The literature pertaining to the study on the “Role of diet counselling, modification and positive therapy in minimising stress and anxiety in school going adolescents in Coimbatore” is reviewed under the following heads:

A. Significance of diet in brain development during adolescence
B. Prevalence of malnutrition in adolescents
   B. I. Iron deficiency
   B. II. Calcium deficiency
   B. III. Over-nutrition: overweight and obesity
C. Effects of malnutrition in adolescence
D. Causes of malnutrition among adolescents
   D. I. Poor eating habits due to lack of nutrition knowledge
   D. II. Impact of media on food choices
   D. III. Sedentary lifestyle
E. Stress and anxiety
   E. I. Definition and models
   E. II. Prevalence among adolescents
   E. III. Coping strategies amongst adolescents
   E. IV. Stress among school teachers
   E. V. Stress among parents of adolescents
F. Effects of stress and anxiety
   F. I. Mental and anxiety disorders
   F. II. Behavioural problems
   F. III. Daytime sleepiness and sleep debt
G. Causes of stress and anxiety among adolescents
   G. I. Academic pressures
   G. II. Iron deficiency
A. Significance of diet in brain development during adolescence

Among the brain regions undergoing considerable transformation during adolescence across a variety of species are frontal brain regions such as the prefrontal cortex (PFC), a brain region critical for a variety of complex cognitive functions, including the so-called executive function tasks. Increases in frontal activation during a variety of cognitive tasks have recently been reported during adolescence (Rubia et al., 2000, Luna et al., 2001), findings suggest that improvements in cognitive function, judgment, and insight during adolescence may be related to maturation of circuitry integrating frontal regions with other brain areas.

Neurons typically communicate with each other at synaptic
connections by means of chemical messengers called neurotransmitters; this chemical input to neurons in the PFC undergoes substantial change during adolescence. For instance, adolescent rodents exhibit substantially lower rates of utilization of the neurotransmitter serotonin than younger or older animals (Andersen and Teicher, 1999); these findings are of particular interest in that a number of characteristics associated with low serotonin activity—including anxiety, greater negative affect, increased alcohol drinking—are reminiscent of those frequently observed in adolescents.

As per WHO (2007), adolescence is a period of major physical and psychological change, as well as great changes in social interactions and relationships. Adolescence is characterised by rapid increase in height and weight, hormonal changes resulting in sexual maturation and causing wide swings of emotion. It is an anabolic phase of life and warrants increased nutrient requirement per unit body weight.

Stang and Story (2005) conveyed that prior to puberty, nutrient needs are similar for boys and girls. It is during puberty that body-composition and biological changes (e.g., menarche) emerge which affect gender-specific nutrient needs. Nutrient needs for both males and females increase sharply during adolescence. Nutrient needs parallel the rate of growth, with the greatest nutrient demands occurring during the peak velocity of growth.

Stang and Story (2005) revealed that energy needs of adolescents are influenced by activity level, basal metabolic rate, and increased requirements to support pubertal growth and development. Basal metabolic rate is closely associated with the amount of lean body mass. Adolescent males have higher caloric requirements since they experience greater increases in height, weight, and lean body mass than females.
B. Prevalence of malnutrition in adolescents

Chakravarty and Sinha (2002) felt that even though they are required in very small amounts, micronutrients—the vitamins and minerals found in food—are of profound importance for physical growth and mental development. Average Indian diets, especially those of the people of poor socioeconomic groups, are often deficient in a number of vitamins, namely vitamin A, riboflavin, folic acid, and vitamin C, as well as essential minerals such as iron, iodine, and calcium. Stang and Story (2005) stated that nutrient intakes of adolescents in United States of America suggest that many youth consume inadequate amounts of vitamins and minerals. This trend is more pronounced in females than males. On average, adolescents consume diets that are inadequate in several vitamins and minerals, including folate, vitamins A and E, iron, zinc, magnesium and calcium.

As per Gleason and Suitor (2001), US adolescents consume more than adequate amounts of protein. National data suggest that on average, teens consume about twice the recommended level of protein and 31 per cent of adolescent boys, 14-18 years of age consume more than twice the RDA for protein.

Grover and Ee (2009) noted that protein energy malnutrition has the potential to affect all organ systems in the body. Initially, clinical findings include lack of adiposity and subcutaneous tissue, poor muscle bulk, irritability, and oedema. As malnutrition progresses, growth is delayed, leading to stunting, and other systems become involved, with changes in hair, skin, nails, mucous membranes, and other organs. Micronutrient deficiencies, particularly deficiencies of vitamins and minerals, are common in malnourished patients, so many patients also will exhibit signs of these deficiencies.
Based on an analysis of current dietary intakes of preschool and school children and adolescents belonging to poor income groups in India, Narasinga Rao (2002) concluded that dietary intakes of adolescents showed a 20–50 per cent deficit of several nutrients, including protein. As in the case of the other age groups, the other deficient nutrients are fat, energy, calcium, iron, zinc, vitamin A, riboflavin, and folate, while rates of dietary deficiencies of iron, vitamin A, and riboflavin among the adolescents are as high as among preschool and school children.

Kotecha (2008) noted that the intake of micronutrients in daily diet is far from satisfactory and largely less than 50 per cent RDA is consumed by over 70 per cent of Indian population. The loss due to micronutrient deficiency costs India one of its GDP. This amounts to a loss of Rs. 27,720 crores per annum in terms of productivity, illness, increased health care costs and death.

Sivakumar et al (2006) conducted a study based on bio-chemical analyses on a sample of a total of 328 middle-income children from a residential school in Hyderabad. It was observed that folate deficiency was present in almost all children (n = 307), while deficiencies of vitamin B2, B6, B12, C and A were reported in 44 to 66 per cent of the children. Vitamin B1 (12%) and zinc (0.7%) deficiency was lower. Assessment of clinical signs of micronutrient deficiencies in the same study population confirmed the presence of micro-nutrient deficiencies.

Muzammil et al (2010) concluded that nutritional deficiencies play an important role in the overall health status of adolescents and are different from those of older adults. Due to lack of accurate information and proper guidance, adolescents are prone to various nutritional morbidities. Vitamin B2
deficiency was observed in 2.5 per cent adolescents and Vitamin A deficiency was almost double in boys (1.7 %) than in girls (0.9 %).

Bose and Mukhopadhyay (2004) have stated that it is generally accepted worldwide that anthropometry is highly sensitive to undernutrition and has been used during adolescence for assessment of nutritional status. According to WHO (1995), the basic intention of nutritional assessment is to improve human health. Body Mass Index (BMI) has been found the most appropriate, non-invasive and cost effective variable for determining nutritional status among adolescents.

About 33 per cent of adult men and 36 per cent of the women have a BMI (Weight in kg/Height in meter$^2$) below 18.5, which indicates Chronic Energy Deficiency (CED). In a study conducted by Mondal (2010) at Darjeeling among 806 adolescents aged 10-18 years, a higher prevalence of stunting was found among girls (50.2 %) than among boys (45.6%).

**B. I. Iron deficiency**

Nutritional Anaemia is defined as a condition in which the haemoglobin content of the blood is lower than normal as a result of a deficiency of one or more essential nutrients. Anaemia is considered to be a late manifestation of nutritional deficiency, and even mild anaemia is not the earliest sign of such a deficiency. WHO (2001) proposed that anaemia is present in a population when haemoglobin (Hb) concentration is less than 12g/dl for children between 12-14 years. The classification of anaemia into different grades has been given by WHO (1989). The same criterion for grading anaemia has been used in the NFHS (2008) report. The classification of anaemia is shown below:
## Review of literature

<table>
<thead>
<tr>
<th>Category of anaemia</th>
<th>Blood Haemoglobin (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe anaemia</td>
<td>&lt; 8</td>
</tr>
<tr>
<td>Moderate anaemia</td>
<td>8 to 9.9</td>
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<tr>
<td>Mild anaemia - girls</td>
<td>10 to 12</td>
</tr>
<tr>
<td>Mild anaemia – boys</td>
<td>10 to 13</td>
</tr>
<tr>
<td>Normal – girls</td>
<td>&gt; 12</td>
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<tr>
<td>Normal – boys</td>
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</table>

Dallman et al (1980) concluded that following early childhood (<2 yr), during the adolescent growth spurt, the risk of iron deficiency and anaemia reappears for both boys and girls, after which it subsides for boys but remains for girls because of menstrual blood loss. Beard (2001) and Yip (2002) proposed that iron deficiency is reported to be the most prevalent nutritional problem in the world today with an estimated 2.5–5 billion people so afflicted.

ICMR (2010) revealed that nearly three fourth (75%) of women in India are anaemic, with the prevalence of moderate to severe anaemia being highest (50%) among pregnant women.

Toteja et al (2006) conducted an assessment of anaemia in 4,337 unmarried adolescent girls (11 to 18 years old), from 16 districts in India. The results indicated that 90.1% of the girls were anaemic. The prevalence of anaemia ranged from 58.2% per cent in Dehradun District to 100 per cent in Badaun District. The average prevalence of anaemia was 89.4 per cent in the eight districts from northern India, 91.4 per cent in the six districts from eastern India, and 91.8 per cent and 87.0 per cent in the single districts from southern India (Mehboob Nagar) and western India (Raigarh), respectively. The overall prevalence of severe anaemia was 7.1 per cent, with the highest prevalence (24.3%) in Bikaner District. The average prevalence of severe
anaemia was 7.4 per cent in the eight northern districts, 5.7 per cent in the six eastern districts, 9.2 per cent in the single southern district, and 11.1 per cent in the single western district. The overall prevalence rates of moderate and mild anaemia were 50.9 per cent and 32.1 per cent, respectively.

A study by Rajaratnam et al (2007) showed the prevalence of anaemia was 40.7 per cent in pre-menarcheal girls as compared to 45.2 per cent in post-menarcheal girls in rural areas of Tamil Nadu. The mean Haemoglobin percentage of pre-menarcheal girls was 11.63g/dl and that of post-menarcheal girls was 11.52g/dl.

B. II. Calcium deficiency

Shatrugna et al (2006) conducted a randomized, placebo-controlled clinical trial on middle income, semi-urban Indian school-children and measured the bone mineral content and densities after a 14 months supplementation study. A plot of bone mineral content with age clearly showed that it increases with age in two phases, one slower phase below 11 years and another steeper phase between 12-15 years, indicative of the growth spurt.

Joanna et al (1997) revealed that deficiency of calcium in adolescence would lead to poor bone structure and lesser calcium reserves in the body. Calcium deficiency in adolescence pre-disposes women for osteoporosis later in life. Osteoporosis is a major public health problem; 40per cent of women will sustain an osteoporotic fracture. Maximising peak bone mass at skeletal maturity may be one of the most important protective measures against fracture in later life. This period is a ‘window of opportunity’ especially for girls to build good calcium reserves and reduce the possibility of developing
osteoporosis in adulthood. An increase in milk consumption among adolescent girls resulted in significant gains in bone mineral.

B. III. Over Nutrition: overweight and obesity

Prema (2010) observed that India is undergoing a rapid nutrition and health transition. During the last two decades the country has witnessed a steep increase in over nutrition and associated non-communicable diseases. As per WHO (2003), poor dietary habits combined with decreased physical activity have led to an increase in overweight and obesity among adults and children.

Gibney et al (2005) reported that during the past two decades, the percentage of children who are overweight has nearly doubled and that of adolescents has almost tripled. One third of American children are now obese or at risk of becoming obese, with an increase in the chances of suffering diabetes, heart problems and strokes into their adult lives.

In a study conducted in Delhi by Kapil et al (2002) the overall prevalence of obesity was 7.4 per cent in children from affluent families and in another obesity study done by Ramnath (2002) in 1500 school children of Meerut UP, prevalence was 9 per cent.

Ramchandran (2002) recorded that in a study of urban school adolescents in Thiruvananthapuram District, India, prevalence of overweight was 17.8 per cent for boys and 15.8 per cent for girls. It increased with age and was higher in lower tertiles of physical activity and in higher socio-economic group. Chatwal et al (2004) summarized in cross-sectional study carried out in Ludhiana, Punjab, on 2008 school-children aged 9-15 years, that
approximately half the subjects belonged to a school attended by children of well to do families while the rest belonged to two schools from middle and lower socio-economic background. Children whose BMI was >85th percentile for age and sex were defined as overweight. Triceps skin fold thickness (TSFT) was measured for all overweight children and those with TSFT >90th percentile for age and sex were defined as obese. The overall prevalence of obesity and overweight was 11.1 per cent and 14.2 per cent respectively. The prevalence of obesity as well as overweight was higher in boys as compared to girls (12.4 per cent vs. 9.9 per cent, 15.7 per cent vs. 12.9 per cent). Prevalence of obesity decreased significantly with age, from 18.5 per cent at 9 years to 7.6 per cent at 14 years, rising at 15 years to 12.1 per cent. Significantly more children from higher socio-economic status were obese and overweight than those from lower socio-economic status groups.

C. Effects of malnutrition in adolescence

Li et al (2005) stated that overweight and obese children are not only at risk for insulin resistance syndrome, hypertension, dyslipidemia and hypertryglyceridemia, but also for poor micronutrient status.

Halterman et al (2001) revealed that micronutrient deficiencies appear to be prevalent even among non-obese, well nourished, school aged children, and Frary et al (2001) reasoned that it is likely to be caused by a high intake of energy-dense foods that do not contain vitamins and minerals. Halterman et al (2001) and Benton (2001) reviewed that inadequate intake of micronutrients can adversely influence growth and development, cognitive performance and increase susceptibility to infections.

Hamiel et al (2003) and Nead et al (2004) quote reports from countries such as the United States, Israel and Canada which have shown that
overweight and obese children have a higher prevalence of iron deficiency than normal weight children.

Gills and Gills (2005) summarized that intakes of micronutrients such as folate, vitamin D, calcium, magnesium and vitamin E are sub-optimal among obese children. In their study across five different cities in India, they observed that micronutrient deficiencies appear to be prevalent even among non-obese, well nourished, school aged children, and are likely to be caused by a high intake of energy-dense foods that do not contain vitamins and minerals. Inadequate intake of micronutrients can adversely influence growth and development, cognitive performance and increase susceptibility to infections.

D. Causes of malnutrition among adolescents

Srihari et al (2007) stated that in India, approximately 19 per cent (190 million) of the growing population comprises school-aged children of whom 30 per cent (48 million) currently reside in urban India. A significant and increasing number of these children belong to middle and high socio-economic groups. Developing countries are undergoing nutrition transition due to increased economic development and market globalization leading to rapid changes in lifestyle and dietary habits. Poor dietary habits combined with decreased physical activity have led to an increase in overweight and obesity among adults and children. Overweight and obese children are not only at risk for insulin resistance syndrome, hypertension, dyslipidemia and hypertryglyceridemia, but also for poor micronutrient status.

D. I. Poor eating habits and eating disorders due to lack of nutrition knowledge

Eating habits of adolescents are influenced by various physical and
psycho-social factors. Despite high nutrient requirements, adolescents usually have lower intake due to poor nutritional knowledge and eating disorders. Teenage girls are more likely to skip meals, especially breakfast. Szajewska and Marek (2010) suggested that eating breakfast is associated with a reduced risk of becoming overweight or obese and reduction in the BMI in children and adolescents in Europe.

Agaras and Hamner (2007) suggested that most of the eating disorders begin in adolescence during puberty. Disordered eating includes dieting, food restriction, binge eating and purging behaviours. Disorders in eating patterns fall into three broad categories, namely Anorexia Nervosa, Bulimia Nervosa and Binge Eating Disorder.

According to Veeraraghavan (2006) it can have its onset at any age and is often not recognized until adulthood.

Rosenberg (1965) revealed that the common psychological underlying factors in each of these eating disorders are low self esteem, loneliness, moodiness, emotional withdrawal, stress, anxiety and depression. Research supports the role of a variety of psychological factors including self esteem as correlates of eating problems. Self-esteem relates to a person’s global self-worth or self-acceptance.

Paxton et al (2006) suggested that having negative perceptions of one’s body and low self-esteem have been linked to level of body-image disturbance and eating problems.

Minuchin et al (1978) proposed that dysfunctional family relationships and styles of communication within the family environment are often identified
as high factors in the development of eating problems.

Dietz and Robinson (2005) indicated that increasing number of American children and adolescents frequently eat food away from home and were likely to consume salty snacks, soft drinks and pizza.

Briefel and Johnson (2006) observed that adolescents do not consume the recommended number of servings of fruits, vegetables and dairy products; and they consume excessive amounts of added sugar, fat and saturated fat.

In a study by Vasanthamani and Devi (2009) involving 2765 students in Coimbatore, India, 73 per cent were found to consume fast foods regularly. The most preferred fast foods were chocolates, ice creams, cold drinks, puffs, chaat items, pastries and candies.

Mishra (2005) proposed that improving knowledge and developing skills which are conducive to individual and community health.

D. II. Impact of media on food choices

The Nutrition and Media Literacy report (2009) revealed that children see estimated 7600 food commercials a year on television. Between 35 to 45 per cent of commercials on children's television are for food. Almost all advertised food is unhealthy. Commercials increase preference for advertised foods and increase children's requests to parents for those foods.

McGinnis (2006) reported that food marketers in the United States spend $10 billion a year on their efforts to influence children’s diets, and most of this is for television advertising. Batada et al (2008) showed that food is the most commonly advertised product on children’s television. Children younger
than five years see an average of more than 4000 television commercials for food each year, or about 30 hours’ worth. Children see an average of one food advertisement every five minutes. The vast majority of foods commonly advertised on television, up to 95 per cent in a study, were of poor nutritional value.

Robinson (2006) concluded that the massive increase in children’s Television (TV) viewing is a significant factor in the rise in childhood obesity. It was found that children spend a huge portion of their lives watching television, many watching more than four hours a day. Television might lead to obesity through three primary pathways, by displacing time that would otherwise be spent in physical activity; by promoting eating while viewing, which may foster both lower-quality and higher-quantity food intake; and by exposing children to food advertising, which adversely affects their diets.

Harrison (2005) found that children eat more high-calorie, low-nutritious foods when watching commercial TV with advertisements for such products. Feldman et al, (2007) argued that adolescents watching TV were found to have lower intakes of vegetables, dark green/yellow vegetables, calcium-rich food and grains; and a higher intake of soft drinks compared to adolescents not watching TV during meals.

D. III. Sedentary lifestyle

A sedentary lifestyle plays a significant role in obesity. Worldwide there has been a large shift towards less physically demanding work, and currently at least 60 per cent of the world’s population gets insufficient exercise. This is primarily due to increasing use of mechanized transportation and a greater prevalence of labour-saving technology in the home (WHO, 2009).

Recent data from WHO (2009) has revealed that presence of childhood
Obesity worldwide is 16.5 per cent and in India it accounts for 12.4 per cent in boys and 9.9 per cent in girls. Conservative estimates indicate that at least one fifth of boys and one third of girls will be obese by 2020. Peitrobelli et al, (2008) expressed that major concern with obesity is that obese children tend to become obese adults, with all the risks or associated co-morbidities.

Narayan et al (2001) reiterate that rapid urbanization and economic growth creates social dynamics that promote diabetes risk factors. These include over-weight, decrease in physical activity, increase in sedentary activities such as television viewing, and high fat and high-energy diet among adults and children. Other factors may also make India’s children and young adults more vulnerable to diabetes.

In children, there appear to be declines in levels of physical activity due to less walking and physical education (Salmon and Timperio, 2007). The World Health Organization indicates people worldwide are taking up less active recreational pursuits. In both children and adults, there is an association between television viewing time and the risk of obesity.

Raj and Kumar (2010) reviewed that children and adolescents typically indulge in sedentary activity like watching TV, sitting in front of computers and video games. Every hour of sedentary activity increases the chance of obesity and is also contributory to failure of many weight reduction attempts in adolescents and children. Excessive TV viewing is associated with higher intakes of energy, fat, sweet and salty snacks and carbonated beverages in addition to reducing consumption of fruits and vegetables. This makes TV time restriction an excellent opportunity to complement dietary management.

Raj and Kumar (2010) observed that dramatic and rapid societal
changes during the last decades have contributed significantly to childhood obesity. There is evidence stating that individual’s eating and physical activity behaviours are heavily influenced by surrounding social and physical environmental contexts both for adults and children.

A comparative study in Kolkata, India by Mukhopadhyay et al (2005) of 215 sedentary (no regular physical exercise undertaken) and 313 physically active (regular physical exercise undertaken) Bengali boys aged 10-17 years was undertaken to investigate the differences in overall adiposity (body mass index), subcutaneous adiposity (skinfolds) and body composition (percent body fat, fat mass and fat mass index). Both groups had a similar age. The results revealed that boys who did not undertake regular physical exercise (NPE) had a significantly greater mean body mass index (BMI) compared with those who undertook regular physical exercise (PE); p < 0.001. The means for all the skinfolds as well as percent body fat (PBF), fat mass (FM) and fat mass index (FMI) were significantly higher among the NPE group.

Jain et al (2010) observed that sedentary lifestyle, poor food habits, binge eating, and prolonged TV viewing have given rise to obesity. Every day our adolescents are becoming over conscious about their body images and are often misguided to inculcate unhealthy habits. It is often felt that health of an adolescent is often neglected due to lack of awareness, busy work schedule, and poor compliance from teens.

E. Stress and anxiety:

Adolescence is a stressful period of life both physiologically and psychologically. The adolescents need greater care in these few years owing to the increased nutritional requirements caused by growth spurt and increased academic burden. Added to that is the psychological stress of
adjusting to puberty-related physical and emotional changes caused by hormones.

Latha and Reddy (2006) propose that since Stanley Hall's characterization of the adolescent period as one of storm and stress, many theorists have portrayed adolescence as a troubled and unique period of the life cycle. The predominant views that have evolved since the early twentieth century conceptualized "storm and stress" in terms of three characteristics: parent-adolescent conflict, moodiness, and risk-taking behaviors.

LeBourgeois et al (2005) stated that adolescence is a period characterized by important changes in cognitive, behavioral, social, and emotional functioning attributable to biological development (ie, puberty) and to new roles and demands in the familial and social milieu (eg, decreased parental involvement, increased academic requirements).

Deb (2001) opined that in India, the main documented cause of anxiety among school children and adolescents is parents’ high educational expectations and pressure for academic achievement. He further explains that in India, this is amplified in secondary school where all 16-year old children attempt the Class X first Board Examination, known as the Secondary Examination. Results of the Secondary Examination are vital for individuals since this is the main determining criteria for future admission to a high quality senior secondary school and a preferred academic stream.

E. I. Definition and models:

The term stress was first employed in a biological context by the endocrinologist Hans Selye in the 1930s. Selye and Wolff (1982) defined “Stress in biology indicates a state within a living creature, which results from the interaction of the organism with noxious stimuli or circumstances”. Stress
is a complex psychological, biochemical and hormonal process. Stress is the reaction to our external environment as well as our inner thoughts and feelings about the situation. Stress in essence is our body’s natural response to dangers by the “fight or flight” mechanism.

Cohen (1980) offered another definition- “Stress can also be defined as a process in which when environmental demands strain in organism’s adaptive capacity. It results in both psychological as well as biological changes that could place a person at risk for illness”.

As per Morgan et al (2002), “Stress is an internal state which can be caused by physical demands on the body (disease conditions, exercise, extremes of temperature, etc) or by environmental and social situations which are evaluated as potentially harmful, uncontrollable, or exceeding our resources for coping”. The physical, environmental and social causes of the stress state are called “Stressors”.

Axelson and Birmaher (2001) estimated the prevalence rates of anxiety in adolescents at 8 to 17 per cent. Mild anxiety is a major motivational force that drives and changes our behavior. When we experience mild anxiety, the body reacts by springing into action, releasing adrenaline into the bloodstream, stimulating the heart, raising the metabolic rate, and increasing the blood glucose concentration. All these processes increase a person’s alertness and improve the ability to perform. However, if the anxiety is extreme, it becomes a hindrance rather than a help. All the same reactions that adrenaline brings about in the body become adverse reactions to the situation.

The Yerkes–Dodson law (1908) is an empirical relationship between arousal and performance, originally developed by psychologists Yerkes and Dodson in 1908. The law dictates that performance increases with physiological or mental arousal (or stress), but only up to a point. When levels
of stress become too high, performance decreases. The process is often illustrated graphically as a curvilinear, inverted U-shaped curve which increases and then decreases with higher levels of stress (Appendix-I). A critical issue concerning stress among students is its effect on learning. The Yerkes-Dodson law postulates that individuals under low and high stress learn the least and that those under moderate stress learn the most.

Amritha (2006) revealed that studies and laboratory tests support the notion that excessive stress is harmful to students' performance. There is high co-morbidity between anxiety and depression in children, and that depressive symptoms may be the first manifestation of an evolving anxiety disorder in adolescents.

Selye (1975) proposed that stress can be both positive and negative: Eustress or positive Stress and Distress or negative Stress. He published a model dividing stress into eustress and distress. Where stress enhances function it may be considered eustress.

Selye (1975) researched the effects of stress as the General Adaptation Syndrome (GAS model) with three broad stages of stress mechanism: Alarm, Resistance and Exhaustion (Appendix-II) Alarm is the first stage. When the threat or stressor is identified or realized, the body's stress response is a state of alarm. During this stage adrenaline will be produced in order to bring about the fight-or-flight response. Resistance is the second stage. If the stressor persists, it becomes necessary to attempt some means of coping with the stress. Although the body begins to try to adapt to the strains or demands of the environment, the body cannot keep this up indefinitely, so its resources are gradually depleted. Exhaustion is the third and final stage in the General Adaptation Syndrome model. At this point, all of the body's resources are eventually depleted and the body is unable to maintain normal function.
Morgan et al (2008) concluded that if stage three is extended, long term damage may result as the body, and the immune system is exhausted and function is impaired.

E. II. Prevalence among adolescents:

Costello et al (2003) reported that anxiety is one of the most common psychological disorders in school-aged children and adolescents worldwide. Boyd et al (2000) showed that the prevalence rates range from 4 to 25 per cent, with an average rate of 8 per cent. Tomb and Hunter (2004) suggest that these figures could be underestimated since anxiety among a large number of children and adolescents goes undiagnosed owing to the internalized nature of its symptoms.

Munsey (2010) reported that in a recent survey in the US by the American Psychological Association (APA), children aged eight to 17 say that they worry about doing well in school, getting into good colleges and their family's finances. They also report suffering headaches, sleeplessness and stomach upsets. More than one in three children report experiencing headaches in the past month, while 44 per cent of children report sleeping difficulties and about one-fifth of children reported they worry a great deal or a lot. In addition, almost 30 per cent of children worried about their families' financial difficulties.

Centre for Adolescent health (2006) conducted interviews with adolescent students as part of a study in Baltimore to research the levels of teen stress. The five sources of stress most often experienced for the youth in the study included "school work (78%), parents (68%), romantic relationships (64%), friends' problems (64%), and younger siblings (64%).

Ulas et al (2007) confirmed that suicide is the third leading cause of death in American adolescents. That is about 10 teenagers out of 100,000
who decide to kill themselves. A WHO (2000) study reported that in the 5-14 years age group the incidence of suicide was 0.4-1.5/100,000, and in the 15-25 years age group the incidence was 4.9-22/100,000.

Dinesh and Syamakumari (2010) argued that contrary to common belief that only adults suffer from stress and problems, children from an early age are suffering from tension and stress of different types in different levels.

Suchday et al (2006) suggested that components of urban stress in India, with some modifications, appear to be similar to components of urban stress reported by adolescents in the United States.

E. III. Coping strategies amongst adolescents

The National Network for Child Care (2006) revealed that managing emotions can be very helpful when an adolescent is dealing with an uncontrollable problem. It can also be helpful in the early stages of coping with a problem. For example, blowing off steam, avoidance, and distraction can be important ways of getting prepared to cope more directly with difficult situations. Studies show that the most common ways young adolescents cope with stress are listening to music and watching television. Another way of resolving stressful situations is to find meaning in the experience. It helps if teens can see that something good is coming out of the problem. Positive Coping involves good nutrition, use of stress relieving foods, exercising, yoga, meditation, support groups and developing a positive attitude. On the contrary, negative coping involves resorting to smoking, drinking, illegal drugs, blaming others, aggression, moodiness, irritability, frequent crying and other self destructive behaviours like suicidal ideation.

In a survey by Centre for Adolescent health (2006), adolescent students in Baltimore were interviewed as part of a study titled, “Confronting Teen Stress, Meeting the Challenge in Baltimore City” and the study also looked at how the teenagers coped with their stress. For boys, approximately
25 per cent avoided or refused to deal with their stress, 23 per cent sought ways to distract themselves away from their stress, 17 per cent sought support, and 35 per cent actively tried to reduce their stress. On the other hand, when it came to the girls, approximately 19 per cent avoided or refused to deal with their stress, 14 per cent sought ways to distract themselves away from their stress, 22 per cent sought support, and 45 per cent actively tried to remove or reduce their stress.

E. IV. Stress among school teachers

Kyriacou (1996) observed that in many countries teacher’s job is often considered as one of the most stressful profession. In the last two decades, intensive researches have been carried out in USA and Europe concerning the sources and symptoms of teachers’ professional stress.

Kyriacou (2001) redefined teacher stress as the experience by teachers of unpleasant, negative emotions, such as anger, anxiety, tension, frustration, depression, resulting from some aspect of their work as a teacher. Studies in the field of teacher’s stress show that the greater part stress is associated with the rapid pace of changes in education, particularly in 1980s and 1990s.

Wilson (2002) stated that, in psychological terms, ‘hardiness’ is a combination of control, challenge and commitment felt by individuals facing stressful situations. The more positive an individual feels, the hardier they are and by extension the more able to keep their own stress levels within manageable limits. Wilson observed that workload and communications are significant causes of stress among teachers. Anticipation, worry, helplessness and executive roles have all emerged from laboratory studies as psychological factors which influence stress. Several writers concur in finding that pupils’ behaviour (misbehaviour), poor working conditions, especially
relationships with colleagues, workload (mainly overload) and poor school ethics are the major causes of teacher stress.

E. V. Stress among parents of adolescents

Parents are an important influence on the development of their adolescent children. However, parenting adolescents can be stressful, largely due to changes in the parent–child relationship as the child develops. Early adolescence (ages 10–15 years) is a particularly difficult period as closeness and time spent together decline.

Thergaonkar and Wadkar (2007) stated that parents are the greatest buffer for children against stress, as they protect them from adversities to the best of their capabilities. This is part of their nurturing instinct as a parent. However, as life gets more and more complicated and challenging, parents are getting worried about their children’s future. The world today expects everyone to be an achiever and mediocrity is not tolerated. This perception of academic excellence and its role in ensuring future professional success has altered the parent–child dynamics. Most parents now expect their children to secure top marks in exams and even small inadequacies are not spared. Another major problem arises when students are negatively compared with their elder siblings or friends. Instead of inspiring the child, this lowers their self esteem and makes them lose confidence in their own capabilities. All these factors make the parent-child relationship very strained and demanding.

F. Effects of stress and anxiety

Seyle and Wolff (1982) summarized the signs of stress as cognitive, emotional, physical or behavioral. Signs include poor judgment, a general negative outlook, excessive worrying, moodiness, irritability, agitation, inability to relax, feeling lonely, isolated or depressed, aches and pains (headaches, neck and back pains), diarrhoea or constipation, nausea, dizziness, chest pain, rapid heartbeat, eating too much or not enough, sleeping too much or not enough, social withdrawal, procrastination or neglect of responsibilities, increased alcohol, nicotine or drug consumption, and nervous habits such as pacing about and nail-biting.

Morgan et al (2008) revealed that once induced by stressors, the internal stress state can lead to various responses. It can result in a number of physiological, behavioural, emotional and cognitive responses. The physiological responses include heightened muscle tension, pain and tightness in the chest; indigestion and gaseous abdominal distension; spasmodic, gripping abdominal pain and diarrhoea; frequent urination; alteration of the menstrual pattern; tingling feelings in the arms and legs, elevated blood pressure and rapid heartbeat, pain in the neck or lower part of the back; persistent headache – often starting in the neck and extending forward over the head; migraine; skin rash; double vision and difficulty in focusing the eyes and impotence or lack of libido.

Morgan et al (2008) reported that behavioural responses of stress are over eating, alcohol consumption, smoking, etc. Emotional responses include heightened anxiety, depression, excessive and rapid swings in mood; worrying unreasonably about things that do not matter; inability to feel sympathy for other people; excessive concern about physical health; withdrawing and day-dreaming; feeling tired and anger. The cognitive responses are increased distractibility and decreased concentration. The
result can manifest itself in obvious illnesses such as ulcers, depression, diabetes, trouble with the digestive system or even cardiovascular problems, along with other mental illnesses. A few adverse effects of stress on physical and mental health are cardiovascular, chronic diseases like type-2 diabetes, dermatological complaints, gastrointestinal, impotence, lowered immunity, fatigue and lethargy, headaches, shoulder, low back and chest pain, etc.

Brottman et al, (2007) opined that Cardiovascular Heart Disease (CHD) risk is increased by psychological stress. Psychological stress elicits measurable changes in sympathetic-parasympathetic balance and the tone of the hypothalamic-pituitary-adrenal axis, which might negatively affect the cardiovascular system both acutely-by precipitating myocardial infarction, left-ventricular dysfunction, or dysrhythmia; and chronically-by accelerating the atherosclerotic process.

F. I. Mental and Anxiety disorders

As per a report by Deutsche Welle (2010), children these days are suffering from diseases of the adults, like depression and anxiety disorders. These are also some of the factors that drive adolescents towards thoughts of suicide. According to WHO (2009), India has one of the highest suicide rates worldwide and almost 40 per cent of them are under the age of 30 years.

The term "Anxiety disorder" refers to Generalized Anxiety Disorder (GAD), Obsessive-Compulsive Disorder (OCD), panic disorder, Post Traumatic Stress Disorder (PTSD), social anxiety disorder (also called social phobia), and specific phobias. According to a study by Anxiety Disorder Association of America (ADAA) (1999), anxiety disorders are the most common psychiatric illnesses affecting children and adults. Anxiety disorders are the most common mental illness in the U.S., affecting an estimated 40 million adults in the United States age 18 and older (18% of U.S. population). Only about one-third of those suffering from an anxiety disorder receive
treatment, even though the anxiety disorders are highly treatable. People with an anxiety disorder are three to five times more likely to go to the doctor and six times more likely to be hospitalized for psychiatric disorders than those who do not suffer from anxiety disorders. Anxiety disorders cost the U.S. more than $42 billion a year, almost one-third of the country's $148 billion total mental health bill.

**F. II. Behaviour problems**

The American Psychiatric Association (2010) has reported that in children, stress can manifest itself through changes in behavior. With teens, while spending more time with and confiding in peers is a normal part of growing up, significantly avoiding parents, abandoning long-time friendships for a new set of peers, or expressing excessive hostility toward family members, may indicate that the teen is experiencing significant stress.

Stansbury and Harris (2000) reported that stress is often seen as a clear physical reaction: mourn, sweaty palms, flying, aggressive or defensive outbursts, rocking and self-comforting behaviours, headaches and stomach aches, nervous behaviour of fine motor skills (e.g. hair twirling or pulling, chewing and sucking, biting of skin and nails), and sleep disturbances.

**F. III. Daytime sleepiness and sleep debt**

Morrison et al (1992) suggested that adolescents need more sleep than their pre-pubertal peers and are more prone to sleep difficulties, which are often associated with psychological issues. There is a trend, partly youth cultural, to stay up late. Stress and anxiety related to school work or social difficulties also come into play. Sleep deprivation may result from this disturbance of the sleep/wake cycle and this, in turn, may lead to emotional disturbance and fall-off in school performance.

As per Bartlet (2006), sleep deprivation can give rise to daytime
fatigue, behavioural disturbance (such as hyperactivity), educational failure, growth retardation and obesity. Kelman (1999) reiterated that the amount of sleep affects the way adolescents perform, feel, think, learn, and remember. Lack of sleep increases the possibility of increased daytime sleepiness, poor school performance, and heightened risk of drug and alcohol use, increased irritability, and aggressive behavior, all of which can interfere with relationships with classmates, parents, and teachers.

Insufficient sleep is a significant risk factor for developing childhood obesity, which can lead to premature heart disease, research shows. Obesity contributes to several risk factors for the condition such as high blood pressure and high cholesterol. McCrindle’s (2010) study of 1,600 Grade nine Toronto students, average age 14 and 15, showed sleep patterns disturbed by staying up to watch television, play video or computer games, and social networking. Poor sleep correlated with higher weight and body mass index, blood pressure, cholesterol and other poor health conditions, including poor food choices and lack of physical activity. Many reported difficulty in staying awake during the day.

Hansen et al (2005) reported that adolescent sleep scheduling is unstable and there is a marked difference between weekday and weekend sleep during the school year. Sleep times and wake times occur later and total sleep time is greater on weekends, which suggests that adolescents are attempting to recover sleep during the weekend.

G. Causes of anxiety and stress among adolescents

Kieling et al (2011) quote a representative study of 3005 adolescents in Mexico City showed that 68% had had at least one type of chronic adversity. Risk factors such as perceived obesity, academic difficulties, bullying in school, family dysfunction, child labour, physical and sexual abuse, and use of
tobacco, alcohol, and drugs, pathological use of the internet, teenage pregnancy, and use as a soldier during childhood have been shown to jeopardise the mental health of children, adolescents, and adults. Kieling et al, (2011) proposed the lifecycle approach which provides a model that maps relevant risk factors in a chronological order, from the preconception period of one generation to the next generation.

THE LIFECYCLE APPROACH TO RISK FACTORS FOR MENTAL DISORDERS

FIGURE-1
(Ref: Kieling et al, 2011)
Life-long risk factors are shown at the centre of figure and consist of the genetic background, problems in the physical health and nutritional status of the child, the physical and mental health of carers, loss of care givers or being orphaned, being raised in institutions, deficiencies in the psychosocial and educational environment, exposure to harmful substances and toxins, violence, armed conflict and war, forced displacement, immigrant status, natural disasters, gender disparity, severe physical punishment and abuse or neglect. Important evidence exists showing that mental health risk factors specific to the school age period (from ages 5 to 18 years, with variable definitions across countries) are prevalent Low Middle Income children.

As per Kieling et al (2011), any children who experience adverse conditions in their early years, however, grow up to become healthy adults. The idea of resilience differs from the general notion of risk and protective factors because it aims to incorporate innate qualities and differences in an individual that enable them to overcome adversity. Some of these qualities—for example, behavioural and emotional self-regulation—have proved to contribute to the mental health and academic achievement of children. Characteristics of a child's carer system, including emotionally responsive and competent parenting as well as carer resources such as education, mental health, and relational history (i.e., attachment and peer network), are direct proximal predictors of resilience in children.

G. I. Academic pressures

Verma et al (2002) opined that Indian middle-class adolescents face a highly competitive examination system. In a study involving one hundred urban, class eight students in Chandigarh, their activities and emotional states were assessed. Adolescents were found to spend one third of their waking time in school-related activities, with girls spending more time than boys. Schoolwork generated negative subjective states as reflected in low affect state, below-average activation levels, lower feeling of choice, and higher
social anxiety. These negative states were most frequent during homework. The trade-off faced by Indian adolescents were evident in the findings that those who spent more time doing homework experienced lower average emotional states and more internalising problems, while those who spent more time in leisure experienced more favourable states but also reported higher academic anxiety and lower scholastic achievement.

In 2007 the Directorate of Education established a toll-free counselling helpline called “Yuva” for distressed students and in 2009, it was brought under the State Council for Education Research and Training (SCERT). This helpline rang continuously just before and during the board exam as well as before and after the declaration of results, indicating the need for help and stress relief of the adolescents facing these examinations. Under the SCERT (2011), a toll free Yuva phone line 1800-11-6888 is being run with the objective of providing support to adolescents, teachers and parents. The Help line is manned by professionally trained and YUVA sensitized “Educational and Vocational Guidance Counsellors” from Directorate of Education. These counsellors are updated from time to time towards the new courses, admission procedures, and employment avenues. Training programmes are conducted to sharpen their counselling skills. The calls are from adolescents, parents, and teachers. Adolescents usually call to seek guidance about their personal problems, like low self-esteem, emotional upheavals, stress related issues, confusions about choice of subjects, interpersonal conflicts. Parents/teachers call to discuss the behavioural problems of adolescents.

Verma et al (2002) reported that Indian middle-class adolescents face a highly competitive examination system. Their study examined the influence of school demands on the daily time use and subjective states of Indian young people. A hundred urban, middle-class, eighth grade students were studied for 1 week for their activities and subjective states at random times, following the procedures of the Experience Sampling Method. These adolescents were
found to spend one third of their waking time in school-related activities, with girls spending more time than boys. Schoolwork generated negative subjective states as reflected in low affect (mood) state, below-average activation levels, lower feeling of choice, and higher social anxiety. These negative states were most frequent during homework. The trade-off faced by Indian adolescents were evident in the findings that those who spent more time doing homework experienced lower average emotional states and more internalising problems, while those who spent more time in leisure experienced more favourable states but also reported higher academic anxiety and lower scholastic achievement.

Hussain et al (2008) conducted a study on 100 high school boys for prevalence of academic stress and found that the magnitude of academic stress among high school students was found to be high. Stress and anxiety in children and teenagers are just as prevalent as in adults. Negligence of parents, high expectations in academic or other performances, abused childhood, growing up tensions and demand for familial responsibility etc. the main causes of childhood and teen stress. Parents, who are not emotionally available for their children or lack positive coping mechanisms themselves, often spur stress in their offspring. Stressed children show signs of emotional disabilities, aggressive behavior, shyness, social phobia and often lack interest in otherwise enjoyable activities.

**G. II. Iron deficiency and its role in stress management**

Iron deficiency affects the cognitive ability of adolescents. Studies in adolescents who were iron deficient, but not anaemic, revealed alterations in cognitive functioning that could be attributed to iron depletion but not anaemia. When specific tests of attention are performed, iron-deficient anaemic adolescents perform less well than iron-sufficient teens and also respond to iron therapy.
Several studies showed that iron is essential for a number of enzymes involved in neurotransmitter synthesis, including tryptophan hydroxylase needed for synthesis of serotonin (Wigglesworth and Baum, 1988 and Beard et al, 1993). Iron is related to the activity of monoamine oxidase, an enzyme critical for proper rates of degradation of serotonin. Morse et al (1999) demonstrated that serotonin transporter density was significantly lower in brains of iron-deficient mice.

Hasegawa and Nakamura (2010) observed that tryptophan hydroxylase (TPH), the rate-limiting enzyme in serotonin biosynthesis, is involved in neural development, which likely affects behaviour in the adult stages. TPH is an iron protein. Potential determinants of existing TPH activity in vivo are: a supply of tryptophan via the tryptophan transporter, synthesis of tetrahydrobiopterin and efficient regeneration of this coenzyme, and iron metabolism. Within the cell, the amount of ferrous iron available to TPH is below saturation. The metabolism of iron may control serotonin production by attenuating actual TPH activity in the cell interior.

Wang et al (2002) reported that the first and rate-limiting step in serotonin biosynthesis is catalyzed by tryptophan hydroxylase (TrpOH), which uses L-erythro-5,6,7,8-tetrahydrobiopterin (BH4) and dioxygen cofactors along with the dietary essential amino acid substrate L-tryptophan, in generating 5-hydroxy-L-tryptophan that is converted to 5-hydroxytryptamine (5-HT or serotonin) by aromatic amino acid decarboxylase.

G. III. Sleep deficit

According to the National Sleep Foundation’s 2009 “Sleep in America” poll, the average amount of sleep Americans get has decreased significantly since 1998, with a 67 per cent increase in Americans getting less than 6 hours
per night (12 per cent in 1998 vs. 20 per cent in 2009), and a 20 per cent decrease in the number of Americans getting more than eight hours sleep per night (35% in 1998 vs. 28% in 2009).

This lack of sleep translates into habits detrimental to overall health. Finkelstein (2009) reported that compared to those sleeping eight hours per night, those sleeping less than six hours per night are significantly less likely to eat breakfast (85 per cent vs. 66 per cent in the eight-hour group), significantly less likely to have four servings of fruits and vegetables per day (78 per cent vs. 66 per cent in the eight-hour group), and significantly less likely to have at least three meals per day (76% vs. 63% in the eight-hour group). These eating habits are risk factors for obesity which increases medical costs by 42 per cent in the United States.

Marcus et al (2005) proposed that the effects of poor sleep on performance may be partly mediated by a biochemical imbalance of brain serotonin (5-hydroxytryptamine or 5-HT). Brain 5-HT seems to be involved in the regulation of sleep and cognitive processes; and sleep abnormalities and cognitive decline in clinical populations are partly attributable to deficient brain 5-HT activity. Accordingly, reduced 5-HT concentrations resulting from the exhaustion of its plasma precursor tryptophan was found to provoke sleep abnormalities seen in depression, whereas increases in available plasma tryptophan for uptake into the brain improved sleep in different subjects.

Owens (2005) argues that many types of pediatric sleep problems are common to both Western and Eastern cultures. These problems include bedtime resistance, night wakings, inadequate sleep, and daytime sleepiness. Although prevalence rates may vary and the etiologic and contributing factors may differ somewhat across cultures, the similarities are often more striking than the differences.

Drake et al (2003) observed that the The Pediatric Daytime Sleepiness
Scale PDSS is a reliable, easy-to-use questionnaire that assesses daytime sleepiness in adolescents. It is a simple, eight-item instrument designed for use with children of middle-school age (11-15 years). Each item assesses the frequency of a sleep related behavior (e.g., how often do you fall asleep or get drowsy during class periods; are you usually alert most of the day; how often do you think you need more sleep) using a 5-point Likert type scale (0= never, 4= always). The PDSS has shown both acceptable internal consistency as well as expected associations with outcomes linked to sleepiness (e.g., decreased sleep time, poor grades and negative moods).

**G. IV. Bullying and Peer teasing at school**

Nansel *et al* (2004) reported that bullying, particularly among school-age children, is a major public health problem both domestically and internationally. Current estimates suggest that nearly 30 per cent of American adolescents reported at least moderate bullying experiences as the bully, the victim, or both. Specifically, of a nationally representative sample of adolescents, 13 per cent reported being a bully, 11 per cent reported being a victim of bullying, and six per cent reported being both a bully and a victim.

Olweus (1993) defines victimization as repeated exposure to negative actions from at least one other person over time, with an imbalance of strength between the perpetrator and target. A negative action is defined as an intentional attempt or infliction of discomfort which may take the form of physical contact, words, facial expressions and gestures, intentional defiance of one’s wishes or requests, or social isolation and exclusion.

As per Nansel (2001), bullying may take many forms, including physical bullying; teasing or name-calling; social exclusion; peer sexual harassment; bullying about race, ethnicity, religion, disability, sexual orientation, and gender identity; and cyber bullying (bullying through email, text messaging, or other digital means). Research has indicated that bullying
involves large numbers of children and youth from the United States in all socio-economic backgrounds, in racial groups that have been studied, and in areas of different population density (urban, suburban, and rural settings).

Nansel et al (2001) and Harris et al (2002) reported that there are gender differences in the types of bullying that children experience, such that boys are more likely than girls to report being physically bullied by their peers; and girls are more likely than boys to report being targets of rumour-spreading and sexual comments. Olweus (1993) and Melton et al (1998) stated that girls report being bullied by boys and girls, while boys report being bullied primarily by other boys.

Several studies have shown that bullying has been found to be related to negative psychosocial functioning among children who are victimized. These included lowered self-esteem (Olweus, 1993; Rigby and Slee, 1993 Hodges and Perry, 1996); higher rates of depression (Olweus, 1993; Slee, 1995; Hodges and Perry, 1996; Craig, 1998; Salmon et al 2000); anxiety (Olweus, 1993; Rigby and Slee, 1993; Hodges and Perry, 1996; Craig, 1998); feelings of loneliness (Kochenderfer and Ladd, 1996; Nansel et al., 2001); suicidal ideation and higher rates of school absenteeism (Rigby, 1996).

Bosworth et al (1999) observed that children and youth who bully are more likely than their peers to hold beliefs supportive of violence and he mentioned that they are more likely to influence their peers to engage in bullying others over time. Research indicates that perpetrating bullying is related to other problem behaviours, including vandalism (Solberg and Olweus, 2003), fighting (Nansel et al., 2001; Nansel et al, 2003), drinking alcohol (Nansel et al., 2001), smoking (Nansel et al., 2001), truancy (Byrne, 1994), dropping out of school (Byrne, 1994), carrying weapons (Nansel et al., 2003), high-risk gun ownership (i.e., guns owned for reasons other than sport) and other antisocial behaviours (Solberg and Olweus, 2003).
G. V. Body image

Olweus (1993) concluded that among obese children, appearance related teasing is more frequent and upsetting. Degree of teasing is associated with higher weight concerns, more loneliness, poor self-perception of physical appearance, higher preference for sedentary or isolated activities and lower preference for social activities.

In a study on 500 school children aged eight to twelve years in rural Maharashtra, Kshirsagar et al (2007) found that bullying was reported by 31.4 per cent of the children interviewed. Teasing and keeping names were the commonest forms noticed. Causing physical hurt was reported by 16 per cent of the students. Only 24 per cent parents were aware that their children were being bullied, indicating thereby that most bullied students did not report these incidents to their parents. The commonest types of bullying reported were teasing (128 children) and keeping names (101). Other forms of bullying reported included use of bad words (53), spreading rumors (9) threatening (8) and isolation (2). Causing physical hurt was reported by 25 (16%) students. Feeling sad, preferring to stay alone and frequent tearing of clothes were almost exclusively noted in bullied children and they were more likely to report symptoms such as school phobia, vomiting and sleep disturbances. Falling sick frequently and headache were the two commonest symptoms noted amongst bullied boys as well as girls. Body ache was the next most frequently reported symptom amongst bullied girls while nightmares constituted the third most common reported symptom amongst bullied boys.

Ramya and Kulkarni (2011) conducted a study on 500 students aged between 8-14 yrs as well as their parents and teachers, from five randomly selected schools in Maharashtra. They aimed to estimate the prevalence of bullying among girls and boys in school and examine its association with psychological and psychosomatic symptoms. Bullying was reported by 60.4
per cent of the children interviewed. Bullying was seen to be more prevalent among boys than girls, the commonest forms being calling names and making fun of one's looks. Teachers were found to be ignorant of the whole issue.

H. Strategies to combat anxiety and stress among adolescents:

H. I. Nutrition education

Subbarao (2010) opined that the goals of nutrition education for students are to acquire and evaluate health related information, make knowledgeable decisions to improve their health and apply their knowledge to improve their physical, mental and social wellbeing and that of their family, peers and community. Health education programme must promote and facilitate voluntary application of health knowledge to health-enhancing actions in daily life.

Many studies measuring the effectiveness of nutrition education confirm that education is one of the best means to break the vicious cycle of under nutrition and underdevelopment. Among these, nutrition education plays an important role in India’s fight against malnutrition. A dietary study of knowledge, attitudes and practices by FAO (2000) revealed that malnutrition was not generally recognized as a disease, except in acute cases, and the idea of a good diet preventing illness was not widespread. In a study conducted in China to assess the nutrition knowledge of University students, the nutrition knowledge was found to be lacking.

Linya et al (2009) have suggested that health and nutrition education should be imparted to increase nutrition knowledge and help students form good nutrition habits.

Srikulchayanonta (2010) suggested that among the different population groups, schoolchildren represent a potentially more important sector. They influence the attitudes of their parents. If they learn sound nutritional principles
and practice them when they become adults, nutrition education imparted to
the school will help greatly towards preventing malnutrition in the next
generation. Introducing nutrition education means more than looking at
nutritional needs. To be effective, nutrition education must tackle the
classroom, the school environment, and the family and community. Nutrition
education and instruction on healthy eating habits in the curriculum combined
with social support from teachers and families may improve and sustain
healthy eating behaviours.

Adolescents may lower their risk of becoming overweight and lead a
healthier lifestyle by improving their nutrition knowledge and attitudes towards
nutrition and health. Watson et al (2009) used a quasi-experimental design to
assess the nutrition knowledge, attitudes, and food consumption behaviours
of students 14 to 19 years old before and after nutrition course in a North
Texas high school. The intervention group significantly improved in nutrition
knowledge, some attitude scores, and milk and breakfast consumption
behaviours. The findings of this study indicate that nutrition education may
positively influence the knowledge, attitudes, and eating behaviours of high
school students.

A study conducted by Shrivaster et al (2010) on 702 adolescent girls in
Delhi revealed inadequate consumption of several nutrients, however, after
imparting nutrition education the girls showed positive changes in dietary
behaviour and a significant improvement in intake of nutrients and food
groups.

A study by Vazir et al (2006) the National Institute of Nutrition (NIN),
Hyderabad, it was found that schoolchildren from middle-income groups
showed high prevalence of sub-clinical micronutrient malnutrition. The study
found that up to 98 per cent of apparently healthy schoolchildren had
inadequate food intake and lower levels of many essential micronutrients. In
fact, assessment of the dietary intake for micronutrients showed that many children were not getting adequate quantity daily. They reported that the vital purpose of the study was to evaluate the impact micronutrient supplementation had on cognitive functions in schoolchildren and thereby give baseline assessment showing overall effect of such supplementations on mental functions. It showed that a micronutrient-enriched group did well in the attention and concentration parameters. The study concluded that there was a strong relationship between nutrient intake and the mental state of a person.

**H. II. Diet modification-Tryptophan**

*Ayurveda*, the 5000 years old scripture of ancient Indian wisdom stipulates three types of diets depending on the effects that they exert on the mind. Chahoud *et al* (2004) quote the Ayurveda and state that *Satvik* diet consists of fresh fruits, vegetables, whole grain cereals and nuts (it promotes peace and most optimal for optimal health); *Rajasik* diet consists of fried, preserved, high calorie foods, and refined grains with large amounts of sugar and salt (it induces restlessness, stress and disquiet in the body); *Tamsik* diet includes animal flesh and intoxicants (it creates sloth and lethargy). Even in such ancient times, in 600 BC, the connection of diet with the state of the mind was well recognized.

Tryptophan is an amino acid possessing an aromatic R-group. It is relatively non-polar and hydrophobic in nature. The distinguishing structural characteristic of tryptophan is that it contains an indole functional group. Indole is an aromatic heterocyclic organic compound that has a bi-cyclic structure, consisting of a six-membered benzene ring fused to a five-membered nitrogen-containing pyrrole ring. Tryptophan absorbs light at 280nm and Ph-6.0, which is useful in its estimation.
The chemical structure of Tryptophan is shown below:

![Chemical Structure of Tryptophan](http://www.usbio.net/misc/tryptophan)

**CHEMICAL STRUCTURE OF TRYPTOPHAN**

**FIGURE-2**

As per the latest ICMR report (2010), the estimated tryptophan RDA for girls and boys in the age groups of 13-15 years is 4.5 mg/kg body weight/ day.

Marcus et al (2000) showed that α-lactalbumin–enriched whey protein increased the plasma Trp-LNAA ratio in subjects both highly vulnerable and relatively invulnerable to stress. With the experimental diet, we observed higher prolactin concentrations, an improvement in mood, and a reduced cortisol stress response in subjects who were highly vulnerable to stress. The plasma Trp-LNAA ratio was 48% higher after the α-lactalbumin diet than after the casein diet, indicating that during the α-lac diet, more tryptophan was available for uptake into the brain. This is expected to lead to an increase in central serotonin synthesis. The higher plasma Trp-LNAA ratio in this experiment exceeded the 42% increase found previously with the Carbohydrate Rich –Protein Poor (CR-PP) diet. Whereas a protein-rich diet has generally been found to reduce the Trp-LNAA ratio, the present results indicate that a diet composed of α-lactalbumin–enriched whey protein effectively raises the Trp-LNAA ratio.

Wurtman and Wurtman (1989) hypothesised that a carbohydrate-rich
meal stimulates insulin secretion and causes most of the amino acids in the bloodstream, other than tryptophan, to be taken up by the peripheral tissues. The resulting higher ratio of tryptophan to other large neutral amino acids (LNAAs) (valine, isoleucine, leucine, tyrosine, and phenylalanine) leads to a greater transport of tryptophan to the brain.

Wurtman et al (2003) conducted a trial wherein nine overnight-fasted subjects consumed, three to seven days apart, a carbohydrate-rich (69.9 g carbohydrate and 5.2 g protein) and a protein-rich (15.4 g carbohydrate and 46.8 g protein) breakfast. Blood samples collected at baseline and after 40, 80, 120, and 240 min were assayed for tryptophan, tyrosine, the five other LNAAs, and insulin. The carbohydrate-rich and protein-rich breakfasts had significantly different effects on the plasma tryptophan-LNAA ratio \( (P < 0.01) \). Among the eight subjects who consumed both breakfasts, the median difference for tryptophan: LNAA was 54% (range: 36-88%). Insulin concentrations rose significantly after the carbohydrate but not after the protein meal.

McGinnis et al (2006) reported that high dietary intake of tryptophan from food source is not known to cause any symptoms of toxicity. In addition, tryptophan has been given therapeutically, as a prescription medicine or dietary supplement for managing stress, in doses exceeding five grams per day with no report of adverse effects. Tolerable Upper Intake Level (TUL) for tryptophan has not yet been established by the Institute of Medicine at the National Academy of Sciences.

**H. III. Serotonin and stress modulation**

Neurotransmitters are the natural biochemicals that facilitate communication between brain cells. These substances control our emotions, memory, moods, behaviour, sleep, and learning abilities. Firk and Marcus (2007) reported that without adequate amino acid conversion, sufficient
amounts of neurotransmitters are not produced. The two major neurotransmitters involved in preventing depression are serotonin (from the amino acid L-tryptophan) and nor-epinephrine (from the amino acids L-phenylalanine and L-tyrosine).

The role of tryptophan in serotonin production is represented below:

THE TRYPTOPHAN EFFECT
FIGURE-3
(Ref: http://recipes.howstuffworks.com/question519.htm)
Wang et al (2002) reported that serotonin (5-hydroxytryptamine) is a neurotransmitter that is widely distributed in nature. In the human brain, serotonin is involved in numerous physiological functions, including sleep, pain, appetite, sexual behavior, and mood, and is the precursor of the pineal hormone melatonin. Tryptophan hydroxylase oxidizes L-tryptophan to 5-hydroxy-L-tryptophan in the rate-determining step of serotonin biosynthesis.
The chemical process involved in production of Serotonin and melatonin is elucidated in Appendix-III.

Serotonin was originally discovered by Italian scientist Vittorio Erspamer in Rome in 1935. It was later isolated and named in 1948 by Maurice M. Rapport, Arda Green, and Irvine Page of the Cleveland Clinic. It is found extensively in the gastrointestinal tract, and about 80-90 per cent of the human body's total serotonin is located in the gut, where it is used to regulate intestinal movements. The remainder is synthesized in the neurons located in the central nervous system (CNS). Here it serves various functions, such as regulation of mood, appetite, sleep, muscle contraction, and some cognitive functions including memory and learning.

The chemical structure of Serotonin is shown below:

![Chemical Structure of Serotonin](Figure-4)

(Ref: http://www.usbio.net/misc/tryptophan)

Hood et al (2005) emphasized that protein contains relatively low concentrations of tryptophan and ingestion of a protein-rich meal increases the LNAA concentration relative to tryptophan. The result is a larger age of circulating LNAAas, which increases the competitive advantage over tryptophan for crossing the blood-brain barrier, which is reflected in a smaller tryptophan/LNAA ratio.
Richard et al (2009) reported that a Positron Emission Tomography (PET) scan of the human brain indicated significant changes in serotonin synthesis occurred at five hours following amino acid consumption with maximal reductions of plasma tryptophan to LNAA ratio measures remaining for another four to five hours.

Firk and Marcus (2009) theorized that tryptophan enriched hydrolysed protein significantly increased positive mood in all subjects and dampened the cortisol response to acute stress, it was concluded that this may be a good dietary method for augmenting brain serotonin and thus serotonin-linked stress resilience.

Research by Marcus (2008) has shown that the production of brain serotonin is limited by the availability of its plasma dietary amino acid precursor tryptophan, different foods and dietary amino acids that influence tryptophan availability are thought to alter affective behavior by changing brain 5-HT synthesis.

H. IV. Melatonin and sleep regulation

Melatonin is a neurohormone produced in the tryptophan/serotonin pathway, which regulates diurnal rhythms and influences the reproductive and immune systems, as well as digestive processes and gastrointestinal motility. Melatonin synthesis is regulated by the blue light spectrum (i.e. 446 to 477 nm) in both artificial and sun light.
Chemical structure of Melatonin is shown below:

![Chemical Structure of Melatonin](http://www.usbio.net/misc/tryptophan)

The melatonin signal forms part of the system that regulates the sleep-wake cycle (Circadian Rhythm) by chemically causing drowsiness and lowering the body temperature. Production of melatonin by the pineal gland is inhibited by light and permitted by darkness. Secretion of melatonin as well as its level in the blood, peaks in the middle of the night, and gradually falls during the second half of the night.

Numerous studies have reported that excessive daytime sleepiness is linked to several problems in adolescents: increased aggression and other behavior problems; negative moods and difficulty controlling emotions, poorer academic performance; increased risk of injury, including accidents at work or behind the wheel; and increased use of caffeine, nicotine, and other stimulants. (Wolfson et al, 1998, Dahl and Lewin, 2002 and Mitru et al, 2002).

Capaldi et al (2005) examined associations among 3 sleep parameters (sleep–wake behavior problems, daytime sleepiness, sleep quantity) and cortisol responses to stress in 31 participants ages 10 to 17 (15 males, 16 females). Significant associations between participant-reported sleep–wake
behavior problems and cortisol reactivity were found, with greater sleep–wake behavior problems associated with decreased cortisol responses. No associations emerged between sleep quantity and cortisol responses to stress; daytime sleepiness showed a trend toward an effect on cortisol reactivity.

H. V. Positive Therapy and Cognitive behaviour therapy

Seligman (2006) observed that Human beings are naturally biased toward remembering the negative, attending to the negative, and expecting the worst. Negative emotion is most proximally driven by negative memories, attention and expectations. Positive psychotherapy aims to re-educate attention, memory, and expectations away from the negative and the catastrophic toward the positive and the hopeful. Increasing clients’ awareness of their signature strengths likely encourages them to more effectively apply themselves at work by approaching tasks in a way that better uses their abilities.

Positive Therapy, developed by Natesan (2004) is a unique system of stress management that combines the eastern techniques of Yoga and the western techniques of Cognitive Behaviour Therapy (CBT). Positive therapy aims at modifying negative thoughts, beliefs, emotions and behaviour by replacing them with positive thoughts. The person learns to be more realistic and reasonable in his/her perception.

Aldwin (2007) proposed that coping is flexible in that the individual generally examines the effectiveness of the coping on the situation; if it is not having the desired effect, s/he will generally try different strategies. A person with a negative perception is bound to have negative thoughts, which lead to negative beliefs, which are often irrational.
Positive therapy can be used to relieve stress and anxiety in the students as well as their parents. Teachers also have their share of stress while dealing with children specially adolescents, and can benefit greatly from these positive therapy sessions. Positive Therapy (Natesan, 2004) consists of the following steps:

**H. V. a. Relaxation therapy**

This helps the person to be relaxed and receive the therapy better and in a positive state of mind. It is the first step and is carried out in three stages:

**H. V. a. (i) Deep breathing practice**

This procedure oxygenates the brain and clears the lungs of residual Carbon-dioxide. It eliminates unwanted thoughts and improves attention, concentration, reasoning, memory and problem-solving abilities.

**H. V. a. (ii) Relaxation Training:**

Ensures complete relaxation of the whole body, helps to get rid of stress, anxiety, anger and tension, mutes the effects of stress on the immune system, increases the level of stress tolerance, increases the efficiency of cardio-respiratory system and facilitates sound sleep. It facilitates complete physical and mental relaxation, enabling the person to get rid of stress, anxiety and tension. It reduces the affect of stress on immune-system and improves the stress- coping ability. It facilitates sound sleep and improves the cardio-respiratory system.

**H. V. a. (iii) Auto Suggestion:**

It helps to instil positive personality traits such as, courage, confidence, optimism and cheerfulness. It reduces negative traits lie pessimism, low self esteem, self-pity, etc. It also reduces negative emotions such as anger, fear
and worry.

**H. V. b.**  **Counselling:** uses the following techniques:

**H. V. b. (i)  Rational Emotive Therapy:**

Helps to identify irrational beliefs and fears and appeal to a person’s reason to get rid of them. Helps people to be positive and realistic. Basically all individuals are intelligent enough to solve their problems, but may be unable to do so due to wrong perceptions and beliefs. The individual is trained to face any problem with clarity and reasoning, instead of getting afraid, angry or worried.

**H. V. b. (ii)  Negative Thought Stopping:**

It trains the individual to identify one’s negative thoughts and get rid of them.

**H. V. b. (iii)  Cognitive Restructuring:**

After removing the negative thought by “Thought Stopping”, the negative thought is replaced by its opposite, self-enhancing and positive statements.

**H. V. b. (iv)  Symptom Stopping:**

To stop the undesirable symptoms of stress such as trembling, shaking of head, belching, hiccups, etc. Helps to get rid of unwanted, recurring and troublesome overt symptoms arising out of stress.

**H. V. b. (v)  Assertiveness Training:**

The assertiveness training is required for people who are extremely timid and unable to express themselves with confidence. Assertiveness is the quality of being able to say “no” without hurting the other person’s feelings.
and self respect. This training is given only when needed by the subjects.

**H. V. c. Exercises:**

Positive Therapy involves the following exercises to relieve tension and promote cheerfulness.

**H. V. c. (i) Tension releasing exercise:**

It releases the tension accumulated in the body and helps the individual to get rid of fear, anxiety, anger and worry.

**H. V. c. (ii) Smile Therapy:**

Smile therapy prevents negative emotions - fear, anxiety, anger, worry and helps to face problems boldly and solve them successfully. It brings people closer and facilitates better interpersonal relationships.

**H. V. c. (iii) Laugh Therapy:**

Laughter therapy has several benefits: it counteracts negative emotions such as worry, anger, fear and hatred. It changes depressed mood, releases tension accumulated in the body, develops positive perception and brings people closer, when practiced in a group.

**H. V. d. Behavioural Assignments:**

Certain exercises and assignments are provided for the participants to be practiced on their own at home to reinforce the affect of the Positive Therapy sessions. They have the following benefits: strengthening good health habits and enhancing positive thinking and happiness.

**H. VI. Sleep management**

According to the National Sleep Foundation’s 2009 “Sleep in America”
poll (2009), one in four Americans rate sleep as more important than either diet or exercise for staying healthy. Yet the average amount of sleep Americans get has decreased significantly since 1998, with a 67 per cent increase in Americans getting less than six hours per night (12% in 1998 vs. 20% in 2009), and a 20 per cent decrease in the number of Americans getting more than eight hours sleep per night (35% in 1998 vs. 28% in 2009).

In a study by LeBourgeois et al (2005) including 776 Italian and 572 American adolescents 12 to 17 years old, Italian adolescents reported much better sleep hygiene and substantially better sleep quality than American adolescents. A moderate-to-strong linear relationship was found between sleep hygiene and sleep quality in both samples. As per Iglowstein et al (2003), there also are dramatic changes in sleep/wake patterns during adolescence, including a decrease in sleep duration, a delay in the timing of sleep and as shown by Pollak (2003), an increasingly large discrepancy between weekday and weekend sleep patterns. Roberts et al (2002) reported that sleep quality is also reduced during adolescence.

LeBourgeois et al (2005) quoted community and school-based studies conducted in Europe, Asia, and the United States suggest that between 6 to 37 per cent of adolescents report difficulties on one or more of the following behavioral dimensions of sleep quality: going to bed, falling asleep, maintaining undisturbed sleep, reinitiating sleep after nocturnal awakenings, and returning to wakefulness in the morning.

Pollak (2003) stated that there is ample evidence that inadequate sleep quantity and quality are linked to significant problems in several aspects of teenagers' lives. Fallone et al (2002) suggested that sleepiness may be a widespread problem in the school setting, where both suboptimal sleep duration and sleep disturbance are associated with reduced academic functioning, including attentional difficulties and increased absences.
Substance use is also greater among teenagers with sleep difficulties.

Zarcone (2002) stated that sleep hygiene for adolescents can be defined as behavioral practices that promote good sleep quality, adequate sleep duration, and full daytime alertness. These practices include avoiding late-afternoon naps and alcohol, tobacco, and caffeine before bedtime; following a bedtime routine; avoiding bedtime activities that are physiologically, cognitively, and emotionally activating; sleeping alone; not using the bed for activities other than sleep; sleeping in a comfortable, quiet, toxin-free environment; and maintaining a stable sleep schedule.

H. VII. Anger management and forgiveness therapy:

Blake and Hamrin (2007) describe anger as a complex emotional construct, comprised of behavioural, cognitive and physiologic components. It can be a significant concern within the schools because of the distress it causes for the individual and those around him or her.

Deffenbacher et al (1996) have suggested that anger is also a concern because of its association with many negative outcomes such as physical harm to other people, animals, and property; dysfunctional personal relationships; poor occupational functioning; mood disorders; substance abuse; and general health problems.

Anger is also considered to be one of the factors contributing to school violence. Anger management, as per Sharada (2005), starts with the realization that we do have the choice to think and feel the way we want to. We can only allow something to trigger our anger—the anger is how we respond to some event or somebody. But because we are so used to reacting on impulse, we forget to choose how we want to feel, and then respond inappropriately, leaving ourselves with angry feelings. One can never control circumstances, people or situations, as they are constantly changing.
The only thing one can control is the way he/she chooses to respond. One can increase one’s capacity to tolerate, develop one’s ability to understand and nurture love for others regardless of their changing behaviour.

Forgiveness is a moral coping response to an instance of unfair and hurtful treatment. McCullough and Witvliet (2002) observed that definitions of forgiveness vary; however, there is consensus that forgiveness involves movement from negative to positive thoughts, behaviours, and emotions. In the current study, we used the definition of forgiveness developed by Enright and Fitzgibbons (2000), that forgiveness is the abandoning of resentment toward an offender and the incorporation of such positive responses as compassion toward that offender.

Several researches proposed that psychological interventions promoting forgiveness have been effective in helping a variety of populations heal emotionally from deeply hurtful and unfair actions of others including adults in drug and alcohol treatment (Lin et al, 2004), divorced individuals (Rye et al., 2005), children with divorced parents (Freedman and Knupp, 2003), married couples (DiBlasio and Benda, 2008), and at-risk youth (Gambaro et al, 2008). These studies demonstrate forgiveness interventions can help people improve their psychological well-being through increased self-esteem and hope and decreased anger, depression, and anxiety (Baskin and Enright, 2004).