

# The Effects of LED Masks and Functional Cosmetics on Facial Skin

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## Abstract

With the public's interest in skincare increasing over the years, many studies have been conducted on the effects of LED masks and functional cosmetics on skincare issues such as enlarged pores, excess sebum secretion, etc. However, most studies were carried out within 4 weeks, which is a quite short period of time, as well as neglected factors such as age, gender, and skincare methods (mixed, single) and thus lack reliability in their findings.

Hence, based on empirical data, this study analyzed the main effects of LED masks and functional cosmetics under various conditions on facial skin over a 12-week period. Results of the analysis show that the main effects of the items on facial skin under various monitored conditions are empirically significant.

**Keywords:** LED Masks, Functional Cosmetics, Skincare Issues, Facial Skin, Empirical Data.

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## INTRODUCTION

Ideal beauty, in all its variations throughout time and culture, is one of the fundamental values that have been long pursued by humanity. In current times, the pursuit of health in beauty, well-being, and anti-aging are becoming increasingly popular[1]. Healthy and beautiful skin refers to a skin that serves basic normal physiological functions, has good blood circulation, is elastic and moist from sufficient nutrition, and is clear of blemishes[2]. Contrary to the human desire for such healthy and beautiful skin, rapid societal development has led to an increase in skin diseases due to environmental issues such as increased fine dust particles in the air and heat waves that negatively stimulate the skin[3]. In order to negate the aging effects of ultraviolet rays and other such external stimuli on skin, people are now focused on replenishing moisture and nutrients and getting rid of built up waste in their skin. Many studies have reported that collagen peptides are effective in recovering from skin damage caused by photoaging and weakened skin barriers as well as protecting the skin[4].

Currently, LED (Light Emitting Diode) masks are all the rage in the skincare device market. Many studies report

that LED light sources are effective in promoting biochemical reactions in cells; increasing collagen synthesis in aging skin; and reducing increased MMPs(Matrix Met Alloproteinase), without causing direct heat damage to the skin[5].

Alongside this, there is also increasing interest in the research and development of natural anti-aging ingredients that may delay aging that can have diverse effects such as brightening the skin, removing wrinkles, moisturizing, removing activated oxygen from skin cells, blocking and absorbing UV rays, and synthesizing collagen. Camelia Sinensis leaf extract, lavender extract, thyme extract, and rosemary extract are natural ingredients that have been scientifically proven to be effective. These are used in the form of complex plant extracts[6].

Beauty devices are used to purify, soothe, relieve tension, aid nutrient absorption, and enhance elasticity in the skin. Devices can be classified as a single skincare method or a mixed method depending on how they are used. Previous studies have proven that the mixed method leads to a relatively greater degree of skin improvement compared to the single method. This is because the mixed method enables better absorption of cosmetics into the

skin thereby enhancing their efficacy, thus leading to greater improvement. However, many previous studies have failed to utilize adequate validation methods in proving the observed improvement on skin. Most studies derived their results by tests that were designed with unclear goals and focal points that were conducted for just 4 weeks, which is a very limited period of time[7].

Hence, this study conducted a test for 12 weeks with the participation of 50 men and women ranging from their 20s to 50s in terms of age, in order to strengthen the validity of the collected empirical data[7][8]. Also, this study aims to empirically prove the effects of LED masks and ampoules that contain plant complex extracts on flushing, excess sebum, hyper pigmentation, and overall glow according to various skin types.

## THEORETICAL BACKGROUND

### 2.1 Definition of Skin Conditions

#### 2.1.1 Facial Flushing

Facial flushing is a condition where the diameter of the blood vessels in the facial skin expands for any number of reasons, leading to increased blood flow and thus reddened facial skin. There are various causes of facial flushing. Exposure to ultraviolet rays can damage the collagen fibers and elastic fibers surrounding the blood vessels in the skin. It can be possible to recover from this damage in the early stages, but chronic exposure to sunlight can cause degeneration, aging, and the dilation of blood vessels, resulting in facial flushing. Facial flushing generally worsens over time and may even lead to complications depending on the root cause and if impacted by diseases. Thus, it is necessary to consult a dermatologist in the early stages and to get continuous treatment for it[9][10].

#### 2.1.2 Sebum

Sebum is an oil produced by human skin and is essential to skin functions. Sebum protects the skin from harmful external stimuli by creating a thin oily barrier and also replenishes moisture in the skin to prevent it from drying out. However, excessive sebum can cause the bacteria within the sebum to produce lipase and use up glycerol and thus produce a stench. The buildup of sebum in certain areas of the skin can also cause inflammation, leading to sebaceous cysts. Sebum clogging pores can also cause acne. Relieving stress and using natural skincare products that do not irritate the skin are recommended for controlling the excessive secretion of sebum[11].

#### 2.1.3 Skin Glow

Skin glow, achieved when the skin is smooth and has a natural subtle shine, indicates the degree to which light reflects from the surface of the skin, or the degree to which moisture naturally fills the skin. Skin texture can deteriorate due to air pollution, exposure to ultraviolet

rays, and the lack of moisture, which can stem from a variety of causes such as excessive exercise. There are many commercial products that have been released that claim to increase skin glow, which contain ingredients that brighten the face by reflecting light. Adversely, this also means that these products do not improve the actual condition of the skin. The most basic requirement for having radiant skin is providing sufficient hydration to the cells. This promotes the body's metabolism and filters out bodily waste. Furthermore, it can alleviate issues of dead skin cell buildup, acne, excessive sebum production, and fine wrinkles around the eyes, which is an area prone to dryness[12].

#### 2.1.4 Pigmentation

The color of a person's skin is determined by melanin pigments, blood vessels in the dermis layer of the skin, hemoglobin, carotene, and the thickness of the keratin layer. Melanin is the most decisive factor among these elements. Melanin is a compound that performs a superior defense function by absorbing ultraviolet rays harmful to the skin thus stopping it from penetrating the skin. However, if the skin is exposed to ultraviolet rays for a long period of time, the melanin in the stratum corneum layer can increase to reach the surface of the skin, causing dark pigmentation. Such pigmentation can be reduced to some degree by using facial scrubs, deep cleansing products containing AHA(Alpha-hydroxy acid), skincare masks, ampoules among skin brightening elements, and by orally ingesting vitamin C[13].

### 2.2. The Mechanism of LED Lights and its Effects

The mechanism behind LED masks is promoting biochemical reactions within human cells by using light from various light sources. LED lights are low energy and do not emit harmful ultraviolet rays or unnecessary infrared rays. Thus, they are not damaging to skin tissues and causes few side effects. The Food and Drug Administration (FDA) of the United States permits LED lights to be used as supplementary medical devices and skincare devices[5]. The technology of equipping facial masks to emit far-infrared rays that can vibrate the skin cells 2,000 times a minute was proven to be effective by the Korea Institute of Dermatology (KIDS). A 4-week clinical test conducted with Korean women in their 30s to 60s proved the device was effective in improving moisture levels, dermal density, and elasticity while brightening and soothing the skin. LED light sources penetrate deep into the skin in a painless, non-invasive way. In particular, the red wavelength band (630nm) of the light, which is effective on hypodermal cells, has been found to successfully induce collagen synthesis by activating HDFs (Human Dermal Fibroblasts), as well as regenerating skin and healing wounds through neovascularization. In addition, numerous studies are being conducted in the

field of skin aging as the red wavelength band is known to aid the recovery of damaged collagen and elastin [14][15][16].

### 2.3. Plant Complex Extracts

Plants that have long been used for medicinal or health purposes are now widely used as raw materials for cosmetics. Plant extracts are taken from the tissues, stems, leaves, and fruits for this purpose. The antioxidant properties of plants are determined by the reactive oxygen species (ROS) elimination activity of flavonoids, polyphenols, and anthocyanins. Such biochemical functions are also effective in boosting immunity and delaying aging. For example, sugar cane extracts are quickly absorbed and have superior moisturizing properties and thus are good for relieving dry skin. Similarly, lotus extracts are able to strengthen skin barriers and soothe damaged skin. In addition, lavender oil to the skin exposed to ultraviolet rays can prevent the keratinocytes in the epidermis from being damaged, and

can reduce inflammation in dermal tissues. Many case studies report that complex plant extracts can minimize skin irritation, provide nutrition, and form a defense system against various pollutants, thereby revitalizing the skin and improving the overall skin condition[6][16].

### METHOD

This study was authorized by the IRB of Namseoul National University (IRB Deliberation Number NSU-202001-001) and was carried out with participation from women and men in their 20s to 50s nationwide.

#### 3.1. Research Procedure

This study provides a definition of various facial skin conditions based on the indicators mainly used by researchers and experts in the field. Research was conducted to examine the effects of LED masks and ampoules on facial skin with the Figure 1.

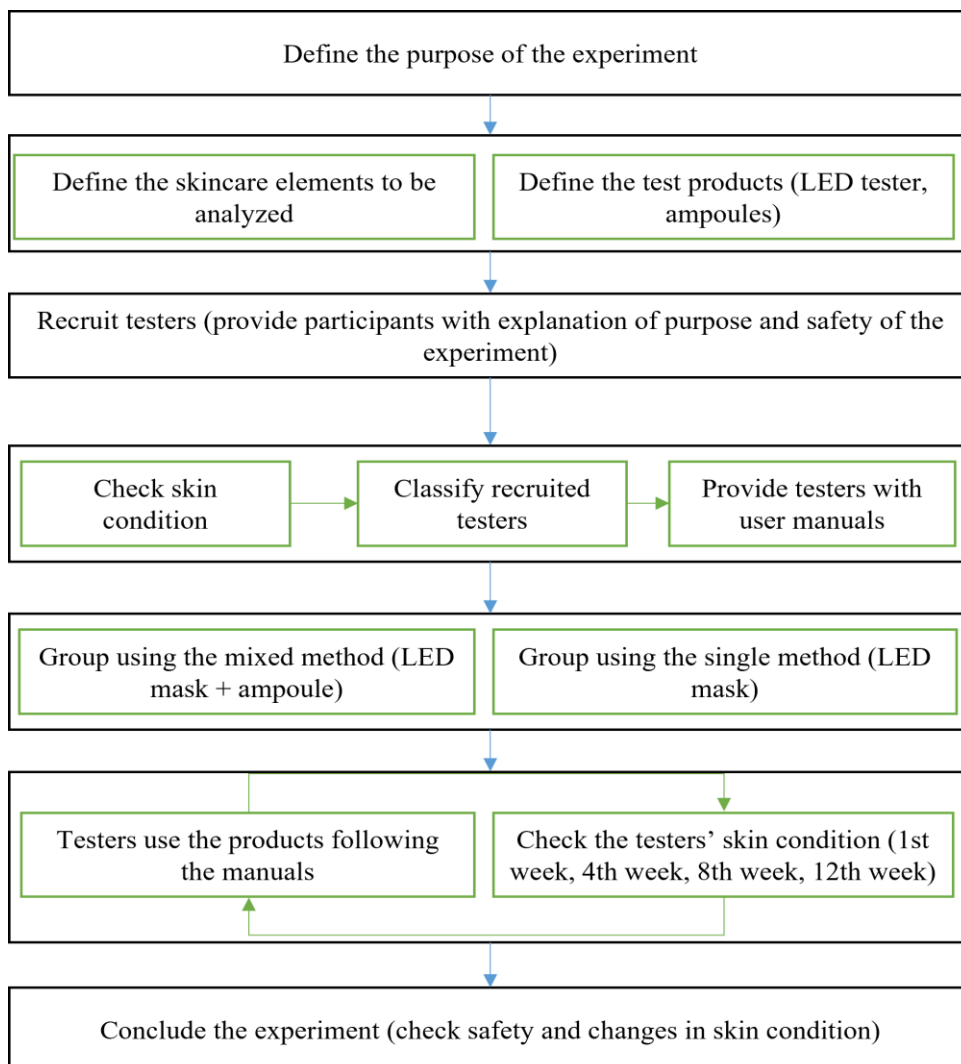


Figure 1. Research Procedures

Following a deliberation by the Institutional Ethics Committee, the recruitment process included informing the possible participants of the purpose of the test and the possible side effects. Once the testers were recruited, an institute specializing in facial skin was recruited to check the testers' skin condition, so that it would be possible to discern if there were any changes to their skin before and after the experiment. In order to validate the experiment, the participants were divided into a mixed group and a single group based on their skin condition. The two groups were tasked to use the LED mask and ampoules based on the manuals provided by Cellreturn according to their skin type.

In this study, the test was conducted for a longer period compared to previous studies. Overall, the test was conducted over 12 weeks to increase the reliability and validity of the results. Over the course of the test period, the participants' skin condition was checked four times to measure the degree of improvement of their facial skin.

### 3.2 Elements for Skin Analysis

This study aimed to obtain empirical data that can verify the effects of LED masks and ampoules on facial skin. For this, four facial skin elements were analyzed based on skin type as seen in Table 1, using the method as shown in Figure 2.

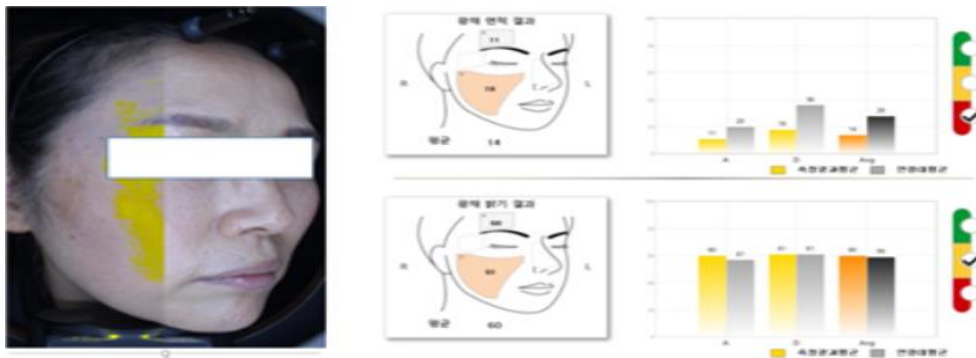


Figure 2. How to check the condition of the facial skin

Figure 2 shows an example of the data from the right side of the face filmed using a skin analyzer. The measurement data for the front and left side of the face are shown in Table 1. The data presented in Table 1 were used to check the changes in the participants' facial skin condition at four points in time (1st week, 3rd week, 8th week, 12th week) during 12-week testing period following the method shown in Figure 2. The participants' skin types were identified by using a specialized skin analyzer Figure 3(c). Their test method (mixed, single) was determined based on the manual provided by Cellreturn Table 2.

Table 1. Facial skin element indicators

	Name	Age	Skin Type	Test Method
Element	Pigmentation	Flushing	Sebum	Glow
Left				
Right				
Front				

### 3.3 Participants and Test Products

#### 3.3.1 Participants and Test Duration

Prior to conducting this study, the criteria for recruiting the participants were established in accordance with the

recommended guidelines of the Ministry of Food and Drug Safety[17][18].

This study was carried out with men and women in their 20s to 50s who met the criteria for recruitment and who did not meet any criteria to be excluded from the test. Among all applicants, those without any acute or chronic diseases and could be tracked and observed throughout the research period were selected. Among the selection, participants were limited to those who voluntarily signed consent forms noting that they were fully aware of the purpose, the research method, as well as the precautions for participating in the study. Out of safety concerns, the following applicants were excluded from the study: those who were pregnant, breast-feeding, or childbearing; those who were using topical medication containing steroids to treat skin diseases for more than a month; those had participated in the same test within 6 months prior to the study; those with sensitive and irritable skin; those with moles or skin disorders such as telangiectasis, acne and erythema on the test areas; those who had undergone treatment on the test areas within 6 months prior to the study; and those who were deemed unsuitable for the research for other reasons.

#### 3.3.2. Test Products

Figure 3 shows the products used for this study: An ampoule provided by Cellreturn (a colorless, transparent

gel containing more than 18 plant complex extracts); a fourth generation Platinum LED mask; and the MARK-VU, a light source LED analyzer for skin analysis.

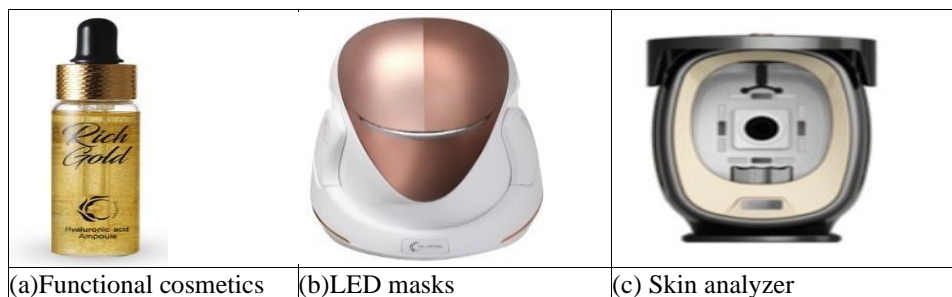


Figure 3. Test products

The cosmetic product used in this study is a “Rich Gold Hyaluronic Acid Ampoule” that has been developed by Cellreturn with their own specialized technology. Cellreturn claims that its formula, which includes 24k gold and concentrated hyaluronic essence, is over 4 times richer than existing therapy ampoules and thus helpful in creating an ideal skin condition. The company claims that this product contains a total of 18 natural plant extracts, including those used in related studies for improving skin conditions as well as those such as astragalus root extracts, which can calm irritated skin by removing harmful foreign substances; and Madonna lily extracts, which contain mineral substances that can eliminate waste buildup from the skin. Therefore, it claims this ampoule can provide a pleasantly refreshing and moisturizing experience to skin negatively impacted by stimuli such as fine dust and ultraviolet rays. The LED mask used in the test is the “4th Generation LED Mask Platinum” provided by Cellreturn. The mask emits lights with NIR wave length (840nm~870nm), red wave length (640nm~670nm), and blue wave length (410nm~440nm). Each wave length is composed of 342 pcs, meaning a total of 1026 pcs. Users are able to choose between 4 modes (red, blue, pink, fast). The LED masks and ampoules were used in adherence to the user manual for each skin type developed by Cellreturn.

Since it is difficult to examine minute flushing and

pigmentation with the naked eye, a professional skin diagnostic device was used to check the skin condition. The MARK-VU, a light source LED analyzer that can decipher images clearly in ultra-high definition, was used before and after on the participants after treatment sessions under the same circumstances. This was done in order to perform a professional skin analysis and for an objective comparison of the skin condition to increase the validity of the test results.

### 3.4 User Manuals based on Each Skin Type

A systematically defined method was sought in order to establish the objective indicators of the test and strengthen the validity of the test. The aforementioned previous studies are limited in their findings as they conducted all tests under the same circumstances, ignoring a number of factors to be considered, such as the participants’ skin type. To compensate for this, research methods that examine the variables among participants such as differing usage method, age groups, and skin types are needed. To this end, this study conducted a systematic test based on the LED mask user manuals developed for each skin type provided by Cellreturn. The manual is comprised of directions for 16 different skin types as shown in Table 2. The division is based on various preexisting studies and user reviews.

Table 2. User manuals for skin types provided by Cellreturn

No.	Skin type	Skin type in Korean	Ampoule	Commentary	LED mask usage guide	Intervals of using ampoules
1	DSPT	Dry	O	This dry skin type features recurrent skin inflammation and uneven complexion.  DSPT skincare prescriptions should treat dryness and	Apply the ampoule before using the mask.  Light mode: Red mode  Duration: Start at 5 minutes and gradually increase to 20 minutes. (1st week: 5 minutes,	Once every 2 days

				inflammation first and then pigmentation. ---The rest is omitted --- -	2nd week~4th week: 10 minutes, 5th~12th week: 20 minutes)  --- The rest is omitted----	
2	ORPT	Oily	X	This skin type is less prone to wrinkles and irritation than other types, but in order to make the skin color uniform,  --- The rest is omitted--- --	Light mode: Red mode  Duration: Start at 10 minutes and gradually increase to 20 minutes. (1st week: 10 minutes and rest weeks: 20 minutes)  ---The rest is omitted----	X
Hereinafter, the rest is omitted.						
16	DRNW	Dry	O	The rest is omitted		5 times a week

Facial skin is generally classified into four types (dry, oily, neutral, and complex). However, it is necessary to also take into consideration the differing complexions and brightness per skin type. Thus, each skin type was subdivided into four types in this study. This means that participants classified into the same skin type can have differing intervals for using ampoules depending on their complexion and other such variations. Such characteristics were reflected into the user manual for the LED masks and ampoules during the test period of 12 weeks.

## RESEARCH VERIFICATION

### 4.1 Classification of Participants According to the Usage Method

In this study, an initial test was performed using a professional skin diagnostic device to classify the participants into groups so that the effects of LED masks and ampoules on specific elements of facial skin conditions could be examined. In order to conduct an efficient experiment, participants were classified based on the user manual provided by Cellreturn as displayed in Table 3. The test was carried out based on this data.

Table 3. Classification of participants according to the usage method

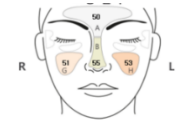
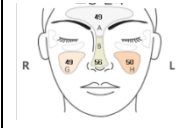
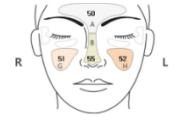



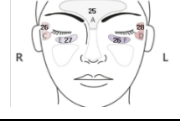
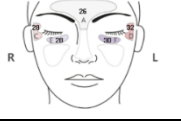
Classification	Sex	20s	30s	40s	50s
Mixed method (Ample+LED mask)	Men	1	8	8	1
	Women	3	10	6	4
Single method (LED mask)	Men	1	1	1	2
	Women	0	0	4	0

As evident in the grouping, the main focus of the study were those in their 30s to 40s with healthy skin who are experiencing rapid changes in their skin due to their age. The grouping also shows that unlike the past where skincare used to be a female-dominated area, men these days with stable jobs and social lives are also greatly interested in skincare to the extent of volunteering for the test.

### 4.2 Checking the Skin Condition

This study looked at the elements as presented in Table 1 to examine the changes to the participants' skin condition. A total of four checks were made throughout the test, as shown in Table 4.

Table 4. Process of checking skin conditions

Classification	First	Second	Third	Fourth
Flushing				
Sebum				
----- No more skin items -----				

4.3 Test Results

A diagnosis of the skin condition per skin type was made based on four elements as seen in Table 1. These four

elements were checked for the frontal, left, and right side of the face, making it a total of 12 defined elements. The participants' skin condition was checked a total of four times, and the results are displayed in Table 5.

Table 5. Recording the results of checking the skin condition

Name	Gildong Hong		Sex	Woman	Age	34	Occupation	Office worker	Skin type	DSN W			
Session	Classification	Details (Average of Measurement results /age average)								Skin			
		Flushing		Sebum		Skin		Pigmentation		Type	Skin age	Sensitivity (redness)	Sensitivity (acne)
Flushing	Browning	Sebum	Porphyrin	Glow	Area	Skin layer	Melanin						
First	Left	4	12	5	36	68	68	15	26	Complex	53	5	4
	Right	2	10	4	21	82	69	12	24				
	Front	5	14	4	27	43	65	19	24				
--- The rest is omitted ---													
Fourth	Left	5	11	5	18	36	64	16	14	Dry	52	5	1
	Right	4	9	4	24	42	64	13	11				
	Front	6	15	6	9	35	63	21	17				

When checking the changes to the skin condition with a diagnostic device, the specialist conducted interviews with the participants regarding any discomfort and/or changes to the body they experienced while using the LED masks and ampoules[19]. Naturally, there can be many variables and issues stemming from individual differences when reflecting the extent of change in their skin condition. In other words, individual differences can exist depending on the extent of daily skincare and innate skin sensitivity. Thus, the degree of the effect on the skin was analyzed numerically, and comments from the specialists were taken into consideration based on the validated data

set.

4.4 Analysis of Results

This study aimed to interpret the results of the test elements in relative terms. To do this, a percentage (100%) was set based on the elements that saw the largest change before and after the test. This percentage was compared with the data collected for each element checked. This was done in order to identify the element that saw greatest impact based on the test data. In addition, the test result data was analyzed in three aspects. The test was classified

by usage method (mixed or single), sex, and age group. For each classification, the skin condition elements were

presented based on numerical changes observed.

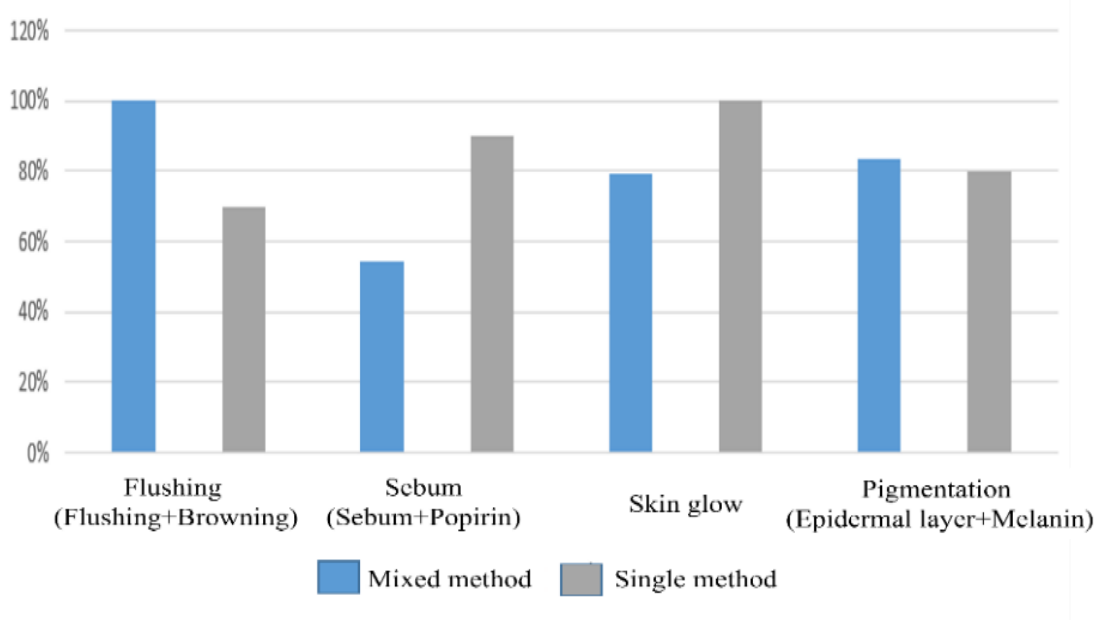


Figure 4. Results by usage method

Figure 4 shows the changes to skin condition by usage method. When the changes per method were statistically analyzed, it was possible to discern that the degree of their influence on each skin element differed. The largest

changes observed were in the flushing element for the mixed method and the overall skin glow for the single method. This indicated that the skin elements may be impacted to varying degrees based on the usage method.

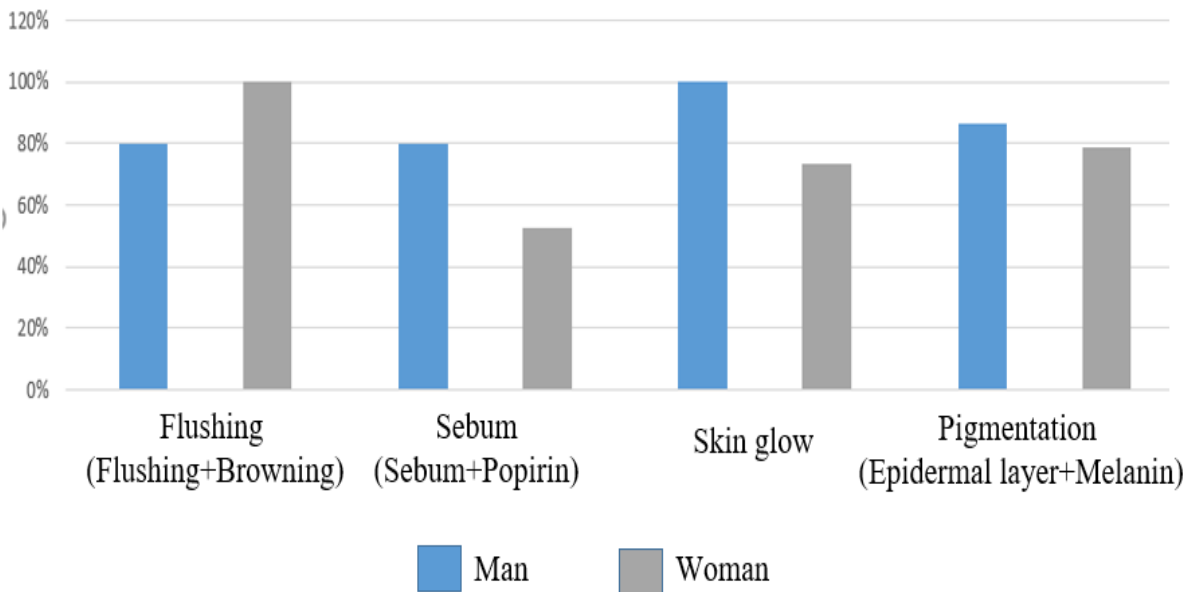


Figure 5. Results by sex

Figure 5 shows a statistical analysis of the changes by sex. It is possible to see that the degree of influence on the skin elements varied according to sex. In men, the greatest change was observed in the overall skin glow, while in

women, it was facial flushing. This indicates that the types of skin elements influenced by the test products differ according to sex. The results of the analysis revealed that the rate of change in men's skin condition was greater than that in women. It could be assumed that this difference is

due to men relatively neglecting skincare in their daily life receiving continuous care during the test period, resulting

in a change in most of the skin elements.

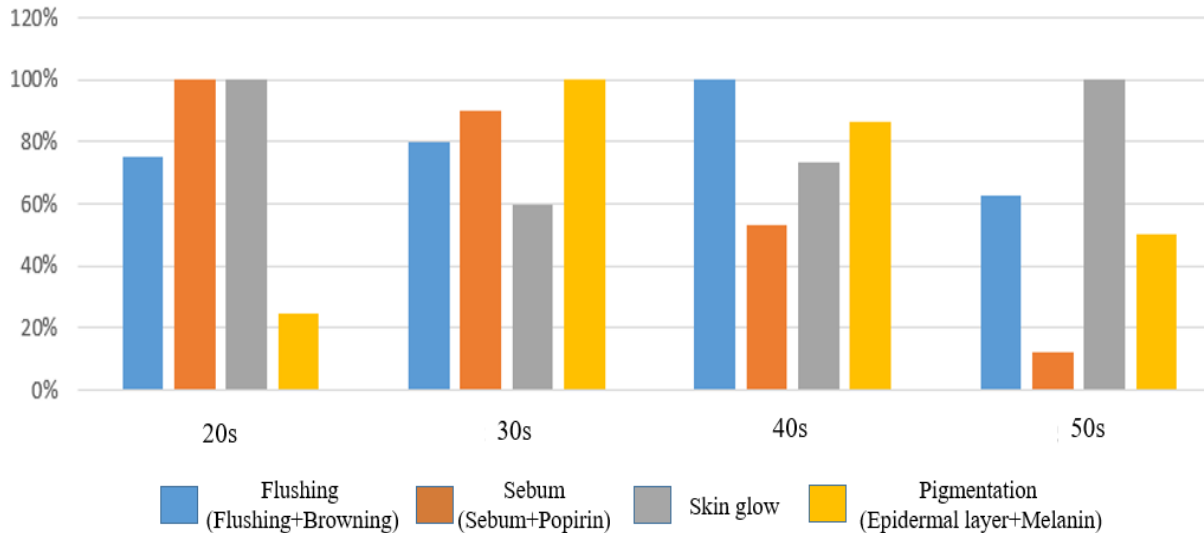


Figure 6. Results by age

Figure 6 shows the results of statistical analysis of the changes according to the age group. It was found that the greatest changes seen per age group were as such: reduction of excess sebum production and increase in overall glow for the testers in their 20s; reduction of pigmentation for those in their 30s; reduction of flushing for those in their 40s; and increase in overall glow for the testers in their 50s. Results indicate that the effect on skin differ according to age.

## CONCLUSION

Many studies report that LED masks aid the active components of functional cosmetics to be safely absorbed into the skin and thus enhance their effectiveness. They also report that since LED masks are low energy devices that do not emit harmful substances nor cause heat damage to the skin, using the masks causes few side effects and can improve skin in a painless, non-invasive manner. However, there is insufficient research on the methods to validate the effectiveness and improvement in skin conditions observed from using beauty devices and cosmetics. This is because many previous studies are characterized by short testing periods of just 4 weeks, as well as unclear goals and focal points in how the tests were designed. That is, those studies lacked reliability in that they applied the same usage method to various skin types, and showed remarkable improvement in such a limited period of time[19][20].

Hence, this study was conducted over a 12-week test period to raise the statistical reliability of empirical data. In addition, user manuals for using LED masks and ampoules based on skin type were developed in order to ensure a systematic test. The usage method, sex, and age

of the users were factored into the effects of the LED masks and ampoules on various aspects of facial skincare such as flushing, excess sebum secretion, pigmentation, and overall glow. Results showed that the effects on the skin varied based on the usage, sex, and age, with statistically significant data. Statistical analysis revealed that the more negligent the user had been in their regular skincare, the greater impact from using LED masks and ampoules. The research also verified the safety of using such products [21][22][23].

It is hoped that this study will lead to subsequent studies that compare its results with that of other beauty devices.

## ACKNOWLEDGEMENTS

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