SUMMARY AND CONCLUSION

The present study entitled "Role of Diet - Counselling, Modification and Positive Therapy in minimising Stress and Anxiety among School-going Adolescents in Coimbatore" was conducted among class X adolescents studying in an English-medium, co-education school in the city of Coimbatore.

Students studying in Class–X appear for board exams and experience high levels of stress and anxiety, sometimes even precipitating in suicide. Therefore class-X adolescents studying in an English-medium, co-educational school, were selected as the target group, using purposive sampling. This facilitated the study of students of both sexes and also ensured ease of communication in English. Purpose and protocol of the study was explained to the school authorities and the parents of the target group students and their consent was taken for the study. A total of 176 (out of 177) adolescents were selected based on willingness and consent of the parents to participate in the study. All students were in the age group of 14-15 years at the start of the study. Students of the same school and class were selected to keep almost all variables identical and minimise external variables. To avoid sample contamination, the selected adolescents studying in four different sections were designated as a Control Group (CG) and three Experimental Groups (EG).

They were given different treatments, with EG-I getting Positive Therapy (PT) and Stress Management Training (SMT); EG-II getting Nutrition Education (NE) along with PT and SMT; and EG-III getting a Dietary Modification (DM) using foods having higher tryptophan/ LNAA ratio, NE, PT and SMT for a period of eight months. Control Group was not provided any kind of intervention. The parents of EG-III were provided training on dietary modification, EG-II and EG-III parents were given NE and EG-I, EG-II and EG-III were provided PT, as a source of support for the adolescents and to help them relieve their own stress as well. The teachers of class X
adolescents were also provided Positive Therapy sessions to help manage their stress.

Nutritional status of the selected adolescents was assessed through anthropometry, food and nutrient intake and blood haemoglobin. To estimate the tryptophan/ LNAA ratio of the food consumed, the tryptophan and tyrosine, phenylalanine, leucine, isoleucine and valine intake of the selected adolescents was calculated for all the four groups, before and after intervention. The Tryptophan/ LNAA ratio of the diet was estimated before and after intervention.

The prevalence and level of stress, anxiety, sleep debt, daytime sleepiness and peer-victimization were estimated for all the four groups before and after intervention. Also the types of stressors, difficulty in falling asleep at night and waking up in the morning, the details of private tuitions and physical activity pattern were assessed. The impact of the study was assessed by comparing the change in all these parameters after intervention using statistical analysis.

**The salient findings of the study on the 176 selected adolescents are summarized below:**

The adolescents selected for the study were overall equally represented by girls (49.4%) and boys (50.6%).

The families of the selected adolescents comprised mostly (66.5%) of four members and the majority (80.7%) of them belonged to a nuclear family set-up. Most (67.8%) of the families were in the High income bracket with a monthly income exceeding ₹14501/- . All the parents of the selected adolescents were educated up to high school, with majority of the mothers (25.3%) and fathers (20.9%) being graduates.

The prevalence of underweight, overweight and obesity among the selected adolescents decreased in EG-III and EG II after intervention. But in EG-I, there was an increase in the number of underweight boys and the number of obese girls. In CG, the prevalence of overweight increased after the study period.
The average intake of cereals and millets was found to be deficient. Before Intervention, the deficit of cereals ranged from 7.5 to 36.5 per cent, with EG-II having the greatest (36.5%) deficit. Similarly, these adolescents also showed a deficit in the consumption of cereals. But after intervention, the highest change was observed in EG-III where the deficit of 32.7 per cent was alleviated and resulted in an excess of 11.4 per cent. The consumption of pulses was found to be in excess in all the groups before intervention, ranging from 3.6 to 63.5, with EG-II showing the highest (63.5%) surplus. The consumption of Green Leafy Vegetables was also grossly inadequate in all the groups, with the deficit ranging from 18.5 to 54.9, highest (54.9%) being in the control group. Post intervention, EG-III showed the greatest improvement in consumption converting a deficit of 18.5 per cent to an excess of 8.4 percent.
Roots and tubers were consumed in excess of the RDA by EG-I, EG-II and CG, while EG-III had a deficit of 21.7 per cent. Other vegetables were also found to be deficient compared to the RDA, with EG-III having the greatest (78.9%) deficit. The consumption of other vegetables was reported to be less than 50 per cent of RDA by 46.6 per cent boys and 47.7 per cent girls. The fruit intake was also much lower than RDA in all the four groups and EG-III showing the greatest (74.4%) deficit. Consumption of milk and milk products was found to be deficient in all the groups, with EG-III having the highest deficit of 66 per cent compared to the RDA. Sugar and jaggery intake was higher than the RDA in CG (20.8%), EG-I (12.5%) and EG-II (55.2%), while EG-III showed a deficit of 13.4 per cent. The fat intake was higher than the RDA in all the four groups, with the highest surplus (40.7%) in EG-II.

But after intervention the EG-III adolescents showed a great improvement in the intake of all the food groups due to awareness created through nutrition education of the students and their parents, as well as the diet modification carried out with constant monitoring. Post intervention, the consumption of all the food groups was surplus, with cereals and millets (11.4%), GLVs (8.4%), roots and tubers (2.4%), other vegetables (3.4%), fruits (4.8%) and milk and milk product (9.6%).

A similar trend was seen in the EG-II group, for whom nutrition education was provided (for the adolescents as well as the parents). The intake of cereals and millets increased to 4.6 per cent and roots and tubers to 21.1 per cent. Even though the intake of GLVs, other vegetables, fruits, milk and milk products were below the RDA post intervention; their deficit was drastically reduced when compared to those before intervention. This improvement in dietary intake may be attributed to the increased awareness about RDA and balanced diet of the adolescents and their parents. EG-II also showed a decrease in the fat intake post intervention. In EG-I and CG there was improvement in the food intake.

The energy deficit ranged from 12.4 to 27 per cent, maximum deficit being observed in the control group (27%). Thus, in the cereal/millet-based Indian dietaries, the primary bottleneck is energy inadequacy and not protein, as was earlier believed. In case of protein, EG-I and control group were found
to have the deficit with a range of 4.9 to 11.6 per cent, whereas EG-II and EG-III were found to have an excess when compared to the RDA. On the other hand fat intake was found to be in excess among all the groups in the range of 8.2 to 62.4%.

The intake of micro nutrients among the adolescents was found to be less than the RDA, especially calcium, iron, β-Carotene, pyridoxin and folic acid among all the groups. Whereas calcium deficit ranged from 18.2 to 45.8 per cent, iron 57.3 to 63.7 per cent, β-Carotene 70.5 to 82.2 per cent, pyridoxin 48 to 84.6 per cent and folic acid 9.8 to 17.8 per cent. Intake of vitamins like, pyridoxin and folic acid were deficient among all the four groups, niacin and vitamin C was inadequate among Control Group and EG-I. After intervention, a marked improvement was observed in EG-III. The greatest improvement was observed in the intake of β-Carotene with a reduction of deficit from 72.6 per cent to an excess of 2.4 per cent, Pyridoxin from -70 to +1.3 per cent, a deficit of iron was brought to an adequacy, as in calcium, energy and folic acid. The consumption of fat was reduced from an excess of 34.6 to 11.2 per cent.

A fair improvement was also observed in the nutrient intake of EG-II, which received nutrition education. The intake of β-Carotene deficit was greatly reduced, as was evident from the increased consumption of fruits and Green Leafy Vegetables. Improvement was also observed in Pyridoxin, iron and calcium intake in their diet. The consumption of fat was also found to have reduced from an excess of 62.4 to 40.2 per cent post intervention.

In EG-I and CG, which received no nutrition education, there was a notable reduction in intake of calcium, iron and pyridoxin. This might be due to lack of awareness about the kind of foods that are healthy. This trend is also evident from the food consumption pattern.

The consumption of tryptophan was found to be in excess of the RDA for all the four groups before and after intervention. Hence it was evident that all the groups were consuming more than the adequate quantity of tryptophan even before intervention. However after intervention the quantity of tryptophan consumed by the EG-III adolescents was much higher than the other three groups and also it increased from 204.1 to 386.1 per cent.
Summary and Conclusion

There was a significant (p<0.01) increase in the tryptophan/LNAA ratio after intervention in EG-III, whereas, none of the other groups showed a significant increase after intervention. Also, when EG-III was compared with the other groups (CG, EG-I and EG-II), a significantly (p<0.01) higher mean ratio of tryptophan/LNAA was observed. None of the other groups had a significant change. The increase can be attributed to the dietary modification conducted in EG-III adolescents using greater number of foods having an elevated tryptophan/LNAA ratio for eight months.

A significant (p<0.01) negative correlation of tryptophan/LNAA ratio with stress and anxiety scores was observed, indicating a fair negative correlation between them.

A significant (p<0.01) negative correlation of tryptophan/LNAA ratio was observed with daytime sleepiness and sleep debt among the selected adolescents.

The consumption compliance by the adolescents in EG-III was much higher and consistent, as compared to the other three groups, EG-II, EG-I and control group. This improved intake of tryptophan-available foods by the adolescents of EG-III resulted in the higher tryptophan / LNAA ratio as observed in the previous Table. Even though the adolescents of EG-II, EG-I and CG were consuming some the foods listed above, their intake was neither adequate, nor consistent as compared to the EG-III adolescents.

Since iron deficiency anaemia plays a detrimental role in the mechanism of stress modulation, it was deemed essential to study the haemoglobin level and prevalence of anaemia among the selected adolescents before and after intervention.

A significant improvement (p<0.01) was observed in the blood haemoglobin levels of the adolescents of EG-III after intervention. This might be attributed to their improved dietary intake. Even though there was a slight improvement in the blood haemoglobin levels of adolescents in EG-II post intervention, the change was not statistically significant. While the blood haemoglobin of adolescents in EG-I remained unchanged, the CG adolescents showed a slight decrease in blood haemoglobin levels. This could be due to increased stress due to the approaching final exams resulting
in poor food choices. Also there was a significant difference between EG-III and CG (p<0.01), EG-I (p<0.01), but between EG-II and EG-III the difference was significant only at 5 per cent.

The adolescents in CG and EG-I did not show a substantial change in the prevalence of anaemia. The prevalence of normal level of haemoglobin increased marginally in EG-II after intervention and there was no prevalence of severe anaemia. Whereas in EG-III the number of adolescents having normal level of haemoglobin increased after intervention, thereby showing a corresponding decrease in the prevalence of mild and moderate anaemia.

The ANOVA test for Nutritional knowledge in the selected adolescents after intervention had a statistically significant F value of 170.8 (p<0.01). Thus indicating that Nutrition Education was effective in bringing about a significant change in the nutritional knowledge among the experimental groups. Comparison of nutritional knowledge scores before and after intervention show a clear difference between the groups that received nutrition education (EG-II and EG-III) and those that did not (EG-I and CG). There was a significant improvement in the nutritional knowledge of the adolescents belonging to EG-II and EG-III after intervention (p<0.01), while EG-I and CG did not show any improvement. No significant difference was observed between EG-II and EG-III since both the groups received similar NE. There was no significant difference between CG and EG-I, since both these groups did not receive any Nutrition Education.

After nutrition education, the nutritional knowledge of the fathers of EG-II and EG-III adolescents was significantly (p<0.01) improved. On the contrary, the fathers of CG and EG-I, who did not receive NE, showed no marked difference in their scores post intervention. The mean score of the mothers of the selected adolescents of EG-II and EG-III was higher than that of the respective fathers post intervention. There was a significant (p<0.01) improvement in the nutritional knowledge of the mothers belonging to EG-II and EG-III, post intervention due to NE. However the mothers of CG and EG-II showed no significant improvement.

The variation in the prevalence of stress between boys and girls (using ANOVA) was significant (F= 36.25, p> 0.01), with girls showing significantly
higher stress levels compared to boys. The impact of intervention on stress of the selected adolescents before and after intervention using ANOVA showed a significant (F=19.34, p<0.01) difference between the experimental groups and the Control Group. There was a significant (p<0.01) increase in the stress levels of the adolescents in the CG during the end of the study period due to final exams. In EG-I and EG-II groups, the levels of stress reduced significantly (p<0.05) due to PT, SMT and NE. However in EG-III there was a significant (p<0.01) decrease in stress after intervention, proving the efficacy of an integrated approach using all the interventions (PT, SMT, NE and DM).

The selected adolescents ranked pre-examination anxiety, result declaration anxiety and parental expectations as the top three out of ten stressors.

After intervention, a drastic increment was observed in the mean use of Positive Coping Techniques (66.9%) by adolescents, with a prominent reduction in the negative coping methods at 33.1 per cent. A reverse trend was observed in the CG, a marginal increase in use of Negative Coping Techniques was observed, which might be due to the increased stress and unresolved anxiety before the final exams, since they received no intervention.

The stress among the fathers of the adolescents of CG was found to have increased before their children’s final exams, since no intervention was provided. In EG-I and EG-II, there was a reduction in stress post intervention, significant at 5 per cent level only (p<0.05) and this could be attributed to the Positive Therapy they received. In case of EG-III the stress reduction was significantly greater. This change in stress pattern might be due to the influence of the dietary modification which was conducted for their children and some of the dietary practices could have been adopted by the rest of the family as well.

The mean stress level of the mothers of the adolescents was found to be higher than the mean stress levels of the fathers. The stress in the mothers of CG was seen to increase significantly (p<0.01) and this might be due to the increased stress during the child’s final exams. In case of the stress levels of
the mothers of EG-I and EG-II who received Positive Therapy, it reduced at 5 per cent (p<0.05) level after intervention. The mothers of EG-III adolescents showed a significant (p<0.01) stress reduction after intervention. This might be due to the lower stress among the EG-III adolescents as well as the dietary modification conducted for this group that impacts the rest of the family as well.

The mean stress was found to be high in both the male and female teachers. The stress levels of female teachers was significantly (p<0.05) higher than their male counterparts. After intervention with Positive Therapy, there was a significant (p<0.01) reduction in the stress level of both male and female teachers.

In Control Group, the number of adolescents having very high anxiety increased three fold after intervention, which might be due to the increased stress and anxiety during final exams. Amongst the three experimental groups the greatest reduction in high anxiety was seen in EG-III with three fold reduction in numbers after intervention. Adolescents having very high anxiety were also greatly reduced (10 to 3 numbers) after intervention. There was no drastic change seen in the anxiety of adolescents belonging to EG-I and EG-II after intervention.

The interventions for EG-I and EG-II helped in maintaining the anxiety at moderate levels and preventing it from increasing further during the final exams, as was seen in the CG.

A significant (F-81.63, p<0.01) gender variation in anxiety levels was observed. Girls were found to have higher levels of anxiety as compared to boys in the present study.

The F-value of 23.2 (p<0.01) consolidates the effectiveness of the intervention on the anxiety level between the groups after intervention. After intervention, the prevalence of overall peer victimization was reduced marginally by 7.5 per cent. All types of peer victimizations showed a decline in prevalence after intervention, however, the greatest reduction was observed in victimization through attack on property, which was minimised by 35.2 per cent after intervention. It is saddening that even after intervention; the prevalence of verbal victimization was highest.
There was a distinct gender variation in the total peer victimization values between the boys and girls that were selected for the study. Girls reported a greater degree of peer victimization when compared to boys. The Physical victimization amongst boys was significantly (p<0.01) more prevalent than amongst girls in the selected adolescents. Social victimization was observed to be significantly higher at 5 per cent level only (p<0.05) in girls than in boys. Verbal victimization was observed to be higher among girls and physical victimization was higher in boys, but difference between the genders was not statistically significant.

The F-value of 16.7 (p<0.01) confirmed the effectiveness of the intervention in minimizing daytime sleepiness among the selected adolescents. The z-test of the mean daytime sleepiness scores of the adolescents within each group before and after intervention showed that there was a significant (p<0.01) increase in all the three groups, CG, EG-I and EG-II, which did not receive dietary modification. In EG-III the mean daytime sleepiness was found to be decreased significantly (p< 0.01) post intervention. The improvement in daytime sleepiness is only evident in EG-III compared with CG, EG-I and EG-II which received dietary modification.

Adolescents from CG and EG-I showed a significant (p<0.01) increase in the sleep debt after intervention, while EG-II also showed an increase in sleep debt, it was not significant. However, adolescents of EG-III showed a significant (p<0.01) decrease in the sleep debt after intervention.

After intervention, the difficulty in falling asleep at night among the EG-III adolescents' was reduced from 75.5 to 20.4 per cent which might be due to lower degree of stress and anxiety; and improved sleep patterns. Even in EG-I and EG-II, there was a marginal reduction, but in CG, it has increased. This could be due to the increased stress and anxiety related to the final exam. In EG-I and EG-II the slight reduction could be due to their improved capability for managing stress.

Majority (45.2%) of the adolescents were awake at night due to worrying thoughts related to studies, school and their personal problems. The
next most prominent cause was being tired and having body pain (28.6%). Watching television at night and being disturbed by noise were also reported. Inadequate sleep was reported as the most prominent (61%) cause for having difficulty waking up in the morning. The next major (33.7%) cause was “feeling tired”, which is a direct indicator for poor quality of sleep. Some adolescents reported laziness (5.3%).

The results post intervention indicated a minor decrease in the percentage of adolescent who were performing some type of physical activity from CG. However in all the three experimental groups, EG-I, EG-II and EG-III, there was a positive change in physical activity. There was a greater increase in the percentage of girls engaging in physical activities post intervention.

It is noteworthy that all the four groups showed an increment in the academic score as the adolescents tend to work harder during the final exams and score relatively higher marks. The z-test indicated a significant improvement in the academic scores of EG-II (p<0.05) and EG-III (p<0.01) after intervention. However, no significant improvement in academic score was observed in EG-I and CG after intervention.

A significantly (p<0.01) high degree of positive correlation was found to exist between stress and anxiety. It is well researched that high levels of stress translate into high degree of anxiety and vice-versa. There was a high degree of negative correlation between stress and physical activity, thereby indicating that physical activity can help to reduce stress significantly. A significantly (p<0.01) high degree of correlation was seen to exist between stress and daytime sleepiness in the selected adolescents.

There was a significantly high correlation between the stress of parents and the adolescents. A higher correlation was observed with the stress of mothers than of fathers. A significantly high degree of correlation was observed between peer victimization and stress among the adolescents. A fairly high positive correlation was observed between teachers’ stress and that of the adolescent students. Low level of negative correlation was seen between stress and haemoglobin level and stress and nutrition education, though it was statistically non-significant. There was significantly strong
negative correlation observed between vigorous physical activity and anxiety among adolescents, whereas a high degree of positive correlation was observed between daytime sleepiness and anxiety among the selected adolescents.

Stress of both parents was shown to have a positive and highly significantly correlation with the anxiety seen among the selected adolescents. A similar trend was observed in the correlation with stress. Anxiety was found to have strong positive correlation with meal skipping habits in the adolescents and peer-victimization. Sleep related problems like difficulty falling asleep and waking up were seen to also have a strong correlation with anxiety in the adolescents. Similarly, sleep debt was also significantly correlated with anxiety. The stress in teachers was also fairly significantly correlated to anxiety in the selected adolescents. Blood haemoglobin was seen to have a significantly negative correlation with anxiety in the selected adolescents.

CONCLUSIONS:

In the light of the above findings the following conclusions may be inferred:

Dietary modification using higher tryptophan and tryptophan/LNAA ratio foods improved not only the ratio of tryptophan to LNAAs but also its quantity in the diet. Intervention using Dietary modification by increasing the tryptophan/LNAA ratio in the diet, Nutrition Education, Positive Therapy and Stress management Training for sustained periods can be effectively used for managing stress and anxiety and for improving sleep patterns in adolescents. The intervention with nutrition education and dietary modification were found to be effective in bridging the gap of deficiency in nutrient intake resulting in better nutritional status with desirable BMI and blood picture.

Positive Therapy, anger management, time management, forgiveness therapy, individual counselling and awareness on sexual abuse are effective in minimizing stress and anxiety experienced by adolescents and helps to
resolve issues related to self confidence, assertiveness, conflict, anger and inter-personal interactions and also improve communication among them.

Rather than a unilateral one, a multi-pronged approach combining the wisdom of nutrition and psychology can be much more effective in managing the detrimental effects of stress and anxiety among adolescents.

Involvement of the teachers and parents of the adolescents ensures greater impact on health, academic performance and behaviour of the adolescents and also ensures a better support system.

**RECOMMENDATIONS:**
1. Adolescents are a nutritionally and psychologically vulnerable group and should be given special preference and addressed as a special target category in developmental programmes.
2. Recipes can be developed by combining locally available, low-cost foods having high tryptophan and tryptophan/LNAA ratio and they can then be used in noon-meal programs, especially for the stress vulnerable groups.
3. In boarding schools, the kitchen staff can be provided a menu plan to include foods that are high in tryptophan/LNAA ratio so that the stress reduction benefit reaches a wider group of students.
4. School curriculum should have more age-relevant education on nutrition, sleep hygiene, peer victimization and physical activity to focus on the needs of adolescents, targeted towards them.
5. Stress management, anger management and forgiveness therapy should be made part of the school timetable so that these techniques are learnt at a young age by students and used effectively throughout their educational life and beyond.
6. Greater focus should be given to teachers and also to parents in helping them manage their stress effectively, since they invariably tend to transfer their stress on to the children.
7. The current study can also be done for younger students and also for those of class-XI and XII. It can in fact be extended to higher educational
centers where students face high degree of stress, sometimes resulting in suicide.

LIMITATIONS OF THE STUDY

1. Due to the extensive and time consuming nature of the interventions and the students being hard-pressed for free time in class-X, only 176 adolescents from a single educational institution could be included in the current study. A larger group can be targeted in future studies, including a greater variety of educational institutions.

2. The focus on parents and teachers was very limited in the current study due to lack of time, hence future research may be designed to increase the type, number and duration of interventions for this group which is also very stress vulnerable.

3. Blood plasma estimation of tryptophan/LNAA ratio could not be carried out due to reluctance of the parents in providing permission for blood sample collection of the adolescents.

4. Class XI and XII students could not be included in the study due to paucity of time, even though they have stress levels.