



## Association of Acne to Smoking and Dietary Habits Among Adolescents and Young Adults

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**Abstract.** Acne vulgaris is one of the critical issues that affect Adolescents and young adults. It is estimated that it affects almost 10% of the population worldwide. Dietary habits and smoking have long been associated with acne; however, there has been a lot of controversies behind this theory. This study aimed to identify the association between the effects of dietary intake and smoking to acne among adolescents and young adults. A traditional review was done using PubMed as the source of articles. Mesh database and general database was utilized to search the following keywords: acne, diet, and smoking. From the list of articles and journals, title search, and abstract screen were conducted, which revealed more precise and well- fit studies that were used in this study. Thirty-seven articles were extracted and utilized for this review. Among these, eleven articles discussed the association between diet and acne, 3 articles tackled acne and smoking, while the rest reviewed both smoking and diet. We have found a positive association of different degrees between high Glycemic Index diet and smoking with development of acne vulgaris.

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### 1. Introduction & Background:

Acne vulgaris is considered to be one of the most common dermatological disorders globally (Lynde, et al., 2019). It is a universal cutaneous disease, which rank 3rd worldwide in terms of prevalence of skin disease, particularly among adolescents, ranging between 40% and 70% (Markovic, et al., 2010). It is though that acne is due to the disorder of the sebaceous unit in the skin with bacterial and perifollicular inflammation that affects most frequently adolescents and young adult (Mohammadi, et al., 2019; Akpınar Kara & Ozdemir, 2020). Recent Studies have shown that 85% of adolescents and two-thirds of adults aged 18 years and older are affected by acne vulgaris (Suppiah et al., 2018).

In the past, the relationship between acne and dietary habits had been disagreement amongst researchers. Earlier it is thought that diet is one of the factors for acne pathogenesis (Mahmood & Bowe, 2014). However, a study conducted in the 70's refuted the idea; there was no correlation found between the consumption of chocolates and the development of acne (Bowe et al., 2010). Recent studies have shown that some foods can also affect acne such as intake of milk and chocolate which may play a role in symptomatic acne vulgaris (Suppiah et al., 2018). One of the article revealed that smoking, insulinotropic foods, and foods with high glycemic index such as milk, can lead to pathological exaggeration of growth factors The growth factor enhances the signaling of puberty which eventually

increases androgen receptor activity and produces more Acne (Melnik, 2010). However, there are very few studies concerning this topic; also, the outcomes of these studies were often equivocal (Suppiah et al., 2018).

Another factor that is thought to affect acne production is smoking; Nevertheless, there are few available contrasting data on a possible correlation between acne and smoking. One study suggested that alterations on the skin microcirculation on keratinocytes, collagen, and elastin synthesis, cause acne in smokers (Capitanio et al., 2009). Another study explained it biochemically and stated that acne's pathogenesis is due to the oxidative stress that results in subsequent accumulation in comedones of the skin (Yang et al., 2014). However, researches and studies have been very limited and few.

Acne is not just an issue of the skin but the health of a person holistically. Studies have shown that people may suffer from psychological and emotional distress due to acne, including low self-esteem, social anxiety, depression, and suicidal ideation (Lynde, et al., 2019).

With this in mind, further and comprehensive studies and understanding about the association between dietary habits, smoking, and acne vulgaris are vital in managing this disease as this may help prevent acne production. The knowledge that we can obtain about this subject matter can educate the community for prevention and treatment. The data that we can obtain will also assist



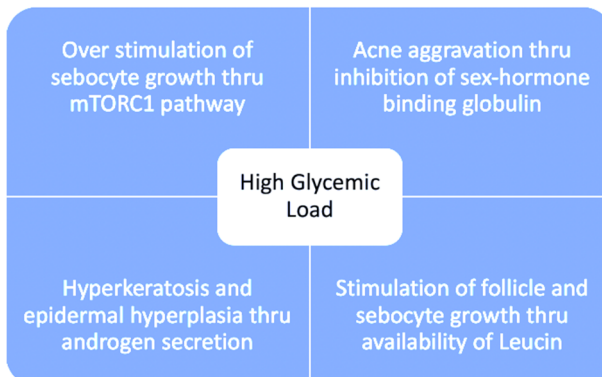
specialists in providing patients with proper dietary recommendations and preventing any false misconceptions and myths. As a result, this study will work towards determining the association between dietary habits, smoking, and acne among adolescents and young adults (Suppiah et al., 2018).

**2. Review:**

**2.1. General Diet and Acne**

Association of different dietary habits with acne has long been studied. However, since each study's results vary, it isn't easy to arrive at a final conclusion. The association of acne and diet was mostly deemed as a myth. Present researches are aiming to produce substantial shreds of evidence to determine which specific type of diet or particular food influences acne (Markovic et al. 2019).

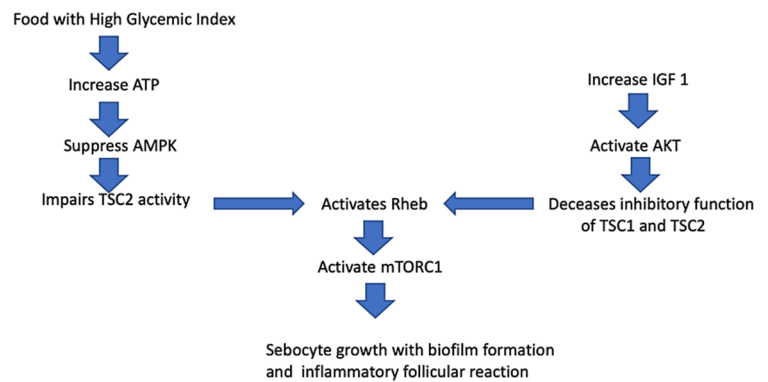
A study conducted by Melnik et al. suggested that insulinemic foods and dairy protein have acnegenic properties. These increases the concentration of insulin and insulin-like growth factor (IGF-1) in the body as shown in Figure 1 (Melnik, 2012). Other authors supported this concept, suggesting that foods that include saturated fat, trans fat, milk, and fish are factors that predispose or aggravate acne development (Burris et al., 2014; Gandolfi, & Hansson, 2015). Other studies have also been done showing an association between diet and acne. Two randomized controlled trials revealed that the risk of developing acne is directly proportional to the food's glycemic index (Figure 1) (Shannon, 2020; Kaymak et al., 2007). However, a contradicting result was found by Kaymak et al. which states that dietary glycemic index, glycemic load, and insulin levels are not associated with acne (Bhate & Williams, 2013). In addition, a study conducted among Danish general population showed that there is no association between milk intake and acne (Juhl et al. 2018a).



**Figure 1.** Effects of High Glycemic load (Glycemic index x the carbohydrate content per serving size) in acne production and aggravation. Food with a high Glycemic Index has a strong effect on acne prevalence thru different pathways, including increasing MTORC1 and activation of sex hormones, specifically androgen. These will promote overstimulation of sebocyte growth in the comedones,

hyperkeratosis, epidermal hyperplasia, and enhance follicular stimulation- all of which lead to acne progression. Abbreviations: mTORC1: mammalian target of rapamycin complex 1

Nonetheless, more recent studies still support an association between acne and dietary habits. In 2017, a research was done, which showed that diet high in glycemic index enhances insulin secretion and induces hepatic insulin-like growth factor-1 (IGF-1) synthesis, as shown in Figure 2. IGF-1 has been known to stimulate follicular epithelial growth and keratinization. In addition, IGF-1 gene polymorphism has also been proven to increase acne prevalence and susceptibility, and IGF-1 plasma levels correlate with acne severity (Figure 2) (Juhl et al. 2018b). A study has been done, which supports that the Western diet is associated with acne vulgaris. An increase in insulin and modulation of FOXO1/mTOR results in over-expression of cytokeratins, hyperproliferation of keratinocytes, and hypercornification of the follicular wall helps bring up acne on the skin surface (Gebauer, 2017).



**Figure 2.** Signaling pathways in acne thru complex protein. An increase of the body's Adenosine Triphosphate (ATP), which was caused by the intake of foods with a high Glycemic index causes the suppression of AMPK. A decrease AMPK leads to impairment of TSC2 activity, which eventually activates Rheb, thus promoting activation of mTORC1. In addition, an increase in IGF 1 from high glycemic foods will activate AKT and decrease the inhibitory functions of TSC1 and TSC2 to Rheb, which will lead to the activation of mTORC1. Hyperactive mTORC1 promotes sebocyte growth and inflammation of follicular reaction. Abbreviations: IGF-1: insulin-like growth factor-1; Akt: Akt kinase; AMPK: AMP-activated kinase; TSC1: hamartin; TSC2: tuberin; Rheb: ras homolog enriched in the brain; mTORC1: mammalian target of rapamycin complex 1.

**2.2. Western Culture and Acne**

Recent studies have shown the differences in the prevalence of acne across the globe. Environmental and dietary factors have been shown to play a part in the

pathogenesis of acne (Shannon, 2020). They relate it to the type of diet that is mostly consumed by each region. In particular, the western diet involves foods with a high glycemic index, including carbohydrates, dairy products, saturated fats- including trans fats, as well as a deficiency of omega-3 polyunsaturated fatty acids, are linked to acne prevalence (Ferdowsian, & Levin, 2010; Skroza et al., 2012). A report has been made that the Kitayan tribes living in the remote island in Papua New Guinea and the Ache hunter-gatherers of Paraguay are acne-free and show no signs of this condition. It was thought that the reason for the absence of acne in these people was mainly due to differences in environmental factors, particularly their diet. This only shows that a low-glycemic-load diet that is common in non-westernized regions is one of the factors in reducing symptoms of acne (Shannon, 2020). Moreover, studies have found an increase in acne prevalence in people who shifted towards a more Westernized diet (Ferdowsian, & Levin, 2010). In support of this theory, Akpınar stated that Omega-6, which is a precursor of pro-inflammatory mediators that increases inflammation in acne, can be found in the western diet with a ratio of 10:1 compared to Omega 3. Whereas there is only a 2:1 ratio of Omega -6 and Omega-3 in non-westernized countries (Maarouf et al., 2019)

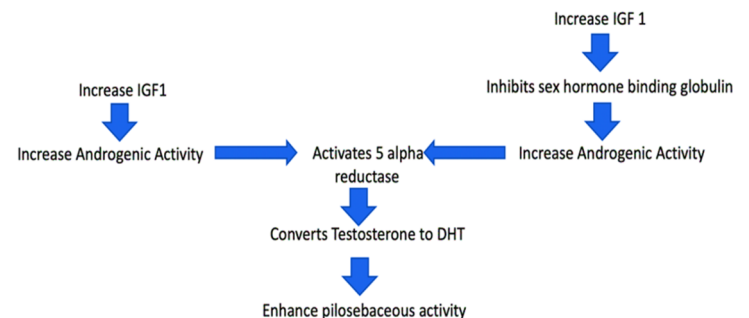
In addition, a recent study revealed that the Mediterranean diet, which is common in the European and middle east region, plays a protective role in the development of acne. However, further studies must be done since this has been a pioneer study (Spencer et al., 2009).

### 2.3. Dairy and Acne

A study was conducted to determine which type of food most commonly consumed by people with acne. The most-reported consumables were sweets and dairy (Markovic et al. 2019). It was found out that Leucine, which is an amino acid found in dairy milk and whey, meat, and eggs, causes activation of mTORC1 signaling. In addition, cow milk contains anabolic androgen precursor of dihydrotestosterone (DHT) which lead to excess production of keratinocyte and sebum (Figure 3) (Wolkenstein et al., 2018). A systematic review and meta-analysis of 78,529 children, adolescents, and young adults were done and revealed that dairy, such as milk, yogurt, and cheese, increased the prevalence of acne (Juhl et al. 2018b). This was also supported by two randomized controlled trials, which showed an association between cow's milk and acne prevalence (Suppiah et al., 2018). A case-control study was done and revealed that acne is more related to skimmed milk consumption than with whole milk. This may be explained by the glycemic index of skimmed milk, which is higher than that of full-fat milk (Gandolfi, & Hansson, 2015). Aside from the Glycemic index being a factor, Adebamowo et. Al reported

that the hormonal component of skimmed milk was more comedogenic, which may enhance acne production.

One typical food that people thought can promote acne is chocolate. However, the association between chocolate and acne remains debatable. A study of seven people showed that chocolate consumption primed blood cells to release inflammatory cytokines interleukin (IL)-1 $\beta$  and IL-10 upon stimulation with *P. acnes*, which causes inflammation of follicle and subsequently causes acne (Gandolfi, & Hansson, 2015)



**Figure 3.** Signaling pathway of acne thru sex hormones. High glycemic index food/ IGF 1 enhances androgen level produce by body organs which can activate 5 alpha-reductase and converts testosterone to DHF. Apart from this, IGF 1 also inhibits the hepatic synthesis of sex hormone-binding globulin, thus increasing the androgenic activity, which will activate 5 alpha-reductase. DHT or dihydrotestosterone enhances pilosebaceous activity, especially in comedones, which promotes acne aggravation. Abbreviations: IGF-1: insulin-like growth factor-1; DHT: dihydrotestosterone; AR: androgen receptor.

### 2.4. Fat and acne

Aside from Carbohydrates, studies have also been done in relation to Fats, causing acne production and severity. However, this has been controversial (Durai, & Nair, 2015). A study conducted by Akpınar et. Al. showed that there was no correlation between fat consumption and acne (Layton, 2010). In contrast, Jung and Wei found an association between frequent consumption of high-fat food and acne (Durai, & Nair, 2015; Schäfer et al., 2001). A diet high in saturated fatty acids increase IGF-1 Concentration (Maarouf et al., 2019). This shows that fatty and oily foods can trigger the mechanism of acne production (Layton, 2010).

### 2.5. Smoking and Acne

Smoking has also been thought to be one of the many factors which contribute to the pathogenesis of acne. However, the association of smoking to acne has been controversial (Layton, 2010). Some observational studies have found that smoking increases the prevalence of acne, others have found a negative association, and some have



found no relationship (Klaz et al., 2006; Tasoula et al., 2012). Studies that have been done to show an association of smoking with acne explained their results thru the biochemical process. The pathogenesis begins with the effect of nicotine on nicotinic cholinergic receptors. Acetylcholine receptor (AChR) and nicotinic activity promote infundibular epithelial hyperplasia and follicular plugging, which contributes to the formation of acne vulgaris (Mills et al., 1993). Another possible etiology of acne in relation to smoking is thru arachidonic acid and polycyclic aromatic hydrocarbons present in the cigarette smoke, which prompts the phospholipase A2 dependent inflammatory pathway (Hazarika, 2019).

A study conducted by Schafer et al. shows that acne is more common and severe among smokers (Jung et al., 2010). This was supported by the group of Klaz et al. which revealed a directly proportional relationship between smoking and acne (Akpınar Kara & Ozdemir, 2020). In contrast to the previous studies, few researchers validate their claim that there is no statistically significant association between acne and cigarette smoking history (Mills et al., 1993). A France researcher found that smoking was independently associated with a reduced probability of having self-reported acne, which is consistent with the finding of other researchers (Tasoula et al., 2012). However, this is not the case in another study, which revealed that an inverse relationship wherein smoking could cause an anti-inflammatory effect, which may inhibit the development of acne (Klaz et al., 2006). As a matter of fact, two recent studies revealed a negative correlation between smoking and acne. They thought that a component of a cigarette, possibly nicotine, has an anti-inflammatory action on acne. (Mills et al., 1993; Wei et al., 2010; Kaaks et al., 2003).

### 3. Conclusion:

From the literature review this study has found an association between High glycemic index diet and acne vulgaris. This represents a positive association between the 2 entities (ie. High Glycemic Index diet and Acne vulgaris). With regards to smoking, literature review suggest there is a weak positive correlation between smoking and acne vulgaris. The mechanism behind both associations (between high glycemic index diet and acne vulgaris, smoking and acne vulgaris) has not been commented upon in a concise manner in the literature. Base on this, we recommend provision of dietary advice to the patients with acne vulgaris in order to substitute high glycemic index food with low Glycemic index diet. We also recommend smoking cessation advice to be given to the patients with acne vulgaris. We also recommend further research work to be done in this field in order to understand the clear mechanisms that drive these associations between high Glycemic Index diet/ smoking with acne vulgaris.

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