

Comparative Study of Male and Female Sebum Production

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ABSTRACT

Background: Evidence is given that gender-related differences in skin physiological properties exist. The **aim of this study** was to evaluate the difference between male and female sebum production by measuring sebum production over ½ hour, 1 hour and 1½ hours in both males and females. **Subjects and Methods:** The study included 200 healthy volunteers and was carried out in the Dermatology outpatient clinic- Ain-Shams University – during the period from January and February 2017 (as the sebum secretion is lower during this time of year). A total of 200 healthy male and female subjects (Fitzpatrick's skin types I–IV) with their age ranged from 15-25years old participated in this clinical study after giving avocal informed consent. Participants were divided to 100 males and 100 females. **Results:** Among male participants, it was found that sebum production significantly increase with time; sebum production at 1 hour was significantly higher than that at 0.5 hour; furthermore, sebum production at 1.5 hour was significantly higher than that at 0.5 hour. **Conclusion:** Sex difference is a significant factor affecting the amount of sebum production; which is significantly higher among males in comparison to age matched females. Rate of casual sebum production significantly increase among both males and females over time. **Recommendations** More studies are recommended to determine the factors and mechanism; molecular and endocrinal, behind the strong relation between male gender and the increased amount of sebum production.

Keywords: sebum, males, females, dermatology.

INTRODUCTION

Sebum is a naturally occurring substance that is produced by the sebaceous glands, which are found in the skin of mammals. The primary function of sebum is to moisturize, lubricate and protect skin and hair, maintaining effective, hydrophobic barrier, preventing water loss and the invasion of microorganisms⁽¹⁾.

The composition and rate of sebum production varies between individuals, and it can even vary depending where on the body the sebum is produced. Sebum is a complex mixture of naturally produced fats, oils, waxes, cholesterol and other molecules. It is important to remember that the fats and oils present in sebum do not originate directly from the fats and oils consumed in the diet. Rather, sebum is manufactured and stored by the sebaceous glands under the direction of a highly specialized biological process⁽²⁾.

In human, sebum is composed primarily of glycerides, free fatty acids, wax esters and squalene. Glycerides are more commonly known as “fats” and are molecules of two or three free fatty acids connected together by a glycerol backbone. Free fatty acids are the building blocks of glycerides and other molecules. They are composed of a polar head group and a non-polar (aliphatic tail). Wax esters are molecules composed of fatty acids linked to fatty alcohols by an ester bond. Squalene are hydrophobic chains of carbon atoms that serve as the basic building block for naturally occurring steroids and other types of signal molecules⁽³⁾.

Research has also shown that people with high sebum levels tend to produce sebum that has a different composition than that of people with normal sebum levels. Apparently, people with acne tend to have decreased levels of free fatty acids, but increased levels of glycerides and squalene. Some scientists have proposed that these compositional changes play a role in the development of acne⁽⁴⁾.

The proliferation of sebaceous glands and the subsequent production of sebum is directly regulated by a complex system of hormones and other cellular signals. Going deeper, these hormonal signals are controlled by an even more complex balance that includes genetics, environmental conditions, metabolic conditions, stress, diet, injury and many other factors⁽¹⁾.

Research has shown that sebum secretion levels change in response to seasonal and environmental changes. Sebum production increases in summer. These changes may be due to the increased fluidity of sebum in warmer conditions⁽⁵⁾.

Androgens in male stimulate the proliferation of sebaceous glands, particularly those located on the face, chest and upper back. Individuals with excessively high levels of androgen hormones tend to have higher levels of sebaceous gland proliferation, sebum production and acne vulgaris. Female with elevated androgen levels tend to have higher levels of acne and hirsutism (excess body hair growth). The effect

of androgens on sebaceous gland activity is the explanation why the use of anabolic steroids, which increase androgen levels, can cause acne symptoms ⁽⁶⁾.

Estrogens are female sex hormones. In most cases, estrogens antagonize (suppress) the effects of androgen hormones. This relationship partially explains why acne symptoms tend to change over the course of a woman's menstrual cycles, or during and after pregnancy. Men do not usually produce estrogen hormones. Estrogens may also directly modulate sebaceous gland activity ⁽⁷⁾.

Oral contraceptives can improve acne by four main mechanisms. Firstly, they decrease the amount of gonadal androgen production by suppressing LH production. Secondly, they decrease the amount of free testosterone by increasing the production of sex hormone binding globulin. Thirdly, they inhibit the activity of 5-alpha reductase activity, so as to prevent the conversion of testosterone to the more potent DHT. Lastly, progesterin that has an antiandrogenic effect can block the androgen receptors on keratinocytes and sebocytes ⁽⁸⁾.

Systemic medication which increases sebum secretion includes testosterone, progesterone and phenothiazine. Systemic medications which decrease sebum secretion include retinoids which are cell signalling molecules that are derived from vitamin A. They control proliferation of sebaceous glands and production of sebum. Retinoids are powerful anti-acne drugs. Binding of accutane molecules to specialized receptors on the surface of sebocyte cells causes them to slow down their growth and sebum production ⁽⁹⁾.

Disorders of sebaceous glands include acne vulgaris, rosacea, seborrhea, seborrheic dermatitis, xerosis and asteatosis. Sebaceous gland can also develop tumors such as sebaceous adenoma, ductal adenoma, sebaceous epitheloma and sebaceous carcinoma ⁽¹⁰⁾.

Aim of the Work

The aim of this study is to evaluate the difference between male and female sebum production.

Subjects and Methods

The study included 200 healthy volunteers and was carried out in the Dermatology out patient clinic- Ain-Shams University – during the period from January and February 2017 (as the sebum secretion is lower during this time of year).

A total of 200 healthy male and female subjects (Fitzpatrick's skin types I-IV) with their age ranged from 15-25 years old participated in this clinical study after giving avocal informed consent.

Participants were divided to 100 males and 100 females.

Exclusion criteria

- Age: below 15 and more 25 years old.
- On systemic treatment affecting sebum production eg; isotretinoids, antiandrogen and psychotherapy drugs).
- Patient with endocrinal disorder affecting sebum production eg; polycystic ovaries in females or congenital adrenal hyperplasia that suggested from history of menstrual disturbance or hairsutism.
- Patient Complaining of sebaceous gland disease e.g. acne or seborrheic dermatitis.

Inclusion criteria

- Age ranged from 15-25 (to match the age of maximum activity of hormones of puberty, affecting the activity of sebaceous gland).
- Volunteers free from any skin diseases (or any other physical disorder with cutaneous manifestation).

All participants were subjected to the following

- Full history taking including age, sex, menstrual disturbance and previous medication or being on diet.
- General and external skin examination.
- Oral consent of participating in the study.

METHODS

All participants were asked to wash his or her face 2 h before the measurement with same form cleanser. And they were asked not to wash the face until the three measurements were taken .Sebumetry (Sebumeter_ SM 815; Courage &Khazaka -jurmany) was used for evaluation of sebum production.

The photometry system determines the translucency of a special tape, which becomes transparent after contact with sebum on the skin surface. The light permeability of the tape changes after 30 s ⁽¹¹⁾.

The casual sebum secretion of the forehead was measured as follows:

- Swabbing the forehead (3-15 cm) with alcohol.
- Calibrating the system.
- Applying the hand piece on the forehead (measured area) for 30 seconds. With marking it to avoid wide variation of different face areas.
- Reading the amount of sebum production.
- Repeating the measurement after ½ hour, 1 hour and 1½ hours. At the same marked area.
- Calculating the mean sebum product for each patient.

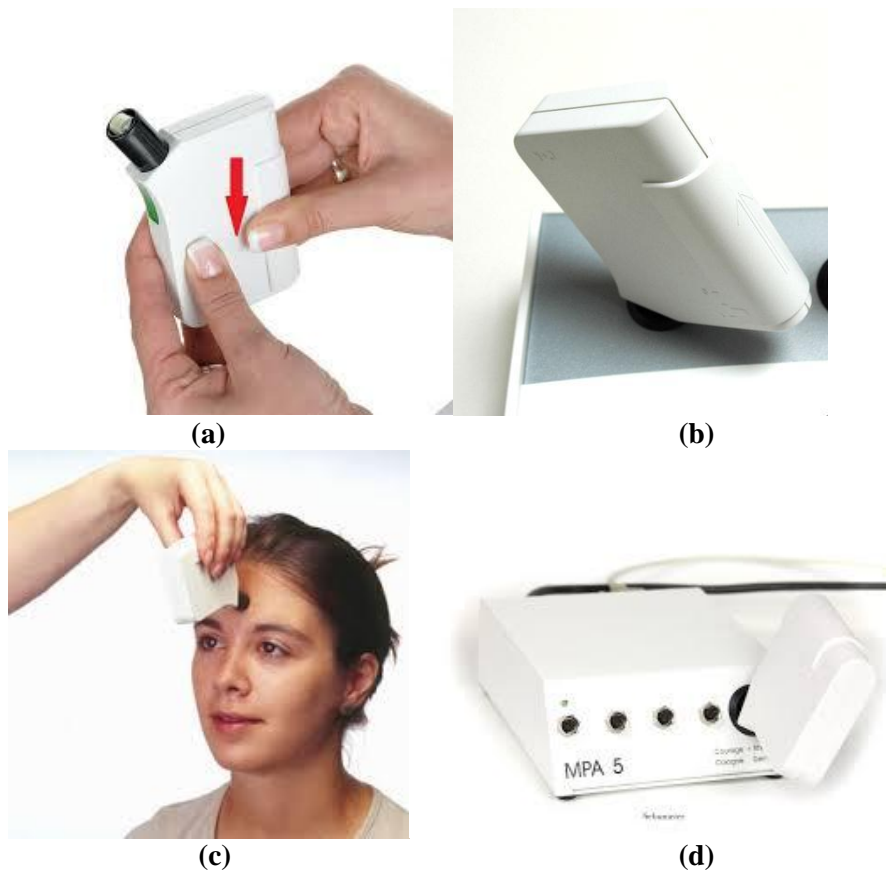


Figure (1): Measuring the sebum secretion in forehead (a) Pulling new tape, (b) Calibrating system, (c) Applying new tape on the forehead for 30 seconds, (d) Measuring sebum (11,12).

The study was done after approval of ethical board of Ain Shams university and an informed written consent was taken from each participant in the study.

Statistical methods

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS (statistical package for social science) soft were version 22.0, IBM corp., Chicago, USA, 2016.

Descriptive statistics were done for quantitative data as (minimum & maximum) of the rang as well as (mean+/-SD) (standard deviation) for quantitative parametric data inferential analysis were done for quantitative variables using:

- 1- **Paired t-test** in case of tow dependent groups with parametric data.
- 2- **2-AN OVA** test for more Than two independent groups with parametric data.

Chi-square test was used for the relationship between two qualitative variables The level of significance was taken at P value Probability (P-value)

- P-value<0.05wase significant,
- P-value, <0. 001wase highly significant,
- P-value>0.05wase considered in significant.

RESULTS

The study was conducted in the dermatology outpatient clinic - Ain-Shams University – during the period from January and February 2017.

The study included 200 healthy volunteers 100 males (50%) - 100 female (50%), age (ranged from 15-25 years (mean±SD: 19.85±3.33).

The studied subjects were divided into two groups according to gender a-b groups table (1).

Table (1): The age of both male (A) and female (B) group

Study	Male (A)	Female (B)
Age (years)		
Mean± SD	19.85±3.33	19.85±3.33
Range	15-25	15-25

Comparison between sebum production among male and female groups showed that sebum production was significantly higher among males at 0.5 hour (t=6.88, p<0.001), 1 hour (t=7.307, p<0.001), and at 1.5 hour (t=7.468, p<0.001). Moreover, the mean total sebum production was significantly higher among males than females. (t=7.42, p<0.001) **Table (2) fig. (2).**

Table (2): Comparison of sebum production among male and female groups

Sebum (mg/cm ²)	Male A	Female B	t-test	
	Mean±SD	Mean±SD	T	p-value
0.5 hr.	135.94±58.33	84.96±45.59	6.886	<0.001
1 hr	163.71±58.94	106.69±51.14	7.307	<0.001
1.5 hr	192.26±62.61	128.99±57.07	7.468	<0.001
Mean total Sebum	163.99±58.60	106.95±49.72	7.422	<0.001

p>0.05 insignificant, p≤0.05 significant

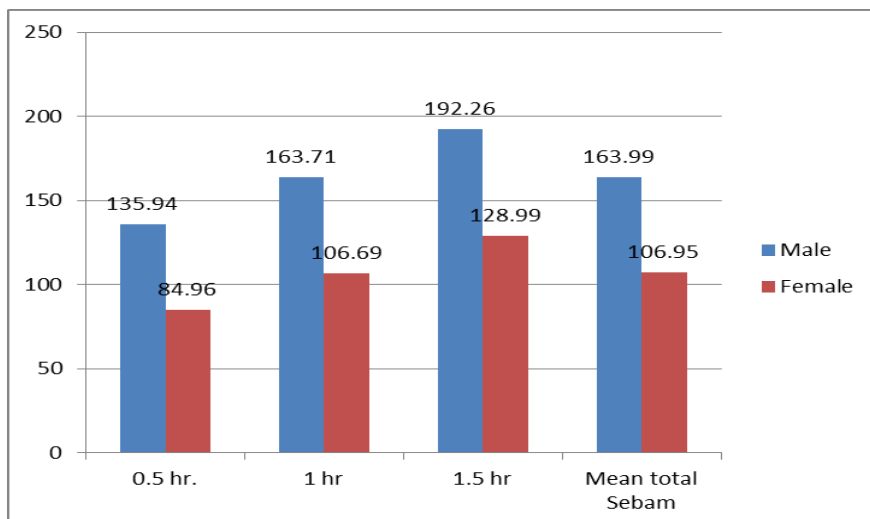


Figure (2): Comparison of mean sebum production among male and female groups at different periods, and the mean total sebum production.

Among male participant it was found that sebum production significantly increases with time; sebum production at 1 hour was significantly higher than that at 0.5 hour (t=-14.026, p<0.001) furthermore, sebum production at 1.5 hour was significantly higher than that at 0.5 hour (t=-19.833, p<0.001) **Table (3) fig. (3)**

Table (3): Difference of sebum production at 0.5hr, 1.hr and 1.5hr in male group

Sebum (mg/cm ²)	Male		Paired Diff.		Paired Sample t-test	
	Mean	±SD	Mean	±SD	T	p-value
0.5 hr.	135.94	58.33				
1 hr	163.71	58.94	27.77	19.80	-14.026	<0.001
1.5 hr	192.26	62.61	56.32	28.40	-19.833	<0.001

p>0.05 insignificant, p≤0.05 significant

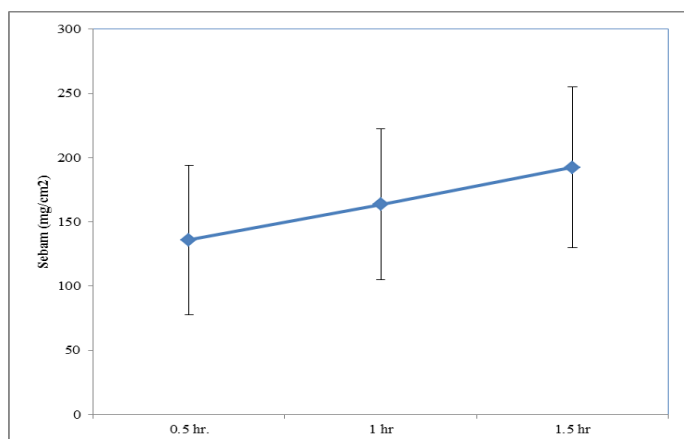


Figure (3): The difference of sebum production over different periods among male group

Our study found that among female group of patients, sebum production significantly increase with time; sebum production at 1 hour was significantly higher than that at 0.5 hour (t=-13.317, p<0.001) also sebum production at 1.5 hour was significantly higher than that at 0.5 hour (t=-14.98, p<0.001) **Table (4) fig.(4).**

Table (4): Difference of sebum production at 0.5hr, 1.hr and 1.5hr in female group.

Sebum (mg/cm ²)	Female		Paired Diff.		Paired Sample t-test	
	Mean	±SD	Mean	±SD	T	p-value
0.5 hr.	84.96	45.59				
1 hr	106.69	51.14	21.73	16.32	-13.317	<0.001
1.5 hr	128.99	57.07	44.03	29.39	-14.980	<0.001

p>0.05 insignificant

p≤0.05 significant

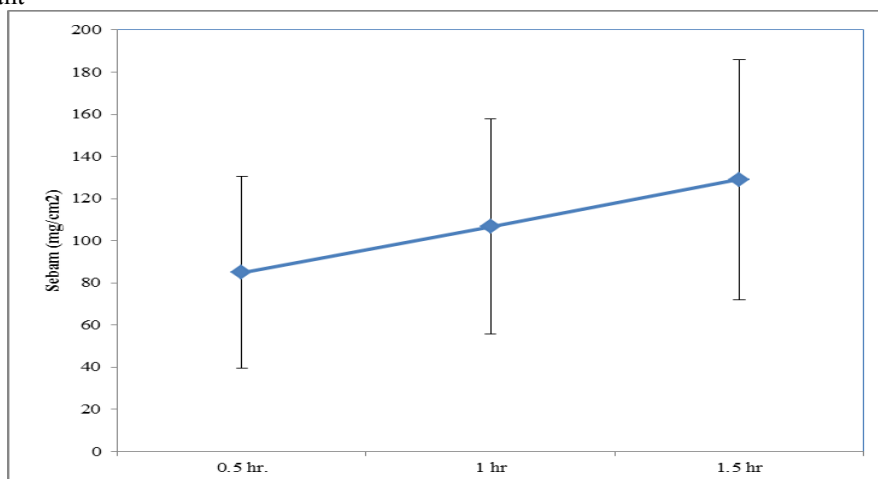


Figure (4): The difference of sebum production over different periods among female group

DISCUSSION

A layer of lipids, which are of both sebaceous and keratinocyte origin, covers the surface of the skin. Lipids of epidermal origin fill the spaces between the cells, like mortar or cement. The sebaceous lipids are primarily non polar lipids as triglycerides, wax esters and squalene, while epidermal lipids are a mixture of ceramides, free fatty acids and cholesterol. The composition of the sebaceous glands lipids is unique and intriguing and elevated sebum excretion is a major factor involved in the pathophysiology of certain skin diseases like acne⁽¹³⁾. The aim of this study was to evaluate the difference between male and female sebum production.

Comparison between males and females as regard sebum production showed that sebum production was also significantly higher among males at 0.5 hour (t=6.88, p<0.001), 1 hour (t=7.307, p<0.001), and at 1.5 hour (t=7.468, p<0.001). The mean total sebum production was significantly higher among males (t=7.42, p<0.001). Our results can be explained by the fact that the sebum content of the skin is mainly influenced by androgens, such as testosterone and dehydroepiandrosterone, whereas oestrogens exert the opposite effect through down-regulation of sebaceous gland function⁽¹⁴⁾. Androgens are also known to play important roles in sebaceous gland physiology through modulation of sebum production⁽¹⁵⁾.

Our results agree with the result obtained by *Kim et al.*⁽¹⁶⁾ who conducted their study on 30 males and 30 females, and measured sebum production using sebumeter from five different facial sites and found that the male casual sebum secretion was significantly higher than that of female. Similarly, with *Lueberding et al.*⁽¹¹⁾ who conducted their study on 300 healthy male and female subjects (20–74 years) and measured the sebum production using sebumeter and they found that sebum content is significantly (P < 0.05) higher, in the forehead of male subjects

On the other hand our results disagree with *Firooz et al.*⁽¹⁷⁾ who conducted their study on fifty healthy volunteers divided into 5 age groups; 10 subjects in each group (5 females and 5 males). Sebumeter SM 815 was used to indicate the amount of produced sebum production. They found that sex did not have a significant effect on sebum production, although skin sebum content was higher in males (60.39 ± 74.52 vs 42.19 ± 54.10). This discrepancy can be explained by their smaller sample size, also in their study they measured skin sebum content of eight body regions (forehead, cheek, nasolabial fold, neck, forearm, dorsal side of the hand, palm, and leg), rather than single region as we did in our study

Among the male group of patients, sebum production significantly increased with time (rate of casual sebum production); sebum production at 1

hour was significantly higher than that at 0.5 hour ($t=-14.026$, $p<0.001$) and sebum production at 1.5 hour was significantly higher than that at 0.5 hour ($t=-19.833$, $p<0.001$). In addition, among female group of patients, sebum production significantly increase with time; sebum production at 1 hour was significantly higher than that at 0.5 hour ($t=-13.317$, $p<0.001$) also sebum production at 1.5 hour was significantly higher than that at 0.5 hour ($t=-14.98$, $p<0.001$). Up to our knowledge no available published studies measured the sebum production sequentially as we did in our study.

Increased amount of sebum production over time might reflect the cumulative sebum production which might be affected by so many factors including climate, psychological state of the patient and other factors to be studied in the future.

CONCLUSION

Sex difference is a significant factor affecting the amount of sebum production; which is significantly higher among males in comparison to age matched females.

Rate of casual sebum production significantly increase among both males and females over time.

RECOMMENDATIONS

- More studies are recommended to determine the factors and mechanism; molecular and endocrinal, behind the strong relation between male gender and the increased amount of sebum production.
- It's recommended to conduct more studies with larger sample size to study the rate of casual sebum production and the factors affecting it other than gender.
- The role of androgens in relation to sebum production can be more studied among males and females.
- Sebum production can be measured from other facial sites to give more précised results.
- Sebum production can be measured in summer, autumn and spring.

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