EXPOSOME HEALTHY LIFE FOR A HEALTHY SKIN

The term exposome establishes a connection between external environmental influences and one's own well-being. It refers to the totality of environmental influences and the associated biological reactions and interactions to which we humans are exposed in the course of our lives.

The exposome is a topical concept even though it was identified by Christopher Wild in 2005. It was first established in oncology and then extended to all sciences. Our health, our body and our skin are not only regulated by genetic factors, but also influenced by external factors, which would be responsible for 80 percent of skin aging. The World Health Organization (WHO) estimates that 23 percent of deaths and 25 percent of chronic illnesses worldwide can be attributed to environmental and behavioural factors. Focus on the devices and methods for exposome impact evaluation.

THE IMPACT OF THE EXPOSOME ON THE SKIN

According to Pr Thierry Passeron, MD, PhD*, the skin exposome is defined as the totality of environmental exposures over the life course. That can induce or modify various skin conditions. Solar exposure, air pollution, tobacco consumption, hormones, nutrition, lack of sleep and psychological factors are the most important exposome factors for the skin. Photoageing, photocarcinogenesis, and pigmentary changes are well-established consequences of chronic exposure of the skin to solar radiation. Expo-

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sure to traffic-related air pollution contributes to skin ageing as well.

Effects on the skin

About air pollution, particulate matter and nitrogen dioxide cause skin pigmentation/lentigines while ozone causes wrinkles and has an impact on atopic eczema. Human skin is a major target of hormones, and they exhibit a wide range of biological activities on the skin. Hormones decline with advancing age, influencing skin ageing. Nutrition has an impact on numerous biochemical processes, including oxidation, inflammation, and glycation, which may result in clinical effects, including modification of the course of skin ageing and photoageing. Stress and lack of sleep are known to contribute to a proinflammatory state, which, in turn, affects the integrity of extracellular matrix proteins, in particular collagen. Hormone dysregulation, malnutrition and stress may contribute to inflammatory skin disorders, such as atopic dermatitis, psoriasis, acne and rosacea, says Pr Passeron. Innovative exposome assessment methods: in vitro and ex vivo models and clinical studies, understanding the effects of the exposome on the skin relies on the development of novel in vitro and ex vivo models, and also on innovative approaches for clinical evaluation, explains Catherine Zanchetta, from Givaudan.

The skin's reaction to irritants

Novel in vitro and ex vivo models have been developed to mimic the skin exposition to different stimuli as photo-pollution, temperature changes, digital stress or mask wearing. These models highlight the skin reaction to these expositions (dehydration, inflammation, modification of the natural cycle of the melatonin for example).
Clinical studies also play a major role in understanding dynamics between skin and exposome. For example, we can today describe tobacco or make up impact on the skin microbiota and define how the skin microbiota can contribute to skin disorders. In addition, the reporting of emotions (including psychological stress, an essential component of the exposome) is increasingly improved in including neuroscientific methodologies: prosody, MoodPortrait™ and EmotionDecodingSystem™ for example.

Claims substantiating methods

Véronique Newton, from CIPD adds: In the last past few years, a new branch of the literature has grown to demonstrate that apart from UV, the visible spectrum of sunlight, as well as ambient pollution, also induce oxidative stress, cutaneous ageing, and pigmentation. These environmental stressors can penetrate the skin stratum corneum triggering an oxidative stress, premature skin ageing and hyperpigmentation. Thus, the detrimental effect of these exposome is becoming more and more obvious.
More and more cosmetics products are launched which claim to ward-off damage from these exposome, but no standardised methodologies have till date been developed to substantiate these claims. At CIDP, we have revisited these claims to propose controlled and calibrated systems as well as evaluation of specific biomarkers to analyse impact of exposome on skin.
For example, the Controlled Pollution Exposure System (CPES) offers a quantified vaporisation of pollutants (ambient dust, indoor dust, diesel, ozone) on the skin at controlled flux and concentration.

Protection effect tests

Additionally, the mechanism underlying exposure to blue light can also be studied using internal models that emits light at 415 nm (blue light obtained from the sun) or at 450 nm which mimics blue light obtained from electronic devices. The tests can be conducted, ex vivo, on human skin explants of different skin phototypes and biomarkers such as reactive oxygen species, squalene/squalene monohydroperoxide, MDA, catalase and activated AhR or NRF-2 can be evaluated.
Moreover, more downstream effectors such as the collagenase MMP-1, collagen and pro-inflammatory cytokines can be monitored. These cost-effective models can be used for screening of raw materials or finished products for exposome protection or repairing claim substantiation. The protective and repairing effect of cosmetic products can be further be confirmed in in vivo model by expert clinical methodologies and instrumental analysis.
Biological markers including squalene/squalene monohydroperoxide, MDA and protein carbonylation can be used to evaluate the efficacy of the product.

In vitro compartmentalised microfluidic devices

At Netri, the team has also identified that drug and cosmetic developments are limited by in vitro models: indeed, they are not always relevant either because they use rodent neurons cells or because the cocultures of skin and neurons do not fully recapitulate the anatomical structure for example the neuronal cell nucleus isolated from the skin. The association between compartmentalised microfluidic device technology and human cells may address these limitations.
The company offers devices that are easy-to-use platforms. They consist of silicone pumpless compartmentalised microfluidic devices allowing the co-culture of human iPSC-derived sensory neurons in one channel and human primary keratinocytes in the other. The design of chips allows the fluidic isolation of cell cultures while enabling the physical connection between axons and keratinocytes through microchannels.
Different chips models were designed to address different questions in the field of dermo-cosmetics such as ingredients' efficacy and toxicity screening or mechanism of action's understanding. The process has demonstrated a high and long-term viability in both chips (until

The exposome describes the sum of all environmental factors that affect our skin health. This includes the combination of external factors such as chemicals in the air, water or food, as well as internal components such as hormones that the organism produces in response to various stresses.

28 days).Neurons' maturation markers were observed and quantified.
K14 and K10, cytokeratins expressed by keratinocytes at basal and early differentiated states respectively, were expressed in the devices reflecting the maturation of the epidermal compartment. Also, the coculture of neurons and keratinocytes in chips has been successfully proved. Thanks to compartmentalisation and fluidic isolation, cells are cultivated with their respective culture medium allowing optimal growth.
This also allows the exposure to a treatment or a stimulus specifically on one cell type. Furthermore, devices can be coupled to microelectrode array technology allowing electrical signals recoding of soma after axonal stimulation, leading to innovative readout for the dermo-cosmetics research.

ALGORITHMS FOR IMAGE ANALYSIS

Innovative approaches involve high resolution imaging and analysis algorithms, that allow new ways of skin disorders investigation. They extend from colour 2D images, either locally for a macro followup of lesions or in a full face protocol for holistic approach, to a hyperspectral imaging and dedicated UV polarized monochromatic systems. Elodie Prestat-Marquis, from Newtone Technologies specifies: These systems and associated analyses provide value, depending on the type of lesions (melasma, lentigo, even vitiligo, post-inflammatory pigmentation), provided that a wide spectrum of solutions and algorithms are available to address all phototypes and variety of forms that can take the pigmentary disorders in different skins. This is the challenge of developing solutions that guarantee objectivity, instrumental precision but also correlation with clinical perception.

CONCLUSION

The complexity lies in the ability to establish the cause and effect link between the exposome and its consequences. This is only possible when a pathology is present and analysed by reads out or skin markers.
Advances and knowledge of its impact are therefore closely linked to the technological progress made to measure it and feed a database over time that will make it possible to establish cause/effect models, thus guiding health professionals in general, and experts in cosmetology on the other hand in the implementation of adapted solutions.

ADDITIONAL TOPIC

Lifestyle exposure and interventions in cancer field. Dr Inge Huybrechts at Circ explains that from the the moment a baby is conceived, genes control his/her development and health. However, several observations suggest that genetics alone is not sufficient to regulate development and systems biology. The exposome, which covers all the exposures (internal and external) experienced during our lives, also influences our development and health for better or worse. Indeed, environmental exposures such as pollutants in our water and air, ionising radiation from sunlight and other sources, the biosynthetic activity of the bacteria living in and on us, and even noise pollution all influence the onset of diseases.
Also, individual lifestyle exposures such as the food we eat, the drugs we take, alcohol we drink, sport activities

photos: Gorodenkoff, TR STOK, Vladimir Zotov, fizkes/Shutterstock.com and sunbathing practices as well as social influences are part of our human exposome. These lifestyle factors have the potential for disease prevention due to their modifiable nature and are as such a target for disease prevention recommendations and strategies. Local authorities and international organisations such as the World Health Organization provide guidance and recommendations for the public to help us adopt a healthy lifestyle for disease prevention and healthy ageing.

INTERPLAY OF SEVERAL AREAS

The World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) recently launched the Third Expert Report on Diet, Nutrition, Physical Activity, and Cancer that provide a framework for public health efforts around the globe by governments and other organisations with the goal of significantly reducing the burden of cancer, enhancing health, and improving quality of life for cancer survivors. The WCRF also provides guidance to healthcare practitioners engaged in counseling individuals who may benefit from diet and lifestyle changes.

In addition, the World Code Against Cancer Framework focuses on actions that individuals can take to reduce their risk of developing cancer (www.cancercode-world.iarc.who.int), also considering lifestyle factors such as exposure to pollutants or radiation, sun exposure, participation in cancer screening and vaccinations, et cetera.

Although several core lifestyle factors have been covered in these international recommendations, yet evidence is still lacking for many other behaviours that remain challenging to study or that have been considered of lower priority, such as circadian rhythm related lifestyle factors (for example meal timing and sleep behaviour), sedentary behaviour, stress management, exposure to electronic devices such as smart watches, and many other lifestyle exposures. Cutting-edge research is needed to extend these international guidelines further with extra evidence-based lifestyle recommendations for cancer prevention and overall healthy ageing.

References:

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The World Cancer Research Fund: www.cancercode-world.iarc.who.int

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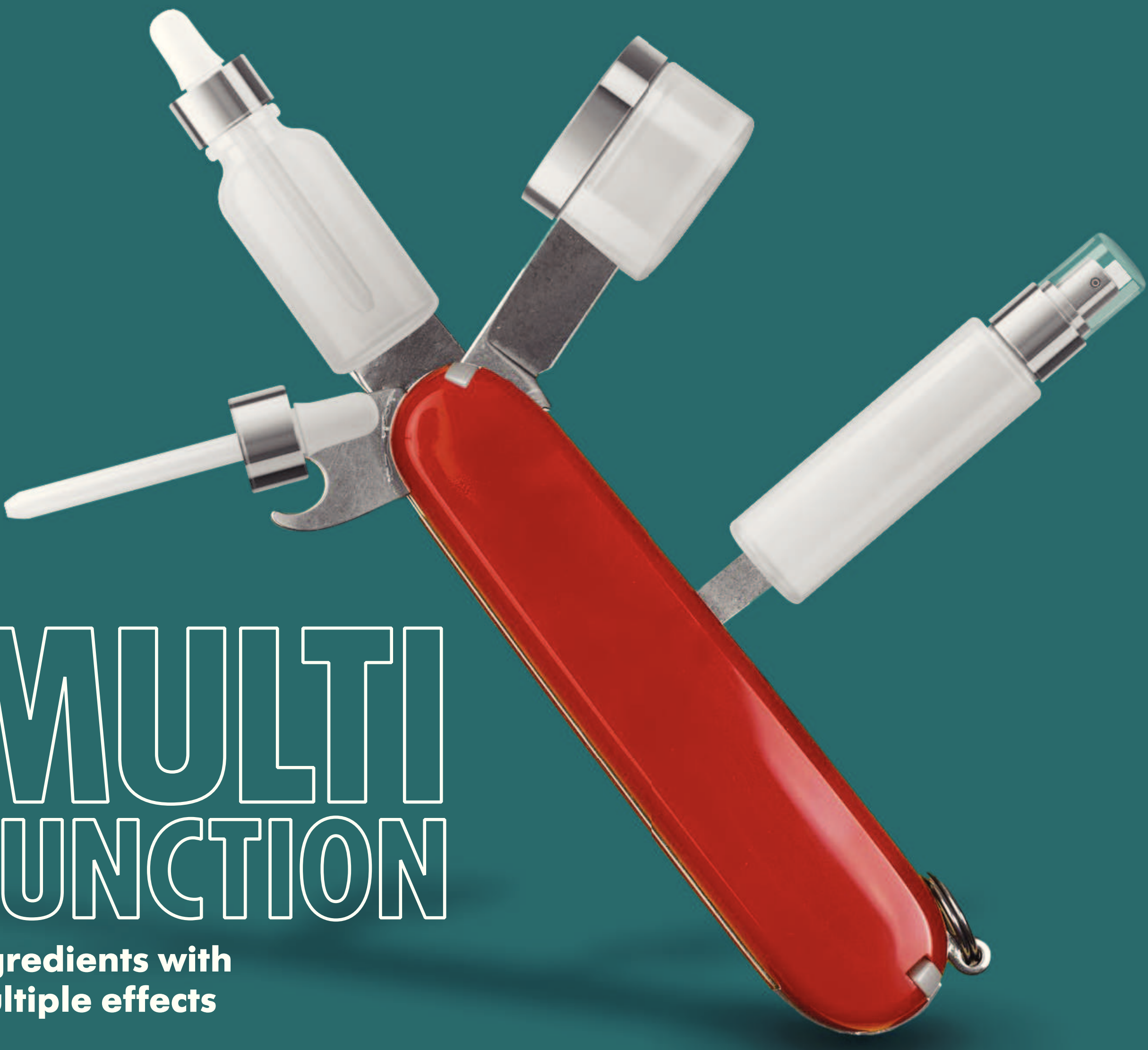

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