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The authors declare no conflicts of interest

Summary

Background/Purpose:

Solar ultraviolet radiation (UVR) doses received by individuals are highly influenced by behavioural and environmental factors. This study aimed at quantifying hats' sun protection effectiveness in various exposure conditions, by predicting UVR exposure doses and their anatomical distributions.

Methods:

A well-defined three-dimensional head morphology and four hat styles (a cap, a helmet, a middle- and a wide-brimmed hat) were added to a previously published model. Midday (12:00-14:00) and daily (08:00 - 17:00) seasonal UVR doses were estimated at various facial skin zones, with and without hat-wear, accounting for each UVR component. Protection effectiveness was calculated by the relative reduction of predicted UVR dose, expressed as a predictive protection factor (PPF).

Results:

The unprotected entire face received 2.5 times higher UVR doses during a summer midday compared to a winter midday (3.3 vs. 1.3 SED) with highest doses received at the nose (6.1 SED). During a cloudless summer day, the lowest mean UVR dose is received by the entire face protected by a wide-brimmed hat (1.7 SED). No hat reached 100% protection at any facial skin zone (PPF_{max}: 76 %). Hats' sun protection effectiveness varied highly with environmental conditions and were mainly limited by the high contribution of diffuse UVR, irrespective of hat style. Larger brim sizes afforded greater facial protection than smaller brim sizes except around midday when the sun position is high.

Conclusion:

Consideration of diffuse and reflected UVR in sun educational messages could improve sun protection effectiveness.

Key Words:

1. Ultraviolet radiation (UV)
2. Protection effectiveness
3. Sun exposure
4. Skin cancer
5. Prevention

Introduction

Skin cancer is the most common cancer in light-skinned populations worldwide and is mainly caused by excessive exposure to solar ultraviolet radiation (UVR) (1-3). Non-melanoma skin cancer is predominantly associated with total cumulative UVR exposure, leaving the most exposed skin zones, such as the face, back of the neck, eyes and ears, at high risk (4-7). Solar UVR doses received by an individual are highly influenced by skin phototype, time and duration of exposure, environmental factors, and sun-protective behaviour and attitudes (2). Indeed, increasing skin cancer rates are mainly attributed to changing lifestyles over the last decades from sun avoidance towards sun-seeking behaviour with positive perception of sunbathing, fashion trends favouring lesser body clothing coverage, more outdoor activities and more holidays spent in sunny destinations (8, 9).

Prevention campaigns have long raised awareness about sun exposure hazards and recommended skin and ocular protection measures such as seeking shade, avoiding peak irradiances (11:00-15:00), using sunscreen, and wearing a hat, sunglasses and long sleeves (10-13). Sun protection effectiveness is generally conveyed by means of indexes of protection such as the sun protection factor (SPF) for topical sunscreen or the ultraviolet protection factor (UPF) for garment. The dose reduction expressed by such factors does not clearly inform the public about how much solar UVR is transmitted to the skin when using such sun protection means (14).

The few previously published studies estimating the UVR doses received by the head used individual dosimetric measurements on manikin head forms, and reported high exposure for several facial zones, with or without hat protection (15, 16). Dosimetric measurements are costly, time-consuming, context-specific, prone to behavioural bias, and, importantly, cannot distinguish direct, diffuse and reflected UVR components reaching the skin. Diffuse UVR has recently been shown to contribute substantially to the total UVR dose received, a fact probably underestimated in current prevention messages (17).

To address these issues, a previously developed three-dimensional (3D) numeric modelling tool predicting solar UVR doses at different anatomical sites, taking into account each UVR component (direct, diffuse and reflected UVR), has been enhanced (5). With the aim to quantify sun protection effectiveness, a specific morphology with precisely defined facial zones has been created for the head and various 3D hat styles have been added to the model (18, 19). To assess UVR doses received by the face and support effective prevention messages, adapted to various environmental situations, this study aims (i) to predict midday (12:00-14:00) seasonal sun protection effectiveness and UVR dose reduction of various hat styles for different facial zones, and (ii) to estimate the daily (08:00-17:00) dose reduction of direct, diffuse and reflected UVR received at various facial zones when wearing a commonly used hat style (a baseball cap).

Material and Methods

Modelling tool

Solar UVR doses potentially received by facial skin zones were estimated by SimUVEx v.2 (Simulating UV Exposure version 2.0). This model uses irradiance data and 3D human body modelling, as well as computer graphics techniques, to estimate skin exposure doses within minutes.

The principles of this model and its on-field validation with dosimetry measurements were detailed previously (5, 17, 18).

This study focuses on the facial skin zones of a detailed adult head morphology. The numeric model delineates 33 skin zones for the head, highlighted in various colours (Fig. 1a, supporting information), and which complies with the topography of the International Classification of Diseases for Oncology (20). The tool includes static and dynamic functionalities, as well as a rotation step, which can be selected according to each exposure situation chosen.

Input data

Ambient irradiance data

Direct, diffuse and reflected erythemally weighted UV irradiance, measured every minute at the MeteoSwiss Payerne Station (46.815°N, 6.944°E, altitude 491 m) for the year 2014, was used for this study. The Payerne station is part of the Baseline Surface Radiation Network of the World Meteorological Organization, World Climate Research Program, and uses broadband UV radiometers with filters mimicking the erythema response (21).

Ambient irradiance data used hereafter refers to midday sun exposure (12:00-14:00) and daily sun exposure (08:00-17:00). Potentially received facial UVR doses were estimated for one day per season (Table 1), taking into account cloudless exposure conditions and albedo (reflection coefficients for reflecting ground surfaces) (22). By selecting days of a typical cloudless situation, worst-case scenarios regarding seasonal UVR were chosen. For midday simulations, a static orientation was assumed (i.e. reading a book, sunbathing or working outdoors in a predominantly static position) and the fixed head orientation option was chosen. For daily simulation runs (08:00-17:00), a dynamic orientation was presumed and a 24° step rotation per minute was selected.

Please insert Table 1

Hats and facial skin zones:

Four hat styles, based on real-life observations, were implemented in the model (Figure 1): 1. a baseball cap (10 cm frontal brim size), often used in leisure and working environments, 2. a small-brimmed hat same sized as a helmet, used for instance in construction work (7 cm frontal brim-, 4 cm lateral brim size), 3. a middle-brimmed hat (6 cm circular brim size), which corresponds to the minimal brim size recommended for sun protection, and 4. a wide-brimmed hat (17 cm circular brim) (23-26). The 17 cm brim size represents a theoretically ideal brim size for high sun protection on a summer day, obtained after varying the virtual brim size of the hat morphology. The fabric of all hats was considered to provide full protection for all covered facial skin zones (blocking 100% UVR).

Please insert Figure 1

The skin zones of the entire face included: (a) the ears (mean dose received by auricular, earlobe, earlobule front/back at the right and left ear); (b) the ocular region (mean dose received by tear-duct, upper, lower and lateral ocular region at left and right ocular region); (c) the nose (dose received by columnella, external nose, tip of the nose and dorsum nasale); (d) the cheeks; (e) the jaws; (f) the chin; and (g) the lower lip. Midday (12:00-14:00) UVR doses received by the above-enumerated skin zones, the entire face and the neck were estimated separately. The daily (08:00-17:00) UVR dose reduction provided by a commonly used headgear such as a baseball cap with no flag, was estimated separately for (a) the left ear, (b) the nose, (c) the oral region (including upper and lower lips) and (d) the forehead (sub-zone of the top of the head: Fig 1a., supporting information).

Output data:

Solar UVR doses and predicted protection factor PPF

The estimated solar UVR doses received are reported in Standard Erythema Dose (SED) (27). The UVR doses reported represent doses potentially received, calculated by summing up the estimated direct, diffuse and reflected UVR for each day and skin zone. The sun protection effectiveness of each hat style was determined by comparing the solar UVR dose potentially received with and without a hat for each facial skin zone for the same exposure duration. The sun protection effectiveness is expressed as a Predictive Protection Factor (PPF [%]), representing the relative reduction in predicted UVR dose for any facial zone (Equation 1). The greater the PPF, the higher the relative sun dose reduction is.

$$PPF\ [\%] = \frac{UV_{withoutprotection} - UV_{withprotection}}{UV_{withoutprotection}} \times 100$$

Equation 1: Predictive Protection Factor (PPF [%]) calculation, estimated for UVR dose received at each facial zone with and without protection.

Results

Total solar UVR doses potentially received by the entire face, and by each facial skin zone, with and without hat protection, during midday exposure (12:00-14:00) are given in Table 2 a day per season. Overall, large variations in UVR doses across facial skin zones are observed within a season and, to a lesser extent, between seasons.

During a two-hour midday exposure, the unprotected face potentially receives 2.5 times more UVR doses in summer than in winter (3.3 SED vs 1.3 SED). Without hat protection, the nose received the highest dose estimated and the largest seasonal dose variation (summer/ winter ratio of 4.4) compared to other facial skin zones, while the chin had the least seasonal dose variation (summer/ autumn ratio of 1.9). Midday summer exposure ranged by a factor of 4.5 across unprotected facial skin zones, from 1.4 SED at the chin to 6.1 SED at the nose. In winter, UVR doses without a hat protection varied by a factor of 0.4 (from 1.1 SED at the ears vs.to 1.5 SED at the lower lip and cheeks), with values in-between summer and winter ones observed for spring and autumn.

With headgear protection, on a cloudless summer day, the lowest mean UVR dose received by the entire face was found with a wide-brimmed hat (1.7 SED). The UVR doses potentially received by the entire face were comparable for all other hat styles (2.0 SED). While little difference was observed in sun protection afforded by hat styles for the entire face in winter, a baseball cap yielded the same lowest mean UVR dose as a wide-brimmed hat in autumn. The middle size brimmed hat in springtime and the helmet or small-brimmed hat in autumn exposed the entire face to the largest potential UVR doses. In summer, doses received at the neck were reduced by the circular brim of some hats (small, middle- and wide-brimmed hats). However, in winter, these hats provided almost no dose reduction.

Please insert Table 2

The PPF of each hat style is reported for each seasonal day in Figure 2 (Fig.2: summer and winter; Fig.2a: spring and autumn, supplemental information). PPF values showed high inter-seasonal variability for most facial skin zones for direct UVR only in cloudless situations. No hat could provide a 100 % sun protection for any facial skin zone during any season (maximal protection: 76% for the nose in summer with a baseball cap). Overall, the PPF values of hats were greater in summer and spring than in winter and autumn. The effectiveness was lowest in winter for each hat and ranged from 0 - 37% across facial skin zones. Wearing a baseball cap on a cloudless day, results in PPF values of 60% and 10% at all seasons for diffuse and reflected UVR, respectively, whereas the degree of protection from direct UVR was season-dependent (PPF: 79% in summer, 60% in spring, 41% in autumn and 29% in winter, Fig. 2c, supporting information).

The chin was the facial zone the least protected by any hat style, with the lowest PPF for all seasons. The nose showed the highest PPF of all facial zones in summer, and was the skin zone for which the relative UVR dose reduction was the least dependent on the hat style worn. Wearing a baseball cap offered the least protection of all hats for the ears, with a UVR dose reduction of 20-25% (compared to 50% for a helmet), but the highest protection for ocular and nasal regions during all seasons. For all hat styles, the lower lip and the ocular region appeared to be the zones for which sun protection effectiveness was the most season-dependent.

Please insert Figure 2

The daily (08:00-17:00) seasonal cumulative dose of each solar UVR component was estimated for four skin zones covered by a baseball cap (Fig.3 (i) a summer day and (ii) winter day; Fig. 3a: (i) spring and (ii) autumn, supporting information). In the absence of hat protection, the direct and diffuse UVR during cloudless situations follow a bell-shaped pattern. On a cloudless winter day with snow covered ground (high albedo), the contribution of UVR reflected from the ground increased materially. Overall, diffuse radiation is the main contributor to the total daily solar UVR dose received, while direct radiation predominates in summertime only. Results were comparable for other implemented hat styles (data not shown).

Please insert Figure 3

In summer, the direct UVR potentially reaching the nose and the oral region is totally blocked by a baseball cap around midday, whereas the diffuse radiation is only reduced by half. In comparison to other facial zones, the dose reduction of direct and diffuse UVR at the ears is small. The dose reduction is largely dependent on the sun position (daytime and exposure situation).The nose for example is protected during long daily period when the sun position is high, however this period is importantly reduced when the sun is low.

Albeit the total UVR is low in winter, the reflected UVR dose is almost as high as the direct UVR with snow on the ground. The reduction of the reflected UVR dose received by each skin zone is very small when wearing a baseball cap, but direct and diffuse UVR doses are almost totally reduced at the forehead. In situation when the sun position is low, especially in winter, the shade provided by the hat does not necessarily cover all facial zones (Fig. 3).

The influence of the sun position towards the total solar UVR received is illustrated for a day in summer and in winter (Figure 4, supporting information). The sun position is given by the solar zenith angle (SZA), which is the angle between the zenith and the centre of the sun's disc (position of the sun =90°-SZA). At midday, the solar zenith angle is lowest and consequently the UVR dose received was highest for each unprotected facial zone. While the solar UVR dose reduction for each zone is important in summer (with a maximal value at noon), the dose reduction in winter is comparatively very small.

Please insert Figure 4

Discussion

Predicting the facial sun protection effectiveness of various hat styles has enabled to quantify the UVR dose reduction and to improve our understanding of the most/ least facial skin zones protected under different environmental conditions, accounting for the effect of direct, diffuse and reflected UVR components. To our knowledge, this is the first study to comprehensively address and assess the protective and environmental contributors of facial UVR exposure. The estimated UVR doses received at different facial zones vary highly and differ strongly with environmental conditions. Although hat protection attenuated the variability in UVR exposure across facial skin zones, our results show that no hat fits all situations, and underline the importance of adapting sun protection use to surrounding conditions. For most facial skin zones, a wide-brimmed hat is the most effective hat style, in particular during peak summer irradiance. However, its effectiveness depends on the considered skin zone and the sun position. It should be reminded that the relative dose reduction expressed by the PPF does not indicate the amount of UVR reaching the skin or the risk associated with the dose received.

Our dose estimates are in line with previous estimates of protection provided by various hats, and confirmed overall the greater facial sun protection effectiveness of larger brim-sizes since they provide proportionally more facial shading in particular when the sun is high (and the SZA is low) (15, 16, 28-30). During clear-sky conditions, hats with a large frontal brim provide high sun protection for the nose, but negligible protection for the ears, assuming no hair protection in the simulation model. This explains why a baseball cap with a 10 cm frontal-brim pull low down to the face is, compared to the other implemented hats, the most sun protective for nasal and ocular regions and as effective for nasal and ocular zones as a wide-brimmed hat in autumn, when the sun position is lower. From an occupational perspective (apart for safety), our implemented helmet protected all skin zones better from the sun than a baseball cap thanks to its additional circular brim.

Although the ambient UV irradiance in winter in many countries does not require hat-wear for sun protection, it is useful to better quantify and understand the contribution of reflected UVR and link this understanding to other reflecting conditions. Our findings show that reflected UVR dose reduction afforded by any hat is low. Hats’ effectiveness depends on the sun position, which is low around midday in winter so the direction of the solar UVR reaching the face is frontal. Thus, sun radiation hits the face even if a hat is worn. When the sun is low (and the SZA is high), the sun protection capability of small or middle –brimmed-sizes hats is reduced due to the UVR dose distribution to more vertical facial skin zones (4). Wide-brimmed hats are most effective when the sun is low (as in spring, winter, autumn, or summer mornings and evening) and provide no further protection at summer midday than smaller-brimmed hats.

The sun protection effectiveness provided by any hat was very low at facial zones where skin cancer and precancerous skin lesions commonly occur (31-33). The chin was the least protected facial zone by any hat style for all seasons. Best sun protected zones were the eyes, the ears, the nose and the cheeks, however their protection effectiveness was highly reduced when reflected UVR was existing. Throughout the year, during cloudless conditions, the sun protection effectiveness of hats is mainly influenced by facial exposure to direct UVR (similar PPF values for diffuse and reflected UVR, Fig. 2b). Our findings underline the importance of integrating diffuse and reflected radiation into sun dose estimates and prevention messages. The association between daily UVR doses received by facial zones and sites of lesion occurrence is moderate and needs further investigations.

This study has several limits. First, the predicted absolute UVR doses might be overestimated as no additional sun protection means (as shade, make-up, sunscreen or sunglasses), or facial (as a beard) or scalp/ears hair protection were included into the simulations, and a well-positioned hat-wear was assumed during the entire exposure conditions (no wind) with no clouds in the sky. Thus, the UVR dose reduction, as expressed in relative terms by the PPF, should be little affected by these study assumptions. Second, the scenario with a circular brim size hat of 17 cm is almost not usable in everyday life, especially in occupational settings. Its virtual implementation was only intended to represent the ideal sun protection during summer when no additional sun protection was used. This very large virtual brim-sized hat, unlikely to be worn by most of the general public, highlights the need an adapted combination of different sun protection means to keep the brim-sized usable. Third, the hat fitting on the forehead influences the sun protection at various skin zones. Although we did not assess hat geometry specifically, the 3D fitting of the middle-sized hat on our head form was slightly deeper suited in the forehead than the wide-brimmed hat. Consequently, a marginally higher UVR dose for the ears with a wide-brimmed than a middle-brimmed hat was estimated for summer and winter (Table 2).

Skin cancer prevention messages lack quantitative and context-specific data on the effectiveness of sun protection means taking into account factors affecting the UVR exposure as ground reflection and sun position, hat style and cumulative exposure doses. Our study’s findings can help to close a knowledge gap in sun protection understanding and may lead to revisit some educational messages.

Sun protection messages need to clearly emphasise that no hat fits all situations and their use should be combined with avoidance of peak radiations periods, shading structures, a neck flag, a scarf, sunglasses and/or sunscreen in high UV irradiance situations, such as being in the snow, on light ground surface or in the sand. A use of UVR exposure models to measure and illustrate sun protection effectiveness of other specific sun protection means, such as sunglasses or shading structures is warranted.

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Tables:

Table 1: Simulation exposure conditions for each selected seasonal day of the year 2014.

Season	Simulated day	Exposure duration (for all hats)	Exposure duration (cap-case)	Weather and setting
Spring	09 April	12:00-14:00	08:00-17:00	Cloudless
Summer	17 July	12:00-14:00	08:00-17:00	Cloudless
Autumn	30 October	12:00-14:00	08:00-17:00	Cloudless
Winter	31 December	12:00-14:00	08:00-17:00	Cloudless and high albedo

Table 2: Estimated UVR dose (SED)** at various facial skin zones for four hat styles, on a cloudless day per season of the year 2014.

Hat style	Midday exposure (12:00-14:00)	Solar UVR dose (SED)								
		Entire face*	Ears	Ocular region	Nose	Cheeks	Chin	Jaws	Lower Lip	Neck
	Spring	2.7	2.5	2.9	4.7	4.2	1.3	1.9	4.7	1.6
	Summer	3.3	3.2	2.5	6.1	4.9	1.4	2.5	4.4	2.1
	Autumn	2.4	1.1	1.5	2.0	1.9	0.7	1.0	2.1	2.1
	Winter	1.3	1.1	1.3	1.4	1.5	1.2	1.2	1.5	1.2
	Spring	1.7	1.9	0.7	1.3	1.9	1.2	1.7	3.8	1.5
	Summer	2.0	2.5	0.9	1.6	2.2	1.2	2.1	2.5	2.0
	Autumn	1.0	0.9	0.4	1.3	1.4	0.7	0.9	1.8	0.8
	Winter	1.1	0.9	0.9	1.0	1.2	1.2	1.2	1.3	1.2
	Spring	1.9	0.9	1.2	3.0	3.0	1.2	1.8	4.0	1.4
	Summer	2.0	1.3	1.6	2.3	2.7	1.3	2.1	3.3	1.7
	Autumn	1.1	0.7	1.3	1.7	1.7	0.7	1.0	1.9	0.7
	Winter	1.2	0.7	1.2	1.2	1.3	1.2	1.2	1.4	1.1
	Spring	1.3	0.9	0.9	1.2	1.6	1.1	1.5	2.3	1.3
	Summer	1.7	1.3	1.3	1.8	2.1	1.1	1.8	2.3	1.5
	Autumn	1.0	0.6	0.7	1.4	1.5	0.7	0.9	1.8	0.7
	Winter	1.1	0.8	1.1	1.0	1.2	1.2	1.2	1.3	1.1
	Spring	1.7	1.2	0.8	1.8	2.3	1.2	1.7	3.9	1.4
	Summer	2.0	1.6	1.1	2.0	2.5	1.2	2.1	2.8	1.8
	Autumn	1.3	0.6	0.7	1.4	1.6	0.7	0.9	1.9	0.7
	Winter	1.1	0.7	1.1	1.1	1.3	1.2	1.2	1.3	1.1

*including the ears **CIE Standard erythema dose (SED) (1SED=100J/m^2 CIE weighted)

Legend for illustration:

Tables:

Table 1: Simulation exposure conditions for each selected seasonal day of the year 2014.

Table2: Estimated UVR dose (SED) at various facial skin zones for four hat styles, on a cloudless day per season of the year 2014.

Figures (main manuscript):

Figure 1: Head with different hat styles (brim size [cm]): 1. baseball cap (10 cm frontal); 2. helmet or small-brimmed hat (7 cm frontal, 4 cm lateral); 3. middle-brimmed hat (6 cm, circular) or 4. wide-brimmed hat (17 cm, circular).

Figure 2: Predictive Protection Factors (PPF [%]) by hat style and facial skin zone in (i) summer and (ii) winter.

Figure 3: Direct, diffuse and reflected UVR dose estimates for facial skin zones with and without protection from a baseball cap on a day in i. summer and in ii. winter. Solid line represents the dose received without head protection in a particular skin zone for all three radiations components. Dashed lines are used to represent UVR dose potentially received in the case of head protection.

Figures (supporting information):

Figure 1a: Skin zones of the entire head (total skin area: 3864 cm2) are highlighted by specific colours according to the ICDO-3 coding system. Following skin zones are defined: top of the head: forehead, top; back head; face: cheeks , jaws, chin; temple; ocular region: tear-duct, upper, lower, lateral; ears: auricula, earlobe, earlobule front, earlobule back; nose: columella, external nose right, external nose left, tip of the nose, dorsum nasale; oral region: upper lip, lower lip, orbicularis oris and neck: front, back.

Figure 1b: Rendering example of head morphology without and with a hat type for fixed simulations for a spring day (09.04.2014) and cumulative dose of a one-hour exposure (11:00-12:00). (1. head without a hat, 2. head with a baseball cap, 3. head with brimmed hat, 4. head with helmet, 5. head with wide-brimmed hat).

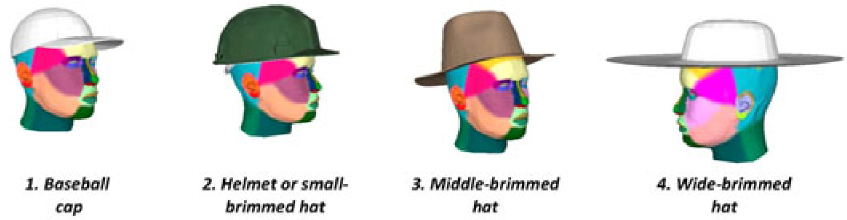
Figure 2a: Predictive Protection Factors (PPF [%]) by hat style and facial skin zone in (i) spring and (ii) autumn.

Figure 2b: Seasonal Predictive Protection Factor (PPF [%]) of each UVR component (direct, diffuse and reflected) for the facial skin zones of the ocular region, protected at midday (12:00 – 14:00) by a baseball cap.

Figure 3a: Direct, diffuse and reflected UVR dose estimates for facial skin zones with and without protection from a baseball cap over a cloudless day i. in spring and ii. in autumn. Solid line represents the dose received without head protection in a particular skin zone for all three radiation - components. Dashed lines are used to represent UVR dose potentially received in the case of head protection with a baseball cap.

Figure 4: Solar Zenith Angle (SZA) and solar UVR dose variation for four skin zones (forehead, oral region, nose and ear) unprotected and protected by a baseball-style cap for a day in i. summer and in ii. winter

Figure 1: Head with different hat styles (brim size [cm]): 1. baseball cap (10 cm frontal); 2. helmet or small-brimmed hat (7 cm frontal, 4 cm lateral); 3. middle-brimmed hat (6 cm, circular) or 4. wide-brimmed hat (17 cm, circular).



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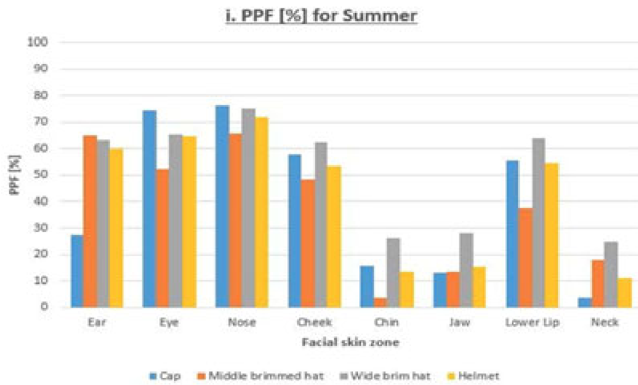

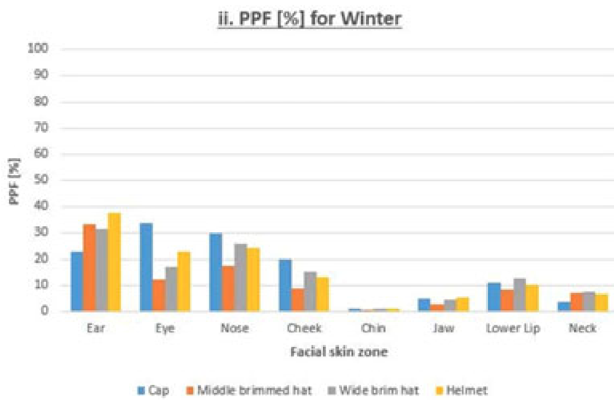

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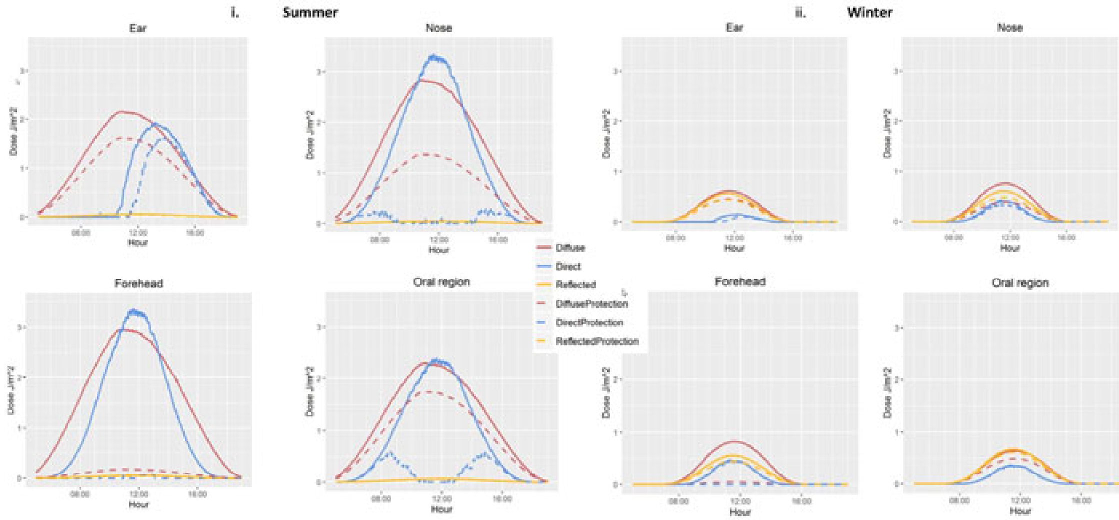
Figure 3: Direct, diffuse and reflected UVR dose estimates for facial skin zones with and without protection from a baseball cap on a day in i. summer and in ii. winter. Solid line represents the dose received without head protection in a particular skin zone for all three radiations components. Dashed lines are used to represent UVR dose potentially received in the case of head protection.



Supporting information:

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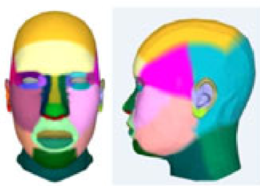

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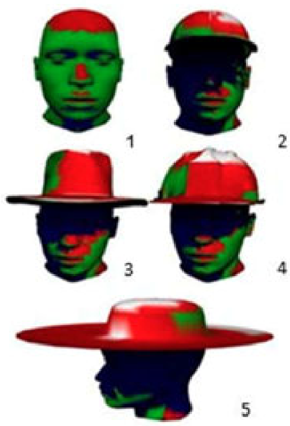

<u>Colour legend of ground irradiance ratio:</u>

Blue: 0 - 33%

Green: 34 - 66%

Red: 67 - 100%

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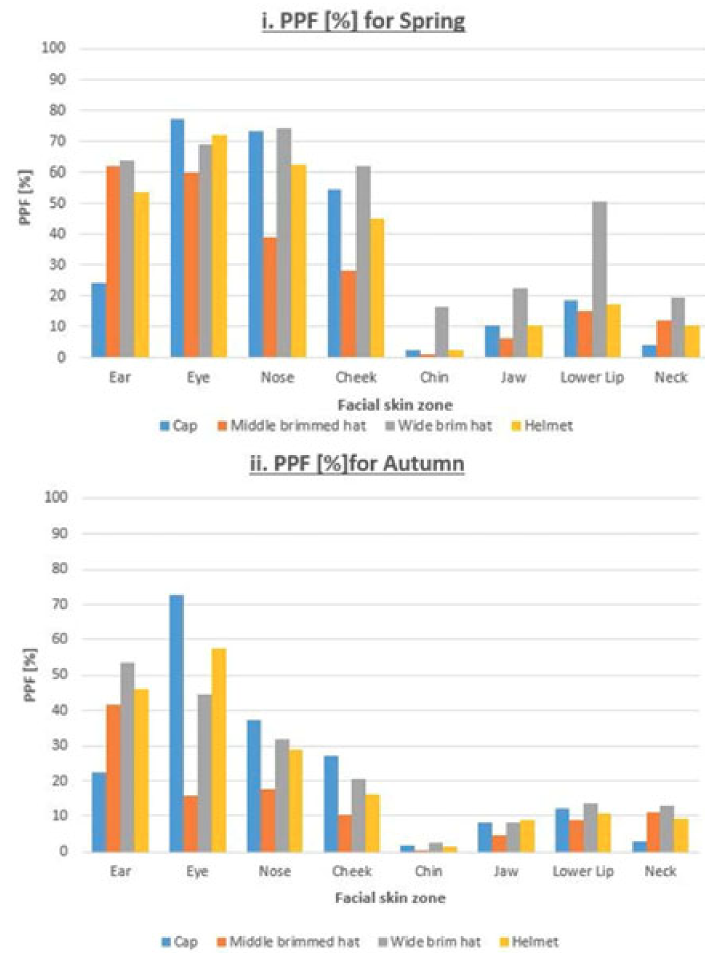
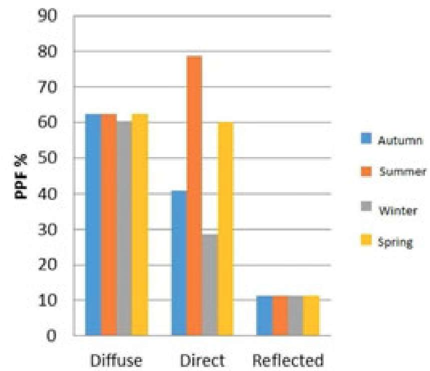


Figure 2b:

Seasonal Predictive Protection Factor (PPF [%]) of each UVR component (direct, diffuse and reflected) for the facial skin zones of the ocular region, protected at midday (12:00 – 14:00) by a baseball cap.



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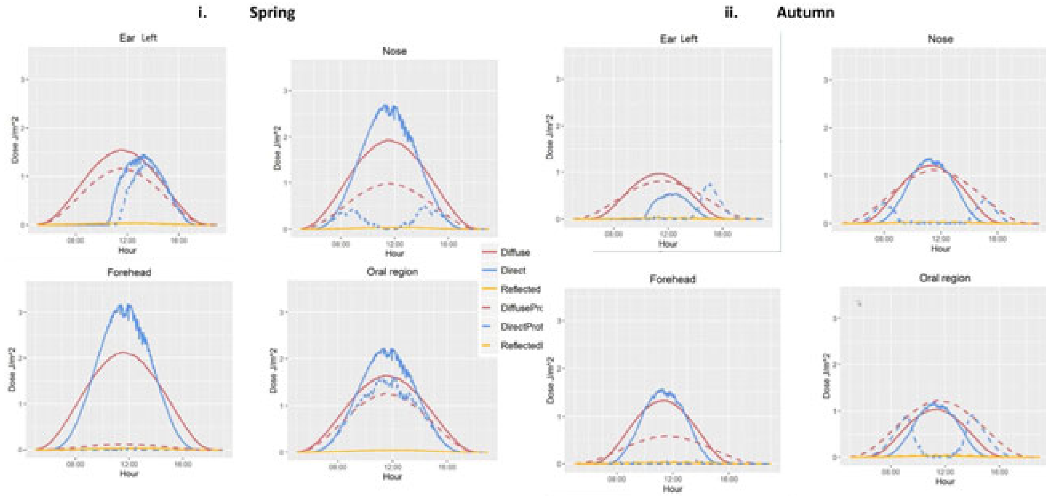

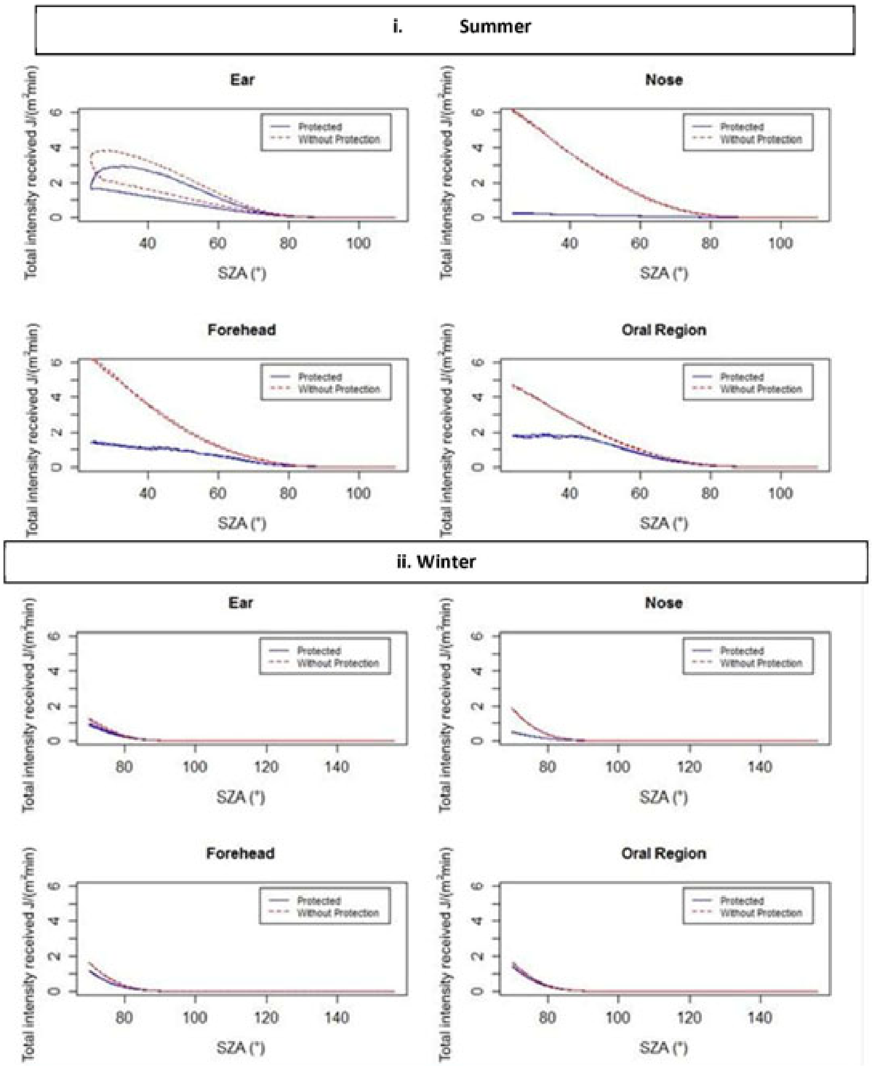

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1. Baseball cap | *2. Helmet or small-brimmed hat* | *3. Middle-brimmed hat* | *4. Wide-brimmed hat*

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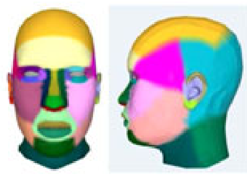

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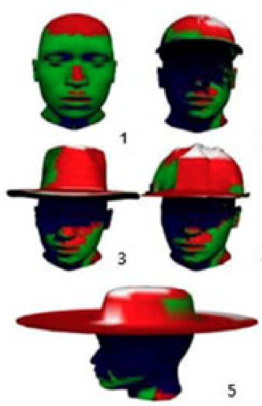

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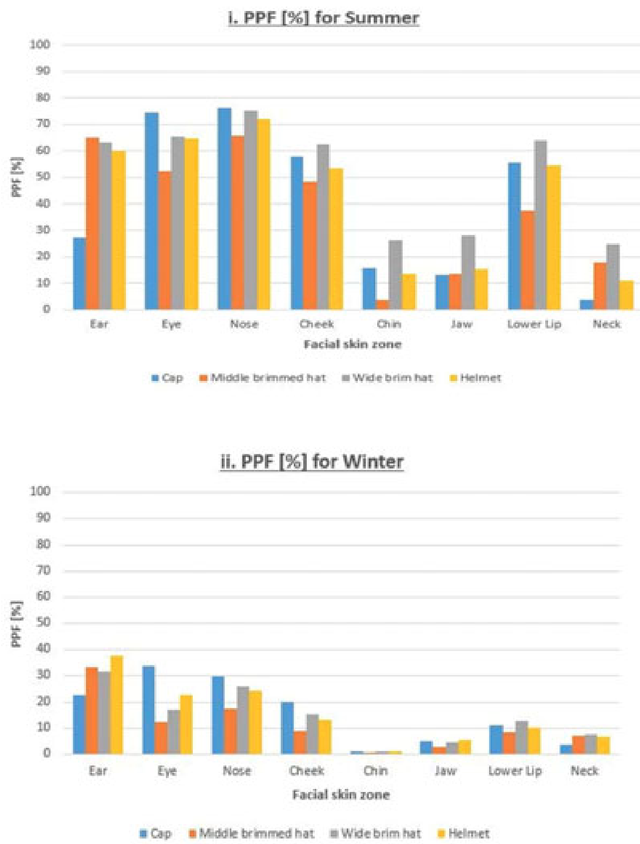

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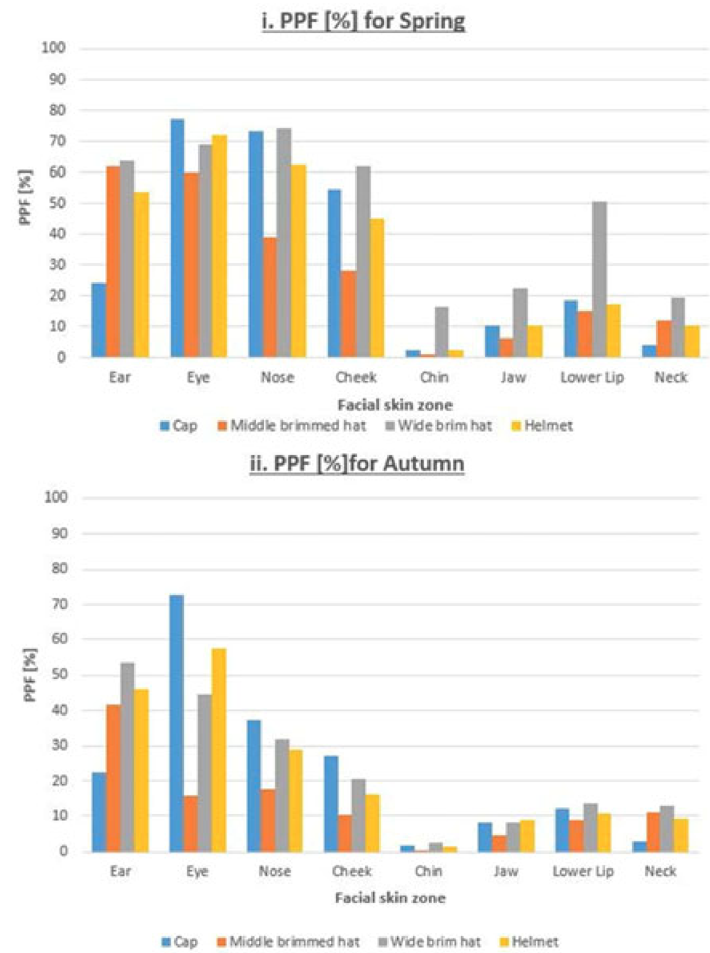

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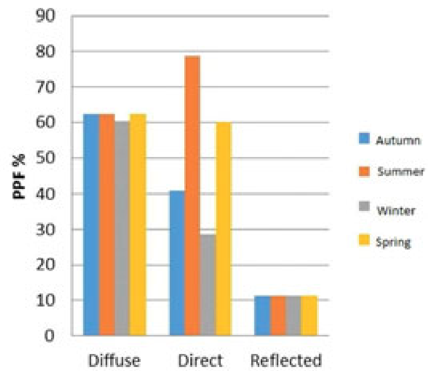

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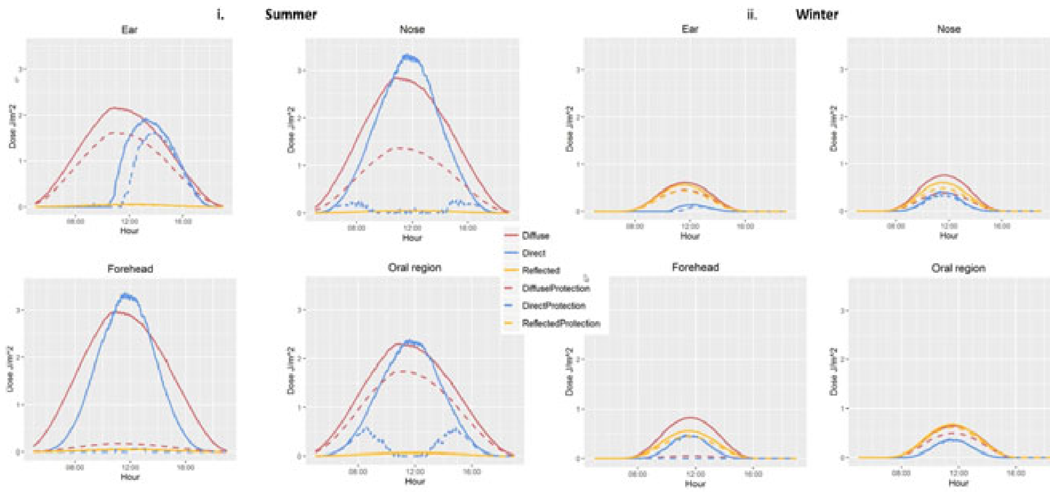

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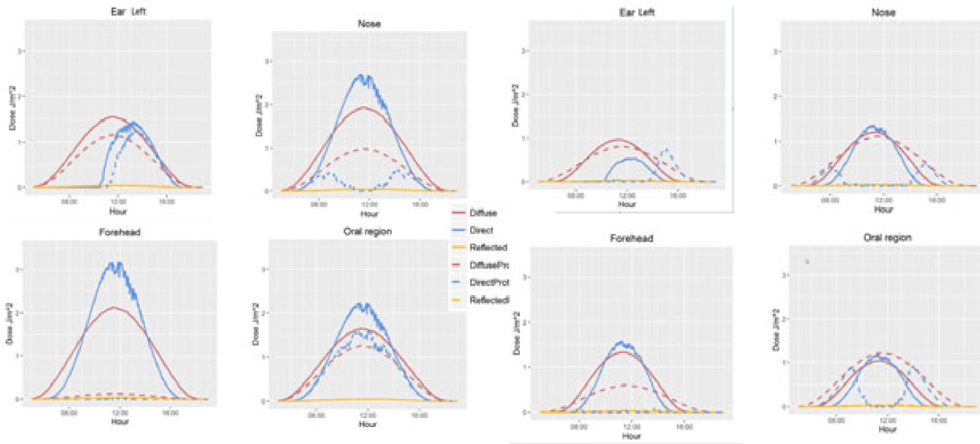

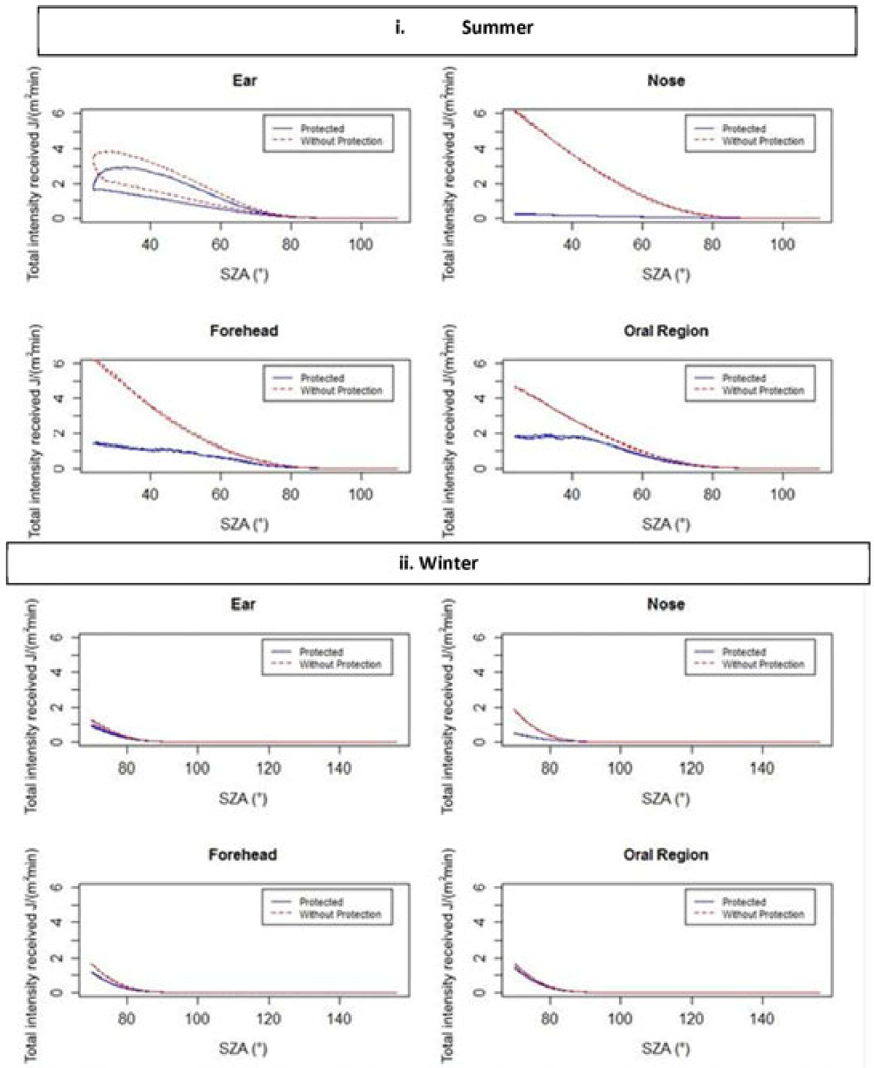

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