

# Phototesting on Difference Anatomical Site of the Body

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## SUMMARY

Phototests were performed in eight subjects from Kuwait and in 18 subjects from Dundee in different anatomical sites of the body to demonstrate any variation in the skin sensitivity to UVR. Four anatomical sites were selected. They included skin of the upper back, upper arm, abdomen and the upper thigh. The phototesting was done on two consecutive days with two wavebands, 295nm and 305nm +/- 5nm. The results obtained were not uniform for the Dundee subjects, while in Kuwaitis, the skin of the back, abdomen, and arm did not show much variations in sensitivity. However, the skin of the upper thigh was consistently less sensitive.

## Materials and Methods

The phototesting was done using the monochromator with the lightguide on two consecutive days with two wavebands 295nm and 305nm both +/- 5nm. The monochromator used in Kuwait was Clinical photoirradiator (Applied Photophysics model UV90). While the one used in Dundee was described by MacKenzie and Fren-Bell in 1973<sup>1</sup>. The flexible liquid lightguide in Dundee, was supplied by Oriol Scientific Ltd. It was one meter long and had a clear aperrature, 5mm in diameter. At its proximal end the lightguide was clumped to the output part of the monochromator and at the distal end it was terminated in a silica exit window within a ferrule. The surface of the lightguide window forms the irradiation plane. In Kuwait this instrument was supplied by

Applied Photophysics (Model 7530) fitted in the exit port of the photoirradiator. The distal

**Table 1, a.** Typical exposure Dose Schedule fore 295nm and 305nm both +/- 5nm at Four Anatomical sites in Dundee.

Waveband nm	Dose mJ/cm2			
	Back	Arm	Abdomen	Leg
295+/-5	15	18	18	22
	18	22	22	27
	22	27	27	33
	27	33	33	39
305+/-5	82	82	82	82
	100	100	100	100
	120	120	120	120
	150	150	150	150

end of the lightguide was placed directly on the skin. The output through this (The irradiance at the skin surface) was measured by bringing it as close as possible to the surface of the thermopile detector without touching the instrument.

A total of 26 volunteer subjects, including 8 Kuwaitis and 18 subjects from Dundee, were phototested.

The skin at four anatomical sites of the body including the upper back, arm, abdomen, and the upper thigh were selected for irradiation. The same series of doses were used to irradiate the upper back and the abdomen, and slightly

**Table 1, b.** Typical exposure Dose Schedule for 295nm and 305nm both +/-5nm at Four Anatomical sites in Kuwait.

Waveband nm	Dose mJ/cm <sup>2</sup>			
	Back	Arm	Abdomen	Leg
295+/-5	10	10	10	18
	12	12	12	22
	18	18	18	27
	22	22	22	33
	27	27	27	39
305+/-5	39	47	47	56
	47	56	56	68
	56	68	68	82
	68	82	82	100
	82	100	100	120
	100	120	120	--

higher doses were used to irradiate the arm and the upper part of the thigh, as suggested by Olson et al<sup>2</sup>. (Table 1 a,b).

**Results**

In the eight Kuwait subjects tested with waveband 295nm +/- 5nm there were little variations in MED when compared to different anatomical sites. It was found that the MED for the upper thigh was always higher by 2-3 doses (each dose 20% increment) to the

**Table 2.** MED Values (mJ/cm<sup>2</sup>) for Waveband 295nm +/- 5nm with Different Anatomical Sites in Kuwait.

Site Subject No	Back	Abdomen	Arm	Upper Thigh
1	27	27	27	46
2	12	12	12	22
3	22	22	22	33
4	12	15	12	18
5	22	22	27	33
6	15	15	15	15
7	18	18	18	27
8	27	27	27	33

exposure series than those for the back, abdomen, and upper arm, which were either the same or differed by one dose (20%) only. (Table 2).

For the waveband 305nm +/- 5nm, the overall results were same. There were little or no variations for back, abdomen and upper arm but in seven of the eight subjects, the MED for the upper thigh skin was again higher. (Table 3).

In the 18 subjects from Dundee, tested with

**Table 3.** MED Values (mJ/cm<sup>2</sup>) for Waveband 305nm +/-5nm with Different Anatomical Sites in Kuwait.

Site Subj. No.	Back	Abdomen	Arm	Upper Thigh
1	100	100	100	180
2	47	56	56	68
3	68	68	68	82
4	47	47	56	68
5	82	82	82	120
6	56	56	68	82
7	56	56	56	82
8	82	82	82	82

waveband 295nm +/- 5nm, the MED varied between the four different anatomical sites. In 10 of the 18 subjects where the skin of the upper thigh was tested, the MED was higher than for any other site. Apart from this no other pattern of variation was observed. (Table 4).

For the waveband 305nm +/- 5nm, only 17 subject were tested. Considerable variations in MED with anatomical site were obtained but no consistent pattern was observed (Table 5) while seven of 10 subjects tested on the upper thigh showed the highest MED in this skin site, in 12 subjects, the MED for the skin of the back was lower than for any other site.

The mean values for the MEDs in different anatomical sites with standard deviations and



**Table 4.** MED Values (mJ/cm<sup>2</sup>) for Waveband 295nm +/-5nm with Different Anatomical Sites in Dundee.

Site Subj. No.	Back	Abdomen	Arm	Upper Thigh
1	12	-	18	-
2	10	-	15	-
3	10	-	18	-
4	12	-	-	-
5	27	39	39	-
6	39	47	-	47
7	15	22	-	68
8	15	18	18	39
9	18	-	27	27
10	39	33	27	33
11	12	-	47	68
12	15	39	27	33
13	22	12	18	27
14	15	-	27	33
15	18	18	18	27
16	27	27	22	47
17	18	22	22	-
18	-	23	18	-

95% confidence limits for 295nm and 305nm all +/- 5nm in the Kuwaiti subjects as obtained by probit analysis are shown in Table 6 (a & b) and illustrated in fig.<sup>1</sup>.

Those for the Dundee subjects are shown in (Table 7 a&b) and illustrated in fig.<sup>2</sup>.

A direct comparison between the results obtained with 295nm and 305nm both +/- 5nm for Kuwaiti subjects and those for Dundee plotted with standard deviations are shown in figs. 3 & 4.

In each instance, Kuwaiti skin on the abdomen, upper arm and upper thigh appears to be more sensitive than the skin of subjects in Dundee.

**Discussion**

The work of Schall and Alius in 1921 and of Wucherpfenning in 1931 as reviewed by Johnson<sup>3</sup> established that the sensitivity of the skin to sunburning UVR varied from one anatomical site to another. They found that the

skin of the abdomen and chest was more sensitive than the skin of the back, but the extremities were less sensitive. Subsequently Olsen et al.<sup>2</sup> observed that the skin sensitivity to UVR decreased towards the extremities. These authors concluded that the MED did vary by a factor of four depending on the anatomical site and the trunk was the most sensitive site. In addition, Tronnier<sup>4</sup> found that the skin of the back was more sensitive than

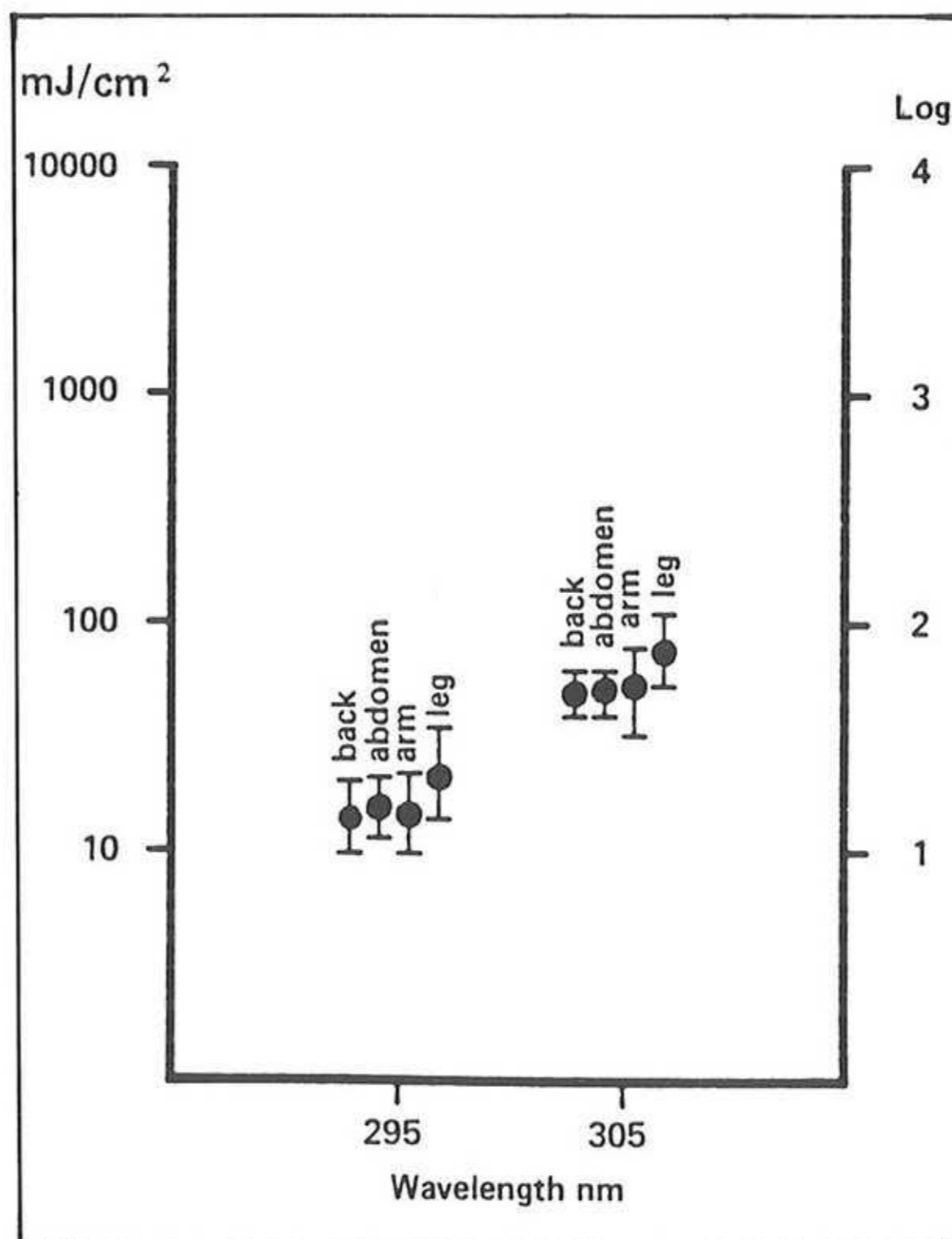


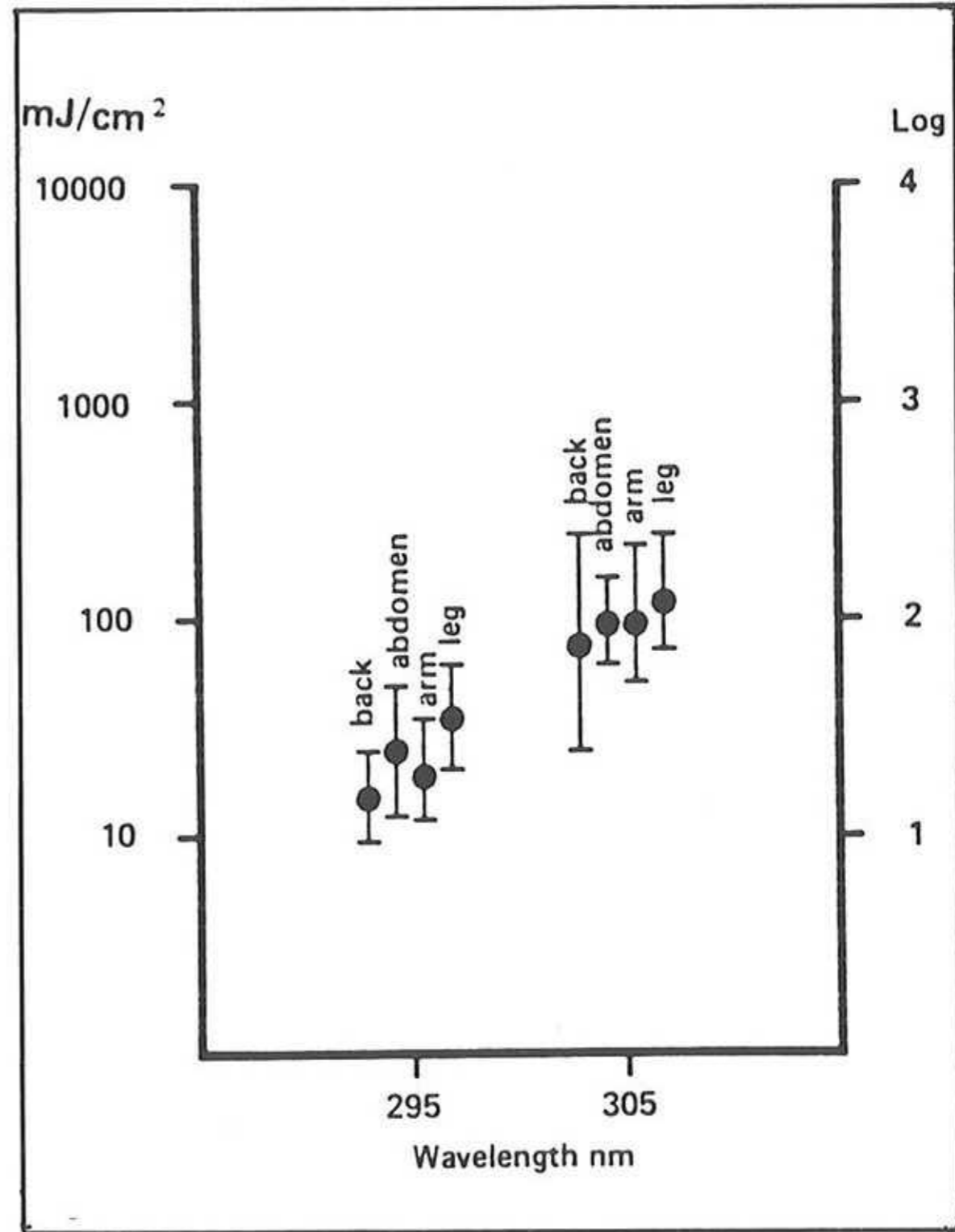
Fig.1 The mean MEDs with standard deviations for 295nm +/- 5nm at the 4 anatomical sites in Kuwait.

the skin of the upper thigh.

The use of the lightguide made it possible for us to study the variations in MED for four anatomical sites, the back, abdomen, arm and thigh both in Kuwait and Dundee to determine whether there were similar variations in the subjects studied in these areas as compared to those reported previously.

**Table 5.** MED Values (mJ/cm<sup>2</sup>) for Waveband 305nm +/-5nm with Different Anatomical Sites in Dundee

Site	Back	Abdomen	Arm	Upper Thigh
1	39	-	47	-
2	39	-	56	-
3	33	-	56	-
4	47	-	-	-
5	56	68	-	-
6	68	100	-	-
7	120	120	-	120
8	68	100	82	100
9	68	-	120	120
10	100	100	68	180
11	68	-	180	82
12	120	68	56	150
13	27	68	56	150
14	100	82	120	150
15	-	120	120	180
16	120	120	120	180
17	120	220	-	-



*Fig.2 The mean MEDs with standard deviations for 295 nm +/- 5nm at the four anatomical sites in Dundee.*

**Table 6,a.** The MED mean value in Log and in mJ/cm<sup>2</sup> with the standard errors for the mean and Standard Deviations for the Log, Mean & 95% Confidence Limits for the mean at different anatomical sites for Waveband 295nm +/- 5nm in Kuwait.

Site	In Log Term			MED mJ/cm <sup>2</sup>	95% Conf. Lim.
	Mean MED	SE	SD		
Back	1.174	+0.285	+0.165	14.92	7-30
Abdomen	1.200	+ .295	+0.137	16.0	8.5-28
Arm	1.185	+0.261	+0.176	15.3	6.9-31.6
Upper Thigh	1.366	+0.225	+0.203	22.9	9.35-57

Our results indicate that among Kuwaitis, the skin of the back, abdomen and arm showed little variations in sensitivity to both 295nm +/- 5nm and 305nm +/- 5nm but the skin of the upper thigh was consistently less

sensitive. Therefore, the results do not fit with those reported in the literature except for one

**Table 6,b.** The MED mean value in Log and in mJ/cm<sup>2</sup> with the standard errors for the mean and Standard Deviations for the Log, Mean & 95% confidence Limits for the mean at different anatomical sites for Waveband 305nm +/-5nm in Kuwait.

Site	In Log Term			MED mJ/cm <sup>2</sup>	95% Confid. lim.
	Mean MED	SE	SD		
Back	1.721	+0.375	+0.118	52.48	31-89
Abdomen	1.745	+0.353	0.115	55	33-91
Arm	1.780	+0.376	+0.089	60	39-89
Upper Thigh	1.908	+0.244	+0.176	79	36-178



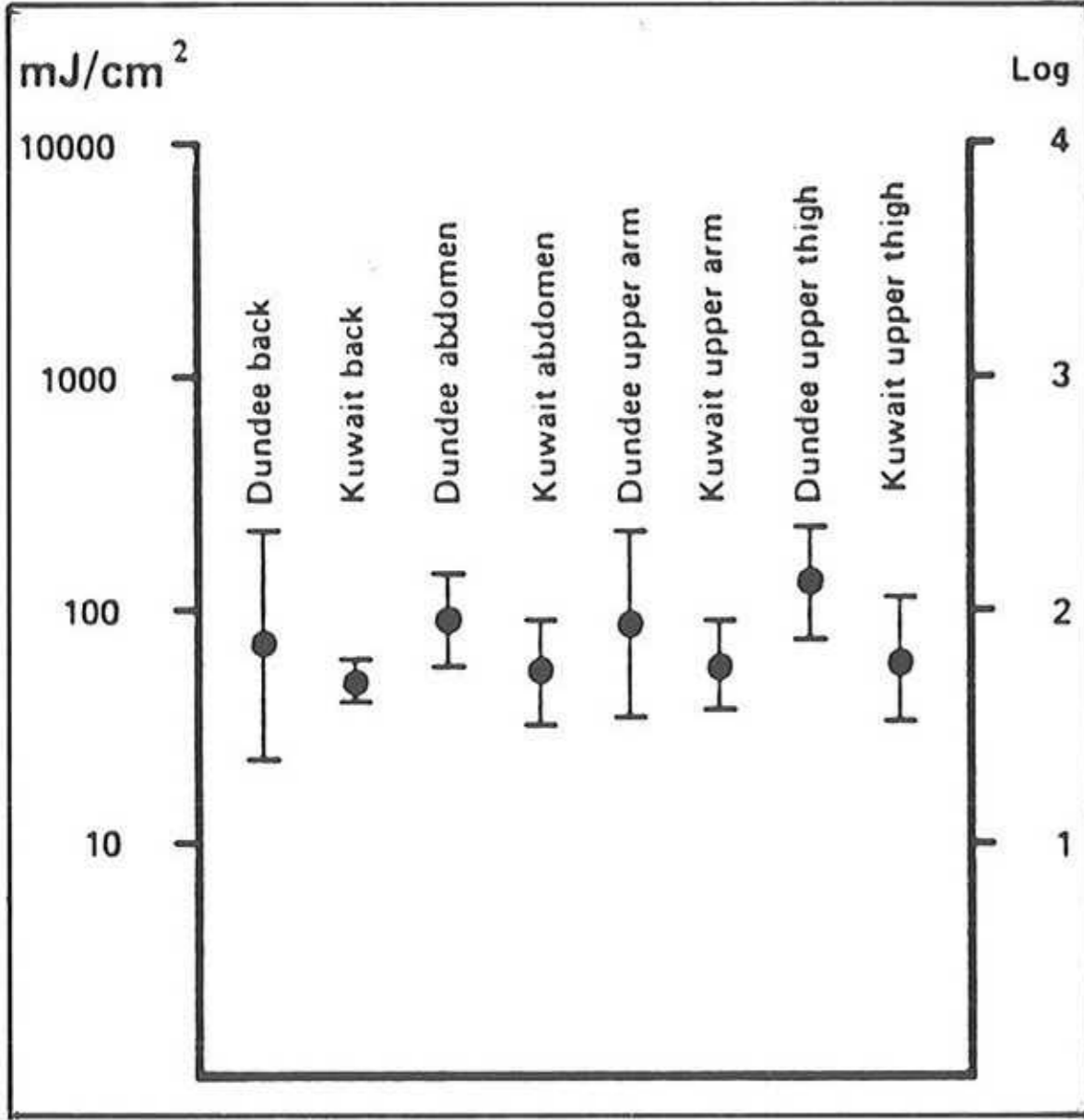


Fig.3 The mean MEDs with standard deviations for each anatomical sites with waveband 295nm +/- 5nm comparing Kuwait with Dundee.

Table 7, a. The MED mean value in Log and in mJ/cm<sup>2</sup> with the Standard errors for the mean and Standard Deviations for the Log, Mean and 95% Confidence limits for the mean at Different Anatomical Sites for Waveband 295 nm +/- 5nm in Dundee.

Site	In Log Term		MED mJ/cm <sup>2</sup>	95% Conf. Lim.
	Mean	SE		
	MED			
Back	1.164	+0.041	14.6	5.5-38.8
Abdomen	1.442	+0.160	27.7	7.01-109.4
Arm	1.334	+0.160	21.6	7.32-63.5
Upper Thigh	1.572	+0.172	37.32	13.18-104.7

site i.e, the skin of the thigh which was observed to be the least sensitive site in all studies (including ours). The reasons for the similarities in MEDs for abdomen, back and arm may be related to the fact that in Kuwait, due to regional customs the skin of the subjects tested is covered at all times which

Table 7,b. The MED mean value in Log and in mJ/cm<sup>2</sup> with the Standard errors for the mean and Standard Deviations for the Log, Mean and 95% Confidence limits for the mean at Different Anatomical Sites for Waveband 305nm +/- 5nm in Dundee.

Site	In Log Term			MED mJ/cm <sup>2</sup>	95% Conf. Lim.
	Mean	SE	SD		
	MED				
Back	1.880	+0.148	+0.485	75.85	8.5-674.5
Abdomen	1.990	+0.181	+0.197	97.7	40.7-238
Arm	1.966	+0.175	+0.311	92.5	22.4-371
Upper Thigh	2.118	+0.180	+0.247	131.2	42.7-390

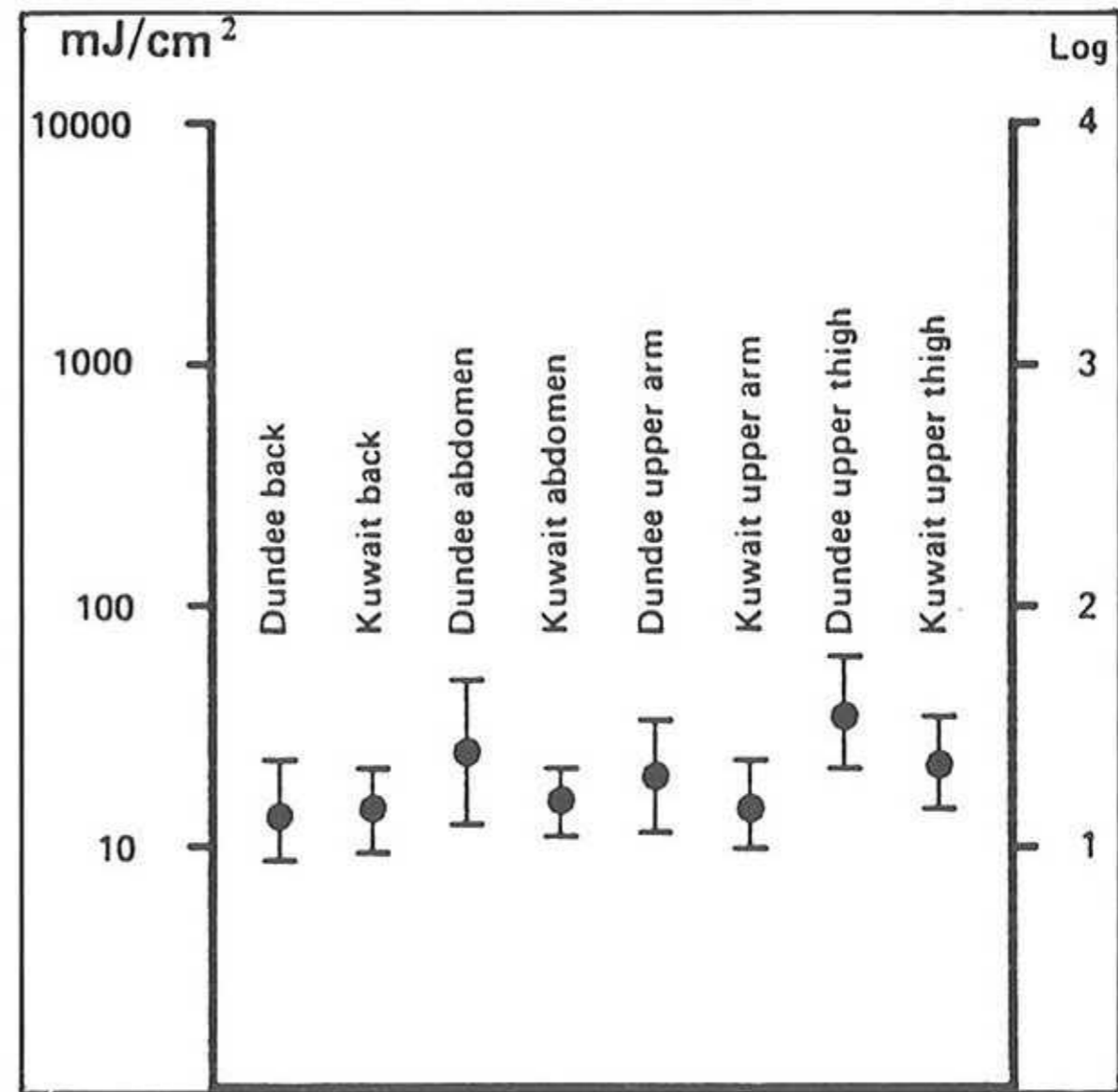


Fig.4 The mean MEDs with standard deviations for each anatomical sites with waveband 305nm +/- 5nm comparing Kuwait with Dundee.

protect them from sunlight. However, this does not explain why these sites differ from the thigh. It could be possible that in this anatomical site, the MED is different due to some difference in the structure of the skin, which is not there in the skin of the back, abdomen and arm.

For Dundee skin, the results obtained were



**Table 8.** The geometric means of the MED in mJ/cm<sup>2</sup> for 295nm +/-5nm and 305nm +/-5nm in Kuwait and in Dundee subjects and the mean MED value in mJ/cm<sup>2</sup> reported by Olsen et al<sup>2</sup>.

Site	Kuwait		Dundee		Olson et al <sup>2</sup>
	295nm	305nm	295nm	305nm	300nm
Back	14.9	52.5	14.6	75.9	23
Abdomen	16	55	27.7	97.7	21
Arm	15.3	60	21.6	92.5	36
Upper Thigh	22.9	79	37.32	131.2	-
Leg	-	-	-	-	80

not uniform as the sensitivity was dependent on the subject and the waveband used. There was a great variation between one subject and another but in general, with waveband 295 + 5nm, the skin of the back was most sensitive followed in order by the upper arm and the abdomen while again, the upper thigh was the most resistant site. With 305nm +/- 5nm as well, the findings were the same.

The results for back skin with both wavebands were more or less the same for the subjects in Kuwait and Dundee. The results are in contrast to the previous study done in Kuwait (unpublished data) where the skin type V of all Kuwaitis was observed to be less sensitive when compared to that of skin types I, II and III tested in Dundee. Where as we observed that when the MEDs for the different anatomical sites were compared, Kuwaiti skin was more sensitive than that of the subjects tested in Dundee.

There was no evidence that the testing procedures had changed or that there was any abnormality with the thermopile detection of irradiance in either location. Although it is not certain but these apparent reversals of skin type sensitivity could be because of some individual variations. It was seen that all the subjects tested later in the program in Dundee,

had greater than expected MED values. The explanation for these finding is that the testing program for this study was extended over the summer in Dundee, the subjects tested later had been sunbathing with whole body exposure at any opportunity and were therefore suntanned with the decreased sensitivity to further UVR which might be expected from that.

The geometric means of the MEDs for 295nm +/- 5nm and 305nm +/- 5nm in Kuwaiti and Dundee subjects at the different anatomical sites are compared with the mean MED values reported by Olsen et al<sup>3</sup> for 300nm in Table 8. It is clear that, although some slight variations between the MEDs for back, abdomen and arm skin were observed in this study, but they did not approach to the difference obtained by Olson et al<sup>2</sup>. However, the decreased sensitivity of the thigh skin in this study does match with the trend shown by Olson et al<sup>2</sup>.

## References

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