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Caroline Moulton
University of Mississippi

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COLLEGE STUDENTS' KNOWLEDGE OF THE RELATIONSHIP BETWEEN DIET AND
FACIAL ACNE

By
Caroline Moulton

A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of the
requirements of the Sally McDonnell Barksdale Honors College.

Oxford
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Approved by

Dr. Melinda Valliant

Ms. Emmy Parkes

Dr. Kathy Knight

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ABSTRACT

A common struggle for many young adults is the infamous acne vulgaris. Americans spend millions of dollars on acne medication, treatments, and dermatology and cosmetic visits each year. One area that is greatly lacking in research is the relation of nutrition and facial skin appearance. In clinical settings this topic is not commonly discussed, but evidence shows diet changes could greatly benefit those struggling with acne. The present study sought to investigate the knowledge of college students regarding various food and beverage items and facial skin appearance by electronically distributing a self-report survey to a sample of 385 college students at the University of Mississippi. The survey consisted of fifteen questions regarding gender, age, food items or supplements, beliefs about what can negatively affect facial skin appearance, the importance of facial skin appearance and from whom they received their information. The results of the study revealed several gaps between the beliefs of students and the literature findings regarding the impact of various food items on facial skin appearance. These gaps include dairy's effect on facial skin appearance, water intake and facial skin hydration levels, processed foods or salty foods effects on facial skin appearance and other food items.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION.....	6
CHAPTER 2: REVIEW OF LITERATURE.....	7
CHAPTER 3: METHODS.....	23
CHAPTER 4: RESULTS.....	25
CHAPTER 5: DISCUSSION.....	32
REFERENCES	

INTRODUCTION

Advances in modern medicine and technology have increased the average life span and thus increased personal emphasis on areas related to appearance. Skin is the largest and most visible organ in the body, and in recent years public attention has been focused on the importance of a clear and glowing facial skin appearance. On average, Americans spend 43 billion dollars per year on topical creams, cosmetic enhancements, and other treatments in an attempt to achieve a desired facial appearance (Neill, 2018). Although there is much attention to topicals such as creams and ointments and steroids, there is not as much attention given to the relationship of nutrition and skin care. Researchers are beginning to realize that diet may just be the key to a desired facial skin appearance. The relationship of chocolate, dairy foods, fast food, greasy food, fruits and vegetables, highly processed foods, soft drinks, water intake and collagen supplements with skin have all been investigated, but current research provides very little definitive information on this topic. With so few published studies, there is need for more investigation. This is an area that interests many, as facial appearance can impact overall confidence for many individuals. It can be frustrating for individuals with acne that cannot seem to find a solution or cannot tolerate the side effects of their medication. Acne vulgaris is an extremely common condition but the causes vary greatly from person to person, making it hard for dermatologists and other skincare experts to fully identify risk and causation. The overall risk of developing acne at some point during a lifetime is 85-90%, if residing in a developed country and eating a Western diet (Danby, 2015). The results may be different if not eating what was considered a Western diet. Therefore, additional research regarding the role of diet would be beneficial and could provide a more cost-effective treatment for many individuals if it could solve their skincare concerns and elevate their confidence.

REVIEW OF LITERATURE

Basics of the Skin Structure:

The skin is classified as an organ because of its key role in supporting many physiological processes. These processes include thermoregulation, vitamin D synthesis, environmental or mechanical protection, sensing stimuli, and moisture regulation (Ahmed 2020). The skin is divided into three regions: the epidermis, the dermis, and the hypodermis. The epidermis is the outermost layer and protects the other layers of the skin from external factors or potential damage. The middle layer, the dermis, contains connective tissue, hair follicles, and sweat glands. The hypodermis is made up of connective tissue along with fat (Chandrasekar, 2020). The outermost layer of the epidermis, the stratum corneum, contains the skin barrier and corneocytes. In the skin barrier there are many tight junctions which attach to the lateral walls of the keratinocytes (Ahmed, 2020).

The largest component of the skin is the extracellular matrix. The extracellular matrix is a network of proteins and carbohydrates, constructed of collagens, proteoglycans/ glycosaminoglycans, elastin, fibronectin, laminins, and several other glycoproteins. The skin receives its smoothness and elasticity from mainly collagen, elastin, and hyaluronic acids. Collagen acts as the main strengthener of the skin. The elasticity of the skin is maintained by elastin and hyaluronic acid plays a role in maintaining the moisture of the skin by filling the free spaces of the skin matrix with water. This is what gives the skin a fuller, firmer and youthful appearance (Ahmed, 2020).

The skin is our most vulnerable organ, as well as the most visible. First impressions are of utmost importance in today's society when it comes to interviewing for a job position, seeking

new relationships, or just meeting other strangers day-to-day. Thus, the skin is commonly seen as a social interface (Ahmed, 2020).

Scientists have claimed that a healthy balanced diet and lifestyle habits can help delay skin aging and improve skin conditions. Looking more specifically, diets such as the Mediterranean diet with added antioxidant supplements could be the key to achieving a desired facial skin appearance. More specifically these authors state that vitamins C and E, exercise, adequate sleep, and the avoidance of both high glycemic index foods and alcohol consumption is their recommendation (Ahmed, 2020).

Types of Acne

There are three main types of acne: acne vulgaris, acne rosacea, and acne hidradenitis suppurativa. Acne vulgaris is the most common type and one of the most frustrating and difficult kinds of lesions to deal with. It is very troublesome for many young adults and in short comes from an excess of sebum secretion in the skin. Though acne vulgaris is not life threatening, or a pressing medical issue, it can greatly alter an individual's quality of life (Chandrasekar, 2020).

Acne vulgaris begins when the follicular pilosebaceous units (FPSU) are plugged and begin to produce one of two different kinds of comedones. A closed comedone is usually referred to as a whitehead, and an open one referred to as a blackhead. Genetics, diet, hormones, and stress are all known triggers to acne formation. With diet specifically, Danby explains that acne is caused by the male hormone dihydrotestosterone (DHT) which links to an androgen receptor. This he compares to putting a key into a keyhole, but the catch is androgen (the keyhole) needs to be open to be prepared to accept the key. For androgen to be open it must have insulin, or a similar growth factor (IGF-1).

Common Methods of Treatment:

A combined approach of topical products and treatments along with oral medications is the current treatment for acne vulgaris. Rona (2008) explains that the rationale behind the combined approach is that two different ways of attacking acne - one from outside and one from inside of the skin - can give a fuller treatment. Although topical treatments are not useless, there is no guarantee that the treatment will be absorbed fully to the target area. Food supplements should be seen as either an alternative or as part of a combined approach to combating skincare problems. Oral treatments or medications exist due to the close relationship between skin and a person's diet. However, even oral medications or products can have a low active effect. Nutritional supplementation could help make up for common nutritional deficiencies in the skin including zinc, vitamin B12 deficiencies, and others (Rona, 2008).

Retinoids are a class of drugs that generally work in three ways: they empty plugged pore, protect open pores, and control the inflammatory response. Isotretinoin, or Accutane, is the oral form and is usually reserved for the most extreme cases of acne vulgaris, because it can have fairly substantial side effects including chapped lips, sensitivity to the sun, depression, thinning hair, headaches and tiredness, digestive issues, joint pain, and severe birth defects if a woman becomes pregnant while using the medication. Isotretinoin reduces sebaceous gland output and minimizes sebaceous glands (Danby, 2015).

Benzoyl peroxide and salicylic acid are both common topical treatments for acne. Benzoyl peroxide is an oxidizing agent and can be used either on its own or in a combined approach. The product works by drying out the skin that is clogging the pores in the applied area. These products also work by killing the bacteria and slowing the bacteria's reproduction rate. Those individuals with extremely sensitive skin, or who use the product too frequently or at too

high of a dose, may become allergic to the product. Salicylic acid is a milder option and lipid soluble option which allows it to travel deeper into the skin (Danby, 2015).

According to Danby (2015), an ideal acne therapy consists of a no-dairy diet, a low intake of high-glycemic foods, an initial low-dose Isotretinoin medication and the use of birth control medication for women. Birth control medication can help control women's hormones, another trigger for acne vulgaris. However, the lowered amounts of estrogen that are in birth control pills today is not as effective in acne control, as they had been years ago. Danby recommends that birth control medication should be taken using the 84/7 regimen, usually accompanied by spironolactone medication. An 84/7 regimen means that an individual would only take the active pills for 21 days, 4 times, moving onto the next package without using the placebo pills in between. Danby explains that this will decrease androgen blockage and the number of menses a woman has. Spironolactone is not as effective of a drug as Isotretinoin, but it can also assist in plugging the pores. The medication was the first androgen blocker to be used in the treatment of acne and was originally marketed for high blood pressure patients. Spironolactone blocks the androgen receptor thus decreasing its effect and increasing estrogen levels. The author further explains that this ideal treatment plan would eliminate the need for as many pricy topical creams and any long-term antibiotic use with hefty side effects. Some of the most common topical creams can cost upwards of \$100. Greater education to patients of the benefit of a healthier diet would not only help their skin and overall health, but it would also help save the patient money and visits to the doctor's office (Danby, 2015).

Dietary Components Related to Acne:

Acne is extremely common, affecting close to 85% of the population. Population studies have also found that there is a greater prevalence of acne in western civilizations where

individuals follow a western style of life, versus those who reside in more rural communities. Researchers state that individuals following a western style of life consume a greater high-glycemic load diet compared to their counterparts. More studies are beginning to look at the question of acne related to diet.

Chocolate:

There was a study conducted by the Department of Dermatology, Pontificia Universidad Católica de Chile, between November 2009 and April 2010. Dietary habits of acne patients were compared with those of a healthy cohort to examine potential association between various foods and acne vulgaris. There was one non-acne control group made up of 40 patients between the ages of 13 to 25 and a group of 40 acne patients in the same age range. In the 40-person acne group, both duration and severity of the disease and post treatment attempts were assessed. The patients took a survey to report how often they ate certain foods in an average week and the results were then statistically analyzed. In the study, 27% of the individuals noticed an exacerbation of acne when they consumed chocolate specifically. Author F. William Danby, adjunct assistant professor of surgery section of Dermatology, writes in his book *Acne: Causes and Practical Management* that he recommends a low-glycemic index diet. He further explains that only the non-sweetened varieties of chocolate should be consumed to follow his advised diet regimen.

In 1969, there was a research paper published regarding the effect of eating a chocolate bar daily for a month on acne. The study was highly criticized for several reasons, including the use of non-identical fats in the two chocolate bars, a lack of controls, small sample size, and the short length of the trial. The research paper wrongly claimed that diet had no effect on acne. A University of Miami study was published in 2014, which contradicted the previous study and

claimed that a higher consumption of chocolate did in fact lead to acne. However, the study was criticized for its short length and more studies need to be conducted (Danby, 2015).

It is notable that even though regular milk chocolate is likely a contributor to acne, pure dark chocolate may be beneficial to include in one's diet. Dark chocolate is classified as a nutritional hormetin, which has a multitude of health benefits (Ahmed 2020). According to Skin Resource MD Cosmeceuticals company, the statement that chocolate causes acne is a myth. However, they agree that dark chocolate is the much better choice, as it has nutritional value that milk chocolate does not. They recommend choosing dark chocolate with 70% + cocoa powder and lowered amounts of sugar. Milk chocolate normally only has around 7-35% cocoa powder and much higher amounts of both sugar and dairy. Dark chocolate contains antioxidants and flavanols. Both of these components are favorable due to their ability to lower blood pressure and improve blood flow in the body. More studies need to be completed regarding the relation of chocolate and acne. However, currently, it should be recommended to acne patients to steer clear of milk chocolate and choose pure dark chocolate whenever possible (Debunking, 2021).

Water:

The Mayo Clinic recommends an 8x8 rule to individuals, meaning one should drink eight glasses of water a day, or 64 ounces. In certain situations, such as an individual who exercises frequently or is in great amounts of heat, more water may be needed. In today's culture the media plays a large part in offering information to a great deal of society, whether fiction or nonfiction. There are mixed opinions between the media and scientists regarding whether water truly affects the appearance of the skin or not. The American Society of Nephrology looked further into this question and did not find a benefit to drinking increased amounts of water. They concluded that there is not substantial evidence to support or disprove the water intake recommendation (Wolf,

2010). Another review article by Vatlin H. et al. (2002) had a similar point of view. The article's conclusion stated that while there is no evidence that supports the 8x8 rule, there is also no evidence against it. Most studies that have looked into this question have found that unless certain circumstances are occurring, we are likely drinking enough water naturally, or potentially even more than we need. Special circumstances where individuals should be drinking more water include spending time in extreme climates, long airplane travel, and while enduring physical activity. The author then further explains her rationale that the osmotic regulation of vasopressin secretion and the body's receptors for thirst occurs quickly, making her believe that humans should only need water when they are thirsty. This is an interesting point of view, as currently most physicians always recommend drinking more water for any sort of health benefit an individual is seeking.

In a study by Williams et al. (2007), long-term water intake was analyzed with skin physiology. The long-term water intake was classified as 2.25 liters daily of mineral water or tap water. Though this study was not directly related to acne vulgaris, the researchers looked at skin density and increased skin thickness. The researchers found that the group that drank excess water for four weeks had an increased skin thickness and a decreased skin density at the end of the period. The results were most substantial for the participants who only drank small amounts of water previously. However, the researchers had no explanation for the different results.

It is important to understand the structure of the skin and its association with water. Doctors are taught in medical school how to successfully assess dehydration by assessing skin turgor. When the skin is pinched it should return immediately to its original form, but if an individual is dehydrated the skin will hold up to 30 seconds. This is an important skill for all of society to learn to gauge if they are dehydrated. The main water reservoir of the skin is the

dermis, but the stratum corneum is the key structure that makes up the main appearance of the skin, including the skin's elasticity and the surface roughness. The extracellular matrix makes up about two-thirds of a person's skin tissue volume and is made up of approximately 50% fluid. The movement of the fluid depends on six main variables, referred to as the Starling equation. The variables include: the reflection coefficient, the filtration coefficient of the capillary wall, interstitial oncotic pressure, capillary oncotic pressure, interstitial hydrostatic pressure, and capillary hydrostatic pressure. Evidence shows that a rapid fluid intake or infusions could lead to an increased interstitial volume or edema. More evidence is still needed regarding the truth of the 8x8 water intake recommendation (Wolf, 2010).

As explained by the University of Wisconsin regional health system, even though organs need water to function efficiently, the skin is the last organ that water is brought to. Therefore, one must purposefully hydrate their skin by doing more than just drinking water that any of their organs could use. The University of Wisconsin regional health system recommends using a hydrating moisturizer when the skin is most vulnerable, preferably after bathing in a bath or shower. This is when the skin is most receptive to absorbing products. Another option is using hyaluronic acid. Hyaluronic acid is said to hold 1,000 times its weight in water, thus keeping the water on the skin. Although there is no clear scientific evidence at this time that drinking water will help your skin appearance, many individuals self-report that they see more of a glow in their skin when they drink ample amounts of water (University of Wisconsin Hospitals and Clinics Authority).

Skin Resource MD company has similar findings regarding water and skin hydration. The company also explains that drinking water is actually the least effective way to hydrate your skin. They illustrate that first water goes through both the digestive tract and the bloodstream

before making its way to the kidneys to be filtered. The other cells of the body will receive the water before the skin cells do. Therefore, Skin MD ultimately recommends the use of moisturizers and serums for optimal skin hydration, as they will greatly assist in locking in moisture. There are many highly thought of moisturizers and hyaluronic acid serums on the market for consumers to choose from (Debunking 2021).

Greasy Foods:

A survey that looked at the beliefs regarding the link of acne and diet was distributed by Nguyen et al. (2016) and completed by 49 individuals at an academic dermatology clinic. Out of the 92% of respondents that stated they believed diet could affect acne, 71% believed acne was caused by greasy or fried foods. Out of the survey group, 20% of respondents then reported improvements with a lowered consumption of fried or greasy foods, the highest reported acne improvement with dietary change. However, Nguyen et al. explain in their article the large misconception amongst society that greasy food is the main culprit when linking diet and acne. The authors' research suggested that high glycemic index foods items can affect the skin the most. Though acne patients should still refrain from eating too much greasy food, more clinical attention should be spent explaining that consumption of some seemingly harmless foods such as white bread and pasta or other refined foods can be troublesome for those eating an already high glycemic index diet (Nguyen, 2016).

According to Skin Resource MD cosmeceuticals company, greasy food will not directly cause acne. However, those who consume greasy food and touch their face without properly washing their hands first can develop breakouts. A diet filled with many fruits and vegetables is undoubtedly preferred but greasy food consumption from time to time will not directly cause breakouts (Debunking n.d.).

Vitamin C:

A biochemist named Margreet Visser looked at the effects of vitamin C on skin health. Visser states that the skin makes up 10-15% of our body weight. She emphasizes the role the skin plays in protecting from dangers, including damage from ultraviolet rays, pollutants and infections. The epidermis, the outermost layer, also frequently renews itself at roughly a monthly rate. All of these processes require a great deal of nutrients and energy. Vice president of bioscience research at Unilever in London, John Casey, further explains that although external factors can affect our skin, it is difficult for the skin to receive any external nutrients. This can be confusing to society since pollutants, and other environmental factors, can definitely make their way through the skin. However, Casey explains that many vitamins and minerals or essential compounds are water soluble and too large, making them unable to pass through all of the layers of the skin. With this being said, the exact diet one should follow for ideal skin appearance is not clear. In large, the current advice given, from Visser's point of view is to follow a diet high in a large selection of fruits and vegetables and other unprocessed foods. Researchers have been struggling to outline a more specific diet for maximum skin benefit (DeWeerd, 2018).

One area in which Visser has spent a great amount of time researching specifically is the role of vitamin C in the body. She emphasizes how crucial it is for the skin to receive vitamin C and compares it to an important link in a long chain of processes that would not work without it. Furthermore, vitamin C aids in the production and maintenance of the protein collagen. Collagen is the protein that gives skin its underlying structure and plump appearance. Collagen also increases the rate of cell proliferation and the movement of fibroblast. Fibroblasts are the cells responsible for collagen production and work in regulating the signaling pathways during

inflammation, when a wound is trying to heal. Scientists were already aware that a lack of vitamin C in the diet could lead to a condition involving dry skin called Scurvy, but they are now also seeing a direct link between vitamin C consumption and vitamin C amounts in the skin.

There have been several studies conducted regarding what diets decrease many signs of aging. In these studies scientists predominantly looked at what keeps the skin youthful, plump, dewy, firm, and unwrinkled. More studies are needed regarding vitamin C consumption through foods in relation to acne, but Visser's research looks promising that foods high in vitamin C could help the appearance of the skin (DeWeerd, 2018).

Dairy Foods:

Both milk products and milk raise the growth factor and insulin levels. The interesting part about milk or dairy products, however, is that they also contain androgens (the key), making it a double threat to your skin. Milk and milk products even have other hormones that can turn into more androgens. Lowered levels of dairy intake have been seen to greatly help in managing acne vulgaris. These effects are usually clearer with males, as females' levels of acne vulgaris are also often affected by the cycle of their menstrual hormones. However, restricting dairy intake is not a quick fix and it may take months before improvements begin to show. This lowered dairy intake in combination with a low-glycemic (low carbohydrate) diet should preferably be carried out for a full six months. Even if the patient does not take isotretinoin medication, most individuals can clear up their acne almost 100%. However, there could be some scarring or discoloration left in the skin. After the six-month period ends, the individual can become a little more lenient with their diet or choose to maintain it, which dermatologists of course prefer. With cheese specifically, Danby recommends as little as possible. For patients that

absolutely love cheese, Danby will advise one ounce per week or a tiny taste occasionally, but it should no longer be seen as a food option in their diet (Danby, 2015).

The American Academy of Dermatology (AAD) says that “according to current data and research, there are no dietary changes recommended to manage your acne. Limited evidence does suggest that milk, specifically skim milk, may influence acne” (Bend Dermatology Clinic, 2020). The academy also notes that more data is becoming available relating high glycemic index foods to acne vulgaris. In sum, all sources pertaining to this subject matter believe that having a healthy diet would do no harm and only a potential benefit for individuals looking to improve their acne.

In the study conducted by the Department of Dermatology between November 2009 and April 2010 discussed earlier, 58% of the participants noticed an exacerbation with foods, predominantly dairy, and butter specifically in 30% of individuals. Additionally, when both the acne group and the healthy cohort were compared, the acne group had greater ice cream consumption (75% versus 47%, $P=0.021$). With milk, the acne group also had a greater consumption milk (97% versus 82%, $P= 0.028$) (Salomone, 2012).

The Skin Resource MD company agrees that milk and milk products can be harmful for patients that suffer from acne. They explain that dairy foods may trigger our bodies in ways that lead to acne development for some of the same reasons that certain individuals have such a hard time digesting dairy foods. The source states that the hormones found in cheese, milk, yogurts, or other dairy products may produce excess sebum. Hormone-free milk and dairy options may be a safer option. As discussed earlier, excess sebum can lead to acne vulgaris. Acne from dairy specifically will often develop around the jawline or chin and usually will be cystic acne. Cystic

acne resides under the skin and is painful and hard and takes a longer time to heal (Debunking, n.d).

Salty Foods:

In the article by Darouti et al. (2016), the authors examined the question of salty, or spicy foods, and acne development. Many patients reported that they believed these foods made their acne worse. The researchers conducted a study consisting of 200 patients with acne vulgaris at a dermatology clinic compared to a 200-person control group of non-acne patients. A questionnaire was taken by each individual where they answered general information and questions regarding the duration of their acne, treatments, and severity. Next, a 24-hour diet recall was taken from every individual. Spicy foods included spicy potato chips, hot sauce, and spicy corn snacks. Each patient also reported if they personally felt their acne grew worse after consuming salty or spicy foods. Amounts of acne were assessed using the International Consensus on Acne Classification. Next the data was evaluated using statistical methods. There was a significantly higher percentage of salt intake in acne patients compared to the healthy cohort. However, the number of spicy foods consumed by the acne cohort and the healthy cohort were essentially equal, meaning there is likely no correlation. Therefore, the authors believe acne patients should consider lowering their salt intake and further studies should be carried out with larger sample sizes (Darouti, 2016).

Processed Foods:

Many processed foods are also considered high glycemic index foods. In most cases, the foods with high glycemic index ratings are highly refined carbohydrates. A glycemic index is a measurement of how fast the carbohydrate is digested. Most studies looking at the correlation between acne and diet have agreed that high glycemic index food consumption should be greatly

reduced. Some ingredients in several processed foods have not been researched enough for us to know what they truly do in our body. Author F William Danby discusses the story of a patient who was suffering from great amounts of acne. After her fourth round of Isotretinoin, she realized a certain unnamed processed cheese product may be why her acne continued to relapse. This patient had not realized that this certain processed cheese product was considered dairy. Danby explains that this certain product uses a product called milk protein concentrate (MPC). MPC is made when milk is filtered through an ultrafine mesh. The product can then lock in more whey and water than a traditional cheese, but it is not an approved food additive, which raises concern.

Many sources all agree that a diet centered around as many fruits and vegetables as possible is recommended for anyone looking to improve their acne. Biochemist Margreet Visser who was discussed earlier in the Vitamin C section, offers that in combination most sources state to “eat a varied diet full of fruits, vegetables and other unprocessed food” for those wishing to see skin improvement (DeWeerd, 2018). The “Comparative Study of Dietary Habits between Acne Patients and a Healthy Cohort” article that was mentioned earlier, also argues that cow milk products and high glycemic foods are the worst for acne patients. Foods examined in their study include chocolates, carbonated drinks, juices, sweets, cakes, pies, junk food, milk and milk products, dried fruits, bread, white rice, potatoes, fish and shellfishes, fruits and vegetables. In the “Anti-Aging Diet and Supplements: Fact or Fiction ” journal article by Jurga Adomaityte MD et al., the authors ultimately recommended a Mediterranean Diet to decrease the appearance of skin aging. This kind of diet mainly consists of fruits and vegetables, legumes, fish, olive oil, and tree nuts (Adomaityte, 2014).

The study referenced earlier by the Department of Dermatology looked at dietary habits between an acne cohort and a healthy cohort, specifically comparing consumption of many different processed or high glycemic foods. When dietary habits were compared between the acne cohort and the healthy cohort the results were as follows: juices with sugar (65% versus 35%, $P= 0.007$), carbonated drinks (67% versus 47%, $P= 0.05$), bread (95% versus 72%, $P= 0.013$) and white rice (100% versus 90%, $P=0.05$). High glycemic index foods were considered to be bread, white rice, carbonated drinks, juices with higher sugar content, and ice creams. Notably, there was also a lower consumption of fruits (85% versus 97.5%, $P= 0.05$) and vegetables (75% versus 97.5%, $P=0.03\%$). These findings suggest that a substantial consumption of fruits and vegetables could be seen as a protective factor against acne development. The authors conclude that greater information regarding the benefits of diet with an increased fruit and vegetable consumption would be beneficial for acne patients (Salomone, 2012).

Collagen Supplements:

Taking collagen supplements has become a recent trend. Some individuals add a collagen powder to their smoothies or take a collagen pill each day. However, these supplements are not FDA approved and most of them have no evidence behind the claims on the bottles. According to the Nutrition Business Journal, US buyers spent nearly \$122 million on collagen supplements in 2018 (Walsh, 2019). The authors of the article spoke with Dr. Tom Rifai and a registered dietitian nutritionist named Jeanna Gorham to hear about their views on the collagen supplement bandwagon. There is limited scientific research on the benefits of collagen supplements, but it is a sure fact that collagen plays a crucial role in the skin structure. As mentioned earlier, collagen offers elasticity and structural reinforcement, but the amount decreases as individuals age, which is what makes wrinkles and sagging occur. However, supplements will not be able to target a

specific area of the body. Once they are digested there is no way to guarantee that the collagen goes to the facial skin. Additionally, some supplements have even been found to have traces of metals or animal bones in them. A smarter use of resources would be to consume foods with high levels of vitamin C, which aids in collagen production. Other foods that can increase collagen production include bone broth, chicken, egg whites, and different berries (Walsh, 2019).

Similarly, an article by Prem (2019) explains that Vitamin C supplements can aid in the increase of collagen production, which is especially beneficial as the skin ages. The article explains that collagen can be found in both the muscles and bones of the body and it works in balancing cell structure. However, as individuals age the production of collagen decreases and the skin begins to loosen. Vitamin C will increase collagen production and works as an anti-inflammatory. In sum, consuming collagen supplements has no true benefit and since they are not FDA approved, they could even be doing the body harm. Consumers would have more benefit by seeking out foods high in vitamin C to increase collagen production naturally (Prem, 2019).

METHODS

The survey was distributed via Qualtrics to undergraduate students enrolled in a southern university. Informed consent was given to each participant providing them the option to proceed or stop the survey. Institutional Review Board (IRB) approval was obtained, and the survey was exempt under protocol #21x-192. All of the responses of the survey were self-reported and participation in the survey was completely optional for all students.

All of the students were the age of 18 or older and they were asked the following questions to gauge their beliefs and understanding of the relation of nutrition and facial skin appearance. The questions asked were:

1. Do you agree? Yes or No
2. What is your gender? Male or Female
3. Please select your age here; do not continue this survey if you are under the age of 18.

Please answer the following with 0 = not at all and 5 = very much.

1. Do you think drinking water can help the appearance of your skin? 0 1 2 3 4 5
2. How much does your facial skin appearance mean to you? 0 1 2 3 4 5
3. How much do you think greasy food (french fries, potato chips, pizza, etc) can have a negative impact on the appearance of your facial skin? 0 1 2 3 4 5
4. How likely are you to believe information from social media about skincare and nutrition? 0 1 2 3 4 5
5. How much do you think chocolate can have a negative impact on the appearance of your facial skin? 0 1 2 3 4 5
6. How much benefit do you think consuming foods with high levels of vitamin C can positively impact the appearance of your facial skin? 0 1 2 3 4 5
7. How much do you think milk, or skim milk, can have a negative impact on the appearance of your facial skin? 0 1 2 3 4 5

8. How much do you think dairy foods (cheese, yogurt, other), other than milk, can have a negative impact on the appearance of your facial skin? 0 1 2 3 4 5
9. How much do you think salty food can have a negative impact on the appearance of your facial skin? 0 1 2 3 4 5
10. How much do you think collagen supplements (powder, pills, etc) can have a positive effect on the appearance of your facial skin? 0 1 2 3 4 5
11. Are there foods you avoid specifically due to maintaining a desired facial skin appearance? 0 1 2 3 4 5
12. How much do you think processed foods (breakfast cereals, microwave meals, soft drinks, crackers, canned/jarred sauces and foods, etc) can have a negative impact on the appearance of your facial skin? 0 1 2 3 4 5

RESULTS

A total of 358 participants completed the online survey, 279 (77.9%) were female students, 65 (18.2%) were male students, and 4 students preferred not to say their gender. Of the total results, 30 students (8.4%) reported their age as 18 years old, 40 students (11.2%) reported their age as 19 years old, 59 students (16.5%) reported their age as 20 years old, 109 (30.4%) students reported their age as 21 years old, 93 students (25.6%) reported their age as 22 years old, and 21 students (5.9%) reported that they were 23 years or older. Lastly, 6 individuals that began the survey did not report their age.

In response to the question, “Do you think drinking water can help the appearance of your skin?”, 187 students (52.2%) selected very much, and 76 students (21.2%) selected the second highest positive value.

In response to the question, “How much does your facial skin appearance mean to you?”, 162 students (45.3%) selected very much, and 94 students (26.3%) selected the second highest positive value.

In response to the question, “How much do you think greasy food (French fries, potato chips, pizza, etc.) can have a negative impact on the appearance of your facial skin?”, 110 students (30.7%) selected very much, 95 students (26.5%) selected the second highest positive value and similarly 83 students (23.2%) selected the third highest positive value.

In response to the question, “How likely are you to believe information from social media about skincare and nutrition?”, 128 students (35.8%) selected the third highest positive value and 91 students (25.4%) selected the third lowest value.

In response to the question, “How much do you think chocolate can have a negative impact on the appearance of your facial skin?”, 96 students (26.8%) selected the third highest positive value, and 87 students (24.3%) selected the third lowest value.

In response to the question, “How much benefit do you think consuming foods with high levels of vitamin C can positively impact the appearance of your facial skin?”, 113 students (31.6%) selected the third highest positive value, and 98 students (27.4%) selected the second highest positive value.

In response to the question, “How much do you think milk, or skim milk, can have a negative impact on the appearance of your facial skin?”, 76 students (21.2%) reported the third highest positive value, and 73 students (20.4%) reported the third lowest value.

In response to the question, “How much do you think dairy foods (cheese, yogurt, other), other than milk, can have a negative impact on the appearance of your facial skin?”, 85 students (23.7%) selected the third highest positive value, and 70 students (19.6%) reported the third lowest value.

In response to the question, “How much do you think salty food can have a negative impact on the appearance of your facial skin?”, 89 students (24.9%) selected the third highest positive value and closely behind 86 students (24.0%) selected the third lowest value.

In response to the question, “How much do you think collagen supplements (powder, pills, etc) can have a positive effect on the appearance of your facial skin?”, 99 students (27.7%) selected the third highest positive value, and 74 students (20.7%) reported the third lowest value.

In response to the question, “Are there foods you avoid specifically due to maintaining a desired facial skin appearance?”, 148 students (41.3%) reported not at all, the lowest option, and 55 students (15.3%) reported the second lowest option.

In response to the question, “How much do you think processed foods (breakfast cereals, microwave meals, soft drinks, crackers, canned/jarred sauces and foods, etc.) can have a negative impact on the appearance of your facial skin?”, 88 students (24.6%) reported the third highest option, and 74 students (20.7%) reported the third lowest option.

Table: Question and Corresponding Answer Breakdown

Survey Question	Answer: 0	Answer: 1	Answer: 2	Answer: 3	Answer: 4	Answer: 5
Do you think drinking water can help the appearance of your skin?	0	4	6	49	76	187
How much does your facial skin appearance mean to you?	0	4	10	52	94	162
How much do you think greasy food	0	4	10	52	94	162

can have a negative impact on the appearance of your facial skin?						
How likely are you to believe information from social media about skincare and nutrition?	11	41	91	128	46	4
How much do you think chocolate can have a negative impact on the appearance of your facial skin?	6	21	37	113	98	47
How much benefit do you think consuming foods with high levels of	6	21	37	113	98	47

vitamin C can positively impact the appearance of your facial skin?						
How much do you think milk, or skim milk, can have a negative impact on the appearance of your facial skin?	35	46	73	76	51	41
How much do you think dairy foods, other than milk, can have a negative impact on the appearance of your facial skin?	33	35	70	85	53	46
How much do you think salty food can have a negative	35	43	86	89	48	21

impact on the appearance of your facial skin?						
How much do you think collagen supplements can have a positive effect on the appearance of your facial skin?	14	32	74	99	65	38
Are there foods you avoid specifically due to maintaining a desired facial skin appearance?	148	55	26	39	24	30
How much do you think processed foods can have a negative impact on	25	32	74	88	52	51

the appearance of your facial skin?						
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DISCUSSION

According to the 358 survey responses, the majority of students very much cared about the appearance of his or her facial skin; making this a topic that should be further invested. Changing diet is more cost effective and would eliminate the negative side effects that come along with several of the common acne treatments. Additionally, dietary changes would not only benefit the skin but also an individual's overall health. Benefits of healthy eating include a lowered risk of developing health problems including diabetes, heart problems and weakening of the bones. Healthy eating can also increase overall mood, productivity, energy levels and memory (The benefits, 2019). Individuals who follow diets consisting of nutritious foods can also have multiple economic benefits. These benefits include less money spent on medical care and reduced morbidity and mortality, as well as an increased quality of life (Anekwe, 2013). In a clinical setting, more attention should be given to this topic when a health care provider is learning about his or her patient and forming a plan of care. In regard to where individuals receive information regarding skincare and diet from, social media does not seem to play a large role based off of the survey responses in this investigation.

In regard to water and facial skin appearance, individuals thought water made a bigger impact in facial skin appearance than the literature claims it actually does. Though drinking water is undoubtedly beneficial for many other health benefits, moisturizes and hyaluronic acid serums and others are a more sensible fix to make sure you're targeting the desired areas. Once water goes through the body the skin is the last organ that it will reach. This is a topic that should be more widely explained to society as it seems to be a common misconception based off of this survey group of 358 students at a southern university.

In regard to greasy food and facial skin appearance, the students seemed to think greasy food definitely didn't help their skin, but they did not seem to be super convinced that it very much negatively impacts your skin. The literature explains that greasy food likely does not negatively impact our skin as much as either food items could. The literature explains that individuals should be sure to not let the grease from the food touch their skin, but the occasional indulgence is likely not a big problem.

In regard to chocolate, most individuals did not seem to think it greatly negatively impacted the appearance of their facial skin. However, based on the literature, chocolate, a high-glycemic index food, can negatively affect the appearance of the facial skin. However, chocolate is no worse than other high glycemic index foods for the skin. The literature explains that dark chocolate is a much better option for the skin for those who would like to indulge in one of the two types of chocolate. Dark chocolate can have multiple health benefits whereas milk chocolate has none.

With foods high in vitamin C, the individuals who completed the survey did not have a strong belief that it did or did not have a benefit on the appearance of the facial skin. 113 students (31.6%) selected the third highest positive value, and 98 students (27.4%) selected the second highest positive value of the survey options, where n=358. Additionally, the survey respondents had similar beliefs regarding collagen supplements, with 99 students (27.7%) selecting the third highest positive value and 74 students (20.7%) selecting the third lowest value, where n=358. Based on the minimal research on foods high in vitamin C and facial skin appearance, there is little evidence to go by. However, the research completed by biochemist Margreet Visser on the subject matter looks promising. Additionally, in the "Best Vitamins and Supplements for Acne" article, it explains that vitamin C supplements can help increase collagen

production. Generous collagen amounts are crucial for an ideal facial skin appearance. Amounts of collagen in the body will decrease as an individual ages and the skin will simultaneously loosen. Vitamin C can increase collagen production while also acting as an anti-inflammatory. An anti-inflammatory can improve healing time for acne vulgaris. Collagen supplements, on the other hand, are said to have a lack of benefit. The supplements are not approved by the government and can contain questionable ingredients. There is also no way to ensure that the supplements make their way to the face after consumption. Therefore, consuming foods high in vitamin C, instead of collagen supplements, would be a smart consumer decision.

From the survey results, students did not seem to think that either milk, skim milk, or other dairy non-milk foods had that large of an influence on the appearance of their facial skin. When asked for the students' beliefs regarding milk or skim milk in relation to facial skin appearance, 76 students (21.2%) reported the third highest positive value and 73 students (20.4%) reported the third lowest value, where $n=358$. When asked for the students' beliefs regarding dairy foods (cheese, yogurt, other), other than milk, 85 students (23.7%) selected the third highest positive value, and 70 students (19.6%) reported the third lowest value. These survey results were lower than expected, as based on the literature consuming dairy can definitely lead towards excess sebum accumulation, thus leading to acne vulgaris. As explained by author Danby, dairy opens the androgen receptor and contains androgens itself, two reasons why dairy products can increase acne vulgaris levels. Danby recommends a zero-dairy diet for six months to clear up acne for his patients, and only very minimal dairy consumption afterwards to maintain clear skin. In the study by the Department of Dermatology the acne cohort had a higher consumption of both milk and ice cream, compared to the healthy cohort. Skin Resource MD company blames the hormones in milk or milk products on the excess sebum production.

Consumers may benefit from consuming organic, hormone-free, milk or milk products instead. In sum, those struggling with acne vulgaris should definitely consider a reduced, or non-existent, dairy diet based off of this evidence. The finding of this investigation suggests a lack of knowledge regarding dairy consumption and acne.

Students that completed the survey did not believe that salty food consumption did, or did not, have a negative impact on the appearance of facial skin. More studies should be conducted directly looking at salty food consumption and acne vulgaris, as there is minimal literature on this subject matter. From the survey, 89 students (24.9%) selected the third highest positive value and, closely behind, 86 students (24.0%) selected the third lowest value of the survey options. In the article by Darouti et al., there was a 400-person study conducted where researchers looked at correlations of acne with salty foods or spicy foods. There was a significant increase of salt intake in the acne cohort to the health cohort. The authors concluded that acne patients should consider a lowered salt intake, but that more studies with larger sample sizes should be carried out to further validate this.

When students at the university were asked their beliefs surrounding processed foods and negative impact on facial skin appearance, results were also not strong that consumption did, or did not, have a negative impact on the appearance of facial skin. Processed foods were identified in the distributed survey as breakfast cereals, microwave meals, soft drinks, crackers, canned/jarred sauces and foods, etc. The ingredients in processed foods are often confusing and not clear to consumers. These obscure ingredients can be troublesome for some individuals and thus can lead to health issues, such as acne vulgaris. Many processed foods are also considered high-glycemic index foods which are noted to lead to acne vulgaris by authors Danby et al.

Biochemist Margreet Vissers also recommends a rich fruit and vegetable diet with other

unprocessed foods for those seeking an improved facial skin appearance. Another study, “Comparative Study of Dietary Habits between Acne Patients and a Healthy Cohort” noted that high glycemic foods and cow products are the worst foods to consume for those suffering from acne vulgaris. Greater consumption of fruit and vegetables is considered a protective factor against acne vulgaris. From all of the literature reviewed, consumption of processed foods will not help the appearance of the facial skin in any way.

Even though participants in this study seem to have some knowledge regarding skin appearance and nutrition correlation, nearly half of the students expressed that they do not at all avoid foods specifically due to maintaining a desired facial skin appearance. Out of the respondents, 148 students (41.3%) selected the lowest option on the survey, meaning they do not at all avoid foods for this reason. Furthermore, 55 students (15.3%) reported the second lowest option, meaning they very rarely avoid foods due to maintaining a desired facial skin appearance. These results explain that even if some students believe a food item may negatively impact their facial skin appearance, they still may consume the food item.

There were notable limitations of this survey that was carried out. The survey responses were self-reported and only received from undergraduate students at one university. The age of the students only ranged between 18 to 23+. The survey was also completed by a much larger sample of female students compared to male students; therefore, results cannot be generalized to other populations.

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