Nephrotic syndrome is a clinical condition, which is characterised by proteinuria, hypoproteinaemia, hyperlipidaemia and oedema. These constellations of biochemical and various other clinical abnormalities can predispose nephrotic patients to fatal complications like cardiovascular disease and progression of renal disease. So therapeutic manoeuvres aimed at correction of lipid abnormalities may slow the progression of nephrotic syndrome to end stage renal disease. Therefore, an alternative therapy, which has an anti-hyperlipidaemic effect, would be an attractive option for nephrotic patients. Hence, in this context, the present study was carried out with the objective of ascertaining the effect of spirulina supplementation in nephrotic patients.

In this regard, eighty patients suffering from nephrotic syndrome were enrolled. Their socio-economic profile, medical history along with anthropometric measurements and dietary history were collected at baseline. The metabolic profile was studied by analysing the lipids and lipoprotein fractions, apolipoproteins, total protein and its fractions along with various analytes representing the kidney functions in these patients at baseline. Nephrotic patients were further divided into two groups – control and experimental group. Patients in control group were only on medication and were studied for a period of four months. Experimental group comprised of patients with medication plus spirulina (1g/day for four months). The number of patients who completed the study included eighteen in control group and thirty-five in the experimental group after a period of two months whereas after four months of study period seventeen in the control group and thirty in the experimental group completed the study. The concentrations of serum total proteins and its fractions, creatinine, urea, lipid and lipoprotein fractions
and apolipoproteins were also analysed at baseline and at the end of two and four months in nephrotic patients.

The mean age of all the nephrotic patients was 8.4±3.8yrs. About 68.8% of the patients had gradual onset of nephrotic syndrome or relapse while in the remaining patients the onset of nephrotic syndrome or relapse was associated with some infection. Of all the patients with nephrotic syndrome, 25% were frequent relapsers/steroid dependent, 36.3% were infrequent relapsers and 6.2% were steroid resistant. The metabolic profile of nephrotic patients at baseline revealed that the levels of total proteins (p<0.001), albumin (p<0.001) and A:G ratio (p<0.001) were significantly decreased as compared to the normal children.

When the lipid levels of nephrotic patients were compared with the normal children, a two-fold increase in TG (p<0.001) and VLDL-C (p<0.001), three-fold increase in TC (p<0.001), non-HDL-C and apo B; and three and a half fold increase LDL-C (p<0.001) levels were observed. The atherogenic indices i.e. TC: HDL-C (p<0.001) and LDL-C:HDL-C (p<0.001) ratios in these patients were significantly increased while the ratio of apo A1:B (p<0.001) was observed to be significantly decreased in comparison to the normal children.

Age-wise comparison of the nephrotic patients, revealed that decreased levels of total protein and albumin were observed in the older children, followed by ≤6yrs and then by 6-12yr old nephrotic patients. With regard to the lipid levels, increase in the concentrations of TG (p<0.01), TL (p<0.05), TC (p<0.05), LDL-C (p<0.05) and non-HDL-C (p<0.05) was seen to be higher in older nephrotics as compared to ≤6yr old patients.

As the level of proteinuria increased in these patients, the concentration of lipids also increased. Concomitantly increment in the atherogenic indices was also observed.
An inverse relationship between the level of serum albumin and the lipid and lipoprotein levels were observed in these patients \( \text{i.e. albumin \& TG} (r = -0.52), \text{albumin \& TL} (r = -0.64), \text{albumin \& non-HDL-C} (r = -0.69) \text{and albumin \& apo B} (r = -0.71) \).

The levels of serum total protein and its fraction revealed that uremic patient exhibited significantly lower level of total protein \((p<0.05)\), albumin \((p<0.05)\) and A:G ratio as compared to non-uremic patients. The levels of analytes representing the kidney function were found to be increased in uremic patients as compared to non-uremic patients. Uremic patients exhibited elevated levels of lipids, lipoprotein fractions, atherogenic indices and apo B as compared to non-uremic patients. The ratio of apo A1:B was observed to be lower in uremic patients in comparison to the non-uremic patients.

The concentrations of total protein and its fractions and analytes representing kidney function of nephrotic patients based on the duration of disease showed that these levels were observed to be higher in the patients with longer duration of disease as compared to the patients with shorter duration of disease. The levels of TG, TL, TC, HDL-C, LDL-C, VLDL-C, non-HDL-C and atherogenic ratios were observed to be higher in the patients with longer duration of disease as compared to the patients with shorter duration of disease.

*Spirulina* supplementation brought about a significant improvement in the levels of total protein \((p<0.001)\) and albumin \((p<0.001)\) after two months in the experimental group patients. In addition, *spirulina* helped in maintaining the raised total protein and albumin levels in these patients after four months of supplementation. No change in globulin concentration was observed after the supplementation for two and four months. Significant improvement in the A:G ratio was observed after two \((p<0.01)\) and four \((p<0.001)\) months of supplementation. A small rise in the creatinine level \((p<0.05)\) was noticed after
two months of supplementation but no change in its level was seen after four months in these patients. Decrease in the values of urea, BUN and BUN: creatinine ratio was witnessed after two and four months of supplementation along with a small decrease in proteinuria. Nephrotic boys exhibited a better protein status after supplementation as compared to girls.

Hypertlipidaemia is a clinical manifestation of nephrotic syndrome and is commonly seen in these patients. *Spirulina* supplementation resulted in a significant drop in the lipids and lipoprotein fractions and apolipoprotein levels thereby decreasing the atherogenic indices in comparison to the control group patients.

Moreover, the supplementation of *spirulina* in the experimental group also showed substantial reduction in the number of relapses. Based on this the clinician has brought down the level of drug to 54% of the initial requirements whereas the control group patients required 87% of the initial level for the treatment of nephrotic syndrome. These observations clearly demonstrate and substantiate that *spirulina* therapy has shown a remarkable improvement in the prognosis of the patients.

Therefore, it was observed that *spirulina* helped in improving the protein status and in decreasing the elevated lipid levels of the nephrotic patients. Reduction in the atherogenic indices and rise in the apo A1:B ratio was also observed in these patients after *spirulina* supplementation for two and four months. Hence, it can be concluded that *spirulina* supplementation aided in improving the quality of life of the experimental group patients in a better way as compared to the patients in the control group.