



Nudging construction workers towards better sun safety behaviour

Summary report 2019

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In this document, you'll find a summary of the independent study we commissioned from Heriot Watt University in collaboration with the Institute of Occupational Medicine, Nudging construction workers towards better sun safety behaviour.



What's the problem?

Excessive exposure to solar ultra-violet (UV) radiation can cause skin cancer. However, inadequate exposure to sunlight limits the production of vitamin D. There is very little research on understanding the barriers to adopting sun-safe behaviours in the workplace and encouraging behaviours that ensure vitamin D sufficiency. In Britain each year there are almost 3,000 cases of non-melanoma skin cancer caused by exposure at work to UV radiation from the sun and around 250 cases of malignant melanoma. Many adults living in Britain, particularly among African-Caribbean and Asian groups, are deficient in vitamin D. Vitamin D deficiency may result in bone pain and osteoporosis. Low vitamin D has also been linked with increases in the risk of some cancers, cardiovascular diseases, metabolic disorders, infectious diseases and auto-immune diseases, although the evidence for causal association is still uncertain. There is no evidence of the extent of vitamin D insufficiency among outdoor workers in the Britain.

Communicating information about sun safety is complicated in Britain because while workers need to minimise their sun exposure during summer months, this will reduce the production of vitamin D. In winter months they cannot get sufficient UV exposure to synthesise the vitamin D necessary for health and the main source during these periods is through their diet, e.g. fish oils, eggs or supplements. The message for sun safety needs to be tailored to outdoor conditions in a way that is impossible in a single training intervention. One option is to use mobile phone short messages (SMS), along with supportive information, to communicate these complex messages.

What did our researchers do?

The aim of the project was to investigate whether short messages delivered to the smartphones of construction workers, in combination with appropriate organisational support, can influence workers' behaviour. In particular, the researchers wanted to see if these interventions could reduce exposure to UV radiation among those at risk of excessive exposure, and increase exposure or promote appropriate dietary changes among those who are likely to receive insufficient sun exposure to synthesise vitamin D. The aim was to influence the behavioural choices of workers to help them make better sun safety choices, which in psychological theory is often referred to as a "nudge".

There were five key objectives:

- to devise a way of delivering short messages to the smartphones of construction workers, to change behaviour to minimise the risk of skin cancer and maximise the health benefits of vitamin D generated from solar UV radiation and diet

- to develop a sun-safe and healthy mobile phone app that could be used more widely in the construction sector
- to conduct an experimental trial to demonstrate it delivers safe and healthy outcomes, based on measured serum vitamin D levels across the course of a year
- to use personal UV monitors to provide evidence of altered personal behaviour as a result of the intervention
- to develop a model strategy to change personal behaviour using smartphone technology, which could be widely applied in a workplace setting.

A smartphone application (mobile app) was developed to provide study participants with general information and guidance about UV exposure, sun safety, dietary health advice and the daily UV Index (UVI) forecast for the user's locality.

Questionnaires were developed by the researchers to assess workers' beliefs about sun safety and healthy eating in relation to increasing vitamin D levels (within the psychological paradigms of the Theory of Planned Behaviour and Stages of Change) and knowledge about sun safety and vitamin D. Support for the project was obtained from key construction companies and study participants were recruited in Central Scotland and Greater London. In total nine sites were included in the study. Researchers met with representatives from the companies and their workers to explain details of the study and what would be expected from participants.

Participants at each site were divided into two cohorts: one to receive the intervention and the other not. Recruitment was for three waves of data collection – two low-UV exposure periods and one high-UV exposure period, with each study period lasting 21 days. At the second and third waves the sites that had not received the initial intervention now had the intervention and vice versa. Where it was not possible to retain the same participant at a site between waves, due to leaving the job or some other reason, a substitute participant was recruited. Between 56 and 61 workers were studied at each wave.

The intervention was delivered to the workers via a mobile phone short message service (SMS). A daily message was sent to participants, tailored to reflect the season, encouraging them to boost vitamin D levels during periods of low UV and to pay attention to sun safety periods of high UV. The supportive phone app contained information about sun-safe actions and sources of vitamin D. During the low-UV intervention period, participants were issued with a vitamin D dietary supplement (daily 10µg) and advised that, if they wished, they could take these during the three-week study period. The number of supplements consumed during the study was recorded at the followup visits. During the control periods participants did not receive the intervention daily text messaging service or prompts to view the sun-safe and healthy behaviour app.

The main outcome measure was the concentration of vitamin D in blood samples (25-hydroxy vitamin D) measured by high-performance liquid chromatography. Samples were collected from each worker at the start and end of each wave. Each participant was sent their results, and these were classified as 'Severe Deficiency' (50.1 nmol/l). During the high-UV period participants were issued with a UV wearable sensor mounted on the rear of their hard hat. These sensors logged UV measurements throughout a working day. The data were summarised as standard erythemal dose (SED) measures over an 8-hour day. The SED is a measure of exposure that is independent of skin type and is equivalent to 100 J/m² of erythemally weighted radiant exposure. Ethical approval to carry out this research was granted by Heriot-Watt University.

What did our researchers find out?

Around half of the workers taking part in the study had insufficient circulating vitamin D in their blood during winter. A small proportion of the participants were either 'deficient' or 'severely deficient' during winter and three participants were 'deficient' in the summer period. During the winter study periods vitamin D levels in the intervention group were significantly higher after the intervention: from 48 per cent with sufficient levels to 88 per cent in the first winter period and from 52 per cent to 70 per cent in the second. These results suggest daily information and availability of a dietary supplement is likely to increase vitamin D levels during periods when UV is too low to be synthesised naturally.

During the summer study period the study failed to show a decrease in vitamin D levels in the intervention group as hypothesised; in fact, levels were higher in the intervention group. Measurements confirmed that UV exposure was higher in the intervention group than the control group. Most workers expressed the view that 'I like to have a sun tan,' and this may be the main reason for the lack of behaviour change from the intervention. These results suggest that a more sustained risk-based management approach is needed to change sun-safe behaviours on construction sites.

External UV dose estimates were generally higher at the southern sites compared to the northern ones. However, at each wave the median and mean 25(OH)D levels were higher in the north. This may reflect differences in skin colour or some other aspect of the work, for example time spent outdoors. This is the first research study of its kind to measure UV exposure among outdoor workers in Britain. We found that in summer construction workers who predominantly worked outdoors were exposed to on average 2.0 SED and those who worked partly indoors and partly outdoors 0.69 SED.

For outdoor workers, around 40 per cent of the daily exposures exceeded 2.0 SED while about 12 per cent of the exposures for the indoor workers were above 2.0 SED.

These levels, over a working lifetime, probably more than double the risk of non-melanoma skin cancer.

Knowledge of sun safety measures and steps to increase vitamin D improved in both the control and intervention groups across the study periods. However, the desirability of having a sun tan remained high, and more effort is needed to improve knowledge of the risks and attitudes to sun tanning, which is really a sign of skin damage.

Beliefs around perceptions of control to increase vitamin D were higher in the intervention group during the low-UV (winter) periods – that is, workers intended to take steps to improve their vitamin D intake during the winter. Participants also felt less social pressure to increase vitamin D, suggesting the information delivered equipped them to change beliefs. Similarly, in the high-UV (summer) period, the intentions to take sun-safe measures were higher in the intervention group.

The intervention also showed a positive effect on desirable behaviours in the first low-UV period (winter). The intervention group reported more contemplation of consuming of vitamin D-rich products and by follow-up at the second winter this had changed from contemplation to preparation. In the high-UV period (summer) the intervention group reported more actively wearing sunglasses for UV protection.

What does the research mean?

This study highlights the pivotal role that the construction industry should play in leading sun safety on-site and in taking an initiative on workforce health and wellbeing in relation to vitamin D. The research demonstrates the potential of delivering health information via text messaging and how this approach could serve to promote sun-safety behaviours during the summer months and help to reduce the decline in vitamin D levels during the winter period. During the summer, workers in the study experienced relatively high UV levels from the sun, and over a working life these would increase the risk of skin cancer.

Disappointingly, the intervention did not reduce solar UV exposure or vitamin D levels, as was originally hypothesised. The main reason for this seems to be a deeply entrenched perceived benefit of sunlight and a sun tan among the British population. A high proportion of workers in our study had insufficient circulating vitamin D in winter, which is not uncommon in the UK, but is rather unexpected in an outdoor working population. The intervention had a positive impact on vitamin D levels during the winter, which increased significantly in comparison to the control group.

This study provides important information about the effectiveness of a technology-based intervention to promote sun-safe and healthy behaviours. It demonstrates that text messaging and a supportive app can be an easy and accessible method of communicating with workers. However, it is suggested that a more prescriptive risk-

based approach is needed to reduce the risk of skin cancer among outdoor construction workers.

Don't forget...

This research has been carried out on a small number of subjects at a limited number of work sites. While the results suggest important challenges for the construction industry in relation to sun safety and vitamin D, there is the need to gather further evidence from other well-designed research projects.

Practice points

This research highlights several issues that practitioners should consider.

- Employers should consider health promotion initiatives to “nudge” workers towards healthier dietary choices, including dietary supplements over winter, to boost their workers’ serum vitamin D levels.
- Sun safety remains a low priority on construction sites and awareness of current sun-safe measures is low. Employers should adopt a risk-based approach to manage exposure to solar UV proactively, in which risk management measures should be prescribed and the use of these measures enforced.
- Employers should provide health surveillance to detect skin cancers among outdoor workers because of the likely high UV exposure and the consequent increased risk of skin cancer.
- Nudging messages can be delivered easily via text messages or location-driven phone apps to help a workforce stay safe in the sun.

Other IOSH resources

We have a range of resources on some of the topics covered in this research:

- The following can be found in our research library at [iosh.com/research](https://www.iosh.com/research):
 - Sun safety in construction: evaluation of a sun safety intervention for the UK construction sector
 - The burden of occupational cancer in Great Britain: cutaneous malignant melanoma and occupational exposure to solar radiation
- Webinar: Sun exposure and skin cancer
[youtube.com/watch?v=OBwoNofqx2E](https://www.youtube.com/watch?v=OBwoNofqx2E)

- Awareness video: Sun Safety in construction.
[youtube.com/watch?v=i1vEuLdOgnw&t=388s](https://www.youtube.com/watch?v=i1vEuLdOgnw&t=388s)

Our review gives you all the major findings of the independent project report by Heriot-Watt University and the Institute of Occupational Medicine. If you want to read about the study in more depth, you can download the full reports at [iosh.com/research](https://www.iosh.com/research).

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