



**Original Article:**

**Health Scenario of Major Tribals of Northern Orissa in Relation to Human Growth, Development and Nutrition and the Role of Genetic Factors in Smell and Tasting Abilities in Children**

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**Abstract:**

The nature of physical growth and development of children depends primarily upon the genetic endowments, nutritional status, psychosocial attitude and surrounding physical environmental conditions. School going children are the most important segment of the society who are affected by under- and mal-nutrition. Good nutrition is an indispensable component of healthy life. Tribal children studying in Ashram schools can be taken as representatives of the predominant tribes of the area. This study was aimed at evaluating the health profile in relation to growth, development and nutrition of a randomly selected cross section of 1038 Ashram school children aged six through 15 years in the state of Orissa. Following the standard methodology, it was noticed that nutritional complications are compounded due to ignorance, bad food habits, food fads, and poverty. About 71% of the Ashram school children showed mild to moderate anemia. According to different grades of malnutrition, the frequency of grade III malnutrition was very low in Ashram-school boys (1.4%) and girls (3.5%), with an average of 2.3%. The grade I as well as grade II malnutrition was also higher in girls (grade II =24.3%; grade I= 37.6%) as compared to boys (grade II=16.7%; grade I=31.5%) with an average of 19.9% and 34.1%, respectively for grade II and grade I malnutrition. There was a consistent pattern of increase in height and weight in the year six through fifteen of age, showing that height and weight of the Ashram school children increases with the corresponding advancement of age in both boys and girls. In general, the girls were shorter and lighter in weight than the boys. This pattern is consistent in the present study of Ashram school children in Orissa. It has been observed that apart from the genetic potential, the intra-uterine environment, mother's nutritional status before, during and post pregnancy, and neonatal nutrition and associated traditional behavior drastically influence the growth and development of individuals. Adequate physical and mental fitness of parents is a marker for physical and mental fitness of the progeny. Heritable genetic factors are responsible for the ability to detect and identify smell and taste of food items of liking and

disliking and for the fussy behavior toward different foods in children.

**Key Words:** Health Profile; Antenatal Growth and Development; Behavioral Genetics; Nutrition; Smell and Tasting Abilities; Tribal children; Northern Orissa

**Introduction:**

The nature of physical growth and development of children depends primarily upon the genetic endowments, nutritional status, psychosocial attributes and surrounding physical environmental conditions.(1,2) Good nutrition is an indispensable component of healthy life. It is a determinant of healthy growth of mind and body. It plays a vital role in the physical, mental and emotional development of a child.(3) School going children are the most important segment of the society who are affected by under- and mal-nutrition. Complications are compounded due to ignorance, food fads, bad food habits, and poverty of the parents.(4) The nutritional status of the young children varies from region to region in India due to differences in dietary habits, socio-cultural attributes, unbalanced intake of food, irrational practices, economy, disease burden, and accessibility to hygienic food, sanitary conditions of living, etc. Consumption of unbalanced food leads to nutritional deficiencies.(4) The prevalence of anemia is mostly attributed to iron, folic acid and other nutritional deficiencies, and is more common among the under privileged communities of India.(1)

This study was aimed at to evolve growth norms for Ashram school children and evaluate the health profile in relation to human growth, development and nutrition of a randomly selected cross-section of 1038 Ashram school children aged six through 15 years in the state of Orissa.

**Subjects and Methods:**

Out of a list of 62 endogamous scheduled tribes (aborigines) in the state of Orissa, a cross-section of ten major tribes each comprising more than one lakh population as per 2001 census, were studied. These major scheduled tribes included were: Bathudi, Bhumiz, Kolha, and Santhal from Mayurbhanj

district, and Bhuyan, Gond, Kharia, Kissan, Munda and Oraon from Sundargarh district in Northern part of Orissa.

The highest concentration districts were first identified for each tribe and then the Ashram schools were listed in that locality, of which 4-5 schools were selected at random, representing different geographical locations in each district. The Ashram schools in the state of Orissa represented about 90% of the total strength of the local tribal population and about 10% of the scheduled castes. Ashram schools are residential type state government funded schools in which apart from imparting the formal education, children are being encouraged to do kitchen gardening in the school premises. They are consuming the vegetable and fruit products of these

gardens while staying in the boarding in addition to outside state government supplied foods. All the children were being fed from the same kitchen.

For the present study, a cross section of Ashram school students aged 6 through 15 years were taken to evaluate the health and nutritional status. Thirteen Ashram schools, seven from Sundargarh (575 children) and six from Mayurbhanj (465 children) districts in Northern Orissa (Fig-1) were selected at random representing different geographically scattered locations. They belonged to Bathudi, Bhumiz, Bhuyan, Gond, Kharia, Kissan, Kolha, Munda, Oraon and Santhal tribes.

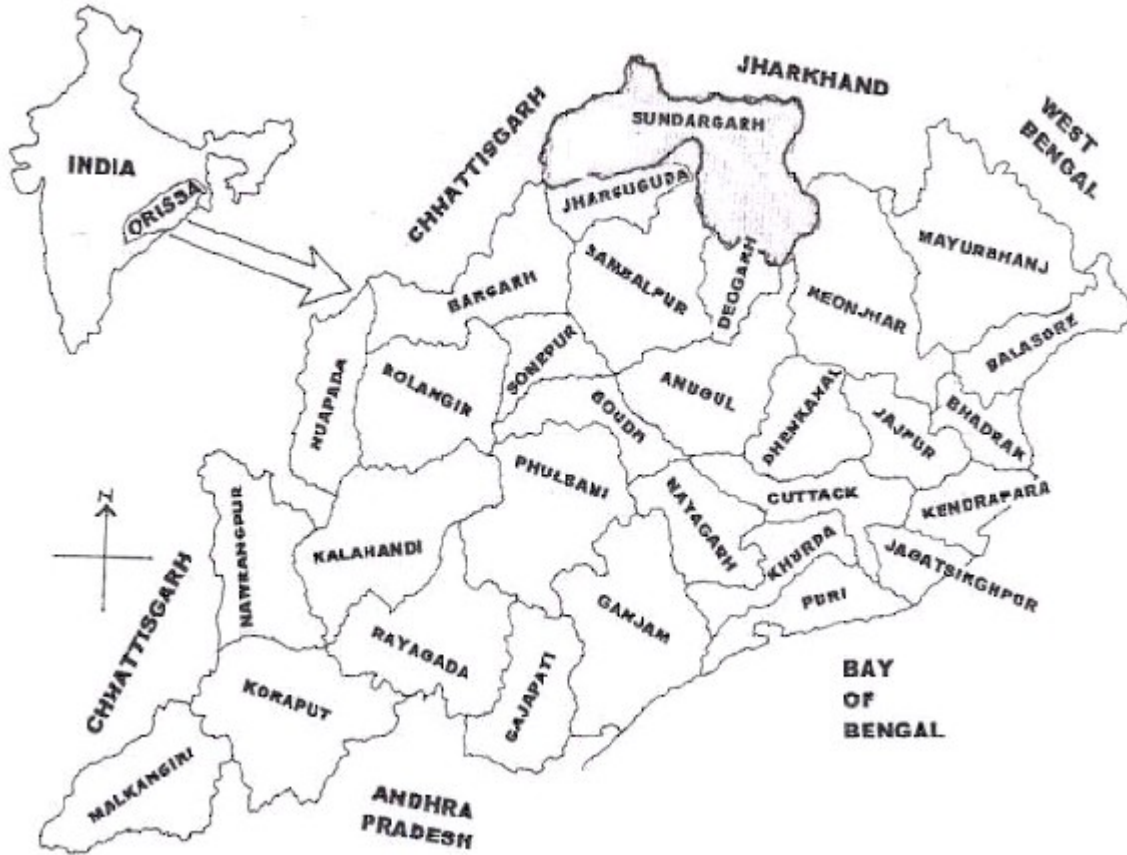


Fig 1: Map of Orissa showing 30 Districts

A total of 1038 children were measured for height (in centimeters) using the anthropometric rod from two districts of the state. The weight (in kg.) was also taken using weighing machine attached with the anthropometer. It was also ensured to take measurements only from unrelated individuals belonging to either sex.

Intravenous blood samples were collected from each student (2-3 ml) under aseptic conditions in disodium salt of ethylene diamine tetra acetic acid (EDTA) coated vials in the presence of a medical doctor after taking informed consent from each individual and transported under ice-cold conditions to the laboratory at Bhubaneswar within 24 hours of the collection. Laboratory investigations were carried out for screening of hemoglobinopathies, following the standard procedures (5, 6) after cross checking for quality control from time to time. Hematolo-

gical parameters were studied by using an automated Blood Cell Counter (Model- MS4, Melet Schloesing Laboratories, France). Grading of anemia was done as per the WHO guidelines.(7)

**Observations and Results:**

About 71% of the Ashram school children showed the mild to moderate anemia (Table-1). This anemia may be due to iron and folic acid deficiency, malarial infection, parasitic infestation, and hereditary hemolytic anemia because of co-inheritance of beta-thalassemia syndrome, the sickle cell disease or the glucose-6-phosphate dehydrogenase (G-6-PD) enzyme deficiency.(6,8)

Grades of Anemia (Hemoglobin Level)	No.	%
Normal (>12.0 g/dl)	297	28.7
Mild (10.1-12.0 g/dl)	616	59.3
Moderate (7.1-10.0 g/dl)	121	11.6
Severe (<7.0 g/dl)	4	0.4
<b>Total Tested</b>	<b>1038</b>	<b>100.0</b>

According to Gomez's classification (9) of different grades of the malnutrition, the frequency of grade III malnutrition was very low among Ashram-school- boys (1.4%) and girls (3.5%), with an average of 2.3%. The grade II as well as grade I malnutrition was also higher in girls (grade II =24.3%; grade I= 37.6%) as compared to boys (grade II=16.7%; grade I=31.5%), with an average of 19.9% and 34.1%, respectively for grade II and grade I malnutrition (Table-2).

Grades of Malnutrition (Gomez Classification)	Boys (No.,%)		Girls (No.,%)		Total (No.,%)	
Normal: >90%	251	50.4	127	34.6	378	43.7
Grade I: 75-89%	157	31.5	138	37.6	295	34.1
Grade II: 60-74%	83	16.7	89	24.3	172	19.9
Grade III: <60%	7	1.4	13	3.5	20	2.3
<b>Total Tested</b>	<b>498</b>	<b>100.0</b>	<b>367</b>	<b>100.0</b>	<b>865</b>	<b>100.0</b>

There was a consistent pattern of increase in height and weight in the year six through fifteen (pediatric age group) of age, showing that height and weight of the Ashram school children increased with the corresponding advancement of age in both the boys and girls (Tables 3 and 4). In general, the girls are shorter and lighter in weight than the boys. This pattern is consistent in the present study for the Ashram school children in Orissa (Tables 3 and 4).

**Table 3: Comparison of Mean Height and Weight of Boys in different ages of Ashram School (Tribal) Children with other Standardized Averages.**

Age in Years	Ashram School Children Mean/SD	ICMR, Orissa (Urban) Mean/SD	ICMR (Average, India) Mean/SD	NCHS* Mean
<b>Height (in cm):</b>				
6	119.5+10.6	113.1+06.8	108.5+07.2	119.0
7	127.7+11.6	118.2+07.6	113.9+08.7	124.4
8	128.5+07.7	124.6+07.5	119.3+07.3	129.6
9	132.5+07.9	128.3+07.3	123.7+09.3	134.8
10	136.9+10.6	131.8+09.1	128.4+10.0	140.3
11	141.8+09.9	138.6+09.9	133.4+09.7	146.4
12	144.1+09.1	144.2+09.2	138.3+10.1	153.0
13	148.7+09.1	148.7+09.1	144.6+09.8	159.9
14	152.5+06.3	153.1+10.9	150.1+10.0	166.2
15	158.1+06.3	159.2+07.9	155.5+10.0	171.5
<b>Weight (in Kg):</b>				
6	20.1+04.3	18.1+02.6	16.3+02.7	21.7
7	23.7+05.5	19.8+03.1	18.0+03.0	24.0
8	24.1+04.0	22.1+03.9	19.7+03.4	26.7
9	26.5+05.2	23.7+03.8	21.5+04.5	29.7
10	28.4+06.6	25.3+04.5	23.5+05.3	33.3
11	31.9+06.6	28.8+05.8	25.9+06.3	37.5
12	33.8+05.8	31.9+06.2	28.5+06.1	42.3
13	37.2+06.3	35.6+06.7	32.1+06.8	47.8
14	41.8+04.4	38.6+07.7	35.7+07.6	53.8
15	45.1+05.5	43.0+06.8	39.6+08.6	59.5

\*from Reference No. 11

**Table 4: Comparison of Mean Height and Weight of Girls in different ages of Ashram School (Tribal) Children with other Standardized Averages.**

Age in Years	Ashram School Children Mean/SD	ICMR, Orissa (Urban) Mean/SD	ICMR (Average, India) Mean/SD	NCHS* Mean
<b>Height (in cm):</b>				
6	114.2+07.6	113.3+06.3	107.4+08.7	117.6
7	120.2+06.9	117.3+06.9	112.8+08.5	123.5
8	126.9+05.9	123.0+07.4	118.2+07.7	129.3
9	131.4+06.8	126.9+06.7	122.9+07.5	135.2
10	135.5+06.9	132.5+07.9	128.4+08.0	141.5
11	137.9+07.3	139.0+08.1	133.6+09.5	148.2
12	143.7+06.7	143.5+07.8	139.2+10.2	154.6
13	145.5+06.5	147.8+06.4	143.9+09.2	159.0
14	146.5+05.9	149.6+05.6	147.5+09.7	161.2
15	149.6+08.5	151.3+05.2	149.6+08.3	162.1
<b>Weight (in Kg):</b>				
6	17.7+02.9	17.4+02.3	16.0+02.7	20.6
7	19.8+03.5	19.9+03.1	17.6+02.9	23.3
8	22.9+03.2	21.4+03.2	19.4+03.3	26.6
9	24.7+05.0	23.0+03.6	21.3+03.7	30.5
10	26.1+04.4	26.2+04.9	23.6+05.7	34.7
11	29.1+05.4	29.8+06.0	26.4+05.5	39.2
12	35.2+05.9	33.5+06.0	29.8+06.6	43.8
13	36.9+04.8	38.1+06.5	33.3+07.3	48.3
14	38.4+04.4	39.3+06.2	36.8+07.2	52.1
15	39.1+06.4	42.0+05.4	38.8+07.1	55.0

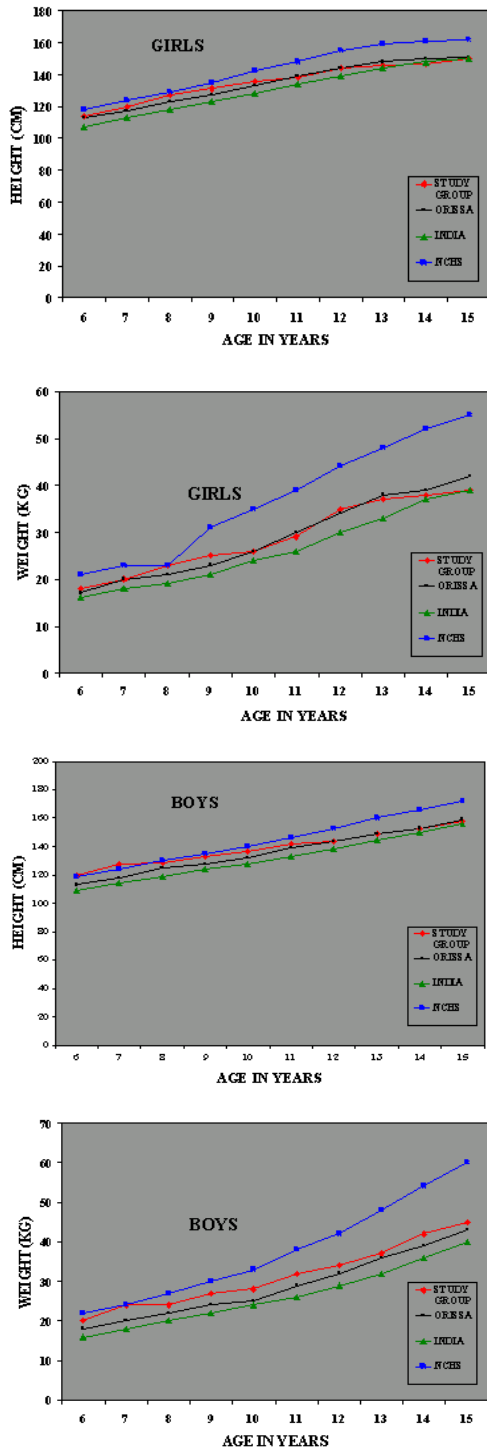
\*from Reference No. 11

#### Discussion:

The nutritional status of young children varies from region to region in India due to differences in dietary habits, socio-cultural attributes, unbalanced intake, irrational practices, economy, disease burden, and accessibility to hygienic food, sanitary conditions, etc. Consumption of unbalanced food leads to nutritional deficiencies.

There was a consistent pattern of increase in height and weight in the year six through fifteen of age among the Ashram school children of Orissa as expected showing increased height and weight with the corresponding advancement of age in both the boys and girls. In general, the girls are genetically endowed with shorter and lighter in weight than the boys. This pattern was consistent in the present study for the Ashram school children in Orissa.

Taking into consideration the physical growth and development among the Ashram school children, it was observed that both boys and girls represented the better health and nutritional status in height (being taller in almost all the age categories) than the respective Indian average (of ICMR) and average for the corresponding age categories (10,11) of the state of Orissa (Fig.-2). However, the Ashram school children showed lower values in almost all the age categories than the National Center for Health Statistics (NCHS) standards (Tables 3 and 4).



**Fig. 2: Comparison of Mean Height and Weight of Boys and Girls in different ages of Ashram School (Tribal) Children with other Standardized Averages.**

One of the important objectives of the study was to evolve growth norms for Ashram school children. From physiological point of view, the normal growth from inception, its maintenance, and termination, depends upon an orderly sequence of constitutional genetic, endocrine, nutritional, and environmental influences. Comparison with Indian average standards (10,

11) may have inherent drawbacks that these children belong to different ethnic stocks and live under different environmental conditions; hence they are not comparable. Therefore, the need for developing a local standard was obviously desired.

Any affliction of communicable, noncommunicable, and genetic abnormality enhances the apoptosis and retardation, and adversely affects the growth and development of individuals. Apoptosis is a cell death process, which occurs during development and aging. Cytotoxic substances that lead to deprivation of survival factors also induce it. Healthy conditions are utmost beneficial and favorable to achieve the target goals for growth and development.

In view of the under- and mal-nutrition still persisting among the Ashram school children, it was observed that the balanced diet was not served to these children and as a result of this, various nutritional deficiencies occurred. These nutritional deficiencies have been recorded and presented elsewhere.(4,12) It was, therefore, suggested that a short-term training should be imparted to the boarding teachers regarding the balanced diet or at least essential nutrient constituents of the food as per the requirements of the children. Simple rice and cereal feeding (of low quality) to the children does not serve the purpose except avoiding the hunger-stricken conditions. For this purpose, the physical instructor available in the school would be the most suitable person to get this nutritional training and should be involved in the management of catering the balanced food to the children.

Regular health check ups of the children are a must for the better prospective health care of the boarders, who stay far away from their parents. The headmaster of the school should be empowered to call the local primary health center (PHC) doctor or District Medical (School Health) doctor for medical check up as and when deem necessary. Sincere efforts and cooperation of the District Health Authority such as Chief District Medical Officer, District Welfare Officer and the headmaster of the school will help coordination for better health care of the future generation builders of the nation.

#### Human Antenatal Development

Apart from the genetic potential, the intrauterine environment, mother's nutritional status before, during and post pregnancy, and neonatal nutrition and associated traditional behavior drastically influence the realization of this potential of an individual in the course of life. In fact, an individual is a product of all those circumstances, which determine, later on, the potential and course of life. Adverse conditions affect the outcome adversely and favorable environment enhances the healthy growth and development of fetus. Adequate mental and physical fitness of parents is a marker for physical and mental fitness of the progeny.

A growing body of evidence suggests that the health in later life of an individual is not simply a matter of genes and lifestyle, but is also intimately linked to what happened in mother's womb.(13) Numerous studies around the world confirm that the first nine months of intrauterine life may be the most important period. Retarded growth in the womb is strongly linked with an increased risk of various killer diseases, including the heart disease, diabetes-II and stroke. Those children who are thin at birth with small placenta have higher death rates of coronary heart disease than the others.(13)

Babies, deprived of nutrients in the last months of pregnancy, for instance, tend to have larger heads and shorter bodies with smaller abdomens, and are more at risk of heart disease.(13) Those individuals experiencing earlier a shortage in their fetal life, on the other hand, are often proportionately smaller with larger placenta, and are more prone to strokes; those affected during the middle months, are commonly thin at birth and likely to suffer from diabetes (13). High blood pressure is asso-

ciated with retarded growth and development at any stage of pregnancy.(13) What is clear is that the babies who grow least in the uterus are, subsequently, at higher risk of these diseases in later life.

Why and what actually happens? When resources are in short supply, the fetus adapts by protecting the essentials, such as the brain or the growth of the placenta, at the expense of other parts of the body.(13) This can reduce the number of cells or produce other physiological alterations in various organs and body parts, i.e. these changes, we may not be able to reverse them later in life. If you have a baby who is growing fairly well in the uterus until the last part of gestation, for instance, it makes a number of adaptations directed towards maintaining growth of the brain at the expense of the rest.(13) Hence, we get the larger head in proportion to the rest of the body. It depends not so much on what mothers eat when they are pregnant, but what mother has stored before the pregnancy and how well the placenta is formed.(13)

Children born to mothers suffering from beta-thalassemia or sickle cell disease have larger size of the placenta. This is because of the fact that the red blood cells of such mothers have very low capacity to carry oxygen to the target tissues, because of the inherited abnormality in red cells and the reduced number of red cells in circulation (anemia). In order to fulfill the requirement or demand of sufficient amount of oxygen for the body from the placenta, the size of the placenta is enlarged. Thus, the placental weight is largely dependant upon the conditions of the mother and child. Abnormal children have abnormally high weight of placenta and normal children have adequate weight of placenta in the above-mentioned afflicted mothers. Thus, human nutrition does not matter much in adult life, but what happened in mother's womb, matters the most!

Similarly, a greater similarity in behavior or trait between identical than between fraternal twins indicates that the behavior or trait is likely to be heritable and consumer preferences have a genetic basis. Twin study showed that a wide range of consumer judgment and decision-making phenomenon is in fact heritable or influenced by genetic factors. Your craving/lurking for chocolate and inclination towards hybrid cars is in your genes. Likings for specific products seem to be genetically related: chocolate, mustard, hybrid cars, science fiction movies, jazz, etc. The current research suggests that heritable and other hard-wired inherent preference components play a key role in behavior and deserve much more attention in marketing and decision making research.

#### **Human fads for Taste and Smell also Matter The Most!**

We often abuse, slap or threaten our children for not taking (eating) particular kind of food prepared in our kitchens or brought from the market. Mothers are also blamed for spoiling the habits of the child. Is a child's socialization at fault? Is the mother really a culprit? Is the child psychologically abnormal? Certainly, the child is not abnormal. These are some of the questions of ignorant parents, which are addressed scientifically and logically in this section.

In any community or population group, there are people who do not worry about any aspect of food; on the other hand, there are people who are seen as allergic, choosy or fussy to certain kind of food.(14) They notice stale foods, strong flavours and even the difference between different brands of flavored foods. Food sensitive people are particularly sensitive to small changes of flavour and smell in food. Thus, the idea is that food sensitive people are most sensitive to flavor. Attempts were made to change the flavors and smells by artificial colors, flavors, some preservatives and salicylates. Smells such as of paint and petrol are also implicated. Some children are often very fussy about taste, texture and temperature; children would often reject over-ripe bananas, mango, milk or cheese if it tasted mouldy to

them.(14) It was learnt that mild flavored, good quality fruits are better tolerated. Food sensitive children seem to either love or hate certain smells. One child would be excited by the smell of petrol, while another would be nauseous.

Clinically, disliked smells are so described, as they are usually known to produce adverse symptoms. How they feel when they have to cope with high doses of perfumes. A perfume that produces migraine in one individual, on the other hand, may be liked by another. Individual variation of tolerance in the population does need to be recognized.(14) Meanwhile, the suspect substances that broaden the chemical content of foods include all additive colors, flavors, most preservatives, salicylates, natural and added monosodium glutamate, and various amines in addition to chocolate. Additive colors and flavors cause the most reactions; and chocolate and tomato sauce are reported to cause reactions in over 80%.(14) Paint and petrol smells are reported a problem in nearly as many. Thus, the concept of total body load is developed which is a combination of all the factors that seem to aggravate the underlying symptoms. These factors include the natural and additive food chemicals, smells, stress, contact dyes, infections, allergy foods and inhalants. There is individual variation in the importance of the various factors, and liked suspect foods and smells are better tolerated than disliked ones.(14)

It is realized that one common factor or culprit for these excluded foods is flavor, additive flavor, tangy fruit, herbs, spices, teas, peppermints, chocolate, aged and matured foods, and flavor enhancers.(14) It includes benzoate and aromatic preservatives, high amine smell in ripe bananas, the mouldy smells in foods, and smells and perfumes in the environment.

It is fascinating that people who are food sensitive, are sensitive in that it (food) can cause adverse reactions in their body, but also sensitive in so far as they are discerning or discriminating, often seen by others as fussy.(14) It is as if, those who are more sensitive or fussy should be that way, to minimize adverse reactions.

As we all are aware of and do testing for phenyl-thiocarbamide (PTC) or urea in anthropology for tasting ability of individuals for estimating ethnic variability because of the fact that there are people who are called supertasters (TT) or homozygous for tasting ability. They are highly sensitive to certain tastes, especially bitter and hot, spicy foods. And specifically, to the taste of PTC, which to a supertaster (TT) tastes bitter, mild to a taster (Tt) or heterozygous for tasting ability and without taste at all to a non-taster (tt) or homozygous for nontasting ability. The ability to be a supertaster is inherited as an autosomal dominant manner. Sweet taste is also enhanced. Anatomically, supertasters (TT) have more nerve endings in their tongues. Interestingly, they (TT) also have more pain and touch nerve endings there. They (TT) notice pepper, alcohol and fizzy drinks more, and are better, at perceiving fat in food.

Research investigations have revealed the role of smell in those living near livestock farms. It is reported that disliked smells impair mood, that people are more depressed, more anxious when they smell unpleasant odors. However, the persons working in leather or shoe industry, for example, become immune to foul smell and their sensitivity reduces with the passage of time. On the other hand, the use of garland with flowers of fragrance in places of worship and smear of sandalwood or "chandani" on the forehead in India serve the same purpose for amelioration of mood. Aggressive behaviour may be culminated from reactive foods or odors in these hypersensitive individuals. In other words, the mood disorders sometimes, are reactions in some individuals to fussy surrounding or environment.(14) This is particularly interesting as the most commonly improved symptoms on a low flavor (low additive and low natural chemicals) diets are mood. Diet has direct bearing on the mood or behavior of an individual.(14)

The food sensitive people are supertasters (TT), and that they form a new sub-group who are also supersmellers (SS). They (SS) often describe foods as strong, and often throw out food that smells stale to them. They (SS) often comment on how hot spices are, or how sickly sweet some foods are. They (SS) are also often very aware of smells, such as of paint or petrol, and strong perfumes. Many food sensitive children are fussy about foods, noticing the smell, taste or feel of the food. The amount of amines in food is important which causes migraine, tummy aches and irritable bowel syndrome in food sensitive people. Clinical findings of research reinforce that food sensitive people should be very wary of any food they think is of poor quality, smells strong or stale to them at the particular time they are assessing it.(14) In doing this, they also incorporate the idea of how robust or fragile they feel, depending on the total body load of factors they react to.

It is possible that the mechanism of food sensitivity for the suspect aromatic compounds is the slower or abnormal metabolism that sensitive individuals have. This would explain why food-sensitive people are reported to have bad breath and high body odor, which is alleviated by diet therapy using what, in fact, is a low aroma diet.

In those individuals with a constitution of iron (strong willed people), there are no food rules; in normal and gourmet people, the rule is: smell your food; it is a guide to likes and dislikes, and therefore, enjoyment of food. In supersensitive people, the rule becomes: smell your food; it might be making you ill. You can try to avoid the problem by using your nose.

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