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Study of Correlation Between BMI and Serum Nitric Oxide Levels in Healthy Adolescent Subjects

Venkatesh D, Prashanth Kumar M*, Wilma Delphine Silvia.**

Department of Physiology, M S Ramaiah Medical College, Bangalore – 560 054, Karnataka, India.
* Dept of Physiology, Rajarajeshwari Medical College & Research Center , Bangalore, Karnataka, India.
** Department of Biochemistry, Akash Medical College, Bangalore, Karnataka, India.

ABSTRACT

Nitric oxide has been identified as endothelium derived relaxing factor. It is known to function as a neurotransmitter and a chemical signal between lymphocytes. It is secreted from the adipose tissue, may play a role in regulation of food intake and influence BMI. In the present study efforts are made to establish the correlation between serum NO levels and BMI. The study was carried out in 17 male and 13 female medical students, in the age group of 17 to 23 years. The serum concentration of nitric oxide was estimated by cadmium reduction method. Height and weight of the subjects were measured in and BMI was calculated. The BMI in males and females was 22.75 ± 4.13 and 21.91 ± 3.79 respectively. The corresponding serum nitric oxide levels were 24.21 ± 5.73 mmol/L and 22.73 ± 6.09 mmol/L. There was a positive correlation between BMI and serum nitric oxide levels in both males and females.

Key words: Nitric oxide, Body Mass index,

Corresponding author

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INTRODUCTION

Nitric oxide (NO) is produced in various tissues of the body having different physiological functions. It is synthesized by the action of Ca^{2+} dependent Nitric oxide synthase I (NOS) or nNOS in central and peripheral neuronal cells. It is responsible for neuronal communication. NOS II or iNOS is present in most nucleated cells, particularly macrophages. It is independent of intracellular Ca^{2+} for its action and is induced by inflammatory cytokines. NOS III or endothelial NO synthase or eNOS is present in vascular endothelial cells. It is Ca^{2+} dependent and is involved in the control of vascular functions [1].

NO acts as a messenger that mediates diverse signaling pathways in target cells. It is known to play an important role in neuronal signaling, storage of long term memory, exchange of respiratory gases, adaptive relaxation in gastro-intestinal tract, modulation of ion channels, phagocytic defense mechanism, cardiovascular homeostasis and vasodilatation, immune and inflammatory responses [2].

Earlier studies have tried to explore the relationship between food intake & serum NO levels [3, 4]. Obesity & overweight as a health hazard is assuming epidemic proportions in developing countries like India. It will have a far reaching impact on the health and economy of the country. It is desirable to explore the etiopathogenesis of obesity to effectively address this serious problem. This study was undertaken to evaluate the role of NO in the causation of obesity in the Indian context as there is very little information in the literature.

MATERIALS AND METHODS

The present study was carried out in the Department of Physiology, M.S. Ramaiah Medical College, and Bangalore. 17 male and13 female medical students in the age group of 17 to 23 yrs participated in the study. They were explained protocol of the experiment, the extent of their involvement and the termination clause for the proposed study. An informed consent was obtained from all the participants the study was approved by the institutional scientific committee and the ethical review board. The participants were asked to report at the laboratory between 8 and 9 am following an overnight fast for the collection of blood sample. They were asked to avoid the consumption of foods rich in nitrates like meat, fruits & green leafy vegetables two previous days. The subjects included for the study did not have history of infections or surgeries in the past month as these factors could alter NO levels. Five ml of venous blood was collected under aseptic precautions. The blood was allowed to stand in a vacutainer tube for an hour. Later, the samples were centrifuged at 3000 rpm for 30 minutes to ensure separation of blood components. The supernatant serum was separated. The serum was deproteinized with Somoyugi reagent. Serum concentration of NO was estimated by modified cadmium reduction method [5]. The nitrate present in the sample was reduced by copper coated cadmium in glycine buffer at a pH of 9.7. The nitrite produced was determined by diazotization of sulphonilamide and coupling with naphthethylene diamine. The colour complex produced is measured at 540 nm filter by colorimeter.

Body Mass Index was calculated by measuring the height and weight of the subjects using the formula; BMI = Weight in kilograms/square of height in meters**.**

BMI and NO levels for males and females were expressed as mean ± S.D. The data obtained were analyzed by student't' test to assess the significance of the difference between the mean serum NO levels and BMI. Correlation between BMI and NO levels were established by using Pearson's correlation coefficient.

RESULTS

The BMI in males was 22.75 ± 4.13 kg/m^2, with a range of 18.24-32.25 kg/m^2. The corresponding value for female was 21.91± 3.79 kg/m^2 ranging from 17.76-28.23 kg/$m.^2$ The serum NO levels for males were between 17 mmol/ L to 37 mmol/ L with a mean value of 24.21 ± 5.73 (Table. 1). The corresponding values for females were 16 to 39 mmol/ L with a mean of 22.73 ± 6.09. There was a significant positive correlation between the BMI & NO levels in males (r =0.905, P<0.001) & females (r =0.802, P<0.001) Table.2. Nitric oxide level was significantly higher in subjects having a BMI >23.0 kg/m^2 when compared to subjects with BMI <23 kg/ m^2 .(Table. 3)

Table 1: Comparison of BMI and Nitric Oxide in male and female subjects

Parameters	Male	Female	P value
BMI (kg/m^2)	22.75± 4.13 (18.24-32.25)	21.91± 3.79 (17.76-28.23)	0.562
NO	24.21 ±5.73 (17-37)	22.73 ± 6.09 (16-39)	0.502

Table 2: Pearson correlation between BMI and NO in male and female subjects

	Correlation	P value
Male	0.905	<0.001**
Female	0.802	<0.001**

Table 3: Correlation of BMI with Nitric Oxide

BMI (kg/m^2)	Nitric Oxide levels (mmol/L)		
	Observed range	Mean ± SD	Predicted Range
<23.0	16-24	20.03±2.88	18.55-21.51
>23.0	19.50-39.00	28.19±5.49	24.86-31.51**
Inference	NO is significantly higher in BMI >23.0 kg/m^2 when compared to BMI <23.0 kg/m^2 t=5.235, P<0.001**		

DISCUSSION

In the present study, a positive correlation between BMI & serum NO levels in both males and females was observed. Further subjects with BMI greater than 23 kg/m^2 were demonstrated to have higher levels of NO when compared to subjects having a BMI ranging from 18 to 22 kg/m^2. These observations suggest the role of NO in the causation of

overweight and obesity. Jong Weon Choi et al have also found an increase in NO levels with increase in South Korean adolescent subjects (6). Endothelial NOS is reported to be present in the human adipose tissue under basal physiological conditions [1, 9].

Further it is also present in adipose tissue of the rat [7, 8]. Lipogenic enzymes and lipid accumulation are induced by NO in preadipocytes in rats [8]. Engeli et al have reported an increase in eNOS, iNOS & PRK G1 in obese subjects. Higher body weights, some degree of hyperinsulinemia, and increase in blood pressure lead to enhanced expression of these genes in obesity. NO produced by adipose tissue in obese individuals appears to increase lipid storage by promoting insulin stimulated glucose uptake [1]. It also enhances lipid storage by reducing basal catecholamine induced lipolysis [11, 12]. The beneficial effect of NO influencing insulin stimulated glucose uptake is facilitated by increased tissue blood flow.

In animal studies it has been established that NO influences the food intake by acting on hypothalamic signaling mechanisms [3, 4]. There are no concrete evidences available to establish conclusively the role of NO on the food intake in human subjects. If increased NO levels in people with greater body weights is indeed involved in altered feeding habits, then this could give new direction for further research in pathophysiology of obesity.

CONCLUSION

- There is a positive correlation between serum NO level and BMI.
- There is an increased NO level in subjects with higher BMI probably due to an increased expression of the Nitric Oxide Synthase gene in the adipose tissue.

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