Author’s response to reviews

Title: Personal Ultraviolet Radiation Exposure in a Cohort of Chinese Mother and Child Pairs: The Chinese Families and Children Study

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Author’s response to reviews:

Dear Dr Pafitis

Thank you for the opportunity to revise our manuscript.

We have addressed the reviewers' comments below. All changes to the manuscript have been tracked.

Kind regards,

Alison

Reviewer reports:

M. Khazova (Reviewer 1): The manuscript presents research in very important area of personal exposures to solar UV radiation and is well written; however, it should not be published without amendments.

REVIEWER COMMENT: Manuscript reported very limited analysis of collected data. It is not clear if 3 days of data collection were weekday, weekends or a mixture of both; during school term or school break. No school or paid employment hours are given; not clear if this information was taken into account in the analysis: it limits available time to spend outdoors and analysis should include information if people had UV exposure at the time when they could.

AUTHOR RESPONSE: Each participant had UV exposure data collected over three consecutive days – from Sunday to Tuesday during the school term. This detail has now been reported in the manuscript. As described on line 179-185, all participants self-reported their daily time outdoors in each of 14 hourly intervals between 5am and 7pm each day (approximately sunrise to sunset). Almost all adolescents were at boarding school, hence their time outdoors and UV exposure would have been impacted by their school activities. Similarly, mothers’ opportunity for time outdoors would have been impacted by their work or home activities. In this study we were interested in participants’ typical UVR exposure during their usual activities of daily living at school, work or home. Whether participants received UV exposure at the time they could is not the focus of this overview paper. Greater analyses of the effect of work and school responsibilities (including time outdoors, clothing worn and sun protection used in hourly intervals on weekends and weekdays) will be presented in a future paper.

REVIEWER COMMENT: Grobner et al 2015 showed that ~85% of sun exposure of adolescent boys was acquired outside school days. Authors very rightly stated importance of "associated
work and/or school responsibilities in determining personal UVR exposures” (lines 317-318) but didn't present any analysis of collected data to support this statement.

AUTHOR RESPONSE: We have now included the following text (lines 350-355) to support this statement… “In our study, urban adolescent students received between 2.34% (males) and 3.95% (females) of the estimated total available UV, which compares favourably with the findings of Liu et al (18). Rural adolescent students received a much higher proportion of the estimated total available UV (10.67% and 5.19% for males and females, respectively), possibly because of a requirement for outside-school assistance with farm or rural tasks.”

REVIEWER COMMENT: It is likely that there is significant difference in ambient erythema effective irradiance between early April and end of May - early June; therefore, logic of averaging of April-June doses is unclear, especially taking into account that there was no data collection in rural areas in April. Furthermore, as presented data showed, April temperatures were too low to facilitate significant area of exposed skin. Analysis should reflect it; data on ambient UV for the collection period also would be useful; as well as explanation of statement in lines 208-209: If the data were not comparable how they were used?

AUTHOR RESPONSE: To better illustrate how time (month) of measurement impacts on UVR exposure, we have now included scatterplots showing participants’ personal UVR dose (as measured by dosimetry) by date in each location, as well as scatterplots showing ambient UVR readings by date in each location (Figures 2 and 3). Because of the limited number of dosimeters available, ambient UV measures were made over 7 days at the beginning and end of data collection in each location (April 10th -16th and May 30th-June 5th in the southern urban location; May 20th-26th and June 10th– 16th in the northern rural location). As the dates of data collection were not completely aligned, the averages were not totally comparable between the two locations.

The following text has been added at line 220-225 to clarify this issue “However, the change in ambient UVR appeared to be gradual over the data collection period (Figure 2) and therefore the average ambient UVR values in each location would be expected to be very similar, if daily measures were made over the entire period of data collection. Ambient UVR and personal UVR were thus comparable within each location (Figures 2 and 3) but were not directly comparable between the two locations. We therefore presented these data separately and no statistical comparisons were made between locations.

REVIEWER COMMENT: Variations in received doses and exposure times are very significant for the same cohort group and the distribution should be given in more details, with some indication of reasons. Difference (if there was any) in sun exposure of working and non-working mothers is not reported.

AUTHOR RESPONSE: We have now added the following text (lines 328-334) “The wide variation in UV dose and time outdoors within cohorts may result from a difference between weekend and weekday exposure (potentially more important for urban mothers and adolescents,
where work or school activities may limit weekday exposure but allow weekend exposure), or a heterogeneity in occupational status (most relevant to rural mothers, where a small proportion were in paid indoor work while many of the remainder tend to farms or greenhouses on weekdays).” As mentioned, in a future paper we will provide a detailed analysis of personal UVR exposure dose according to occupation/activity, day of week, time spent outdoors, clothing cover and use of sun protection each day.

REVIEWER COMMENT: Correlation between reported times and dosimetry is poor for children, it is obvious problem with proposed study protocol but no explanation is given why and how it would be rectified in a large-scale study.

AUTHOR RESPONSE: The following text has now been added (lines 317-323, 325-328) “Urban adolescent boys had the longest self-reported time outdoors but the minimum objectively-measured personal UVR exposure dose, among the urban population. This may be because they 1) over-reported their time spent outdoors due to misunderstanding the sun diary protocol, 2) covered the dosimeter with clothing while outdoors, or 3) removed outer clothing layers and the dosimeter while participating in outdoor activities, and did not replace the dosimeter band on their arm as required. Rural male adolescents did, however, have a high personal UV dose and significant time outdoors. This may have resulted from a requirement for outside-school assistance with farm or rural tasks or other outdoor activities. As the correlation between reported time outdoors and objectively-measured personal UVR exposure was generally poor in adolescents, further pilot testing is warranted to understand any difficulties experienced by adolescents in using the dosimeters and/or following the diary protocol.”

REVIEWER COMMENT: Authors stressed an important distinction between exposure of the skin and available dose for the person (lines 319-325) but didn't report analysis of collected data to take this distinction into account. In a way, presented data and drawn conclusions may be misleading as the findings are given for available doses but not for an exposure of the skin.

AUTHOR RESPONSE: We have included the following text (lines 373-385) “An individual who spends much time outdoors may record a high personal UVR exposure dose by dosimetry, however if their body is fully covered with clothing then the UVR cannot reach the skin to trigger vitamin D synthesis., and will be the subject of future detailed analyses. As clothing cover is impacted by ambient temperature, it is likely that the cooler average temperatures in both locations during the April and May data collections resulted in greater clothing cover (and less skin exposure to UVR) during these months. As temperature rises in June, skin exposure to UVR would be expected to increase, however time outdoors may decrease as people seek shade from the hot sun. As shown by others (5), an individual’s objectively-measured maximum personal UVR exposure dose (incorporating their skin UVR exposure) may not always be in summer, as other factors such as temperature (often dependent on latitude and altitude) can change personal behaviour.”
EDITORIAL COMMENT: 1 MED of 210 J/m2 seems to be on a lower side for Chinese population; authors, in fact, mention variations in skin pigmentation across China. To use SED as a universal reference may be better.

AUTHOR RESPONSE: An SED is \( \frac{1}{2} \) an MED and uses the same weighting criteria (erythemal action spectrum). As such, we would prefer to use MED.

EDITORIAL COMMENT: Line 21. Underexposure to UVR doesn't inhibit Vitamin D production; it results in limited opportunity for VitD synthesis.

AUTHOR RESPONSE: Thank you. The text has now been changed to “Underexposure to UVR results in limited opportunity for vitamin D synthesis…”

Qian Gao (Reviewer 2):

REVIEWER COMMENT: The aim of this paper is not clear. Comparing the difference of individual UV exposure between urban population and rural population or evaluation the feasibility of individual UV quantification by polysulfone dosimetry? The key point of the whole paper may be different for different aims. The discussion and the conclusions of present paper do not match.

AUTHOR RESPONSE: Thank you. We have reordered the discussion and updated the conclusion (and last paragraph of the introduction), such that the aims, discussion and conclusion are clearer and better aligned.

REVIEWER COMMENT: The authors know that the two cities which participants were involved in are different in latitude. It will be better if the participants were collected from both urban and rural areas in the same city.

AUTHOR RESPONSE: We understand that investigating urban/rural differences in UVR exposure in one location would remove the confounding effect of latitude, however this was not possible in this pilot study as the larger study (of which this UVR study was only a small part) was conducted in these two different geographically dispersed locations, and participants were limited to those involved in the original study in 1993-1995. We believe it is important to investigate latitude in studies of personal UVR exposure as it adds valuable information about how differences in latitude may affect residents’ time outdoors and sun-protective behaviour.

Abstract:

REVIEWER COMMENT: There is a mistake in line 7-8. Both locations are rural location.
AUTHOR RESPONSE: Thank you for picking this up. We have corrected this error.

Methods:

REVIEWER COMMENT: Was the ratio of each individual UV exposure and ambient UV exposure in the same days?

AUTHOR RESPONSE: As described on page 175-177, “the average ambient UVR was calculated for each location by averaging the 14 daily measures obtained from the dosimeters exposed on the hospital roofs – 7 measures from the first week of data collection in that location, and 7 from the last week.” The personal fractions (Table 4) were not matched for each individual, but were calculated for groups (the average personal exposure in that group as a fraction of the average ambient exposure corresponding to that group/location).

REVIEWER COMMENT: There is only half brackets in line 153.

AUTHOR RESPONSE: This has been corrected – the bracket has been removed

Discussions:

REVIEWER COMMENT: How do you explain the results that the urban boys had the longest outdoor activity time but the minimum personal UV exposure dose among the urban population.

AUTHOR RESPONSE: We provide the same response to the similar question from Reviewer 1. We have included the following text (lines 317-323; 325-328) “Urban adolescent boys had the longest self-reported time outdoors but the minimum objectively- measured personal UVR exposure dose, among the urban population. This may be because they 1) over-reported their time spent outdoors due to misunderstanding the sun diary protocol, 2) covered their dosimeter with clothing while outdoors, or 3) removed their outer clothing layers and dosimeter band while participating in outdoor activities, and did not replace the dosimeter band on their arm as required. Rural male adolescents did, however, have a high personal UV dose and significant time outdoors. This may have resulted from a requirement for outside-school assistance with farm or rural tasks or other outdoor activities. As the correlation between reported time outdoors and objectively-measured personal UVR exposure was generally poor in adolescents, further pilot testing is warranted to understand any difficulties experienced by adolescents in using the dosimeters and/or following the diary protocol.”

REVIEWER COMMENT: The sentence of 'While an individual may have a high UVR exposure, if they are fully covered with clothing then their skin exposure to UVR will be minimal.' In line 322-324 is confused. Please rewrite it.
AUTHOR RESPONSE: Thank you. We have replaced this text as follows (line 373)- “An individual who spends much time outdoors may record a high personal UVR exposure dose by dosimetry, however if their body is fully covered with clothing then the UVR cannot reach the skin to trigger vitamin D synthesis”.