

# The Association of Acne Vulgaris With Diet

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*Acne vulgaris is a common disorder of the pilosebaceous unit affecting adolescents and adults. The rise in incidence of acne in the United States may relate to the Western diet—which is rich in dairy and refined sugars, and high in glycemic load—and to the obesity epidemic. We reviewed the literature on diet and acne. Evidence exists highlighting the association of acne and high glycemic loads, certain dairy products, and refined sugar product ingestion. Future studies are required to determine if dietary modification will reduce long-term acne burden.*

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**A**cne vulgaris is an emotionally troubling disease of the skin affecting at least 85% of the US population at some point in time. The pathology consists of blockage and inflammation of the pilosebaceous unit, usually with the initial occurrence around the time of puberty in mid adolescence.<sup>1</sup> Androgens, which increase during puberty, stimulate the sebaceous gland to produce sebum and cause retention of keratinocytes around the sebaceous hair follicle orifice causing partial to complete blockage and leading to colonization with *Propionibacterium acnes*, which participates in the production of pro-inflammatory mediators.<sup>2</sup> There are many triggers of androgen production that can affect this process.

Although controversial, certain dietary factors recently have been implicated as causative agents in disease progression. It is a common perception among acne patients that foods such as sweets, chocolate,

and nuts, as well as fried and oily foods, will exacerbate the disease.<sup>3,4</sup> Many studies have been performed to determine the true effect of diet on acne; however, the results have been largely inconclusive. A current review of the information is needed to guide future efforts in eliciting the definite role of diet in acne. We conducted a meta-analysis of the data reported in the literature to draw conclusions on the impact of diet on acne, including high glycemic load; milk and dairy; chocolate; salty, oily, and fatty foods; and obesity.

## Methods

A literature search was conducted using the National Library of Medicine's Medical Subject Headings (MeSH) database for PubMed articles (March 8, 2011). All searches included acne vulgaris (*International Classification of Diseases, Ninth Edition*, 706.1) as the major topic (Majr). A search for acne and diet using *acne vulgaris [Majr]* and *diet [MeSH]* yielded 65 articles. Similar searches to include *acne vulgaris [Majr]* and *glycemic index, milk, chocolate, and obesity [MeSH]* yielded 40 additional articles. No MeSH topics were available for potato chips, oily foods, and fatty foods. These topics were searched independently with acne as the major topic, each yielding 1 article. Articles in the English language with primary focus on the topic were included in this review. Review articles and anecdotal reports were excluded from this review. A total of 23 studies are included in this review and outlined in the Table.

## Results

**High Glycemic Load**—Bett et al<sup>24</sup> provided evidence that sugar consumption did not significantly increase the incidence of acne in 1967. However, more recent studies demonstrated that high glycemic index and/or glycemic load foods (eg, refined sugars, white carbohydrates) specifically increased the risk for acne,<sup>5,13,15,17,18,21</sup> which was strengthened by the results of the study published by Cordain et al<sup>21</sup> that showed the absence of acne in individuals from Papua New

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The authors report no conflict of interest.

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Studies Addressing Diet and Acne Vulgaris<sup>a</sup>

Reference	Year	Participants, n	Study Design <sup>b</sup>	Age Range (Average) of Evaluated Patients	Acne Contributing Factor(s) Studied	Conclusions
Jung et al <sup>5</sup>	2010	1285	Prospective	N/A	Dairy, high-fat diet, high glycemic load	Junk food, carbonated drinks, fried chicken, roast pork, and nuts aggravate acne
Yang et al <sup>6</sup>	2010	627	Prospective	14–40 y (27.8 y)	Obesity	Obese women have higher serum testosterone levels but less acne
Kim et al <sup>7</sup>	2010	36	Interventional with placebo control	18–30 y (22.7 y)	Dairy	Lactoferrin-enriched milk may decrease acne inflammation vs fermented milk
Wei et al <sup>8</sup>	2010	5696	Retrospective	17–25 y (21.56 y)	High-fat diet	Fried food is correlated with an increase in acne
Law et al <sup>9</sup>	2010	322	Retrospective	17.4–20.8 y (19.1 y)	Dairy avoidance; high glycemic load	For a subset of patients, desserts and fruit juices are associated with acne, and milk is protective; overall, no specific dietary factor is associated with acne risk
Ghodsai et al <sup>10</sup>	2009	1002	Retrospective	12–20 y (16 y)	Oily foods, sweet foods	Strong correlation exists between consumption of sweets, oily foods, and acne

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Reference	Year	Participants, n	Study Design <sup>b</sup>	Age Range (Average) of Evaluated Patients	Acne Contributing Factor(s) Studied	Conclusions
Halvorsen et al <sup>11</sup>	2009	3775	Retrospective	18–19 y (N/A)	Chocolate, oily foods, sweet foods	In adolescent boys, increased consumption of potato chips, chocolate, and sweets is associated with acne; in adolescent girls, the only dietary association is a lack of vegetables
Abulmaja <sup>12</sup>	2009	60	Prospective	16–22 y (18 y for obese with acne; 20 y for obese without acne; 17 y for not obese with acne; 18 y for not obese without acne)	Obesity (BMI, >27)	Higher serum triglycerides were found in obese patients with acne
Smith et al <sup>13</sup>	2008	12	Pilot	15–20 y (16.6 y for low glycemic load diet; 17.6 y for high glycemic load diet)	Glycemic load	High glycemic load diets are associated with a reduced serum hormone-binding globulin and increased IGF
Adebamowo et al <sup>14</sup>	2008	4273	Prospective	9–15 y (144 mo without acne; 141 mo with acne)	Dairy	Skim milk is associated with acne in teenaged boys

Reference	Year	Participants, n	Study Design <sup>b</sup>	Age Range (Average) of Evaluated Patients	Acne Contributing Factor(s) Studied	Conclusions
Smith et al <sup>15</sup>	2008	43	Interventional	15–25 y (N/A)	Glycemic load	Low glycemic load diet increased the ratio of saturated to monosaturated fatty acids on the skin, which was correlated with fewer acne lesions
Kaymak et al <sup>16</sup>	2007	91	Prospective	19–34 y (21.71 y for acne; 22.14 y for controls)	Glycemic load, overall glycemic index	Dietary glycemic index, glycemic load, serum testing, leptin, glucose, and IGF-1 did not differ significantly between acne patients and controls
Smith et al <sup>17</sup>	2007	31	Interventional	15–25 y (18.2 y for low glycemic load; 18.5 y for controls)	Glycemic load	Low glycemic load and high protein diet causes further clinical improvement of acne than a high glycemic load diet
Smith et al <sup>18</sup>	2007	43	Interventional	15–25 y (18.2 y for low glycemic index; 18.5 y for controls)	Glycemic load	Low glycemic index diet associated with clinical improvement in acne and increased insulin sensitivity
Adebamowo et al <sup>19</sup>	2006	6094	Prospective	9–15 y (144 mo)	Dairy	Greater levels of milk consumption are associated with acne in adolescent girls
Adebamowo et al <sup>20</sup>	2005	47,355	Retrospective	25–42 y (N/A)	Dairy	Total milk and skim milk consumption is associated with an increase in acne in women

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(continued)		Age Range (Average) of Evaluated Patients	Acne Contributing Factor(s) Studied	Conclusions
Reference	Year	Participants, n	Study Design <sup>b</sup>	
Cordain et al <sup>21</sup>	2002	300	Prospective	15–25 y (N/A) Glycemic load Low glycemic load diet of Kitavan Islanders of Papua New Guinea and Aché hunter-gatherers of Paraguay is correlated to the absence of acne in all ages
Yeh <sup>22</sup>	1975	568	Retrospective	14–16 y (N/A) Fatty food, fried food Peanuts and fried food are associated with acne risk
Fulton et al <sup>23</sup>	1969	65	Interventional	N/A Chocolate No correlation was found between consumption of chocolate and acne development
Bett et al <sup>24</sup>	1967	16	Retrospective	15–27 y (N/A) Sugar Sucrose consumption was not correlated with an increase in acne prevalence
Gaul <sup>25</sup>	1965	4 case studies	Interventional	N/A Salt Low sodium diet is correlated with a regression of acne pustules
Grant and Anderson <sup>26</sup>	1965	8	Interventional	N/A Chocolate Chocolate consumption is not associated with acne
Hubler <sup>27</sup>	1959	30 with safflower oil; 180 with corn oil	Interventional	N/A Unsaturated fatty acid (safflower oil [6% saturated]; corn oil [13% saturated]) Consumption of corn oil was not associated with flares in acne patients; some safflower oil patients had reduction in acne

Abbreviations: N/A, not available; BMI, body mass index; IGf, insulinlike growth factor.

<sup>a</sup>Listed in reverse chronology based on month and year of publication.

<sup>b</sup>Study design was assessed as prospective, retrospective, or interventional.

Guinea and Paraguay; individuals residing in these areas are devoid of a high glycemic load in their diet.

A prospective cohort study showed no difference overall in glycemic load, dietary glycemic index, leptin levels, serum fasting glucose, or insulinlike growth factor 1 (IGF-1) (a marker of acute insulinemia) between acne patients and controls.<sup>16</sup> However, between 2007 and 2008, Smith et al<sup>13,15,17,18</sup> reported 4 studies that clearly correlated the consumption of a high glycemic load diet to the prevalence of acne. Most notably, Smith et al<sup>18</sup> showed that patients in a 12-week interventional trial of low glycemic index diet had fewer acne lesions. Additional studies with broader foci also have shown a correlation in the consumption of sweets and acne.<sup>9,11</sup>

**Milk/Dairy**—A study based on traditional Chinese medicine showed the consumption of dairy to be associated with a lower incidence of acne.<sup>9</sup> On the contrary, Adebamowo et al<sup>19,20</sup> showed through 2 cohort studies (1 prospective and 1 retrospective) that milk, cream cheese, cottage cheese, breakfast drinks, and especially skim milk are associated with an increase in acne vulgaris in adolescent girls. A similar study also has shown skim milk to be a positive predictor of acne in teenaged boys.<sup>14</sup> Additionally, these studies have implicated vitamin D supplementation to have a slight positive correlation with acne.<sup>14,19,20</sup>

Newer research gives evidence of an acne benefit from a modified form of milk enriched with lactoferrin, which demonstrated a clinical improvement in a small number of patients (n=18) over 12 weeks.<sup>7</sup>

**Chocolate**—The association between chocolate and acne was dismissed by 2 interventional studies more than 40 years ago.<sup>23,26</sup> A newer study showed an association between acne and self-reported consumption of chocolate and/or sweets that was considered to occur often.<sup>11</sup>

**Salty, Oily, and Fatty Foods**—The case studies presented by Gaul<sup>25</sup> in 1965 associated excessive salt intake as a risk factor for the progression of acne.

In 1959, Hubler<sup>27</sup> showed intervention with unsaturated fatty acids, such as corn oil, did not exacerbate acne symptoms. However, the authors found that saturated and hydrogenated fatty acids may aggravate acne vulgaris.<sup>27</sup> The consumption of nuts, particularly peanuts; fried foods; and potato chips also have been implicated in the risk for acne.<sup>5,8,10,11,22</sup>

**Obesity**—A study published in 2009 showed that adolescent girls with obesity had higher testosterone levels and higher prevalence of acne.<sup>12</sup> On the contrary, a study of Taiwanese women (aged 14–40 years) published in 2010 showed that participants with acne had higher serum testosterone

levels; however, participants who were not obese had a higher prevalence of acne than obese women, though the testosterone levels of obese women were markedly elevated.<sup>6</sup>

## Comment

The evidence is strong for an association between high glycemic load foods and acne. Recent estimates suggest that the incidence of acne vulgaris is increasing in the United States.<sup>2</sup> The increase may be accounted for by an increase in the proportion of refined sugars (eg, sucrose, high-fructose corn syrup) in the Western diet.<sup>13,15,17,18,21</sup> Individuals in countries where diet does not consist of high glycemic index foods are not afflicted with acne, whereas the prevalence of acne in the United States is nearly universal.<sup>21</sup>

The role of high glycemic load foods in the pathogenesis of acne has been characterized by its ability to cause acute hyperinsulinemia, thus increasing androgen levels and IGF-1, resulting in an increase in sebum production.<sup>18</sup> Researchers have sought to clarify the role of free serum androgen levels in the pathogenesis of acne vulgaris.<sup>13</sup>

Patients, especially overweight and obese individuals, can be advised to reduce their consumption of processed and refined sugars and to seek high-fiber sources of carbohydrates in an effort to reduce acne symptoms.

Cow's milk naturally contains hormones such as testosterone and androstenedione, which are associated with an endogenous increase in IGF-1 levels.<sup>20</sup> Thus milk would, by the same mechanism as high glycemic load, increase sebum production and potentially promote follicular keratinization, leading to an increase in acne symptoms.

In light of the beneficial effects of vitamin D, the contention that vitamin D supplementation may have a role in producing acne symptoms is of particular concern; however, the idea that vitamin D may be linked to acne may be an artifact of standard supplementation of milk with vitamins A and D in the United States.<sup>14,19,20</sup> For now, an acne patient could be advised to limit dairy intake while supplementing his/her diet with calcium and vitamin D.

Although evidence is limited, milk enriched with lactoferrin, a milk whey protein devoid of casein and known for its anti-inflammatory properties, may be a suitable alternative to milk in patients with moderate to severe acne.<sup>7</sup> Data suggest that the casein component of whey protein is most comedogenic.

It is unknown if the addition of recombinant bovine growth hormone is contributory to acne exacerbations. However, in small quantities, IGF-1 levels will rise after prepubertal boys are exposed to

recombinant bovine growth hormone.<sup>28</sup> Theoretically, switching to organic dairy also may be of benefit to patients with acne, but no clinical trial data exist to support this conclusion.

Studies that denied an association between chocolate and acne before 1970 were small and/or did not account for caloric intake, weight, presence of obesity, or control for regular dietary patterns.<sup>23,26</sup> Furthermore, the incidence of obesity steadily rose in North America from the 1980s to the late 2000s,<sup>29</sup> thereby creating a high rate of background insulin resistance. The subjective nature of self-reported data and the inability to distinguish between chocolate and sweets in newer studies on this subject provides little evidence for the causative association between acne and chocolate alone.<sup>11</sup> The chocolate and acne dilemma still lacks sufficient proof.

It would be reasonable to assume that the consumption of sweets could increase the overall glycemic load and dairy consumption may further exacerbate comedogenesis. Patients may then be instructed to specifically limit consumption of chocolate foods high in sugar and milk as opposed to those high in cocoa (ie, dark chocolate).

In reference to excess salt intake, sodium may lead to comedones while chloride overload produces the inflammation and pustules.<sup>25</sup> Although the results are based on a small number of study participants, it is reasonable to assume that some patients may benefit from salt restriction.

Although evidence is limited, it is wise to advise patients wishing to resolve their acne symptoms to avoid saturated and hydrogenated fatty acids such as fried food and potato chips.

Obese individuals (body mass index, >27) show increased levels of androgens, especially free serum testosterone. The association of hyperandrogenism and acne vulgaris has been described in the setting of hyperandrogenism, insulin resistance, and acanthosis nigricans syndrome (HAIR-AN), a subvariant of the metabolic syndrome, as well as other endocrinopathies in which excess androgens are noted (eg, polycystic ovaries).<sup>30,31</sup> The discrepancy between androgen levels found in acne patients in the 2010 study by Yang et al<sup>6</sup> may be due to differing degrees of androgen sensitivity between normal and obese individuals. Also, the higher age group in the Yang et al<sup>6</sup> study (average age, 27.8 years) as opposed to the study by Abulnaja<sup>12</sup> (age range, 16–22 years) may account for differences in the results. More work is needed to understand the association between acne and obesity. However, preliminary results point to obesity in adolescence as a contributor in the multifactorial development of acne. Interestingly, studies that show acne relief due to low glycemic load diets also show marked

decrease in weight,<sup>15,18</sup> which may be an effective mechanism for obese adolescents to resolve symptoms of acne while achieving a healthy weight.

Other factors that may play a role in acne are low meal frequency<sup>5</sup> and a lack of raw vegetable consumption.<sup>11</sup> Investigation into these dietary aspects also may provide clinical guidance for the treatment of acne vulgaris.

## Conclusion

Environmental factors have been shown to play an important role in the exacerbation of acne vulgaris symptoms. Patients who report disfiguring aspects of acne should be guided to avoid high glycemic load diets (ie, processed foods, refined sugars), limit milk consumption while supplementing with calcium and vitamin D, and maintain a healthy weight. Further studies are required to delineate the role of specific dietary components (eg, casein, saturated fats, chocolate) versus overall dietary intake (eg, obesity, low glycemic index diet) as acne promoters in the general population.

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