Calculations of the human Vitamin D exposure from UV spectral measurements at three European stations*

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* A. Kazantzidis et al. (2008), Journal of Photochemical and Photobiological Sciences
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- Climatology of Vitamin D dose
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Short Introduction (1/2)

- Solar UVB radiation:
  - **Dangers**
  - Cataracts and corneal injuries
  - Non cancerous skin diseases/Skin cancer
  - Burden on the health care system
  - DNA damage
  - etc.
Short Introduction (2/2)

- Solar UVB radiation:
  **Benefits**
  Production of Vitamin D$_3$ against:
  Multiple sclerosis/rheumatoid arthritis
  Autoimmune diseases
  Type 1 diabetes
  Prostate, colon and breast cancer
  etc.
Climatology of Vitamin D dose

Stations’ Latitudes

Thessaloniki: 40,39N
1990-2005

Bilthoven: 52,13N
1996-2005

Jokioinen: 60,82N
1996-2005

Vitamin D effective dose as a function of the day of year
The Biological Effective Dose threshold (BED), as defined by Engelsen et al. (2005), is 3.46 mW/m². McKenzie et al. (2008) Even for more limited exposures the vitamin D produced would be non-zero. So the threshold/detection value is under discussion.
Vitamin D dose rates during the day (2/3)

9 LOCAL TIME

Day of Year

Threshold value (3.46 mW/m²)

Beginning of December

End of September

Mid of February

Early March

VDED rate (mW/m²)

30 60 90 120 150 180 210 240 270 300 330 360
Vitamin D dose rates during the day (3/3)

16 LOCAL TIME

Mid of January
Mid of October
Mid of January
Early March

Day of Year

VDRED rate (mW/m²)

Threshold value (3.46 mW/m²)
Minimum recommended exposure for Vitamin D production (1/2)

**LOCAL NOON ± 7.5 min**

<table>
<thead>
<tr>
<th>Skin Type</th>
<th>Color</th>
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<tbody>
<tr>
<td>I</td>
<td>Caucasian; blonde or red hair, freckles, fair skin, blue eyes</td>
</tr>
<tr>
<td>II</td>
<td>Caucasian; blonde or red hair, freckles, fair skin, blue eyes or green eyes</td>
</tr>
<tr>
<td>III</td>
<td>Darker Caucasian, light Asian</td>
</tr>
<tr>
<td>IV</td>
<td>Mediterranean, Asian, Hispanic</td>
</tr>
<tr>
<td>V</td>
<td>Middle Eastern, Latin, light-skinned black, Indian</td>
</tr>
<tr>
<td>VI</td>
<td>Dark-skinned black</td>
</tr>
</tbody>
</table>

**Standard Vitamin D Dose**

Minimum recommended exposure for Vitamin D production (2/2)

LOCAL NOON ± 30 min

<table>
<thead>
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The sunburn is defined by the Minimal Erythemal Dose (MED).
Relationship between Vitamin D and Erythematic dose rates

- Can we estimate VDED rates from erythematic dose rates?

- Why isn’t it a linear relationship?

A linear fit can introduce uncertainties from -50% up to +30%
Conclusions (1/3)

- The maximum average daily VDED (from 3.5 at Jokioinen up to 8 kJ/m$^2$ at Thessaloniki) are observed during the second half of June.

- The winter averaged values of VDED are from 20 (Thessaloniki, Southern site) to 250 times (Jokioinen, Northern site) lower than those of summer.
Conclusions (2/3)

- The average values of VDED rates around local noon reveal the sustainability of the cutaneous production of Vitamin D at Thessaloniki & Bilthoven.

- At 9 & 16 local time this time period lies between 6.5 and 9.5 months at Jokioinen and Thessaloniki respectively.
Conclusions (3/3)

- Even for an exposure of one hour around local noon, no production of Vitamin D can be detected for skin types I-III in Bilthoven and Jokioinen throughout the year.

- When using MacLaughin et al. action spectrum, the daily values decrease from 2.5% up to 8% during winter and less than 2% in summer.
Thank you for your

- Attention and patience!

- Any questions/comments please...?

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  P.N. den Outer, T. Koskela, H. Slaper. & me.