ORIGINAL RESEARCH PAPER

Dermatology

# EVALUATING THE ROLE OF BMI AND SERUM LIPID PROFILE IN ADOLESCENT ACNE

KEY WORDS:

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**ABSTRACT**

**Introduction:** Acne is one of the most common skin disease of pilosebaceous unit that affects adolescents mainly. The pathogenesis is multifactorial. High glycemic food, milk and dairy products, sedentary lifestyle lead to high BMI and deranged lipid profile. These ultimately converge on MTORC1 activation leading to acnegenesis. There are few Indian studies correlating the acne with BMI and lipid levels.
**Aim:** To evaluate the BMI and lipid levels of adolescent acne vulgaris patients and compare it with controls.
**Method:** 100 cases of acne vulgaris and age and sex matched controls were included in the study. Their BMI was calculated and fasting lipid profile was measured.
**Results:** Mean BMI was higher among cases than control. The lipid levels were deranged (high serum cholesterol, serum triglyceride, LDL and low HDL) more among cases than control. All the outcomes were statistically significant.
**Conclusion:** Dermatologists should also focus on improving the dietary and lifestyle in their acne patients rather than just treating the disease per se.

## INTRODUCTION:

Acne vulgaris is a common, chronic inflammatory disease of the pilosebaceous unit that affects 80% of the adolescence.[1] Increased sebum production, follicular hyperkeratinisation, *Propionibacterium. Acnes* colonization and inflammation play an interactive pathogenic role in acne.

Various factors responsible for acne in adolescents include androgenic surge around puberty, high body mass index (BMI), high glycemic diet and raised insulin and insulin like growth factor-1 (IGF-1). Some recent studies have described a higher prevalence of acne with high BMI.[2,3,4,5]

Recently studies have reported high BMI and deranged lipid profile in acne.[10,11] There also occurs physiological rise in insulin and IGF-1 levels during puberty stimulating androgen synthesis, increase sebum production and sebocyte proliferation leading to acne.[6,7,8,9] Lipid alterations like high serum total cholesterol (CH), triglycerides (TG) and low High-Density Lipoprotein-cholesterol (HDL) have also been linked to acne .[10,11]

Thus, acne appears to be a visible indicator of systemically exaggerated mTORC1 signalling, an unfavourable metabolic deviation on the road to serious mTORC1 driven disease of civilisation especially overweight, obesity, insulin resistance and metabolic syndrome.

This study was undertaken to evaluate the BMI and serum lipid levels in adolescent acne.

## AIM:

To measure the BMI and serum lipid levels in adolescents with acne

## MATERIALS AND METHOD:

One hundred clinically diagnosed patients of acne vulgaris in the adolescent age group (10-18 years as defined by WHO) along with one hundred healthy controls were enrolled in the study. Informed consent was received from the parents of all the adolescents and the Ethics Committee approved the study. A detailed history was taken from each participant and physical examination was performed. The participants were excluded from the study if they reported intake of any medications known to be acnegenic or affected the insulin or lipid metabolism, previous treatments with oral retinoids, hormonal therapy for any reason in the last 6months and a history of PCOS, diabetes, congenital adrenal hyperplasia, liver disorder, thyroid disorder or any neoplasm. The severity of acne was measured using the Investigator Global Assessment score tool for acne vulgaris severity grading. Body mass index was calculated using Quetelet index (weight/height2, kg/m2) and correlated according to Indian Academy of Paediatrics guidelines and growth chart revised in 2014. Peripheral venous samples were collected from participant after 8 hours of fasting and about 6ml of non-heparinised venous blood was drawn from the antecubital vein. Serum lipids were measured by spectrophotometric analyzer (Beckman-Coulter fully automated AU series analyzer) by the respective kits. Dyslipidemia was considered as:

- Serum triglycerides (TG) ≥ 150mg/dl
- Serum High Density Lipoprotein – cholesterol (HDL) < 40mg/dl
- Serum Low Density Lipoprotein – cholesterol (LDL) >100mg/dl
- Serum total cholesterol (CH) ≥ 200mg/dl.

## STATISTICAL ANALYSIS

Available SPSS software version 21 was used in the study analysis. The data for quantitative variables was presented in terms of mean±Standard deviation. Unpaired t test was used to compare means between two study groups. Pearson's coefficient was used to find out correlation between two variables. p value was considered significant if less than 0.05.

## RESULT:

One hundred adolescent of acne vulgaris and 100 healthy controls participated in the study (40 males and 60 females). The controls were age and sex matched. The age group ranged from 10-18 years Indian adolescents. 48% of the cases had grade 2 acne, followed by 30% grade 1, 16% grade 3 and 6% grade 4 acne.

Overall mean BMI among all the adolescents was 18.82. Mean BMI among cases was 19.39±2.85 kg/mt$^2$ while mean BMI of controls was 18.24±1.59 kg/mt$^2$ and these were found to be statistically significant (p value-<0.001). 6 boys and 7 girls were overweight. All the controls had normal BMI.

Mean values of serum lipid (serum triglyceride 106.31±26.37 mg/dl, serum HDL 52.53±10.65 mg/dl, serum cholesterol 137.81±29.54 mg/dl, serum LDL 59.98±14 mg/dl) among the cases and control (serum triglyceride 84.95±12.07 mg/dl, serum HDL 56.15±7.56 mg/dl, serum cholesterol 113.65±18.83mg/dl and serum LDL 56.60±9.18 mg/dl) was found to be statistically significant (p value <0.005). 5%of the cases showed raised triglyceride, 3% of the cases showed low HDL, 3% of the cases showed high cholesterol and 1% of the cases showed high LDL.

**Table 1: Comparison of Mean BMI and lipid profile between cases and controls**

| Features | Patients (100) Mean± SD | Control (100) Mean±SD | P- Value |
|---|---|---|---|
| AGE | 15.44±2.1383 | 15.44±2.1383 | |
| Male/female | 2:3 | 2:3 | |
| Weight (kg) | 49.64 ±9.86 | 51.48 ±7.25 | 0.148 |
| Height (metres) | 1.60 ±0.09 | 1.66 ±0.08 | 0.000 |
| BMI (kg/m$^2$) | 19.39±2.85 | 18.24±1.59 | -<0.001 (Significant) |
| S. Triglyceride (mg/dl) | 106.31±26.373 | 84.95±12.075 | 0.001 (Significant) |
| S. HDL (mg/dl) | 52.35±10.659 | 56.15±7.563 | 0.004 (Significant) |
| S. cholesterol (mg/dl) | 137.81±29.547 | 113.65±18.832 | 0.0001 (Significant) |
| S. LDL (mg/dl) | 59.98±14.008 | 56.60±9.180 | 0.045 (Significant) |

**Table 1: Comparison of Mean BMI and lipid profile between cases and controls.**

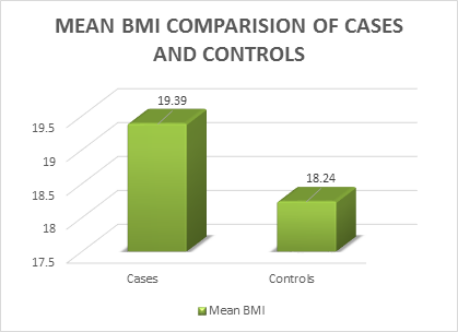


**FIG 1: Mean BMI among cases and controls**

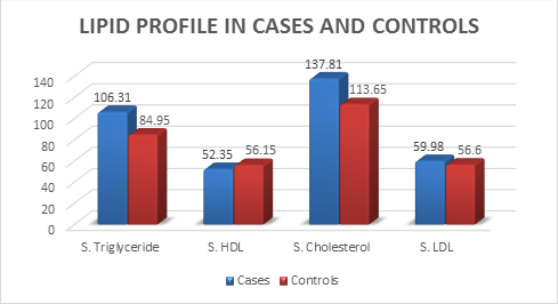


**FIG 2: Lipid profile among cases on controls**

## DISCUSSION

Acne vulgaris is a common, chronic inflammatory disease of the pilosebaceous unit that begins in adolescence and is clinically characterized by comedones, erythematous papules, pustules, nodules and scarring in few.

Estimated global prevalence of acne is around 8.5%, accounting roughly to 650 million people according to global burden of disease study.[5] Prevalence of acne among adolescents in India was found to be around 75%.[6]

The primary structure involved in acne involves the pilosebaceous unit. Under the influence of hormones namely androgen, growth hormone, insulin and insulin like growth factor 1 during puberty, the sebaceous cells, keratinocytes and ductal lining cells of pilosebaceous units are activated and they begin to proliferate. These proliferating cells form keratinous plug along with the sebum production. The pressure within the pilosebaceous unit provides an anoxic environment for the skin microflora (*P. acnes*) to grow by limiting the availability of diffusible oxygen to the cells. *P. acnes* is an anaerobic gram-positive bacterium, a part of the normal skin flora that has been centrally playing a role in the inflammation of acne. The overproduction of sebum provides a source of nutrition in the form of fatty acids favoring the growth of bacteria within the pilosebaceous unit.

As the growth beneath the plugged pilosebaceous unit exceeds the retention capacity of its structural basement membrane, its bursts exposing its content into body's immune system. White blood cells come into picture along with expression of toll like receptor-2, TLR-4, interleukin 6 and interleukin 8 secretion finally giving rise to erythematous pustule. This explains the pathophysiology of acne vulgaris.

Various factors responsible for acne in adolescents include androgenic surge around puberty, high body mass index (BMI), high glycemic diet and raised insulin and insulin like growth factor-1(IGF-1). Some recent studies have described higher prevalence of acne with high BMI[3,4,10,11,12,1314,15] High glycemic load and high levels of milk or dairy protein overstimulate a kinase termed mammalian target of rapamycin complex 1 (mTORC1). The activation of mTORC1 signaling is involved in both acne pathogenesis (altering sebaceous gland homeostasis with promotion of cell growth and proliferation) and insulin resistance (stimulating the kinase S6K1, which negatively controls insulin signaling at the level of insulin receptor substrate phosphorylation).[3] Moreover milk and dairy products act as enhancer of insulin/IGF-1 signaling, supporting sebaceous lipogenesis and acne aggravation through the derepression of androgen receptor.[2,3,4,8.]

Overall, it has been seen that mTORC1signalling pathway is the crucial molecular connection between acne, western diet and insulin resistance. Since **insulin/IGF-1** receptors are expressed in epidermal keratinocytes, hyperinsulinemia may lead to increased proliferation of basal keratinocytes within follicular pilosebaceous unit duct including failure of terminal differentiation of follicular corneocytes thus playing role in acne pathogenesis. Furthermore, insulin and IGF-1also stimulates synthesis of androgens leading to high sebum production, a recognized correlate of acne severity.[14] Indeed IGF-1 is the growth promoter of puberty playing a central role in acne development.

Thus, high BMI, increased waist circumference, androgens, insulin and IGF-1 interplay together leading to acne in adolescents predisposing them to a higher risk of metabolic syndrome as supported by recent studies.[15,16]

In our study cases, the mean values of serum triglyceride was 106.31 mg/dl, serum HDL was 52.53 mg/dl, serum cholesterol was 137.81 mg/dl and serum LDL was 59.98 mg/dl respectively as compared to controls which were serum triglyceride of 84.95 mg/dl, serum HDL was 56.15 mg/dl, serum cholesterol was 113.65mg/dl and serum LDL was 56.60 mg/dl respectively and all these were found to be statistically significant among the cases and control (p value <0.05). 5 % of the cases showed raised triglyceride, 3% of the cases and one

control showed low HDL, 3% of the cases showed high cholesterol and 1% of the cases showed high LDL.

Studies have also shown various lipid abnormalities like high serum total cholesterol, high triglycerides and low HDL in acne.[10,11]

In the study by Cunha et al. of 219 adult acne patients (21-61years) there was increase in cholesterol in 17.35% of the cases.[11] HDL were low in 11.42% of the patients, high TG in 8.22% of the cases. Acne patients are at increased risk of hyperandrogenism, glucose intolerance, hyperinsulinemia which are all plurimetabolic conditions. PCOS patients have dyslipidemia and acne is a common finding in such patients.

The relationship between blood lipids (cholesterol, triglycerides, plasma lipoprotein) and acne have not been widely reported until date. In the present study, we found that lipid profile was deranged in patients of acne vulgaris as compared to healthy controls. Dietary factors and socioeconomic status could account for it.

In our study, plasma cholesterol levels were significantly increased in the patients when compared with controls, whereas Akawi and associates reported that total cholesterol levels were not significantly elevated in acne vulgaris patients compared to healthy controls.[17]It is difficult to explain but difference could be due to effect on serum lipid concentration by racial, environmental and genetic factors, smoking, dietary habits. Total cholesterol levels may affect development of acne vulgaris lesions because androgens in adrenal gland are synthesized from cholesterol derived from the plasma. The immediate precursor of the gonadal steroids, as for the adrenal steroids, is also cholesterol. So, increase in cholesterol levels would lead to increased production of androgens, which is one of the important predisposing factors for development of acne vulgaris.

Low-density lipoprotein cholesterol (LDL-C) levels in acne patients were significantly increased compared to controls. LDL-C is a calculated parameter, increased cholesterol level and decreased HDL-C lead to increase in LDL-C. This finding is in accordance with the similar study done by Akawi and associates in severe acne vulgaris patients.[17]

Whereas it is in contrast to the study done by Vergani et al., no statistically significant difference in LDL-C levels has been reported by them between patients with acne or controls. This difference might have occurred due to selection criteria.[18]

In our study, we found patients had significantly decreased high density lipoprotein cholesterol (HDL-C) levels compared to controls. This was in corroboration with the study done by Akawi and colleagues and Vergani et al.[17,18] They noticed that there was a trend for plasma HDL-C to decrease as the severity of acne increases.

Cholesterol ester transfer protein (CETP) could play a plausible role in increased LDL and decreased HDL-C levels. It transfers the esterified cholesterol from HDL (HDL2) to VLDL and LDL and replaces it with triacylglycerol. LDL, so altered, is a potential substrate for hepatic lipase. The enzyme plays a major role in lipoprotein metabolism as a lipolytic enzyme and hydrolyzes triglycerides and phospholipids in chylomicron remnants, IDL, and HDL. It has been reported in the literature that hepatic lipase activity is increased by androgens and decreased by estrogens. If the activity of the enzyme is high enough, lipolysis will generate smaller, denser particles. This subfraction binds less well to the LDL receptor in comparison with its larger counterparts, which has the consequence of prolonging its lifetime in the circulation. This might be the reason for increased LDL-C levels in patients group.

There was significant change in serum triglyceride in patients compared to controls. The findings were in agreement with those of Akawi and Colleagues, Cunha et al and Vergani et al.[11,17,18] Serum triglyceride levels are known to be directly related to intake of fat-rich food. Levels were significantly raised in patients because most of the patients might be on fat-rich diet because of common belief of its relation with acne vulgaris.

## CONCLUSION

Thus, it is observed that adolescent acne has high BMI and deranged lipid profile. Dermatologists should not only focus on the treating acne, but should appreciate the underlying systemic effects of overstimulated mTORC1 signalling induced by high glycemic load, fatty meals and increased consumption of milk and milk products. Dietary and lifestyle attenuation will help in preventing the acne vulgaris.

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