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Original Article

Physiology Section

Serum Proteins Alteration in Association with Body Mass Index in Human Volunteers

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ABSTRACT

Introduction: Serum proteins are an important indicator of the nutritional status in an individual. There is a worldwide prevalence of both undernourishment and obesity. It has been suggested that low Body Mass Index (BMI) is associated with a decrease in serum protein levels predisposing them to other illnesses. Overweight and obese individuals carry risk for various other non-communicable diseases.

Aim: To compare the serum protein levels in underweight, overweight and obese individuals with that of normal body mass index individuals.

Materials and Methods: This prospective study was conducted in subjects who attended the master health checkup clinic of PSG hospitals. Subjects in the age group of 20-50 years were selected. Their serum proteins and BMI was measured. Twenty subjects each of underweight, normal, overweight and obese individuals were selected, categorized and compared.

Results: The serum protein level of normal individuals (Group I) was compared with underweight (Group II), overweight (Group III) and obese subjects (Group IV) by one-way ANOVA analysis. The mean serum total proteins in gm/dl in group I controls was 7.555±0.37 compared to Group II (underweight) which was 7.295±0.419. Low BMI was found to be associated with a decrease in serum protein level which was not statistically significant. Elevated BMI as in overweight and obese subjects showed no significant alterations in serum protein levels with p >0.05 and the changes were found to be independent of the body mass index.

Conclusion: Underweight individuals showed a decrease in serum protein levels whereas there were no significant changes in the serum protein levels in overweight and obese individuals.

Keywords: Obese, Overweight, Serum total proteins, Underweight

INTRODUCTION

According to the recent national family health survey and UNICEF reports, 46% of preschool children and 30% of adults in India suffer from moderate and severe grades of protein calorie malnutrition [1].

The total proteins in serum are made of albumin, globulin and fibrinogen. Research on human proteins has been directed toward problems of physiological and biochemical interest. The serum proteins play important roles as biological buffer systems, maintenance of osmotic pressure of blood, control of blood pH, transport of lipids, in immunological reactions and other functions [2]. Reduction of serum proteins has been observed in nephritis [3], liver cirrhosis, malnutrition, injury reactions, and oedema. Low Body Mass Index (BMI) with low serum albumin was one of the poor prognostic indicators in chronic obstructive pulmonary disease [4], and increased risk of mortality in patients with chronic kidney disease on haemodialysis [5]. Patients with high BMI had an increased risk of high mortality after cardiac surgery [6]. High fibrinogen levels also represent a risk factor for elevated arterial hypertension, inducing cardiovascular morbidity and mortality. In addition fibrinogen and its derivatives seem to be-involved in both the initiation and sustained growth of atherosclerotic lesions [7]. A rise in protein levels is noted in dehydration, amyloidosis and chronic inflammatory states.

Body Mass Index (BMI) is a measure of weight adjusted for height. It is calculated as weight in kilograms divided by the square of height in meters (kg/m^2) [8]. It correlates to direct measures of body fat. Studies have been done to observe changes in serum protein levels with age. This study was done to analyse the relationship between anthropometric indicators like BMI and serum protein levels of an individual and to observe if serum proteins can act as an indicator to assess nutritional deficiencies.

MATERIALS AND METHODS

This prospective study was conducted in subjects undergoing Master health checkup in PSG Hospitals from May 2015 to June 2015. Total 80 subjects of both sexes in the age group of 20-50 years were included in this study. The study was conducted after getting clearance from the Institutional Human Ethics Committee. Written consent was also obtained from subjects before participation in this study. Baseline examination included a brief history, anthropometric measurements and serum total protein estimation. Both males and females with the age group between 20 to 50 years were included in the study. Those suffering from diabetes, hypertension, subjects with respiratory diseases, renal problems were excluded from the study.

Standing height was measured on a clinic stadiometer. Body weight was assessed using a calibrated weighing scale, with subjects using light clothes and no shoes. BMI calculated as weight in kilograms divided by square of height in meters [8]. They were further classified as per Indian council of medical research classification. Underweight<18.5 kg/m^2, 18.6 to 24.9 kg/m^2 is normal, 25 to 29.9 kg/m^2 is considered overweight and >30 kg/m^2 is considered obese [9].

The subjects were informed to fast overnight for 10 hours before blood specimen collection. Aseptic precautions were taken while collecting venous blood samples. The sample was collected in plain vacutainer, allowed to clot for 10 minutes and centrifuged. The serum was separated and analysis was done by Photometric assay. The normal serum total protein levels range from 6 to 8 gm/dl [10].

Depending upon the BMI, 80 subjects were divided into 4 groups of 20 each, after calculating the BMI

Group I (n=20) with normal BMI, 18.6 to 24.9 kg/m^2 served as control.

Group II, (n=20) with BMI <18.5 kg/m^2 (underweight)
Group III (n=20) with BMI 25 to 29.9 kg/m^2 (overweight)
Group IV (n=20) >30 kg/m^2 is considered obese.

STATISTICAL ANALYSIS

Statistical analysis was done on SPSS version 19.0. Mean and Standard Deviation (SD) was calculated for BMI and serum proteins in all the four groups. Change in serum protein parameters between the groups were compared by one way ANOVA and Bon-ferroni post-hoc tests. The p-value less than 0.05 were considered statistically significant.

RESULTS

[Table/Fig-1] Shows the height and weight of subjects, depending on the BMI they were classified into four groups. Subjects with Normal body mass index (Group I), underweight (Group II), overweight (Group III) and obese subjects (Group IV).

Variables	Group I (N=20) (Mean±SD)	Group II (N=20) (Mean±SD)	Group III (N=20) (Mean±SD)	Group IV (N=20) (Mean±SD)
Age (Years)	35.25 ±9.32	35.75±8.06	37.6±7.35	39.4±7.03
Height (Cm)	172.10±8.58	167.80±12.27	164.75±10.50	159.75±8.39
Weight (Kg)	70.15±7.85	51.20±8.02	72.30±9.17	82.15±8.44
BMI (Kg/m^2)	23.56±0.75	18.010±0.89	26.49±0.85	32.11±1.94

[Table/Fig-1]: Shows the anthropometric data of normal (Group I), underweight (Group II), overweight (Group III) and obese subjects (Group IV).
BMI: Body Mass Index

[Table/Fig-2] depicts the comparison of serum proteins in the underweight, overweight and obese individuals to that of normal subjects in ANOVA analysis. There was a decrease in serum total proteins levels in underweight subjects as compared to normal BMI individuals, which was statistically not significant. But no significant association was present between the serum protein levels of overweight and obese individuals to normal subjects.

Variables	Normal (Group I)	Underweight (Group II)	Overweight (Group III)	Obese (Group IV)
Serum Total Proteins	7.555± 0.372	7.295± 0.419	7.380±0.529	7.470±0.591
'F' value	0.992			
Significance	0.529 (NS)			

[Table/Fig-2]: Comparison of serum proteins in Underweight (Group II), Overweight (Group III) and Obese individuals (Group IV) with the Normal subjects (Group I).
Non-significant (NS) = p>0.05.

[Table/Fig-3] denotes the comparison of serum proteins of Normal subjects (Group I) with Underweight (Group II), Overweight (Group III) and Obese individuals (Group IV) using Bon-ferroni post-hoc tests. The comparison between group I and group II showed a statistical significance of p<0.04. The comparison between group I and group III showed a statistical insignificance of p= 0.2. The comparison between group I and group IV showed a statistical insignificance of p= 0.58. The comparison within the groups was also statistically insignficant.

Variables	Normal (Group I)	Underweight (Group II)	Overweight (Group III)	Obese (Group IV)
Serum Total Proteins	7.555± 0.372	7.295± 0.419	7.380±0.529	7.470±0.591
p-value		p< 0.04* (S)	p= 0.2 (NS)	p= 0.58 (NS)

[Table/Fig-3]: Comparison of serum proteins of Normal subjects (Group I) with Underweight (GroupJ II), Overweight (Group III) and Obese individuals (Group IV).
*Significant (S) = p<0.05 Non-significant (NS) = p>0.05.

DISCUSSION

In this study, we have investigated the role of serum proteins in association with BMI in human volunteers. BMI value below 18 kg/m^2 was considered as the cutoff to detect an underweight individual [9].

Amino acids are the binding blocks of protein. Protein is the basis of the human body structure. Proteins contain nitrogen and are responsible for the synthesis of enzymes involved in ulcer healing, cell multiplication, collagen and connective tissue synthesis. Calorie needs must be met first in order to spare protein from being utilized as an energy source. Protein is essential to promote positive Nitrogen balance. The recommended range of protein is 1.2 to 1.5gm/kg/body weight/day [11]. According to Framingham study, factors like body weight, heart rate, alcohol consumption, carbohydrate dysmetabolism, haematocrit, haemoglobin, serum total proteins and total triglyceride correlate positively with the incidence of hypertension [12]. An increase in serum proteins would contribute to the development of prehypertension and hypertension in overweight and obese subjects [12].

In our study, the underweight category showed a decline in serum proteins. Serum protein levels have been proposed as one of the tools for assessing nutritional status of an individual. Protein deficiency can be due to malnutrition or under-nutrition which can be associated with morbidity and mortality. Early identification and treatment of nutritional problems is critical. Intake of protein with vitamin and mineral supplementation is essential for the underweight group, so that we can prevent them predisposing to frequent recurrent infections. An interventional study done on adolescent school children of low socioeconomic background in the age group of 10 to 15 years revealed, 9.9% of them had a low serum protein level [13]. A cross-sectional study done by Hossein on patients who underwent coronary artery bypass grafts showed increased risk of complications after surgery if the BMI was high and increased incidence of mortality if the serum albumin was low [14].

BMI ranging from 25 to 29.9kg/m^2 is said to be overweight and above 30kg/m^2 is considered obese. Obesity is considered one of the leading causes of diabetes mellitus in the world population due to the growing trend of sedentary lifestyle and increased food consumption of high calorie diet. Due to this, a concomitant increase has been observed in the incidence of coronary artery disease, hypertension and even diabetes. The omni heart study showed that the protein diet lowered LDL cholesterol, triglyceride, and HDL cholesterol levels compared with the carbohydrate diet because proteins have a direct triglyceride lowering effect [15]. The association of obesity with serum proteins was insignificant in our study. A study conducted by Riaz and Alam showed an increase in serum proteins in obese individuals with diabetes mellitus [16].

Adipose tissues have endocrinal properties and secrete certain proteins, adipokines that have an important role in glucose homeostasis. Some of these adipokines are upregulated in diabetic and obese individuals while others are down regulated. Adipocyte secreted protein like leptin can affect glucose homeostasis and serve as an important marker to study the progression of diabetes in obese individuals [17,18]. A pilot study done by Venkataramana showed a increase in serum protein and fibrinogen level in Type 2 diabetes mellitus [19]. Another study done by Ravish et al., revealed a linear increase in serum fibrinogen and BMI in prediabetics compared to normal individuals [20].

Since energy needs take priority in metabolism, dietary protein is converted to energy via gluconeogenesis when caloric intake is inadequate. Decreased protein availability can result in muscle wasting and failure to achieve usual growth related increase in lean body mass. Hence, individuals who are underweight should be supplemented with proteins and multivitamins and the obese need to be monitored so that they do not progress to develop metabolic syndromes like diabetes, hypertension and coronary artery diseases.

CONCLUSION

Low BMI is associated with a decrease in serum total protein levels suggesting major contribution of proteins is from diet. Hence a proper dietary advice regarding adequate intake of protein rich food is recommended for underweight individuals to prevent the associated morbidity. But, an elevated BMI as in overweight and obese individuals showed no significant changes in serum proteins suggesting role of body's regulatory mechanism to maintain the adequate protein levels in the serum.

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