

Research and Development

Shiseido, in collaboration with RIKEN, develops novel skin prediction models based on relationships between skin, body, and mind

- Application to development of original algorithms

that can serve as a compass directing to each individual's own beauty -

Shiseido, through joint research with RIKEN*1, has comprehensively and quantitatively elucidated physical and psychological conditions that are related to the conditions of the skin, leading to success in developing innovative skin prediction models. In addition, the company has created its own beauty algorithms, which combine the novel skin prediction models and research knowledge the company has accumulated over the past 100 years or more. In the future, the algorithms will be evolved to contain more than 2,000 types of skin-body-mind relationships. This is expected to accelerate the development of new approaches, including the proposal of lifestyle habits focused on the conditions of the body and mind in addition to the cosmetic product-based care, which will lead to a state of harmony between the skin, body, and mind, in order to help each and every consumer to actualize their "ideal skin" and "best possible state." Furthermore, these algorithms will continue to evolve with the input of various research results from new studies in and outside the company, while also reflecting changes in society and the changing lifestyles of consumers that come about as a result of social change.

The results of this study were presented in part at the 33rd IFSCC Congress in Barcelona*2 (2023/9/4–7).

*1. Period of joint research: April 1, 2020 through December 31, 2022

*2. IFSCC: The International Federation of Societies of Cosmetic Chemists

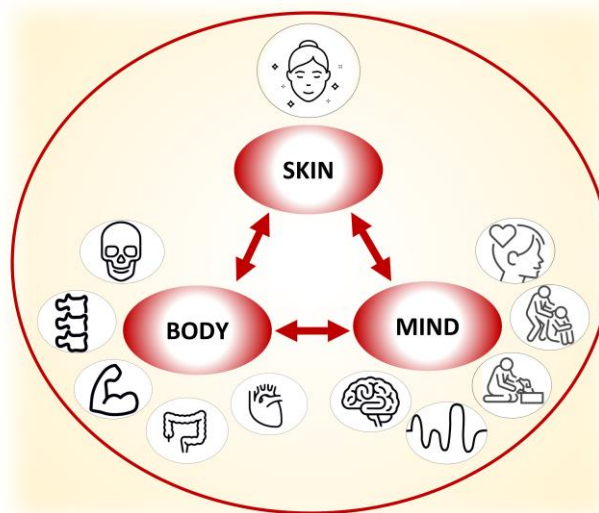


Figure 1. Elucidation of the relationships between the skin, body, and mind

Research background

Under the company's vision for 2030, Personal Beauty Wellness Company, which aims to realize the health and beauty of each individual throughout his or her life, Shiseido has been working toward the realization of a sustainable world where everyone can enjoy a lifetime of happiness through the power of beauty. In order to realize this vision, the company is accelerating the creation of Beauty Wellness innovations to "achieve healthy beautiful skin from within the body" by elucidating the connections between

the skin, body, and mind, and contributing to the prevention of skin irregularities using approaches that go beyond the use of cosmetic products, in addition to improving the current skin conditions and predicting future skin conditions.

In research and development, we are promoting studies that incorporate the technologies to "visualize the conditions of the mind," which we have long been pursuing in the area of *kansei*^{*3} research, our strong point, and strengthening analyses that incorporate data science methods in collaboration with outside parties. With regard to the latter, we have established a joint research program with Hirosaki University for the purpose of promoting scientific research on the skin, body, and mind relationships and implementing it in the society^{*4}. Other efforts include the development of quick and highly accurate ways to analyze large amounts of data obtained through research, and to this end, we have concluded a comprehensive partnership agreement on data analysis with DeNA Life Science, Inc.^{*5}. As one of the outcomes of efforts related to the aforementioned studies, we have elucidated the relationships between the skin, body, and mind, and created our own beauty algorithms encompassing this new knowledge.

*3. *Kansei* research is an approach to product innovation that focuses on emotional engineering. Fusing aesthetics, sensory psychology and design, it seeks to create objects and experiences that appeal to the senses (visual, olfactory, auditory and tactile) in order to arouse an emotional response in the user.

*4. Shiseido and Hirosaki University Graduate School of Medicine Jointly Establish Research Program "Department of Beauty Wellness Science" (2022) <https://corp.shiseido.com/jp/news/detail.html?n=0000000003464>

*5. Shiseido and DeNA Life Science Sign Comprehensive Partnership Agreement on Data Analysis (2022) <https://corp.shiseido.com/jp/news/detail.html?n=0000000003529>

Shiseido succeeds in elucidating the relationships between the skin, body, and mind and visualizing them as mathematical formulae

This time, with the aim to clarify the relationships between the skin, body, and mind, we conducted joint research^{*1} with a team led by Dr. Kei Mizuno, Senior Researcher at the RIKEN Center for Biosystems Dynamics Research, who has a proven track record in research to develop, for example, Health Compass that allows for visualization of an individual's health levels using various indices.^{*5} We carried out a study targeting healthy Japanese women in their 20s–40s, in which measurements of skin conditions such as age spots and dullness, wrinkles, and moisture, as well as physical shape and composition, blood components, lifestyle habits, and psychological indicators were performed. In order to reveal what factors of the body and mind are associated with the conditions of the skin, we set out to create mathematical formulae (novel skin prediction models) that could explain the measured skin indices in terms of physical and psychological indices. As a result, we succeeded in obtaining multiple mathematical formulae. For instance, with respect to the amount of moisture in the stratum corneum of the skin, the formula shown below was obtained; this formula clearly shows that high / low amounts of moisture in the stratum corneum are related to the body's oxidative stress state, physical constitution, electrolytes (minerals) in blood, grip strength, and so on (Formula 1, Figure 2). To date, a very few attempts have been made to reveal the physical and psychological conditions that are related to skin conditions in a comprehensive and quantitative manner. In this sense, the novelty of the findings obtained in the present study is considered extremely high.

$$\text{Amount of moisture in the stratum corneum} = a \times \text{Oxidative stress level} \\ + b \times \text{Physical constitution} + c \times \text{Blood electrolytes} + d \times \text{Grip strength} + \dots$$

Formula 1. Obtained mathematical formula representing the relationships between the amount of moisture in the stratum corneum and each physical / psychological factors

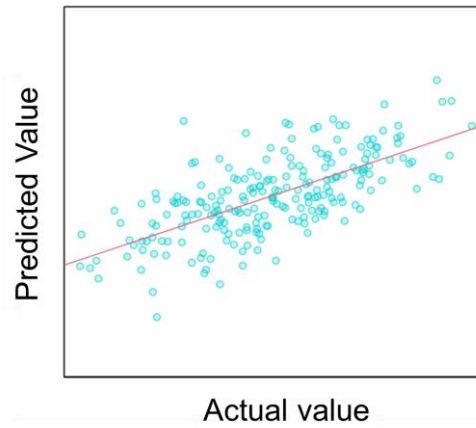


Figure 2. Relationship between the developed novel skin prediction model for the amount of moisture in the stratum corneum and actual values

The points are properly gathered along the straight line, indicating that the accuracy of the novel skin prediction model is high.

Development and future application of Shiseido's own beauty algorithms

Taking this opportunity with the findings obtained in collaboration with RIKEN regarding the relationships between the skin, body, and mind, Shiseido has created its own beauty algorithms that include the relationships between the skin, body, and mind by integrating the company's knowledge accumulated from the past 100 years or more. In order to realize the company's vision, Personal Beauty Wellness Company, Shiseido will strive to further accelerate the creation of various Beauty Wellness Innovations not limited to cosmetic products to "achieve healthy beautiful skin from within the body," and the algorithms created in the present study will serve as a basis to this end. The algorithms, which include the results of the present study, will enable us to quantitatively understand the relationships between the skin, body, and mind, which in turn will allow us to develop and propose, with higher accuracy than ever, measurement technologies that consumers can deepen their understanding about their own skin, and care that will help each and every consumer to actualize their "ideal skin" and "best possible state. Our algorithms will continue to evolve to contain more than 2,000 types of skin-body-mind relationships in the future, being fused with the latest knowledge that will be revealed by future studies in and outside the company, while also reflecting changes in society and the changing lifestyles of consumers that come about as a result of social change.

About Our R&D Strategy:

This study was conducted with the aim of elucidating the relationships between the skin, body, and mind under Future Beauty INNOVATION, one of the three pillars of Shiseido's R&D strategy.

- Integrated Report 2022 (Beauty Innovation)

https://corp.shiseido.com/report/en/2022/value_creation/innovation/

- Keywords

Future Beauty INNOVATION; elucidation of the relationships between the skin, body, and mind

<Reference>

Researchers' challenges

■R&D Philosophy DYNAMIC HARMONY approach

This research was carried out under the Individual/Universal approach of Shiseido's R&D philosophy, DYNAMIC HARMONY. Focusing on the universality that is commonly held among individuals and the individuality as expressed in varying forms such as age, gender, race, and lifestyle in each person, Shiseido has ventured into research on the elucidation of skin-body-mind relationships.

■Visualize the connection between the skin, body, and mind using cutting-edge data science

"When I am emotionally depressed, my skin condition also deteriorates, and everything goes wrong..."; We think not a few people have had similar experiences to this. The skin, body, and mind are connected in a variety of ways, and we have been researching this topic suspecting that we may be able to think more broadly about solutions to beauty issues than we do now.

In the present study, together with Dr. Mizuno and his colleagues, we made full use of data science to capture people as a whole, not just as parts, and also, to understand the relationships between the skin, body, and mind in a pre-disease state (condition in which one suffers no illness but has some disorders that are making their body less healthy temporary or chronically), rather than in the state of extreme disease. This is what makes our study novel and interesting. The marriage between the Eastern philosophical concept of the comprehensive link between the skin, body, and mind and science, i.e., data science, is reminiscent of Shiseido's founding, which originated from the fusion of Western science and Eastern wisdom.

The results of the present study have led us to visualize connections that had not been considered relevant until now, such as that between grip strength and skin. Going forward, we will continue to carry out various studies aiming at the prediction and the prevention of skin disorders and proposal of new solution to beauty issues.



Chieko Okamura, Group Manager

Shiseido's R&D Philosophy DYNAMIC HARMONY

- Shiseido Formulates Its Unique R&D Philosophy "DYNAMIC HARMONY" (2021)

<https://corp.shiseido.com/en/news/detail.html?n=00000000003252>

- DYNAMIC HARMONY website:

<https://corp.shiseido.com/en/rd/dynamicharmony>