Why "Slip Slop Slap" is Not Enough

Each year some 250 New Zealanders die from skin cancer. Sun protection is more than just slapping on a sunscreen.

A Little Sun History

It was only 400 odd years ago that Copernicus declared the sun was the centre of our universe. But throughout the history of the human race the sun has been the centre of a special relationship. On every continent primitive societies, and even some very sophisticated ones, have worshipped the sun as the god that provided warmth and life.. that made the crops grow.

Cultures changed over hundreds of years and class systems developed, which unconsciously used the sun as a different kind of symbol, one which often defined who you were. Skin colour became the visible definer, separating working classes from ruling classes, master from servant. Pale skin indicated the upper classes, the ruling classes, the leisure classes. Darker skin indicated a life of outdoor labour, or even of inferior, primitive origins.

The paler your skin, the higher the class and men and women went to great (sometimes very unhealthy or even dangerous) lengths to be pale.

Women of ancient Greece and Rome used lead paints and chalks to whiten their faces. Unfortunately slow lead poisoning resulting from this beauty treatment could cause death.

Arsenic became a preferred skin whitener by the mid10th century in Europe, again with unhealthy and sometimes deadly results. During the reign of Queen Elizabeth I women painted thin blue lines on their foreheads to suggest a more translucent look. Parasols and/or masks became the norm whenever they ventured outdoors.

These class distinctions also found their way to America. No Southern belle or Northern society debutante would dare go into the sun without a parasol to protect her delicate pallor. It wasn't until the 20th century that society began to accept, and ultimately worship bronzed skin.

Blame it on the French?

French fashion celebrities can take at least part of the credit (or blame) for starting the transformation from pale to tanned skins. In the 1920s fashions were freeing women from confining clothes. It is suggested that designer Coco Chanel accidentally gave the fashion world another trend when she obtained a sun tan while cruising from Paris to Cannes.

Life styles were changing at the same time as the fashions. Women came outside to enjoy the outdoor life, with lawn tennis, picnics, boating, hiking and other activities which became "acceptable", yet still "feminine".

On beaches throughout Europe women could be found sunbathing, wearing decorative shawls and hats not so much for sun protection as for fashion statements. Brown and beige-tinted creams and powders were developed to be applied on the places the sun had missed. The fashion world featured clothes for women to flaunt their new tans. Sleeveless dresses became stylish and shoes were worn without stockings.

Where previously bathing costumes featured large bloomers which covered to the ankles, legs were now bared and swimming became an acceptable sport for women. The sun tan had arrived as a symbol of wealth and leisure. A tan in winter meant the bearer had the status and money to afford a vacation to an exotic, warm, sunny climate.

By the 1970s whole generation had baked their bodies in the sun, oblivious to the fact that the tans they had acquired in their youth would age their skin prematurely 10 to 20 years later and the sunburns develop into skin cancers.

Recognising the Dangers of Sunlight

It wasn't until 1978 that regulatory authorities concluded that sunscreens could help to prevent skin cancer. The American Federal Drug Administration (FDA) developed the first official system for rating Sun Protections Factors (SPF) of sunscreens. In 1985 the American Academy of Dermatology (AAD) was sufficiently alarmed to become the first medical society to start a skin cancer education campaign, warning the public about the dangers of overexposure to the sun. By 1988 the AAD had held a consensus conference on photo ageing and photo damage (premature skin ageing), concluding that "there is no safe way to tan".

SOLAR RADIATION

Sun "light" actually consists of a wide spectrum of energy rays of various wave lengths, of which the spectrum visible to the human eye can be seen in a rainbow (red, orange, yellow, green, blue, indigo, violet). Beyond the red end of the spectrum we move into the longer wave-length infra-red and heat rays which warm our planet.

Above the violet end of the spectrum we move to invisible "cold" rays, the ultra-violet rays. These have a short wave-length and high energy which give them their penetrating and damaging properties. The UV rays are further sub-divided into UVA, UVB and UVC according to their wave-length, all three of which are harmful to humans (and other animals) with excess exposure.

Of the total solar energy reaching the surface of the earth, about 56% is in the infrared range (700-3,000 nm), and 39% is the visible light (400-700 nm), where nanometers (1 nm – 1 billionth of a metre) are the measurement of wavelength. However, it is the remaining 5%, the ultraviolet light (290-400 nm) which has the most profound effect on the body.

All three UV rays are harmful and implicated in sunburn, skin cancer, eye disease, photo damage and premature skin ageing and suppression of the immune system. Fortunately the earth has its own UV shield in the form of the "ozone layer".

The Ozone Layer

Most atmospheric ozone is concentrated in a layer in the stratosphere, about 15-30 kilometres above the Earth's surface. Ozone is a molecule containing three oxygen atoms. It is bluish in colour and has a strong, distinctive odour. The normal oxygen, which we breathe, has two oxygen atoms and is colourless and odourless. Ozone is much less common than normal oxygen. Out of each 10 million molecules of air, about 2 million are normal oxygen, but only 3 are ozone.

However, even this small amount of ozone plays a key role in the atmosphere. The ozone layer, which has about 90% of the world's atmospheric ozone, acts as a gigantic shield by absorbing a portion of the radiation from the sun and preventing it from reaching the planet's surface. Most importantly, it absorbs all of the UVC rays and a large portion of UVB rays. Beyond the harmful effects on humans, UVB can be of harm to some crops, certain materials and some forms of marine life.

At any given time, ozone molecules are constantly formed and

destroyed in the stratosphere. The total amount, however, remains relatively stable. The concentration of the ozone layer can be thought of like a stream at a particular spot. Although the water is constantly flowing in and out, the stream's depth remains constant.

While ozone concentrations vary naturally with sunspots, the seasons, and latitude, these processes are well understood and predictable. Scientists have established records spanning several decades that detail normal ozone levels during these natural cycles. Each natural reduction in ozone levels has been followed by a recovery.

Ozone Depletion

Recently, however, convincing scientific evidence showed that the ozone shield was being depleted well beyond changes due to natural processes. We now know that some man-made chemicals increase the rate at which ozone is destroyed. The chemicals, which have been widely used for some 60 years, include chlorofluorocarbons (CFCs) which are (or were) used in freezers, refrigerators, air conditioners and aerosols.

One example of ozone depletion is the annual ozone "hole" over Antarctica that has occurred during the Antarctic Spring since the early 1980s. Rather than being literally a hole through the layer, the ozone hole is a large area of the stratosphere with markedly lower amounts of ozone. During the worst years, ozone levels fall by over 60%. Studies have also shown that the amount of UVB measured at the surface can double during the annual ozone hole. While steps are being taken world-wide to phase out the use of the ozone-damaging chemicals, it will be a long time (estimates range up to 100 years) before the ozone layer returns to normal.

Media attention on the ozone hole has highlighted the risks we face and the likelihood of an ongoing increase in health problems such as skin cancer. Countries in the southern hemisphere lie closer to the sun and therefore receive more UV radiation. Our largely smog-free air also has less pollution, providing a clearer passage for UV radiation. We have also experienced more than 15% reduction of ozone over New Zealand in the last 30 years.

We therefore need to be very careful to protect our skins in this country, especially in the daylight saving months.

Ultraviolet Rays

The ultraviolet light band ranges from 200 to 400nm. The UVC (200-290nm) has the shortest wavelength of the UVs. UVB (290-320nm) reaches the earth causing sunburn and is an important factor in skin cancer. UVA (320-400 nm) is the least energetic of the three bands. However, one hundred times more UVA reaches the earth's surface than UVB. But UVB is 10 times more potent than UVA in causing sunburns.

Even on an overcast day, 80% of the sun's ultraviolet rays pass through the clouds. On bright, sunny days, the reflection of the sun is considerable: 17% off of sand and 80% off of snow!

UVA Radiation (320-400)

UVA could be called the "ageing ray". It is the longest wavelength and makes up 95% of UV light reaching us. Although less likely than UVB to cause sunburn, UVA penetrates the skin more deeply into the dermis and is considered the chief culprit behind wrinkling, leathering, and other aspects of "photo-ageing". It is involved in the generation of singlet oxygen and hydroxyl free radicals which can cause damage to cellular proteins, lipids, and carbohydrates. Like UVB, it can cause structural damage to the DNA and impair the immune system. The latest studies show that UVA not only exacerbates UVB's carcinogenic effects, but may directly induce some skin cancers, including melanomas.

- It turns melanin dark (moles, sun or "age" spots).
- It is at full strength from sunrise to sunset.
- It is strong from pole to pole.
- It is strong at any altitude.
- It penetrates glass (including car windows).
- It is present 100 times more than UVB.

UVB Radiation (290-320 nm)

UVB can be considered the "burning ray". It is of medium length in the UV spectrum and makes up 4 to 5% of UV light. It is the most active UV radiation in producing sunburn. UVB rays are considered the main cause of basal and squamous cell carcinomas as well as a significant cause of melanoma and penetrate into the epidermis (outer protective layer) of the skin. UVB significantly decreases anti-oxidants in the skin, impairing its ability to protect itself against the free radicals generated by exposure to sunlight. It is considered to be responsible for inducing skin cancer due to DNA damage. It is also suspected of lowering the immune system's defenses. UVB radiation:

- Stimulates melanin formation (tan).
- Is strongest between 10:00 a.m. and 4:00 p.m.
- Is stronger at the equator.
- Is stronger at high altitudes.
- Reflects off shiny or white surfaces (water, sand, concrete, etc.) .
- Is 10 times stronger than UVA.
- Reduced by to sunscreen protection.

UVC Radiation (200-290 nm)

This is the shortest wavelength. This radiation is harmful to living tissue but fortunately all of it is absorbed by the ozone layer. It is a sterilizing ray that is carcinogenic and can kill small organisms on contact.

Sun Protection Factors

The concept of a sun protection factor (SPF) was originally proposed by Austrian scientist Franz Greiter and subsequently adopted by many regulatory authorities and the cosmetic and pharmaceutical industries. It measures the degree of protection from UVB radiation.

Essentially an SPF number is a ratio which indicates by how much the amount of time required to cause skin reddening (erythema, the visible onset of sun damage to the skin) from UVB is extended. If it takes 10 minutes without protection to begin reddening, then an SPF 15 indicates it will take 15 times as long (150 minutes or 2.5 hours), while an SPF 30 doubles that again to 300 minutes, or 5 hours.

The SPF factor does not relate directly to the amount of UVB filtering. For example, the amount of UVB filtering only increases from 94% at SPF 15 to 97% at SPF 30, even though the sun protection factor doubles.

European v US SPFs

Over the years there has been confusion over the meaning of SPF ratings around the world, particularly supposed differences between European and US SPF ratings. It has often been suggested that European sunscreen products are not as effective as US formulations

However, the SPF numbers around the world are actually very

similar and for practical purposes can be accepted as being the same. Whether the product is made in Auckland, Sydney, Paris or Chicago, an SPF15 is an SPF15. The confusion (which is still fed by some web sites) is largely based on outdated information.

As we said earlier, the American FDA published its first monograph on sunscreens in August 1978. The sunscreens were tested for filtering effect by applying 2mg per square centimetre onto the skin. When the German Institute for Standards (DIN) introduced the first European standard, their DIN standard for sunscreen measurement used an application of 1.5mg/cm^2 of skin. The German benchmark was accepted at the time by COLIPA (the European Cosmetic, Toiletry & Perfumery Association).

On this basis, the maths might suggest that an SPF 15 tested in Europe might only be about SPF 11 to 12 when tested in the USA. However, about 15 years ago the Europeans switched to the US standard of 2mg/cm^2 of skin, so well over a decade there has been no significant difference in the meaning of SPF numbers anywhere.

There may still be small differences between European and US products because of other testing variations. One of the differences is the source of UV rays. In the US exposure can be measured either with direct sunlight or a xenon lamp solar simulator. The Europeans may also use a mercury vapour lamp as a sun source. This additional testing nuance may potentially result in variations between products, though exactly how much if any difference isn't clear.

It is important to point out that the EU is working on a more standardised testing approach to SPF. The European Directorate and the US FDA are also cooperating in the development of commonly accepted standards.

It is also worth pointing out that in the US sunscreen ingredients have been treated as OTC (over-the-counter) drugs, while the Europeans came via a cosmetic ingredients approach. Therefore another difference exists. While the active ingredients are almost the same everywhere, in the European Union (also Canada and Australia/NZ) no concentration minimums are set when they are used in combination. The US FDA on the other hand controls how much and in what combinations manufacturers may use active ingredients. But in the end, it is the testing of the SPF which counts because the SPF numbers tell us how long we can stay in the sun without our skin starting to turn pink.

There's another important issue to remember. An SPF doesn't give any indication of UVA screening… it is essentially a test of UVB protection. As we now know, UVA light rays are also important in damaging our skins, requiring protection. The only standard for UVA protection is actually in Australia (and NZ, because we use the same standard). This uses a photometric process to estimate the reduction of UVA radiation reaching the skin and the standard demands that the sunscreen product absorbs at least 90% UVA radiation.

The bottom line? An SPF 30 is for all intents and purposes an SPF30 anywhere and will give comparable protection from sunburn. When it comes to UVA, which is not represented by the SPF number, we need to check for the active ingredients which are known to offer protection in this spectrum. Titanium dioxide, zinc oxide, avobenzone and Mexoryl SX are such ingredients.

Broad-spectrum protection indicates that a product shields against UVA as well as UVB. In Australia or New Zealand, sunscreen products which meet the AS/NZ 2604 test standards will reduce UVA exposure by 90% and meet the nominated SPF rating.

But "Slip, Slop, Slap" is Not Enough!

Even with the ideal sunscreen, some UV rays still get through to your skin and cause damage. In fact a number of studies have shown that even with much the more effective SPF 30+ sunscreens, the preventive benefits which might be expected are not necessarily accruing.

Perhaps the most important factor is that the term "SPF" encourages users to prolong their sun exposure. If your normal "burn time" is 20 minutes, it is tempting to extrapolate that using an SPF 30+ sunscreen will allow you to spend 10 hours (pretty much the whole day) in the sun without further concern.

While exemplary use of an SPF 30 sunscreen may well give you 97% filtering of UVB rays, at best you'll get 90% filtering of UVA rays. Because the effects of both rays are cumulative (they add up over time) in the short term and the long term (over days, months and years), the damage you cause can still be significant. And repeated sunburns substantially increase the risk of melanoma.

Three percent UVB radiation might not seem much (after all, you get 97% UVB filtering from an SPF 30 sunscreen). But remember, the 3% difference between an SPF 30 (97%) and an SPF 15 (94%) halves the time before you burn.

The problem is that an exact number, like 15 or 30, gives a false sense of accuracy or security. There are so many other factors: your skin type, the time of day, your surroundings (reflective water, sand, concrete, snow), your 'wear and tear' (rubbing or sweating, swimming, etc), the time of year, the weather conditions, your health and nutrition, quantity and evenness of application, previous sun damage, use of certain medicines, and so on.

(Photo-sensitising medicines include ibuprofen, digitoxin, doxepin, amiodarone, trimethoprim, chlorpropramide, proxicam, doxycycline and promethazine.)

Remember, SPF's are derived under controlled conditions, using an even application of 2mg of sunscreen per cm2 (about 30-40gm to cover your body) and a measured dose of UVB radiation. Indications are that in practical use, the average coverage is probably nearer a half to two-thirds of the required amount.

What More Can You Do?

Although sunscreens have improved markedly as our appreciation of the risks of solar radiation has increased, no sunscreen today is sufficiently protective to be used as a sole means of sun protection.

Your primary protection from the sun should be avoidance (stay out of the sun between 10am and 4 pm as much as possible), staying in the shade, wearing wide brimmed hats and protective clothing (a thin white T-shirt may have no more than SPF 10, so use clothes with a tested SPF rating or denser weaves). A sunscreen is a backup, not an alternative.

Use an SPF factor more as a guide to how much protection you are getting, rather than extending your time in the sun. Use an SPF 30+ sunscreen during the daylight savings months as an assurance of maximum protection, not an excuse for staying out in the sun as long as you like.

Make sure you apply sunscreen evenly to every visible part of your body. Coverage of your whole body will require at least a "shot" glass full of sunscreen. Reapply regularly, especially after swimming or strenuous activity.

Finally, give your body every opportunity to protect itself with a diet rich in antioxidants. But that's a whole topic in itself.