



**ORIGINAL RESEARCH PAPER**

**Biochemistry**

**ASSOCIATION OF ADIPONECTIN AND INFLAMMATORY CYTOKINES WITH BMI IN YOUNG ADULTS OF INDORE**

**KEY WORDS:** Adiponectin, TNF- $\alpha$ .

**Dr. Maninder Bindra**

Associate Professor, Department Of Biochemistry, L.N. Medical College, J.K. Hospital, Bhopal, M.P.

**Dr. Purnima Dey Sarkar\***

Professor, Department Of Biochemistry, MGM Medical College, Indore, M.P.  
\*Corresponding Author

**ABSTRACT**

**BACKGROUND:** Association of adiponectin and inflammatory cytokines with BMI in young adults of Indore.  
**METHODS:** The analysis to study some measures of TNF- and adiponectin with BMI in young adults of Indore.  
**Results:** Out of 425 samples, 274 met the eligibility criteria. Analyzed parameters clearly indicated that blood pressure, and selected adipocytokines of overweight and obese young adults was found to be significantly elevated as compared to underweight and normal weight young adults. This clearly reflected that the body mass index found to be the dependent factor on blood pressure, and selected adipocytokines.  
**CONCLUSION:** The present study concluded that there is the significant relationship of BMI and WC of young adults with adiponectin and inflammatory cytokines.

**INTRODUCTION:-**

According to the Diabetes Atlas 2006 published by the International Diabetes Federation, India is the Diabetic Capital of the World with currently around 40.9 million diabetics and this number is expected to rise to 69.9 million by 2025.

IDF data reveal that India ranks second just behind China. Over the past 30 years, the status of diabetes has changed from being considered as mild disorder of the elderly to one of the major causes of morbidity and mortality affecting the youth and middle aged people

Adiponectin, commonly called as adipocyte complement-related protein of 30 kDa, was identified by different groups<sup>1,2,3,4</sup>. Adiponectin is an adipokine produced and secreted by adipose tissues and known for its cardioprotective effects, anti-inflammatory, antiatherogenic, and antidiabetic<sup>5,6,7</sup>. Adiponectin expression and serum levels are decreased in obese patients, pigs, and rodents<sup>8,9</sup>.

Tumour necrosis factor alpha (TNF) is a pleiotropic cytokine that has many proinflammatory actions with negative inotropic effects. It is seen to be involved in the pathogenesis of many non-infectious disorders, from rheumatoid disease<sup>10</sup>, to multiple sclerosis<sup>11</sup>.

**MATERIAL AND METHODS:**

The study will be carried out on 425 adult individuals (both males & females) catering to all socioeconomic sections of the society in Indore.

A total size of 425 young adults (1:1 ratio of males and females will be maintained if possible) in the age group of 18-25 years will be taken. They will be divided into five groups based on BMI.

Age	BODY MASS INDEX (Kg/m <sup>2</sup> )			
18-25Y	22-24	24-26	26-28	28-30

Total Indore Population according to 2001 population census is 1600000. According to NFHS-3 2005-2006 – 22% of urban population is obese or overweight. (Frequency of disease). Worst acceptable frequency is 25%. Population size for our study at 99% confidence level is 425.

**DATA COLLECTION:**

All adults between the ages of 18 to 25 years will be examined at the allocated time. The collected information will be recorded on a pre-tested proforma. Prior to starting the actual study the measurement techniques and all the instruments that will be used in this study will be standardized.

Details of birth date and birth weight (if available) will be sought

from the participants or from their parents. Other information sought will include family background, diet consumption (including food frequency questionnaire) and activity profile.

**EXCLUSION CRITERIA:**

None of the subjects should be suffering from any systemic illness, obesity due to hormonal misbalance will be ruled out.

**Anthropometrics to be recorded in each individual will include:**

- Weight
- Height
- Waist to hip ratio (WHR)
- Blood pressure

**Biochemical parameters to be measured in each individual include:**

- Fasting lipid profile (includes TC, HDL, LDL, TG, FFA)
- Adiponectin
- IL6
- TNF $\alpha$

**Serum Normal levels of biochemical risk factors (FASTING):**

Cholesterol	150-200 mg/dl.
HDL cholesterol	30-60 mg/dl (M), 35-70 mg/dl (F).
LDL cholesterol	60-170 mg/dl.
Triglycerides	<150 mg/dl.

**STATISTICAL ANALYSIS:**

Appropriate statistical methods will be applied to study the strength of associations between measures of adiposity and risk factors for diabetes and CHD. Descriptive results of continuous variables will be expressed as mean  $\pm$  SD for normally distributed or as median for non parametrically distributed variables. Comparison between study groups and control will be done by student t-test or Mann Whitney U test whichever is appropriate. Relationship between continuous variables will be expressed by applying Pearson's correlation (r) for normally distributed variables and Spearman's correlation for non parametric distribution. P value <0.05 is considered significant and <0.01 as highly significant.

Linear regression will be performed to evaluate the association among B.M.I. as independent and plasma adiponectin and others, insulin, adipocytokines, TNF, IL6 as dependent variables. P value <0.05 is considered to be statistically significant and p<0.01 as highly significant. All the data will be analyzed using statistical software SPSS version 19.

**METHODS:**

**Lipid Profile:**

**Estimation of Total Cholesterol** - By enzymatic end point CHOD-POD method, (Allain C, et.al 1974.) Normal Value: Cholesterol : 150-200 mg/dl.

**Estimation of triglycerides** - By GPO-POD method, (Werner et.al.) Normal Values: Triglycerides : <150 mg/dl

**Estimation of HDL** – By method of Burnstein ,M.et .al 1970, Normal Values: HDL cholesterol : 30-60 mg/dl (M), 35-70 mg/dl (F).

**RESULTS:**

The present study entitled "Association of adiponectin and inflammatory cytokines with BMI among young adults of Indore " is carried out in the Department of Biochemistry at Mahatma Gandhi Memorial Medical College, Indore. Out of a maximum of three hundred twenty two young adults that deemed fit into inclusion criteria, 274 young adults selected randomly had aged from 18 to 25 years of both the sexes that deemed fit into inclusion criteria.

Two hundred seven four young adults divided into four categories as per their body mass index levels (underweight, normal weight,

overweight and obese). Out of total 274, thirteen (4.7%) young adults were underweight while one hundred fifty (54.7%) were normal weight but one hundred two (37.2%) were overweight and few (9, 3.3%) found with obesity were studied as subjects for the present study had analyzed statistically.

A total of 274 cases were studied in present observational study and that distributed into four groups based on their body mass index (underweight, normal weight, overweight and obese). The age of all cases (N=274) of young adults found to be in the ranges from 18 to 25 years with mean (Mean ± Standard Deviation) age of 21.90±2.05 years.

**Table 1:- DISTRIBUTION OF ALL STUDIED YOUNG ADULTS ACCORDING TO BODY MASS INDEX**

Body Mass Index (kilogram/meter2)	Male		Female		Total	
	N	%	n	%	n	%
< 18.5 Underweight	1	0.4	12	4.4	13	4.7
18.5-24.9 Normal weight	91	33.2	59	21.5	150	54.7
25.0-29.9 Overweight	67	24.5	35	12.8	102	37.3
≥30.0 Obese	1	0.4	8	2.9	9	3.3
<b>Total</b>	<b>160</b>	<b>58.4</b>	<b>114</b>	<b>41.6</b>	<b>274</b>	<b>100.0</b>

**Table 2:- COMPARISON OF ADIPONECTIN AND TNF-ALPHA AMONG YOUNG ADULTS WITH RESPECT TO FOUR TYPES OF BODY MASS INDEX LEVELS**

Variable	Group	Spread Mean ± SD	95% Confidence Intervals of Mean		p-value (LOS)
			LB	UB	
Adiponectin (pg/ml)	Underweight	11.81±3.12	9.925	13.691	F=7.73 p<0.001
	Normal weight	12.05±3.56	11.474	12.622	
	Overweight	13.50±3.02	12.906	14.092	
	Obese	16.24±1.23	15.301	17.188	
TNF-α (pg/ml)	Underweight	13.22±3.74	10.966	15.480	F=4.33 p<0.005
	Normal weight	13.47±4.88	12.678	14.252	
	Overweight	14.87±3.17	14.249	15.494	
	Obese	17.42±2.93	15.166	19.678	

#The mean differences are highly significant at the 0.005 and 0.001 levels of significance. [SD-Standard Deviation; LB-Lower Bound, UB- Upper Bound; LOS-Level of Significance]

**Table 3:- COMPARISON OF TOTAL CHOLESTEROL, TRIGLYCERIDE, LDL, HDL AND VLDL OF YOUNG ADULTS WITH RESPECT TO FOUR TYPES OF BODY MASS INDEX LEVELS**

Variable	Group	Spread Mean ± SD	95% Confidence Intervals of Mean		p-value (LOS)
			LB	UB	
Total Cholesterol (mg/dl)	Underweight	163.54±13.36	155.46	171.61	F=16.95 p<0.001
	Normal weight	176.47±15.27	174.01	178.94	
	Overweight	186.22±20.71	182.15	190.28	
	Obese	206.11±14.20	195.20	217.03	
Triglyceride (mg/dl)	Underweight	107.38±16.23	97.58	117.19	F=7.10 p<0.001
	Normal weight	129.93±36.40	124.05	135.80	
	Overweight	139.40±28.95	133.72	145.09	
	Obese	163.89±15.33	152.11	175.67	
LDL (mg/dl)	Underweight	101.31±7.47	96.80	105.82	F=15.45 p<0.001
	Normal weight	123.81±26.70	119.51	128.12	
	Overweight	138.57±23.80	133.89	143.24	
	Obese	153.11±17.07	139.99	166.23	
HDL(mg/dl)	Underweight	45.31±6.68	41.27	49.34	F=23.55 p<0.001
	Normal weight	43.62±6.68	42.54	44.70	
	Overweight	39.78±6.05	38.60	40.97	
	Obese	27.56±4.98	23.73	31.38	
VLDL(mg/dl)	Underweight	25.77±2.32	24.37	27.17	F=52.31 p<0.001
	Normal weight	34.64±4.13	33.97	35.31	
	Overweight	36.91±6.44	35.65	38.18	
	Obese	52.78±7.65	46.90	58.65	

The mean differences are highly significant at the 0.001 level of significance. [DM-Diabetes Mellitus; non-pro.-non-proliferative; SD-Standard Deviation; LB-Lower Bound, UB- Upper Bound; LOS-Level of Significance]

**Table 4:- MEASUREMENT OF ASSOCIATION OF BODY MASS INDEX WITH ADIPONECTIN LEVELS**

Body mass index (kilogram/meter <sup>2</sup> )		Levels of Adiponectin		Total
		≤8.9 pg/ml	>8.9 pg/ml	
< 18.5	Underweight	4	9	13
		1.5%	3.3%	4.7%
18.5-24.9	Normal weight	36	114	150
		13.1%	41.6%	54.7%
25.0-29.9	Overweight	13	89	102
		4.7%	32.5%	37.2%
≥30.0	Obese	0	9	9
		0.0%	3.3%	3.3%
<b>Total</b>		<b>53</b>	<b>221</b>	<b>274</b>
		<b>19.3%</b>	<b>80.7%</b>	<b>100.0%</b>

$\chi^2_3 = 8.18$  and  $p < 0.05$

\*The association is significant at the 0.05 level of significance.

**Table 5:- MEASUREMENT OF ASSOCIATION OF BODY MASS INDEX WITH TWO LEVELS OF TNF-ALPHA**

Body mass index (kilogram/meter <sup>2</sup> )		Levels of TNF-α		Total
		≤17.6 pg/ml	>17.6 pg/ml	
< 18.5	Underweight	11	2	13
		4.0%	0.7%	4.7%
18.5-24.9	Normal weight	127	23	150
		46.4%	8.4%	54.7%
25.0-29.9	Overweight	79	23	102
		28.8%	8.4%	37.2%
≥30.0	Obese	4	5	9
		1.5%	1.8%	3.3%
<b>Total</b>		<b>221</b>	<b>53</b>	<b>274</b>
		<b>80.7%</b>	<b>19.3%</b>	<b>100.0%</b>

$\chi^2_3 = 9.91$  and  $p < 0.02$

The association is significant at the 0.02 level of significance.

**Table 6:- MEASUREMENT OF ASSOCIATION OF WAIST CIRCUMFERENCE WITH ADIPONECTIN LEVELS**

Waist circumference (inches/centimeter)	Levels of TNF-α		Total
	≤8.9 pg/ml	>8.9 pg/ml	
≤ 33.46 inches (85 cm)	44	151	195
	16.1%	55.1%	71.2%
> 33.46 inches (85 cm)	9	70	79
	3.3%	25.5%	28.8%
<b>Total</b>	<b>53</b>	<b>221</b>	<b>274</b>
	<b>19.3%</b>	<b>80.7%</b>	<b>100.0%</b>

$\chi^2_1 = 4.50$  and  $p < 0.05^*$

The association is significant at the 0.05 level of significance

**Table 7:- MEASUREMENT OF ASSOCIATION OF WAIST CIRCUMFERENCE WITH TWO LEVELS OF TNF-ALPHA**

Waist circumference (inches/centimeter)	Levels of TNF-α		Total
	≤17.9 pg/ml	>17.9 pg/ml	
≤ 33.46 inches (85 cm)	165	30	195
	60.2%	10.9%	71.2%
> 33.46 inches (85 cm)	56	23	79
	20.4%	8.4%	28.8%
<b>Total</b>	<b>221</b>	<b>53</b>	<b>274</b>
	<b>80.7%</b>	<b>19.3%</b>	<b>100.0%</b>

$\chi^2_1 = 6.79$  and  $p < 0.09^*$

The association is highly significant at the 0.009 level of significance.

**Table 8:- CORRELATION OF BODY MASS INDEX AND WAIST CIRCUMFERENCE OF YOUNG ADULTS OF FOUR GROUPS WITH ADIPONECTIN AND TNF ALPHA**

Parameter	Correlation	Adiponectin	TNF-α	
Underweight	Body Mass Index	r	-0.05	-0.05
		p-value	>0.05	>0.05
	Waist Circumference	r	0.42	-0.58
		p-value	>0.05	<0.05
Normal	Body Mass Index	r	ABSoC	ABSoC
		p-value		
	Waist Circumference	r	ABSoC	ABSoC
		p-value		
Overweight	Body Mass Index	r	ABSoC	-0.17
		p-value		<0.09
	Waist Circumference	r	ABSoC	-0.09
		p-value		>0.05
Obese	Body Mass Index	r	-0.41	-0.59
		p-value	>0.05	<0.09
	Waist Circumference	r	-0.22	-0.37
		p-value	>0.05	>0.05

The correlation is highly significant at the 0.005 level of significance. \*The correlation is significant at the 0.05 level of significance. @The correlation isn't (Insignificant) significant at the 0.05 level of significance. ^The correlation is poorly/suggestively significant at the 0.06 and 0.07 levels of significance. [LOS-Level of Significance; ABSoC-Absence of correlation]

**DISCUSSION:**

Our study entitled "Association of adiponectin and inflammatory cytokines with BMI in young adults in Indore" was carried out in the Department of Biochemistry, Mahatma Gandhi Memorial Medical College, Indore.

Out of a maximum of three hundred twenty two young adults that deemed fit into our inclusion criteria, 274 young adults were selected randomly between the ages of 18 to 25 years of both sexes.

Two hundred seventy four young adults were divided into four groups with respect to their body mass index categorization namely underweight, normal weight, overweight and obese and were purposively allocated a group as per their respective categorization.

Macrophage numbers in adipose tissue increase with obesity<sup>12</sup> where they apparently function to scavenge older adipocytes. Analysis revealed that the average (17.42±2.93 pg/ml) TNF- of obese young adults found to be significant increased as compared to overweight (14.87±3.17 pg/ml) young adults and that followed by normal weight (13.47±4.88 pg/ml) and underweight (13.22±3.74 pg/ml) young adults. Overall, one way analysis of variance indicated that these differences in average TNF- of young adults among four types of body mass index levels were highly significant (p<0.005).

Research reported there was a significant bonding between body mass index and adiponectin levels in young adults. One hundred fifty (54.7%) young adults were more frequently normal weight and followed by 102 (37.2%) overweight but few [9 (3.3%) and 13 (4.7%)] were obese and underweight respectively was measured among 274 studied young adults. Results showed that 221 (80.7%) young adults diagnosed with elevated adiponectin level (>8.9 pg/ml) had at more risk of diseases than 53 (19.3%) had more frequently lower risk of diseases had noted adiponectin level either of <8.9 pg/ml or equal to 8.9 pg/ml. Increased adiponectin levels was more frequently diagnosed among all (9, 3.3%) obese young adults whose body mass index was more than or equal to 30.0 kilogram/meter<sup>2</sup> and that followed by 89 (32.5%) overweight young adults whose body mass index was between 25.0 and 29.9 kilogram/meter<sup>2</sup>. However, the levels of adiponectin was >8.9 pg/ml noted among few (9, 3.3%) underweight but observed in more than one third (41.6%) normal weight young adults that had risk of diseases.

Analysis highlighted that there was a significant relationship between body mass index and TNF- $\alpha$  levels in young adults. One hundred fifty (54.7%) young adults were more frequently normal weight and followed by 102 (37.2%) overweight but few [9 (3.3%) and 13 (4.7%)] were obese and underweight respectively was measured from a total of 274. Results showed that a maximum of 53 (19.3%) young adults diagnosed with elevated TNF- $\alpha$  level ( $>17.6$  pg/ml) had at more risk of cardiovascular disease while rest 221 (80.7%) had more frequently lower risk of cardiovascular disease noted TNF- $\alpha$  level either of  $<17.6$  pg/ml or equal to 17.6 pg/ml.

Increased TNF- $\alpha$  levels was more frequently diagnosed among five (1.8%) obese young adults whose body mass index was more than or equal to 30.0 kilogram/meter<sup>2</sup> and that followed by 23 (8.4%) overweight young adults whose body mass index was between 25.0 and 29.9 kilogram/meter<sup>2</sup>. However, the levels of TNF- $\alpha$  was  $>17.6$  pg/ml noted among few (2, 0.7%) underweight but observed in more than one fifth (23, 8.4%) normal weight young adults that had risk of cardiovascular and other diseases. Moreover, the association of body mass index classed as underweight, normal weight, overweight and obese with two levels of TNF- $\alpha$  ( $\leq 17.6$  pg/ml and  $>17.6$  pg/ml) was statistically significant ( $p < 0.02$ ).

#### CONCLUSION:

Present study involved 274 young adults were studied and that distributed into four groups based on their body mass indexes (underweight, normal weight, overweight and obese).

Increased adiponectin level was more frequently diagnosed in 3.3% obese young adults and 32.5% overweight whereas TNF- $\alpha$  level found to be elevated among five obese young adults and 23 overweight young adults.

Research indicated that the proportional difference in body mass index of young adults with respect to hypertension, levels of insulin, adiponectin and TNF- $\alpha$  to be statistically strongly significant ( $p < 0.001$ ).

One hundred fifty one noted with WC of  $\leq 33.46$  inches had more frequently elevated adiponectin level ( $>8.9$  pg/ml) had at more risk of diseases whereas 70 had of  $>33.46$  inches had noted adiponectin level either of  $<8.9$  pg/ml or equal to 8.9 pg/ml. Further, this was also noted that the WC of 28.4% was  $\leq 33.46$  inches diagnosed with elevated TNF- $\alpha$  level ( $>17.6$  pg/ml) had at risk of cardiovascular disease as compared to 10.9% noted TNF- $\alpha$  level either of  $<17.6$  pg/ml or equal to 17.6 pg/ml.

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