to children's parents and caregivers and to adolescents. Young pediatricians should also receive continued medical education and be encouraged to participate in workshops to keep abreast with latest in growth monitoring and nutrition. Parental education about right feeding practices will go a long way in improving nutrition in children and adolescents.

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Conflict of Interest

None of the Authors has conflict of Interest.

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