SUMMARY
AND
CONCLUSIONS
The present study involved the quantitative evaluation of the nutritional status and knowledge, attitudes and practices of adolescent girls under recently launched (April, 1994) National Adolescent Girls Scheme (NAGS) of ICDS by the Department of Women and child welfare, Ministry of Human Resource Development, Govt. of India. A review and analysis of ongoing NAGS revealed certain limitations in terms of input of dietary supplementation as well as content, duration and mode of delivery of educational package. These interventions of the ongoing scheme were improved upon in the improved module of NAGS. The impact of improved module of Nutrition and health education along with modified and enhanced supplementation was assessed in quantifiable terms. It was a pre- and post- design study, wherein the nutritional status assessment by various methods was done at the beginning of the study before the interventions were given and after the interventions were provided to girls of the experimental (EXPT) group. The EXPT group comprised of 171 non-migrant, school going adolescent girls in the age group of 9-15 years from 8 villages of Pinjore block of Panchkula District of Haryana. For the purpose of evaluation of ONG scheme, 60 adolescent girls from 2 blocks of Sirsa District of Haryana, where the scheme was on in its original form, were enrolled, which served as the ONG group.

Demographic details of the adolescent girls and their family were collected on a pre-tested schedule. Details of some ecological aspects concerning type of housing and facilities available to the family having bearing on the physical health and hence on morbidity of the adolescent girls were also collected. Nutritional status of adolescent girls was assessed using different methods i.e. dietary and nutrient intake, anthropometry, clinical and biochemical examination. Dietary and nutrient intake of girls was assessed using 24-hour recall method for 3 consecutive days. The nutrient intake was, then, calculated using 'MSU Nutriguide Programme for Asian Indian Foods (Song et al (1992)).' A set of various anthropometric measurements was taken on each subject according to the procedures described by Weiner and Lourie (1969) and then compared with their respective standards. Clinical signs and symptoms of various nutritional
Deficiency diseases were recorded by a physician according to the schedule prescribed by Jelliffe (1966). Details of menarcheal status were obtained from the subjects by the recall method and median menarcheal age was assessed using Probit Analysis (Finney, 1971). Biochemical examination was done on blood/serum of the subjects for the assessment of their hematological profile, indicators of iron status and indicators of protein status. Physical work capacity of the subjects was assessed using Harvard Step Test (Weiner and Lourie, 1969). The basal metabolic rate and total energy expenditure of the subjects were also calculated using MSU Nutriguide Programme. A specially designed questionnaire on various aspects of NHHCC was prepared, pre-tested and used to assess KAP of adolescent girls vis-à-vis NHHCC.

Demographic profile of the girls and their family revealed that majority of them (76.6% of EXPT group and 78.3% of ONG group) had average family size of 5–7 members. Majority (62%) of the girls of EXPT group had 4–6 siblings whereas majority (65%) of the girls of ONG group had upto 3 siblings. Regarding their position among siblings, 83.6% of EXPT group and 81.7% of girls of ONG group were among the first three siblings. Per capita income of the girls revealed that 44.4% of girls of EXPT group and 60% of girls of ONG group were below poverty line. The educational level of the parents of the adolescent girls revealed that fathers of nearly two-third of the girls (63.1% of EXPT group and 65% of ONG group) were illiterate. Majority of mothers (78.4% and 90% of EXPT and ONG groups respectively) were also illiterate. The occupational grades of parents revealed that majority of them (92.4% and 91.6% of EXPT and ONG groups respectively) were engaged in very low or low occupational grades. Majority of the mothers in both groups were housewives. However, a few (28%) were engaged in low occupational jobs as household maids in EXPT group to supplement their family income. The ecological background of the girls of both groups revealed poor household and environmental conditions.
The meal pattern of girls of both groups was similar and majority of the girls followed three meals pattern daily. Majority of the girls (82%) of EXPT group and all girls of ONG group were vegetarian. At T1, there was no significant difference in food intake of girls of both groups, except milk and milk products, pulses and tubers. Intake of milk and milk products was significantly higher by girls of ONG group, though inadequate as compared to RDA, but was highly deficient by girls of EXPT group. Intake of pulses and tubers was significantly higher by 13-15 years adolescent girls of EXPT group. The staple food used by girls of both groups was wheat. The intake of even staple food i.e. cereals and pulses was deficient to the extent of 50% and 60% of RDA respectively in both groups. GLV’s were consumed by negligible number (2%) of girls and comparatively more girls consumed seasonal and other vegetables. However, the girls consuming these vegetables were consuming these in adequate amounts. Intake of sugar and jaggery was also deficient to the extent of 60% of RDA in both groups. Intake of visible fat as well as invisible fat, obtained mainly from cereals and pulses, was also low. Seasonal fruits were consumed by negligible number of girls of EXPT group and girls of ONG group were not consuming fruits at all.

The nutrient intake of girls, calculated from food intake of 3 days using MSU Nutriguide Programme, revealed no significant difference between the two groups in 9-12 years age group, except for intake of vitamin C, calcium and potassium, which were found to be significantly higher in girls of ONG group. A significant difference was observed in the intake of various nutrients, except carbohydrates, fats, vitamin A and niacin between the two groups in the age group of 13-15 years. To begin with, all the nutrients were deficient to the extent of 50% or more in the diet of girls of both groups, except thiamin and phosphorous, which were found to be adequate.

A set of various anthropometric measurements namely weight; linear measurements i.e. height, bicondylar breadth of humerus and femur; circumferential measurements i.e. chest circumference, pelvic girth, MUAC and
calf circumference as well as skinfold thickness at four sites namely Bicep, Tricep, Subscapular and Suprailiac were recorded. At T1, there was no significant difference in height and weight of girls of all age groups belonging to EXPT and ONG group. The girls of both groups were shorter and lighter, when compared to their respective NCHS standards. The percentile status of girls of both groups revealed that the deficit in height and weight increased with increasing age. Indices based on height and weight i.e. height–for–age and weight –for –age revealed the prevalence of stunting to the extent of 31% and 39% and underweight to be 64% and 68% in girls of EXPT and ONG group respectively.

Among circumferential measurements, all the circumferential measurements had lower values as compared to respective standards and revealed no significant difference between the two groups, except calf circumference, which was found to be higher in girls of EXPT group. There was no significant difference in bicondylar breadth of humerus and femur between the two groups.

The biochemical examination of blood/serum of girls included changes in haematological profile, changes in indicators of iron status and changes in indicators of protein status. The haematological profile of girls revealed that girls of both groups had low haemoglobin level below the normal value (12 gm/dl) in all age groups, there being no significant difference between two groups at T1. The girls of both groups revealed a high prevalence of anaemia, majority of the girls being in Grade I and II of anaemia, as indicated from their haemoglobin status. However, the PCV and RBC values were within the normal range in all age groups. Indices based on haemoglobin, PCV and RBC revealed a low level of MCV, MCH and MCHC, indicating the prevalence of hypochromic microcytic anaemia at T1. The indicators of iron status revealed a low level of serum iron, high level of TIBC and a low value of TS% in both groups. The indicators of protein status also revealed a low level of serum protein and albumin to begin with.
Clinical examination of girls revealed a highly significant difference in the prevalence of vitamin & mineral deficiencies and PEM between the two groups at T1, the incidence being higher in adolescent girls of EXPT group as compared to ONG group. In both groups, the incidence of iron deficiency anaemia was the highest, incidence being 54.4% and 33.3% in girls of EXPT and ONG group respectively. The incidence of PEM and other vitamin deficiencies was significantly higher in girls of EXPT group as compared to girls of ONG group.

The median age of menarche was found to be 11.53 ± 1.1 years and 12.59 ± 1.07 years for adolescent girls of EXPT and ONG group respectively. The menarcheal age followed the peak height velocity and was preceded by peak weight velocity in both groups.

One of the functional consequences of under-nutrition and anaemia is an impairment of physical work capacity because of reduced oxygen uptake at maximum exertion, which is indicative of ones physical fitness. The physical fitness index (PFI) scores of girls of both groups revealed no significant difference in all age groups at T1, except in the age groups of 10&13 years, in which PFI scores of girls of ONG group were significantly higher as compared to EXPT group. However, PFI scores of adolescent girls of both groups were categorized as ‘Poor’ in all age groups to begin with. A strong positive correlation has been observed between physical work capacity and haemoglobin level of girls of both groups, indicating deleterious functional consequences of iron deficiency anaemia on physical work capacity.

The girls of EXPT group, to whom dietary supplementation in the form of Puffed rice / Alapahar /Biscuits was given regularly @ 125 gm per head per day for 3 months, a significant increase in height and weight of girls was observed in all age groups, resulting in an improvement in their percentile status. Height and weight velocities accelerated and the acceleration were higher than NCHS
standard in all age groups. However, the acceleration was higher in younger girls as compared to older girls.

At this stage, the biochemical profile of girls revealed that the haemoglobin level of girls increased marginally and consequently majority of the girls still continued in Grade I & II of anaemia. Girls, who were severely anaemic, improved and shifted from Grade II & III to normal and Grade I of anaemia. However, some of the older girls deteriorated in their haemoglobin status.

After supplementing the girls for 3 months, dietary supplementation was discontinued for 3 months to assess whether catch-up growth and other improvements observed during supplementation period continued, when girls were on their usual home diets.

During T2 to T3 (3 months of non supplementation), height gain and weight gain, though marginal and insignificant, continued but there was no change in percentile status of girls. However, height velocity and weight velocity deescalated as compared to supplementation period in all age groups and was below NCHS standard during this period of non-supplementation. Six monthly increments revealed that height increments were higher than NCHS standard and weight increments were comparable to NCHS standards in all age groups. The prevalence of stunting was reduced by only 11% and underweight by just 4% in these girls.

During this period, there was no change in haemoglobin level of girls in all age groups and the distribution of girls into various grades of anaemia remained the same, as at T2.

Though dietary supplementation given to girls for 3 months improved the physical growth status to some extent but most of the girls continued to be anaemic. It was, therefore, planned to give iron and folic acid supplementation along with
dietary supplementation for 4.5 months to all adolescent girls to treat anaemia, to promote physical growth and to improve physical work performance.

During T3 to T4 (4.5 months of dietary and nutrient supplementation period), there was again significant gain in height and weight of girls, resulting in an improvement in percentile status. The height velocity and weight velocity again accelerated and revealed a declining trend with age but acceleration was less as compared to first 3 months of supplementation period. The indices derived from height and weight revealed that the prevalence of stunting (low height-for-age) was further reduced by 3% at T4. However, the prevalence of underweight (low weight-for-age) remained more or less the same at T4.

Among the circumferential measurements, chest circumference and pelvic girth revealed a significant increase in all age groups. However, MUAC and calf circumference revealed no significant change in all age groups. Linear measurements i.e. bicondylar breadth of humerus and femur as well as skinfold thicknesses increased significantly in all age groups at the end of intervention.

At T4 i.e. after 4.5 months of dietary supplementation and iron/folic acid supplementation (comprising of 20 mg of elemental iron and 0.1mg of folic acid), the haemoglobin, PCV and RBC increased significantly in all age groups of EXPT group. Majority of the girls shifted from Grade II & III to normal or Grade I of anaemia. A normal MCV, MCH and MCHC level also indicated an improvement in their haematological status and correction of hypochromic microcytic anaemia. The indicators of iron status revealed a significant increase in serum iron and transferrin saturation level and a significant decrease in TIBC level, indicating better availability and utilization of iron for haemoglobin synthesis. The indicators of protein status also revealed a significant increase in serum protein level due to increased intake of good quality protein obtained from cereal-pulse combination of dietary supplementation, while the level of serum albumin remained unaffected.
Clinical examination of girls revealed a reduction in the incidence of iron deficiency followed by other deficiencies. Though dietary supplementation given to adolescent girls of EXPT group reduced the deficit in calories, protein and iron but the iron status of adolescent girls in the state of negative iron balance could not be met through diet alone in the first phase of dietary supplementation alone. Thus iron/folic supplementation (comprising of 20mg of elemental iron) went a long way in improving the iron status of adolescent girls by replenishing the depleted iron stores and reducing the incidence of anaemia.

With the decline in incidence of iron deficiency anaemia, the PFI scores of girls increased significantly in all age groups and was categorized as 'average', though most of the girls were at the threshold of being average. The improvement of PFI scores of adolescent girls of this group was due to a highly significant improvement in their haemoglobin level as a result of dietary and folate supplementation, which increased their work output by increasing the aerobic capacity of the body. This resulted in less cardiovascular stress in girls with improved iron status for prolonged physical activity, as evidenced from decreased recovery heart rate and increased exercise time in these girls.

An improvement in nutritional status of these girls occurred as a result of dietary and nutrient supplementation, which increased the total food intake and consequently nutrient intake of girls. Besides this intervention, another intervention i.e. NHHCC education given to these girls through improved module of NHHCC education, resulted in an increase in quality and quantity of home diet.

An analysis of home diet conducted at the end of the intervention (T4) revealed a significant increase in intake of various foods and improved variety through home diet of girls of EXPT group. A significant increase was also observed in the number of girls consuming green leafy vegetables and seasonal fruits at the end
of intervention. Moreover, intake of various foods i.e. milk and milk products and visible fat also increased at the end of intervention.

Consequent upon increase in intake of various foods, a significant increase in intake of various nutrients through home diet of girls occurred. Intake of calories, deficient by 44-48% of RDA in both age groups at T1, increased by 5.5% and 2.2% of RDA in younger and older girls respectively. Protein intake was deficient by 47-50% of RDA in both age groups at T1 and improved by 5-6% of RDA. Its quality also improved with the inclusion of increased amount of milk and milk products as a source of good quality animal protein. The deficit in intake of calories and protein still continued to the extent of 42-43% and 41-45% of RDA respectively in both age groups. Intake of B-vitamins, especially riboflavin and niacin, deficient to the extent of 40-50% of RDA at T1, increased by 8% and 2-4% of RDA respectively in both age groups. A highly significant increase occurred in intake of vitamin C from 19-22% of RDA at T1 to 228% & 160% of RDA at T4 in both age groups. Among minerals, intake of calcium was deficient by 56-57% of RDA at T1 and increased by 10-12% of RDA at T4. Iron was deficient by 28% and 49% of RDA in younger and older girls respectively and increased by 10-11% of RDA in both age groups.

The adolescent girls of ONG group, who visited the anganwadi centers of their village only once in a while and received the dietary supplementation then. It was observed that the dietary supplement was received on an average of not more than twice a week in 6 months. Results indicated a significant gain in height of girls in all age groups, except 13-year age group and a significant gain in weight of girls in all age groups, except in 11-year age group. However, the percentile status of girls remained the same in all age groups, as it was to begin with. The height velocity and weight velocity revealed an acceleration but it was less than NCHS standard up to 11 years in case of height and 13 years in case of weight and higher thereafter. The prevalence of stunting, which was 39% at T1, reduced by 9% at T3 and prevalence of underweight, which was 68% at T1, reduced by
3% at T3. All the circumferential measurements, except MUAC, revealed a significant increase at T3. A strong positive correlation was observed between intake of calories and protein with height and weight, indicating an increase in these measurements with increase in these nutrients.

The biochemical profile of these girls revealed that there was no significant change in haemoglobin, PCV and RBC level of girls in all age groups after 6 months of intervention i.e. at T3. The distribution of adolescent girls into different grades of anaemia revealed that girls, who were severely anaemic, improved to better haemoglobin status whereas girls, in 13-15 years age group, in which majority of the girls had attained menarche, revealed deterioration in their haemoglobin status. There was no significant improvement in indicators of iron status, indicating poor availability and utilization of iron for haemopoeitic activity. The indicators of protein status also revealed no significant change in adolescent girls of ONG group.

Clinical examination of girls revealed that the incidence of iron deficiency reduced significantly from 33.3% to 18.3%, thus registering 44.9% decline PerSe. However, incidence of vitamin C deficiency increased while the incidence of iodine deficiency and PEM remained unchanged at the end of the intervention i.e. T3.

The PFI scores of adolescent girls of ONG group also increased significantly in all age groups, except 10 & 13 years age group at the end of the intervention i.e. at T3. The girls were categorized as ‘average’ in 10-13 years age group and ‘poor’ in 14-15 years. The poor response in PFI score of adolescent girls of ONG group might be attributed to insignificant increase in haemoglobin level of adolescent girls as a result of intervention.

The marginal improvement in nutritional status of girls of this group occurred as a result of dietary supplementation, thus increasing the total food intake and
consequently the nutrient intake of girls. Besides this, NHHCC education given to these girls through educational package of NAGS for 6 months, resulted in a marginal increase in intake of various foods. However, whether this increase in food intake was an indirect impact of educational intervention or an impact of seasonal variations could not be ascertained.

An analysis of home diet of these girls revealed no significant change in intake of various foods, except in the quantity of milk and milk products, fat and seasonal fruits. Besides an increase in number of girls consuming GLVs was also observed, though the amount consumed and its variety remained more or less the same as at the beginning of intervention.

No significant change was observed in the intake of various nutrients by these girls as a result of increased food intake. Intake of calories, deficient by 39-49% of RDA in both groups at T1, increased by 2% and 5% of RDA at T3. Protein intake, deficient by 42-46% of RDA in both age groups at T1, increased by 4% and 2% of RDA in both age groups. The deficit in intake of calories and protein still continued to the extent of 37-44% and 40-42% of RDA respectively in both age groups. Intake of B vitamins, deficient to the extent of 40-50% of RDA in both age groups at T1, increased by 8% of RDA. Vitamin C, which was deficient by 33% and 48% of RDA in younger and older girls respectively at T1, increased to the level of 152% and 130% of RDA in these girls. Intake of calcium, which was deficient by 47% and 28% of RDA in younger and older girls, also increased by 5% and 7% of RDA respectively in both age groups.

Second intervention given to girls was NHHCC education. The knowledge, attitudes and practices (KAP) vis-à-vis NHHCC of adolescent girls of both groups was pre-tested at the beginning of the intervention i.e. at T1. It was post-tested at T4 i.e. after giving an intervention of NHHCC education through an improved module of NHHCC for one year using different teaching methods and aids to adolescent girls of EXPT group and at T3 after giving 6 months of intervention of
NHHCC education through the educational package of NAGS to adolescent girls of ONG group.

The results of pre-test scores at T1 revealed no significant difference in the scores of attitudes but a highly significant difference in the scores of knowledge and practices between the two groups, the scores being significantly higher in adolescent girls of ONG group. It was found that older girls had a better pre-test scores in most of the aspects of knowledge, attitudes and practices as compared to younger girls in both groups.

Among various aspects of knowledge, the girls of EXPT group had average scores in the area of ICDS/NAGS and poor scores in the area of maternal and child health care in both age groups. The girls of ONG group possessed average scores in the area of therapeutic nutrition in both age groups. Girls in the age group of 9 -12 years possessed average scores in the area of ICDS/NAGS whereas older girls possessed poor scores in this area. Basic knowledge possessed by girls of both groups was poor in both age groups. Significant differences were observed in the area of therapeutic nutrition, MCHC and GOBI between the two groups, the scores being higher in the girls of ONG group.

Measurement of attitudes using two-point scale revealed that girls of both groups scored good scores in the area of status of girls in the society and average in respect of adolescent health in both age groups. The attitudes of therapeutic nutrition were significantly higher in adolescent girls of ONG group in both age groups and attitudes of MCHC were significantly higher in only 13-15 years adolescent girls of ONG group. However, adolescent girls of 13-15 years had higher scores in favourable attitudes as compared to 9-12 years adolescent girls in both groups because attitudes get well established, firm and less likely to change at the higher age.
So far as practices regarding NHHCC are concerned, significantly higher number of girls of ONG group followed overall correct practices as compared to girls of EXPT group. The pre-test scores in respect of correct practices by girls of EXPT group were very poor in all aspects of practices. On the other hand, girls of ONG group scored good in the area of therapeutic nutrition and average in the area of adolescent health, MCHC, cooking and feeding practices.

After giving the intervention of NHHCC education through an improved module of NHHCC for one year using various teaching methods and aids, the post-test scores of adolescent girls of EXPT group revealed a significant increase in all aspects of KAP, the highest increase being in the area of knowledge (41-47%) followed by practices (39-45%) and least in attitudes (26-31%) in both age groups.

Analyzing the various components of knowledge, it was observed that the increase in scores was maximum in the area of basic knowledge and minimum in the area of ICDS/NAGS in both age groups.

Regarding attitudes, adolescent girls of EXPT group revealed highly significant increase in all aspects of attitudes in both age groups. The increase in scores was maximum in the area of therapeutic nutrition and minimum in the area of MCHC in both age groups. The change in attitude was more in 9-12 adolescent girls as compared to 13-15 adolescent girls in both groups. This may be due to more flexibility in attitudes and beliefs and also more flexibility in minds of younger girls.

Regarding practices, there was highly significant improvement in practices of adolescent girls of EXPT group. The increase in scores was maximum in the area of cooking and feeding practices and minimum in the area of therapeutic nutrition in both age groups.
Another important finding was that the increase in scores in most of the areas of knowledge, attitudes and practices was higher in younger girls as compared to older girls.

In ONG group, in which NHHCC education was imparted only for 6 months by the Supervisors of ICDS scheme according to the educational package of NAGS prepared by Department of women and child welfare, Govt. of India, the overall increase in scores was significant in case of knowledge but not significant in attitudes and practices.

A further break up of the post-test scores of knowledge revealed a maximum and a highly significant (P<0.01) increase in the area of therapeutic nutrition and minimum increase in the area of MCHC by girls of both age groups.

Among attitudes towards various aspects relating to NHHCC, the increase in scores was maximum in area of maternal and child health care (MCHC) and minimum in the area of adolescent health in 9 – 12 years age group but in 13 – 15 years age group, the increase was maximum in the area of adolescent health and minimum in therapeutic nutrition.

In case of practices vis-à-vis NHHCC, the increase in scores, though marginal, was maximum in the area of maternal and child health care (MCHC), especially in younger girls.

Findings, which were common to both groups were that the correlation coefficient between knowledge, attitudes and practices revealed highly significant correlations between knowledge and practices followed by knowledge and attitudes but the correlation between attitudes and practices was not significant. In both groups, increase in score in most of the aspects of knowledge, attitudes and practices was more in 9-12 years age group as compared to 13-15 years age group.
An interesting finding that came to light was that learning by 9-12 years adolescent girls was more as compared to 13-15 adolescent girls of both groups, which was perhaps due to their receptive and impressionable minds. Thus, young adolescent girls can serve as a potential agent of change for bringing about an improvement in nutritional status of community.

The improvement observed in nutritional status and knowledge, attitudes and practices of girls of EXPT group was an outcome of improvements made in the two interventions. The highly significant improvement in nutritional status of girls could be attributed to input of dietary and nutrient supplementation given regularly in the form of cereal-pulse combination in the proportion of 2:1. This input of supplementation raised the calorie intake of girls to the level of adequacy, besides improving the quality and quantity of protein. Moreover, enhanced amount of dietary supplementation @ 125gm per head per day could partially make for the deficit in total food intake. Nutrient supplementation given along with dietary supplementation for 4.5 months after giving hematinics to girls resulted in greater impact of dietary supplementation on nutritional status of girls.

A highly significant improvement in knowledge, attitudes and practices of girls was due to improved package of NHHCC education, which was improved upon in terms of its content, duration and mode of delivery. The content was enlarged, prepared in a simple regional language (Hindi), was made understandable, meaningful and relevant to their life situations. The duration and continuity of educational intervention was extended to one year. Use of various teaching methods/aids and experienced resource persons from varied fields made the sessions interesting and effective. This resulted in more learning and hence significant improvement in knowledge, attitudes and practices of girls.

Thus, a judicious combination of dietary and nutrient supplementation given regularly for longer duration, especially if given before menarche along with
NHHCC education to younger adolescent girls would improve their nutritional status and knowledge, attitudes and practices vis-à-vis NHHCC of adolescent girls as well as the nutritional status of their future generations too.