

Association Between Dietary Practices and Acne in Young Adults; A Review

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ABSTRACT

Acne being one of the skin condition that is not deadly but is affecting emotionally and psychologically. Many factors contribute in causing acne and leading it towards severity. Diet is considered as one of the important factor in making acne severe. Foods that are high in glycemic index are thought to aggregate acne severity. Fried items, sugary beverages, pastries etc are considered as food items that may cause acne. Where as many non-diet related factors such as family history, self-hygiene, environmental factors are also held responsible for causing acne. Where unhealthy eating habits promotes acne, healthy diet such as low glycemic index foods, fish consumption, omega 3 fatty acids etc. helps to reduce acne severity and also diet rich in anti-inflammatory foods helps to reduce redness and inflamed pimples.

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Introduction

About 80% of the population aged 11-30 and 85% of the population aged 15-17 years is being affected by body acne. It is mostly affecting adolescents and young adults [1]. Though it is not deadly condition but has very strong emotional and psychological effect on the effected individuals of every age group [2]. Acne, one of the distressing chronic skin conditions which is resulting from pilo-sebaceous follicle and is characterized by excessive sebum production, white heads, blackheads, cysts and Acne lesion. Acne can affect all parts of body expect the area with less amount of pilo-sebaceous follicle [3]. When level of androgens increases, it causes increased sebum production and abnormal follicular keratinization that further leads to obstruction as a result of which no inflammatory lesions (comedones) and inflammatory lesions (papules, pustules, nodules) are developed on acne prone areas of the body [4]. Propionibacterium acnes are the functional unit in the acne development. It is an aerobe present in the pilosebaceous ducts within the sebum. It generates numerous biologically active mediators that cause inflammation followed by follicular rupture. In a precise way, comedones are formed when the pilosebaceous ducts become blocked with keratinocytes and the sebum level increases and dilates the follicles which results in the proliferation of Propionibacterium acnes in the sebum. Inflammation occurs if comedone become ruptured in the dermis and then a papule or pustule is formed [5]. The four commonly known etiological factors affecting acne include: Increased production and excretion of sebum, presence of propionibacterium in the ducts, increased cornification in sebaceous glands and building up of inflammation [6]. People with acne have an increased rate of sebum excretion than those without acne. Furthermore, females have also an increased rate of sebum production than males of the same age. It was reported

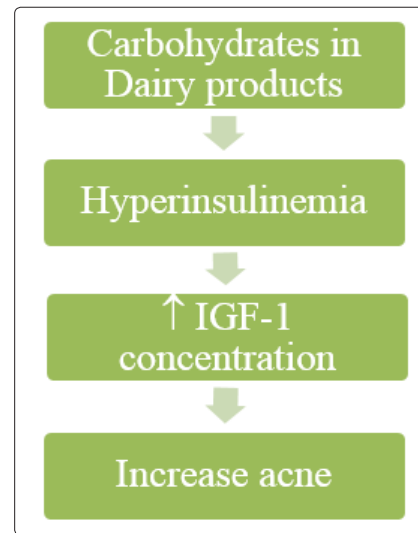
from a recent research held in Quetta Pakistan that 68% of women and 48% of men get affected by acne [7]. The severity of acne depends upon the increased level of sebum excretion [8]. It usually begins with the onset of puberty as more sebum starts getting produced. Menstrual cycle in females can cause the acne to spread. Breakout of acne can also increase if the person in facing emotional stress [3]. Research has suggested that a family history of acne can increase the risk of moderate to severe acne. Mother and father being the main members cause an increase in the risk of acne, if any of them has it. This means that there may be a link between acne and X-chromosome [9]. It has been reported that factors such as prolonged contact with sunlight and high temperatures in summer and hygiene may also have a part in provoking acne [10]. Although smoking has no direct relation with acne but prevalence of acne in females who smoke has been noticed [9]. Some patients have a habit of repeatedly picking their acne spots which can increase the inflammatory response in acne and thus causing it to spread more [11]. In last 10 years, there has been a rise in public awareness regarding diet and health and how functional foods have been used for their disease combating abilities. However still, there is insufficient research on the relationship between acne and diet [1]. Western diet is playing a major role in acne production. Individuals with high intake of milk (more than 3 servings a day) had acne breakouts more often when compared to individuals with low intake of milk (less than 1 serving), the reason being certain hormones that were found in milk which were acne causing [13]. According to some studies, a strong link has been developed between acne, glycemic load of food and insulin sensitivity. Composition of fatty acids has also been under attention for acne as inflammation can occur due to consumption of omega 6 fatty acids which causes acne [14]. Although it is very common to hear that chocolate can cause acne

but no conclusive evidence regarding this claim has been found yet [15]. Physical examination of acne is an important factor to evaluate the severity of this skin condition [16]. Acne can be mild, moderate, severe and very severe. Different measuring systems (such as grading, counting the number of lesions) have been formulated to evaluate the extent of severity of acne. Many grading systems were formulated since the birth of acne. It is graded on basis of number and size of papules, pustules, open and closed comedones, scarring and nodules [17]. Acne lesion system is considered more applicable and feasible in clinical setups than grading system which includes two types of grading (Global acne grading system and comprehensive severity acne system) [16]. The most recent acne grading system was developed in 2008, which was based on lesion counting and photographic system. Mild acne was denoted by 0-5 acne lesions on whole face, 6-20 was considered as moderate, 21-35 for severe, more than 50 was counted as very severe [18]. After evaluation of severity of acne medical treatment is required accordingly. There are three main treatments for the acne vulgaris. One of the treatments include the merger of many agents i.e. Benzoyl peroxide, antibiotics, retinoid etc. while the second treatment mostly selected by the acne sufferer requirement includes orally taken antibiotics, hormonal therapies, and 13-cis-retinoic acid. The third is the physical treatment which includes the laser treatments, light based therapies and removal of lesions through surgery [19]. Azithromycin and Doxycycline can also be used for the cure of acne vulgaris. People who take azithromycin along with tretinon cream four days per month are more likely to be successfully treated ones for acne vulgaris other than the people who take doxycycline daily along with tretinon cream [20]. Light/laser therapy is also one of the treatments for acne vulgaris which proves to be more successful and better than any other medications. For the phototherapy there are two lights involved in the procedure the blue light renewing the porphyrins which are associated with the effectiveness of phototherapy and the red one is good for inflammatory responses. Laser treatment is the most effective treatment for acne vulgaris, it includes Er: YAG laser which is not dangerous for skin and makes your skin pitted less or lighten the pigmentations on skin, also helps to remove excess oil. For the cure of acne vulgaris laser therapy has shown incredible results [21].

Association of Dietary Factors with Acne Dairy and Acne

Carbohydrates present in dairy products results in increased hyperinsulinemia which results in increased IGF-1 concentration resulting in acne severity. Based on the carbohydrate content of the milk, both the whole milk and skim milk, excluding cheese products have three to six fold higher glycemic load and insulinotropic response. As compared to other carbohydrate foods the intake of total milk or total milk protein have more effect on acne. The concentration of IGF-1 (which is a growth stimulating hormone present in milk) remains high even after pasteurization, homogenization, and digestion. Similar to the human IGF-1, Bovine IGF-1 can also bind to the human IGF receptor [22]. The link is stronger in skim milk in comparison to high fat milk, showing that the fat content in the milk can cause acne. Other factors such as milk proteins present in skim milk can cause increase production of comedones. Different growth-promoting effects are shown by whey and casein, which are main milk proteins. Postprandial hyperinsulinemia is produced by whey protein, whereas increase in IGF-1 concentration is caused by casein [23]. The link between milk protein or dairy milk on cellular signaling has not been examined by any randomized control trails but one theory propose that whey protein that is high with leucine, there is an increase in acne due to the secretion of androgen

hormone, induced cellular growth and lipogenesis of sebaceous may be induced by mammalian target of rapamycin complex 1 and similar pathways [24]. Moreover, acne severity may be due to the presence of whey protein concentration present in popular sports supplements [25].



Abedamowo and his fellow members conducted three big studies to see the link between the consumption of dairy and acne. In the first study Retrospective cohort design was used which involved 47,000 female of age ranging from 25-42 years. It was done to see the link between the intake of dairy and teenage acne. A food frequency questionnaire was used to recall dietary intake in their high school and asked that if a physician had ever diagnosed them with acne. Result showed that there was a positive link between the total milk (PR 1.22, P trend- 0.002), skim milk (PR 1.12; P trend- 0.003), whole milk (PR 1.12; P trend- 0.56), and low fat milk (PR 1.16; P trend-0.25) and negative link with the saturated fat consumption (PR 0.88, P trend- 0.04). This study had certain limitations, it has low clinical importance, data collection was retrospective, self-reported acne, and not capable for potential confounder such as heredity. A three years prospective study was done again by Abedamowo and his fellows which involved 6000 girls of age ranging from 9-15 years. The study showed that the consumption of full fat, skimmed and low fat milk has a link with the occurrence of acne. It is hard to find out that whether milk causes acne or it is linked with increasing the severity of acne. Another study in boys showed that with skimmed milk it has weak link whereas no link with milk with greater fat amount. Again the main reason for the start of acne was unknown. All Adebamowo studies had certain limitations as the occurrence of acne was not constructed on blinded objective measurements but rather based on a questionnaire. Moreover, skimmed milk and low fat milk has a glycemic index 4, whereas full fat milk is 3, which shows that it may be the glycemic load that causes acne rather than dairy and fat. Other reason for the occurrence of acne can be hormones such as 5- α reduced steroids, α lactalbumin, IGF 1 which is involved in the production of androgen and testosterone precursors which may remain even after is milk is processed and fat is being removed therefore can cause the pathogenesis of acne. Acne has a positive link with IGF-1 [26].

Another case control study was conducted by Di Landro and his members to check acne prevalence. They took 205 participants with acne, and 358 control with no or mild acne, with age ranging from 10-24 years. And analyzed there dietary habits by using a no validated FFQ. Result showed that there was a positive link of

acne with more consumption of total milk and skim milk whereas frequent consumption of fish had negative link with acne. It also had certain limitations such as the FFQ used was non validated, the dietary intake was self-reported, addition of people with mild acne into control cases, and study design was retrospective [27].

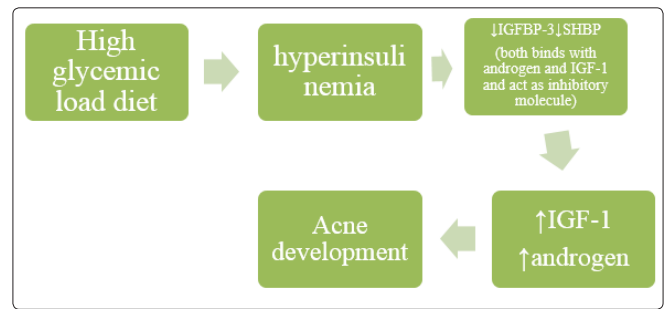
Another research was conducted by Kim and his fellows, which showed that the intake of lactoferrin enriched fermented milk may help to aid acne. 36 participants of age ranging from 18-30 years were randomly appointed to take 200 mg lactoferrin with fermented milk or placebo. Participants with acne showed betterment in the intensity of acne, sebum formation and the total number of lesions after 12 weeks of intake of lactoferrin enriched fermented milk. The researchers found out that due to the ability of lactoferrin to suppress the growth of microbe as well as its anti-inflammatory property there was reduction in the severity of acne after 12 weeks of intake of lactoferrin enriched fermented milk [28].

Caroline L LaRose et al did a case control research in teenagers to see the effect of dairy intake with and without acne targeting 225 individuals of 14-19 years of age. The severity of acne was determined by clinically certified skin specialist and diet related data was collected by 24 hour dietary recall (for 3 days). The amount of low fat/skim milk consumed by participants with acne were significantly higher ($P = .01$) than those with no acne. No significant difference was found for total energy intake or body mass index [29].

Glycemic Index, Glycemic Load and Acne

There is an increase in hyperinsulinemia due to diet high in glycemic load which will lead towards the stimulation of IGF-1 whereas suppress IGFBP-3. Cellular growth including unregulated tissue and follicular growth are caused by IGF-1 which also boost up the bio availability of androgen. The production and secretion of sebum are caused by androgen hormone which lead towards acne. Sebum production is stimulated by IGF-1 by increasing the effect of SREBP-1, which causes activation of phosphoinositide 3- kinase/Akt pathway and accelerate lipogenesis in sebocytes. IGFBP-3 and SHBP binds with IGF-1 and androgen hormone and act as inhibitory molecules. The level of IGF-1 and androgen hormone increases as IGFBP-3 and SHBP are suppressed by insulin leading towards acne development [22]. Evidence support that the severity of acne can be reduced by reduction in hormones such as IGF-1 [30]. And the increase in severity of acne occurs due to increase circulating IGF-1 concentration [31]. Medication and reduced insulin secretion involved in hormone management have shown effective results in treating acne.

Reduced IGFBP-3 caused by hyperinsulinemia results in increased follicular growth through retinoid- signaling pathway which results in acne development. Inhibition of cellular proliferation and stimulation of apoptosis through binding of retinoic receptors is caused by a chemical compound called retinoids. Reduced cellular growth occurs when IGFBP-3 binds to retinoid X receptor- alpha. Similarly, the functioning of retinoid Xreceptor- alpha decreases due to reduced bioavailability of IGFBP-3, which enhance acne development by increasing cellular growth [22].



Noor Hasnani Ismail et al, along with his fellow group members conducted a case- controlled study in 2012, to find out that whether dietary could be a cause of acne vulgaris among Malaysian young adults. This study involves 44 acne vulgaris patients and 44 controls between the ages of 18 to 30 years. The data was collected through questionnaires. Acne severity was determined by comprehensive acne severity scale. Results showed that higher dietary glycemic load compared to controls was observed in the cases. As compared to the control the intake of milk and ice cream were higher in cases. It has been concluded that higher intakes of dairy products and Glycemic load diets are positively linked with the severity of acne vulgaris [32].

Jennifer Burris et al. conducted a cross sectional study in 2014 and the purpose was to determine the relationship between self-reported dietary factors and perceived acne severity of New York young adults. Data was collected from 248 individuals between the ages of 18-25 years with the help of questionnaires. The result showed that greater dietary GI, added sugar, total sugar, number of milk servings per day, Trans fatty acids, saturated fatty acids and fewer servings of fish per day were seen in people with moderate to severe acne as compared to those with no or mild acne. It was concluded that among total participants 58.1% had acne due to poor dietary habits [33].

Smith et al. conducted a randomized control trail in which controlled diet or LGL diet was given to 31 male patients with acne for 12 weeks. The seriousness and existence of acne in subjects was measured by an unknown investigator. On forehead lipid absorbent strips were applied to measure skin surface lipid. Calculation of fatty acid constitution of skin surface triglycerides and sebum outflow were done. The ratio of skin surface fatty acids to monounsaturated fatty acids in people of Low glycemic load group were high as compared to the controlled group. The amount of acne lesions were negatively linked with this ratio. High amount of sebum monounsaturated fatty acids was related to high follicular sebum outflow. According to the findings the seriousness of acne and sebaceous lipogenesis are both caused by desaturase enzyme [34].

To check the link between dietary glycemic load and acne Reynolds and his fellows in 2010 did an experiment. He used randomized control design and took 58 male participants with a mean age 16.5 ± 1 year. They gave them low glycemic diet or high glycemic load control diet. The once following the low glycemic diet for 8 weeks showed improvement in facial acne. Insulin sensitivity was not effected among the participants following high- or low glycemic load diet. This study had some limitations such as small sample size, lack to account for baseline diet, small duration and increased dropout rate and limited generalizability [35].

To determine the link between low glycemic load and acne, a blind randomized control trial was done by Kwon and his members in 2012. They took 32 people of age 20-27 years and told them to randomly follow either a control group diet (significantly carbohydrate rich diet) or low glycemic load diet. After 5 week reduced amount of inflammatory lesions (P=0.03) were seen in people following low GL diet. Similarly, reduced size of sebaceous glands (P=0.03), decreased non inflammatory lesions (P=0.02), and decreased expression of (SREBP)-1 (P= 0.03) [36].

Fat and Acne

Omega 3 and Omega 6

A comparison between diet of westernized nations and diet of non-westernized countries was made which showed that the omega 6: omega 3 consumption ratio is considerably greater in nations that are westernized than the countries. There is evidence suggesting that countries that are not westernized and their people are consuming local and traditional foods that have high amount of omega 3, show absence of acne. Hence the absence of acne in some groups of people is explained by the significant and consequential differences in omega 6: omega 3 ratios in diet of nations that are westernized and non-westernized countries [33]. Less number of studies have been performed examining the connection between fat consumed through diet and acne. More studies are required for better understanding [22]. Omega 3 polyunsaturated fatty acids are furthermore believed and conceived to be helpful in reducing the acne development and progression by reducing insulin, IGF and the concentration of male hormones known as androgen. Omega 3 is also found to be useful in reducing acne by increasing insulin-like growth factor binding protein 3. It has been hypothesized by other researchers that acne severity is reduced by omega 3 fatty acids. This is done by regulating inflammatory reactions of the surface epithelium of the skin, overlying the dermis known as epidermis. Essentially by affecting T-lymphocytes, that is acting on the TLRs, which are a class of proteins that have an important role in the immune system [33]. A study published in the year of 2008 involving a small number of patients; 5 concluded that omega 3 fatty acids supplementation orally decreased the total number of acne affliction and lesions [37]. A study in which 10 week clinical trials were performed found out that γ -linoleic acid and omega 3 could heal acne and could reduce it [38,39]. In a randomized control trial and a double blinder study involving 75 people who suffered from plaque psoriasis, the scores of index severity and mean area of psoriasis decreased by 11.2(9.8) in a group of people supplemented by omega 3 fatty acids [40]. Another control study proved and provided with positive results and evidence that temperate amount of omega 3 fatty acids can be used for healing acne bruises and marks [38]. Greater and increased acne risk has been connected and linked to increased omega fatty acid 6 levels [41].

Trans-Fats and Saturated Fats

The relation between Trans-fatty acids or saturated fat and acne is backed up by very little evidence. No studies have assessed the correlation between acne severity and trans-fatty acid or saturated fat utilization. The association between different foods that are high in fat content and acne has been inspected via three cross sectional studies, nonetheless a relationship between acne and recurrent fried food consumption was formed by Wei and colleagues in 2010. Likewise, Jung and colleagues noticed a definite relationship between consuming high fat food or fried food and acne graveness in 2010. On the other hand, some cross sectional studies have failed to prove a relationship between higher fat diet and acne. The basic operations of creating a link between acne and high fat food in unknown due to limited explorative literary texts and

studies investigating their relationship. Low-fat foods are linked with decrease in the concentration of Insulin-like Growth factor 1, decreasing the occurrence of acne, whereas elevated congregation of Insulin-like Growth factor 1 and decreased concentration of Insulin-like Growth Factor Binding Protein – 3 are linked with presence of saturated fat [33].

The following table shows fats, their possible metabolic effects and sources. [42,43]

Nutrient	Metabolic effect	Food sources
Saturated fats	mTORC 1 activation	Junk/fast food
Trans fats	mTORC 1 activation	butter
	Inflammasome activation	cream
	Proinflammatory signaling	French fries

Sunlight

Acne is most probable to ameliorate while being subject to sunlight. This information has paved the way for many types of therapies to be developed over the past twenty years, the most significant being laser and light treatments. Both the mentioned treatments are either amalgamated with topical or oral treatments or given as a substitute treatment [44]. In a study performed in 2016 by G Fagihhi and colleagues, they found out that visible light phototherapy resulted in partial healing in lesions caused by acne [45].

A gram positive microaerophilic skin bacterium, namely P.acnes, is involved in the pathogenesis of acne. Vulnerability to light wavelengths influences these photosensitizers to initiate reactive free radical species, which successively leads to bacterial expulsion [44]. After being subject to sunlight, 70% of patients reported that betterment in their acne condition had taken place. Both UVA and UVB treatments are perceived to have a favorable effect to some extent on acne, however it may possibly be carcinogenic. Numerous research and works have displayed the successful coalition between both red and blue light for the medication of docile cases of acne. Acne elimination varies patient to patient, however relapse rates are high after the medical treatments have been brought to an end [44]. But problems such as scarcity of blinding and controls and less statistical significance of researches restrict the interpretation of the research outcomes to different extents [46]. In another study published in 2013, K Bhatte shared a study wherein no strong proof was found by a systematic review of 7 studies that sunlight can heal acne lesions [26].

Hygiene and Acne

Even though it is widely believed to influence acne, the relation between facial hygiene and its effect on acne has not been established yet. A study conducted among undergraduate students 80% believed that poor facial hygiene was a causative factor of acne [47].

Although some evidence was found that medicated washes and washing face twice a day helped with acne lesions, the evidence found was weak and no strong connection between hygiene and acne was found in these studies [26].

Another study performed by Sharma Rk et al tried to explore this subject, but the result collected was not reliable as students were not comfortable telling about poor facial hygiene [48].

Detailed studies about the effect of facial hygiene in development or treatment of acne have not been performed to conclude any

positive or negative effect. However quite a few surveys have been done on the perception among people regarding acne flares. For example, a study performed revealed that 80% of the subjects believe that hygiene does not affect acne [49]. Whereas 58.4% of the subjects in another studied believed that frequent washing decreased acne lesions [50].

Consumption of Chocolate Associated with Acne Vulgaris

Health of skin is directly associated with whatever food we intake. Nutrition plays an important role in our skin related problems. Nutrition have direct impact on our skin health. A large- scale study was conducted to understand the association of food with skin and how consumption of dark chocolate associated with acne vulgaris. As dark chocolate has a lot of health qualities. But at the same time, it also aggravates acne vulgaris in many adolescents. The studies based on before and after 1-month consumption of dark chocolate by 17 adolescents and 16 middle aged-men. And it has been proved that young men who are more likely to consume dark chocolate are more vulnerable to have acne vulgaris [51]. From so many years, it was believed that consumption of chocolate is not associated with acne vulgaris. For to clear this another study was conducted on consumption of dark chocolate and its association with acne vulgaris. For analyzation they performed a research on young-men and told them to consume 25g of 99% dark chocolate on daily basis for almost 1-month. After the samples they took it has been proved that young-men who consumed moderate amount of dark chocolate on daily basis for 1-month can aggravates acne vulgaris in them. It can make their acne even worse [52].

Another randomized controlled study was conducted to evaluate the effects of consumption of dark chocolate in young-men who had an acne vulgaris. For assessment they took 40 young-men of age 18-35 years who had history of acne vulgaris and asked them to take capsules full of unsweetened 100-percent cocoa, hydrolyzed gelatin powder, or combination of both. It has been proved that consumption of chocolate in any form can aggravate acne vulgaris in young-men. It directly related with the worsening of acne vulgaris [53].

Many studies also supported this theory that chocolate consumption is also associated with the development of acne vulgaris. Pierre

Dougan and Naser Rafikhah conducted a case-control study to investigate the impact of dark and white chocolate consumption with acne lesions. 87 volunteers with mild to severe acne were classified in three groups (white chocolate group, dark chocolate group and control group respectively). According to the results, no prominent difference was seen in patients of dark chocolate group and control group ($p > 0.05$). All inflamed ($p = 0.04$), noninflamed ($p = 0.02$) and total ($p = 0.02$) acne lesions in white chocolate group increased significantly as compared to the other two groups. The study indicated that only white chocolate consumption is linked with the aggravation of acne lesions [54]. Many studies propose that chocolate consumption is associated with the increase in acne prevalence and severity [55].

Consumption of Fish Associated with Acne Vulgaris

Another study performed on consumption of fish oil supplements and their effects on acne vulgaris. For this they conducted 13 individuals with inflaming acne and were given three grams of fish oil containing 930mg of EPA for almost 3 months. According to results there were not any specific changes to acne grading. The results revealed that 8 individuals have improved acne inflammation, 4 individuals have aggravated and 1 individual remained stable. It has been proved that individuals who had fish oil supplementation are one associated with an improvement in overall acne severity. Fish oil supplementation shows association with betterment of acne vulgaris [56]. Another study performed on individuals take omega-3 fatty acids and its association with acne vulgaris. Omega-3 fatty acids can be taken through any source. Fish, nuts and even direct supplements. For this they performed a research on 45 individuals and asked them to take omega-3 fatty acids for almost 10 weeks. According to results the acne inflammation improved in many individuals. This shows that omega-3 fatty acid can also use for medication of acne vulgaris. It improves acne severity in many individuals [38].

In a similar case control study on Koreans found that individuals with acne consumed considerably less fish and more junk food than the control group [57]. A similar study on Italian teenagers found that consumption of fish was associated with a protective effect against moderate to severe acne [27].

Title	Study design	Sample characteristics	Results	References
Trials of light and laser therapies for acne vulgaris.	Randomized and/or blinded controlled trails	25 trials (patient no. was 694), 13 were of light therapy and 12 of a cream activated by light (PDT) and therapy by light both.	In short term, benefit was seen to some extent from light therapy. Infrared, blue/red and blue was found to be more advantageous than green, red or yellow light.	(26) Bhate K, Williams H. Epidemiology of acne vulgaris. British Journal of Dermatology 2013; 168(3): 474-85.
Study focused on different graded levels of acne compared to the fat consumption	Analytic observational study with cross sectional design	76 students aged 14-18 years old female students suffering from acne vulgaris	Most students suffered from mild grade of acne vulgaris. There was a considerable difference in total intake of fat based on grade of acne vulgaris. But no important connection of saturated fat consumption based on the grading of acne was found.	(58) Minerva P, Rosalina L, Astuti M, Yuniarti E. Fat Intake Comparison Based on Acne Vulgaris Gradation in Beauty Vocational High School Girls in Padang City. 2019.
Diet, Smoking and Family History as Potential Risk Factors in Acne Vulgaris	Cross-sectional study	148 high school students from ages 16-20 110 male students 38 female students	52.7% healthy subjects 47.3% acne subjects In acne group 57.1% had family history of acne	(59) Al Hussein SM, Al Hussein H, Vari CE, Todoran N, Al Hussein H, Ciorba A, Dogaru MT. Diet, Smoking and Family History as Potential Risk Factors in Acne Vulgaris—a Community-Based Study. Acta Medica Marisensis. 2016 Jun 1;62(2):173-81.
The constellation of dietary factors in adolescent acne	Semantic connectivity map approach	563 subjects aged 10–24 years participating in a case–control study of acne from March 2009 and February 2010	A close relation between presence of moderate to severe acne and family history of acne was found.	(60) Grossi E, Cazzaniga S, Crotti S, Naldi L, Di Landro A, Ingordo V, Cusano F, Atzori L, Tripodi Cutri F, Musumeci ML, Pezzarossa E. The constellation of dietary factors in adolescent acne: a semantic connectivity map approach. Journal of the European Academy of Dermatology and Venereology. 2016 Jan;30(1):96-100.
Acne and dairy products in adolescence	Longitudinal study	3811 students in grade 10 from year 2001-2002 participated. Three years later 2489 students now in grade 13 in year 2004 participated in the follow up stud.	Prevalence of acne was 11.7% in subjects with no intake of dairy, 13.4% in subjects with moderate total intakes and 15.1% in subjects with high total intakes.	(61) Ulvestad M, Bjertness E, Dalgard F, Halvorsen JA. Acne and dairy products in adolescence: results from a Norwegian longitudinal study. Journal of the European Academy of Dermatology and Venereology. 2017 Mar;31(3):530-5.
Consumption of dairy in teenagers with and without acne	Case-control study	225 participants, ages 14 to 19 years 24 dietary recall.	Amount of low-fat or skim milk ingested by the subjects with acne was considerably higher ($P = .01$) than subjects who were healthy.	(29) LaRosa CL, Quach KA, Koons K, Kunselman AR, Zhu J, Thiboutot DM, Zaenglein AL. Consumption of dairy in teenagers with and without acne. Journal of the American Academy of Dermatology. 2016 Aug 1;75(2):318-22.

Individuals take omega-3 fatty acids and its association with acne vulgaris.	Randomised, controlled group study	45 individuals and asked them to take omega-3 fatty acids for almost 10 weeks.	Acne inflammation improved in many individuals.	(38)Jung JY, Kwon HH, Hong JS, Yoon JY, Park MS, Jang MY, et al. 2014;94(5):521-526
Relationship between consumption of fish oil supplements and their effects on acne vulgaris.	Randomised controlled study	13 individuals (inflamed acne) take three gram of fish oil containing 930mg of EPA for almost 3 months	8 individuals have improved acne 4 individuals have aggravated and only 1 individual remained stable.	Khayef G, Young J, Burns-Whitmore B, Spalding T. su2012;11(1):1-4.

References

- Shrewsbury D (2015) Acne vulgaris. *InnovAiT* 11: 645-672.
- Wolff K, Johnson RA (2009) Fitzpatrick's color atlas and synopsis of clinical dermatology: McGraw Hill.
- Williams HC, Dellavalle RP, Garner S (2012) Acne vulgaris. *The Lancet* 379: 361-372.
- Tahir CM (2016) Pathogenesis of acne vulgaris: simplified. *Journal of Pakistan Association of Dermatology* 20: 93-97.
- Bhambri S, Del Rosso JQ, Bhambri A (2009) Pathogenesis of acne vulgaris: recent advances. *J Drugs Dermatol* 8: 615-618.
- Brajac I, Bilić-Zulle L, Tkalčić M, Lončarek K, Gruber F (2004) Acne vulgaris: myths and misconceptions among patients and family physicians. *Patient education and counseling* 54: 21-25.
- Ali F, Hasni MS, Ali SZ, Nadeem M, Khan A, et al. (2019) Determination of various risk factors associated with acne vulgaris infection in Quetta, Pakistan. *Pure and Applied Biology (PAB)* 8: 1919-1924.
- Cunliffe W, Shuster S (1969) Pathogenesis of acne. *The Lancet* 293: 685-687.
- Ghodsí SZ, Orawa H, Zouboulis CC (2009) Prevalence, severity, and severity risk factors of acne in high school pupils: a community-based study. *Journal of Investigative Dermatology* 129: 2136-2141.
- El Akawi Z, Abdel Latif Nemr N, Razzak A, Al Aboosi M (2006) Factors believed by Jordanian acne patients to affect their acne condition. *EMHJ-Eastern Mediterranean Health Journal* 12: 840-846.
- Gupta MA, Gupta AK, Schork NJ (1996) Psychological factors affecting self-excoriative behavior in women with mild-to-moderate facial acne vulgaris. *Psychosomatics*. 37: 127-130.
- Wolf R, Matz H, Orion E (2004) Acne and diet. *Clinics in dermatology* 22: 387-393.
- Ferdowsian H, Levin S (2010) Does diet really affect acne. *Skin Therapy Lett* 15: 1-2.
- Spencer EH, Ferdowsian HR, Barnard ND (2009) Diet and acne: a review of the evidence. *International journal of dermatology* 48: 339-347.
- Magin P, Pond D, Smith W, Watson A (2005) A systematic review of the evidence for 'myths and misconceptions' in acne management: diet, face-washing and sunlight. *Family practice* 22: 62-70.
- Witkowski JA, Parish LC (2004) The assessment of acne: an evaluation of grading and lesion counting in the measurement of acne. *Clinics in dermatology* 22: 394-397.
- Adityan B, Kumari R, Thappa DM (2009) Scoring systems in acne vulgaris. *Indian Journal of Dermatology, Venereology, and Leprology* 75: 323.
- Ramli R, Malik AS, Hani AFM, Jamil A (2012) Acne analysis, grading and computational assessment methods: an overview. *Skin research and technology* 18: 1-14
- Rathi SK (2011) Acne vulgaris treatment: the current scenario. *Indian journal of dermatology* 56: 7.
- Parsad D, Pandhi R, Nagpal R, Negi K (2001) Azithromycin monthly pulse vs daily doxycycline in the treatment of acne vulgaris. *The Journal of dermatology* 28: 1-4.
- Nouri K, Villafradez Diaz LM (2005) Light/laser therapy in the treatment of acne vulgaris. *Journal of cosmetic dermatology* 4: 318-320.
- Burris J, Rietkerk W, Woolf K (2013) Acne: the role of medical nutrition therapy. *Journal of the Academy of Nutrition and Dietetics* 113: 416-430.
- Melnik BC (2011) Evidence for acne-promoting effects of milk and other insulinotropic dairy products. *Milk and Milk Products in Human Nutrition*. Karger Publishers 67: 131-45.
- Melnik B (2012) Dietary intervention in acne: Attenuation of increased mTORC1 signaling promoted by Western diet. *Dermato-endocrinology* 4: 20-32.
- Silverberg NB (2012) Whey protein precipitating moderate to severe acne flares in 5 teenaged athletes. *Cutis* 90: 70-72.
- Bhate K, Williams H (2013) Epidemiology of acne vulgaris. *British Journal of Dermatology* 168: 474-485.
- Di Landro A, Cazzaniga S, Parazzini F, Ingordo V, Cusano F, et al. (2012) Family history, body mass index, selected dietary factors, menstrual history, and risk of moderate to severe acne in adolescents and young adults. *Journal of the American Academy of Dermatology* 67: 1129-1135.
- Kim J, Ko Y, Park Y-K, Kim N-I, Ha W-K et al. (2010) Dietary effect of lactoferrin-enriched fermented milk on skin surface lipid and clinical improvement of acne vulgaris. *Nutrition* 26: 902-909.
- La Rosa CL, Quach KA, Koons K, Kunselman AR, Zhu J, et al. (2016) Consumption of dairy in teenagers with and without acne. *Journal of the American Academy of Dermatology* 75: 318-322.
- Ben Amitai D, Laron Z (2011) Effect of insulin-like growth factor I deficiency or administration on the occurrence of acne. *Journal of the European Academy of Dermatology and Venereology* 25: 950-954.
- Tasli L, Turgut S, Kacar N, Ayada C, Coban M, et al. (2013) Insulin-like growth factor I gene polymorphism in acne vulgaris. *Journal of the European Academy of Dermatology and Venereology* 27: 254-257.
- Ismail NH, Manaf ZA, Azizan NZ (2012) High glycemic load diet, milk and ice cream consumption are related to acne vulgaris in Malaysian young adults: a case control study. *BMC dermatology* 12: 13.
- Burris J, Rietkerk W, Woolf K (2014) Relationships of self-reported dietary factors and perceived acne severity in a cohort of New York young adults. *Journal of the Academy of Nutrition and Dietetics* 114: 384-392.
- Bowe WP, Joshi SS, Shalita AR (2010) Diet and acne. *Journal of the American Academy of Dermatology* 63: 124-141.
- Reynolds RC, Lee S, Choi JY, Atkinson FS, Stockmann KS, et al. (2010) Effect of the glycemic index of carbohydrates

- on acne vulgaris. *Nutrients* 2: 1060-1072.
36. Kwon HH, Yoon JY, HONG JS, Jung J, Park MS, et al. (2012) Clinical and histological effect of a low glycaemic load diet in treatment of acne vulgaris in Korean patients: a randomized, controlled trial. *Acta dermato-venereologica* 92: 241-246.
37. Kucharska A, Szmurło A, Sińska B (2016) Significance of diet in treated and untreated acne vulgaris. *Advances in Dermatology and Allergology/Postępy Dermatologii i Alergologii* 33: 81.
38. Jung JY, Kwon HH, Hong JS, Yoon JY, Park MS, et al. (2014) Effect of dietary supplementation with omega-3 fatty acid and gamma-linolenic acid on acne vulgaris: a randomised, double-blind, controlled trial. *Acta dermato-venereologica* 94: 521-526.
39. Suh DH, Kwon H (2015) What's new in the physiopathology of acne? *British Journal of Dermatology* 172: 13-19.
40. Khanna R, Shifrin N, Nektalova T, Goldenberg G (2018) Diet and dermatology: Google search results for acne, psoriasis, and eczema. *Cutis* 102: 44.
41. Ozdarska K, Osucha K, Savitskyi S, Malejczyk J, Galus R (2017) Diet in pathogenesis of acne vulgaris. *Polski merkuriusz lekarski: organ Polskiego Towarzystwa Lekarskiego* 43: 186.
42. Melnik BC (2015) Linking diet to acne metabolomics, inflammation, and comedogenesis: an update. *Clinical, cosmetic and investigational dermatology* 8: 371.
43. Claudel J-P, Auffret N, Leccia MT, Poli F, Dréno B (2018) Acne and nutrition: hypotheses, myths and facts. *Journal of the European Academy of Dermatology and Venereology* 32: 1631-1637.
44. Rai R, Natarajan K (2013) Laser and light based treatments of acne. *Indian Journal of Dermatology, Venereology, and Leprology* 79: 300.
45. Faghihi G, Vali A, Asilian A, Radan MR, Esteki H, et al. (2016) Comparative efficacy of filtered blue light (emitted from sunlight) and topical erythromycin solution in acne treatment: a randomized controlled clinical trial. *Journal of Pakistan Association of Dermatology* 21: 179-184.
46. Hui RW (2017) Common misconceptions about acne vulgaris: A review of the literature. *Clinical Dermatology Review* 1: 33.
47. Niazi NAK (2016) Beliefs and perceptions about acne among undergraduate medical students. *Journal of Pakistan Association of Dermatology* 17: 231-234.
48. Sharma RK, Dogra S, Singh A, Kanwar AJ (2017) Epidemiological patterns of acne vulgaris among adolescents in North India: A cross-sectional study and brief review of literature. *Indian Journal of Paediatric Dermatology* 18: 196.
49. Kokandi AA (2013) Acne flares among university female students: the role of perceived factors. *J Cosmet Dermatol Sci Appl* 3: 26-29.
50. Al Mashat S, Al Sharif N, Zimmo S (2013) Acne awareness and perception among population in Jeddah, Saudi Arabia. *Journal of the Saudi Society of Dermatology & Dermatologic Surgery* 17: 47-49.
51. Chalyk N, Klochkov V, Sommereux L, Bandaletova T, Kyle N, et al. (2018) Continuous dark chocolate consumption affects human facial skin surface by stimulating corneocyte desquamation and promoting bacterial colonization. *The Journal of clinical and aesthetic dermatology* 11: 37.
52. Vongraviopap S, Asawanonda P (2016) Dark chocolate exacerbates acne. *International journal of dermatology* 55: 587-591.
53. Caperton C, Block S, Viera M, Keri J, Berman B (2014) Double-blind, placebo-controlled study assessing the effect of chocolate consumption in subjects with a history of acne vulgaris. *The Journal of clinical and aesthetic dermatology* 7: 19.
54. Dougan P, Rafikhah N (2014) Dark and white chocolate consumption and acne vulgaris: A case-control study. *Asian Journal of Clinical Nutrition* 6: 35-40.
55. Netea SA, Janssen SA, Jaeger M, Jansen T, Jacobs L, et al. (2013) Chocolate consumption modulates cytokine production in healthy individuals. *Cytokine* 62: 40-43.
56. Khayef G, Young J, Burns-Whitmore B, Spalding T (2012) Effects of fish oil supplementation on inflammatory acne. *Lipids in health and disease* 11: 1-4.
57. Jung JY, Yoon MY, Min SU, Hong JS, Choi YS, et al. (2010) The influence of dietary patterns on acne vulgaris in Koreans. *European Journal of Dermatology* 20: 768-772.
58. Minerva P, Rosalina L, Astuti M, Yuniarti E (2019) Fat Intake Comparison Based on Acne Vulgaris Gradation in Beauty Vocational High School Girls in Padang City.
59. Al Hussein SM, Al Hussein H, Vari CE, Todoran N, Al Hussein H, et al. (2016) Diet, Smoking and Family History as Potential Risk Factors in Acne Vulgaris—a Community-Based Study. *Acta Medica Marisiensis* 62: 173-181.
60. Grossi E, Cazzaniga S, Crotti S, Naldi L, Di Landro A, et al. (2016) The constellation of dietary factors in adolescent acne: a semantic connectivity map approach. *Journal of the European Academy of Dermatology and Venereology* 30: 96-100.
61. Ulvestad M, Bjertness E, Dalgard F, Halvorsen J (2017) Acne and dairy products in adolescence: results from a Norwegian longitudinal study. *Journal of the European Academy of Dermatology and Venereology* 31: 530-535.