PROVIDING PUBLIC HEALTH INFORMATION TO PREVENT SKIN CANCER

Review of effectiveness and cost-effectiveness

Adjunct to Main Report

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West Midlands Health Technology Assessment Collaboration

The West Midlands Health Technology Assessment Collaboration (WMHTAC) is an organisation involving several universities and academic groups who collaboratively undertake research synthesis to produce health technology assessments. Most of our members are based in the Department of Public Health, Epidemiology & Biostatistics, University of Birmingham, however other members are drawn from a wide field of expertise including economists and mathematical modellers from the Health Economics Facility, University of Birmingham.

WMHTAC produce systematic reviews, health technology assessments and economic evaluations for NHS R&D HTA programme (NCCHTA), the National Institute for Health and Clinical Excellence (NICE), and for the health service in the West Midlands. WMHTAC also undertakes methodological research on research synthesis, and provides training in systematic reviews and health technology assessment.

Name of other institution(s) involved

WMHTAC work in close collaboration with the Peninsula Technology Appraisal Group (PenTAG) with respect to providing support to the CPHE.

This document is an adjunct to the report on the reviews of evidence on the effectiveness and cost-effectiveness of providing public health information to prevent skin cancer. The report was undertaken by the West Midlands Health Technology Collaboration and the process and resulting report were tailored in response to comments and direction received from the NICE CPHE technical team.

Since producing the report, feedback has indicated that whilst the complexity of the evidence is adequately reflected in the narrative, the document might benefit from additional summarising of the findings of the effectiveness review.

In the report, studies were grouped by intervention category (verbal, mass-media, new media, printed materials or combinations thereof) and comparator (current provision/do nothing, or one of the intervention categories) combinations. Each of these themes were then subdivided into children or adults. Each of these subcategories was further divided by the intervention setting (e.g. school, university, workplace). In the case of a school setting there were further subdivisions, where possible or evidence allowed, by age bands corresponding approximately to UK school age ranges.

Presented here are short summaries of the available evidence (and its limitations) addressing the four main themes: verbal, mass media, printed materials or new media facilitated advice compared to current provision/do nothing. To augment these summaries tables detailing study characteristics, outcome measures and where relevant the findings are presented. Visual representation of data is provided where possible for illustrative purposes. However, summaries are not provided where there was only a single study in a category or where only a single study measured an outcome. The main report should be consulted in such cases.

It is perhaps pertinent to begin with an overview of the volume of evidence identified and a brief synopsis of the frequency of the outcomes relevant to the analytical framework measured in each theme.

For the effectiveness review over 34000 articles were identified and 136 articles met the inclusion criteria. Forty-nine RCTs and 10 controlled before and after studies were analysed.

Figure A details the frequency of outcomes measured for each theme. It is evident that those outcomes relating to skin cancer and UV exposure were infrequently or never measured. Knowledge (followed a long way behind by behaviour) related outcomes were the most frequently measured. The figure also indicates that studies on verbal advice were by far the most common included in the review, followed by those on printed materials.

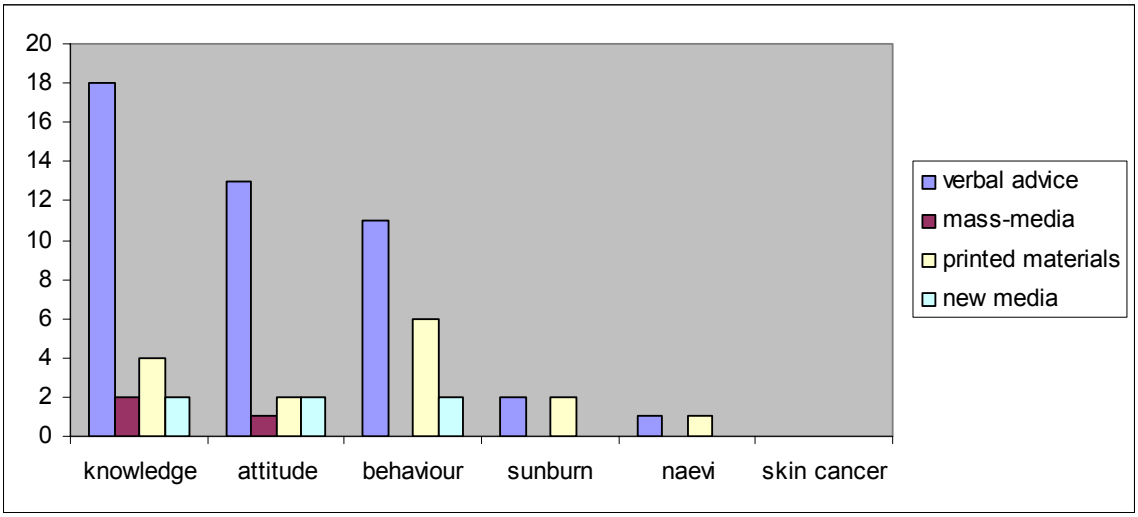

Figure A Frequency of outcomes measured in each theme

It is clear that apart from verbal advice the volume of evidence for the other themes is small. Furthermore, even for verbal advice, evidence is spread over the multitude of sub-themes indicated above.

Where there is more than a single study in a sub-theme a further consideration is the heterogeneity between those studies with regard to population, intervention (content, duration, intensity), outcomes measured, the tools used to measure them, duration of follow-up and analysis undertaken. This is in addition to quality and reporting issues.

Given the paucity of evidence, heterogeneity between studies and the quality/reporting limitations there is limited scope for synthesis and a strong degree of caution would need to be applied where it was possible. This document serves to highlighted this heterogeneity.

Theme 1: Verbal advice vs. Current provision of information/do nothing

Studies on prevention in children

School based studies in children aged four to seven years

Each of the three studies (2xRCT, 1xCBA) identified were undertaken in different countries (1xUK) and used different interventions. The intensity of the interventions was similar between studies. See Table A in this document.

Two of the studies measured knowledge gain and had similar duration of follow-up (months) but the assessment tools used were different. In one study the findings favour the intervention and in the other study they favour the control (Figure B).

No studies measured self-reported behaviour outcomes.

Two of the studies measured skin exposure but used different assessment tools and very different length of follow up (months vs. years). Numerical data were presented differently for each. No significant benefit for the intervention over the control was seen in either study, with one favouring the control and the other the intervention.

One study measured naevi development at different anatomical locations and this study had a long follow up period (6 years). There was no significant difference between groups, but the number of naevi was lower in the intervention group for each anatomical site examined. A statistically significant reduction in naevi development was seen in the intervention group compared with controls in a pre-specified, sub-group analysis of boys chests and a post-hoc, sub-group analysis of boys backs.

Table A and Table B in this document provide details of these studies.

School based studies in children aged seven to 11 years

Of the five studies included four (RCTs) were undertaken in the USA and one (CBA) in the UK. All used different interventions, with the duration and intensity specified in three and less well reported in the remainder. See Table C for further detail.

All five studies measured knowledge gain, with duration of follow up ranging from immediate post intervention to seven months. The assessment tool used was different for each study and there were variations in the type of data/analyses reported. However all studies showed a benefit for the intervention compared to control (Figure B).

Four of the studies measured self-reported behaviours. The assessment tools were questionnaires although it appeared these were different for each study. There were variations in the type of data/analyses presented. No consistent benefit of the intervention was observed. Only one study measured sun exposure and this was based on skin tone.

Table C and Table D in this document provide details of these studies.

School based studies in children aged 11 – 16 years

The six RCTs in this category were undertaken in a variety of countries (2xUK, 2xUSA, Australia, Sweden). The two UK studies appeared to assess similar interventions and all the others differing interventions. There was a degree of variability in intensity and duration of the interventions. Duration of follow up was from one week to eight months. See Table E for further detail.

All studies measured knowledge gain but the assessment tool used was different for each study and there were variations in the type of data/analyses reported. All of the five studies with evaluable data found a significant positive effect of the intervention (Figure B). However, the analyses either did not account for baseline knowledge levels or did not directly compare findings between arms in some cases.

Four of the studies measured self-reported behaviours. The assessment tools were questionnaires or diaries although it appeared these were different for each study. There were variations in the type of data/analyses presented. Whilst some studies reported a benefit of the intervention on behaviour, no consistent benefit was observed across studies (or within the one that compared self-reported behaviours to diary entries).

Sun exposure was measured in two studies but these used different tools (sunburn in previous month, hours spent outdoors). Findings were only reported in one study and there were no differences in sunburn frequency between groups.

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Table E and Table F in this document provide details of these studies.

Community based studies

Although two studies assessed community based interventions (both in USA) one was aimed at children and the other at the carers of children. Therefore these studies are not comparable.

See main report, section 4.1.1.4, page 111 for further details on both studies.

Studies set in the place of domicile

There was only one study in this category. See main report, section 4.1.1.5, page 122.

Studies on prevention in adults

Studies in a university/college setting

Although three studies (USA; RCTs) were in this category they investigated different interventions and/or had differing comparators.

All three only measured knowledge gain, used different assessment tools with a follow up of immediate post intervention and/or three weeks. There were variations in the type of data/analyses reported. The studies either reported higher adjusted post-test mean level of knowledge in the intervention group compared with control or higher post-test level of knowledge in the intervention arm compared to controls when baseline data was not collected (Figure C).

Table G and Table H in this document provide details of these studies.

Studies in a hospital/ medical practice setting

There was only one study in this category. See main report, section 4.1.2.2, page 138

Studies in a sports venue setting

There was only one study in this category. See main report, section 4.1.2.3, page 142

Theme 2: Mass-media vs. Current provision of information/do nothing

Studies on prevention in children

There were no studies that evaluated mass-media interventions in children.

Studies on prevention in adults

Studies in a university/college setting

Although three studies (RCTs) were in this sub-category only two (USA, Australia) reported data allowing assessment of the intervention. Both used different video presentations as the intervention and had different comparators.

Both studies measured knowledge gain but used different assessment tools, follow-up (3 weeks, 10 weeks) and there were variations in the type of data/analyses reported. In both studies there was a significantly higher post-test knowledge level in the intervention compared to the control arm (Figure D).

Table I and Table J in this document provide details of these studies.

Theme 3: Printed materials vs. Current provision of information/ do nothing

Studies on prevention in children

Studies set in the place of domicile

There was only one study in this category. See main report, section 4.3.1.1, page 156.

Studies in a hospital/ medical practice setting

There was only one study in this category. See main report, section 4.3.1.2, page 159.

Studies on prevention in adults

Studies in a workplace setting

Two studies (RCTs) assessed printed materials in a workplace setting (USA, UK). One covered a wide range of occupations and enrolled those over 45, the other study used employees of all ages at industrial companies. Both interventions were provision of printed messages, however it is clear that they were not the same intervention. Control was either a message unrelated to skin cancer or unclear. Follow-up was only reported in one study (20 weeks). Neither study compared differences between groups, but rather within-arm changes were analysed.

Only one of the studies assessed knowledge gain and reported that those in the intervention, but not in the control arm, significantly increased their level of knowledge.

The other study was the only one to assess a behavioural outcome reporting that the likelihood of using sunscreen was significantly increased in participants provided with the intervention but not in the control group.

Table K and Table L in this document provide details of these studies.

Studies in a university/college setting

Each of the four studies (3xUSA, UK; 3xRCTs, 1xCBA) in this sub-category used different printed material interventions/messages compared to either a message unrelated to skin cancer, no intervention or the comparator was not specifically reported. Two of the studies only enrolled women.

One of the studies did not present results by study arm. Follow-up in the remaining studies was one to four weeks. Only two studies assessed knowledge gain and they used a different assessment tool and one did not report baseline data. The studies found a significant increase in knowledge in the intervention group compared to control group or a higher post-test knowledge level in the intervention arm (Figure E). One of these studies also assessed self reported behaviours but did not report the findings.

The fourth study delivered messages aimed at reducing tanning bed use in women. It found a significant decrease in tanning bed use in participants given statistical information compared to the control group, but no significant effect of a narrative message compared to the control group (with no indication of trend).

Table M and Table N in this document provide details of these studies.

Studies in a hospital/ medical practice setting

There was only one study in this category. See main report, section 4.3.2.3, page 184.

Studies set in the place of domicile

There was only one study in this category. See main report, section 4.3.2.4, page 187.

Studies on airports and/or flights

Two studies (RCTs) assessed the effectiveness of leaflets distributed to passengers departing for holiday (UK, Australia). The interventions were not the same but the control groups in both studies appeared to receive no information. In one study leaflets were placed in seat pockets and outcomes assessed by a cross-sectional survey of passengers returning from holiday. In the other it appears fair skinned people were targeted at departure gates and then sent questionnaires on their return. Follow-up time was unclear in both studies. Knowledge was not measured in either study.

Both studies assessed sunburn during holidays. There were variations in the assessment tools and the type of data/analyses reported. Neither found a statistically significant difference between groups although there appeared to be less sunburns in the intervention group in one study. One of the studies assessed self-behaviours and found only a difference between groups for hours spent in the midday sun in favour of the intervention.

Table O and Table P in this document provide details of these studies.

Theme 4: New media vs. Current provision of information/ do nothing

Studies on prevention in children

School based studies in children aged seven to eleven years

There was only one study in this category. See main report, section 4.4.1.1, page 200.

Studies on prevention in adults

Studies in a hospital/ medical practice setting

There was only one study in this category. See main report, section 4.4.2.1, page 202.

Commentary

From the above it should be evident that despite the number of studies included in the effectiveness review these are distributed over a number of themes and sub-themes. Although there are a few sub-themes with multiple studies, there is considerable heterogeneity between studies with regard to design, intervention, comparator and outcomes measured, tools used, length of follow up etc. This is before issues related to the quality of the studies, validity of outcome measures, the way in which the data are analysed and presented, and the often under-reporting of studies are considered. All these factors hinder comparability. In fact, for the most part comparing or pooling data from studies within a theme/sub-theme is impossible or could be misleading. The discussion chapter of the main report (Section 6) contains a detailed commentary on the issues faced in interpreting the evidence base on this topic.

Add to this the detail from Figure A which indicates that little or no evidence exists on skin cancer incidence or possible markers for skin cancer compounds this field.

To determine what is an effective intervention, the definition of the effectiveness measure(s) needs to be resolved. If in this case it is skin cancers avoided then there are

no studies that measure it and thus determination of an effective intervention is not possible. Therefore a decision needs to be made whether other outcome measures (or combinations thereof) are acceptable, taking into account their position earlier in the analytic framework. Furthermore, it is necessary to agree on what constitutes a meaningful change in the outcome(s). Once that has been decided, what is required are well conducted and reported randomised trials (or other appropriately designed primary studies) for each candidate intervention or variation thereof which measure the appropriate effectiveness outcome(s).

What is an acceptable alternative measure for skin cancers avoided is debatable, as is what a meaningful change in any candidate outcome might be. A further complication is the validity of the tool used to measure the outcome. For example self-reporting of sunburn is a proxy for actual sunburn which in itself may be a proxy for skin cancer incidence.

All this makes determining what is an effective intervention for delivering information on the prevention of the first occurrence of skin cancer difficult. All this must be clarified before it is even possible to contemplate outlining what are the effective contents of interventions.

Given these issues, there are a few key points that arise from the evidence identified.

It is evident that verbal interventions applied to children might lead to an increase in knowledge about exposure to, and protection from, UVR. The content and delivery of these interventions were not always adequately described, and they varied in the intensity and duration of delivery and length of follow-up. As the evidence comes from relatively short term studies it is unclear whether the knowledge gained is retained and leads to the adoption and sustained use of protective behaviours.

From the only long term study identified, it appears that there may be a benefit of verbal advice in reducing the development of naevi at some anatomical sites in boys. However some of this evidence comes from unplanned analyses and as in the point above whether effects translate into reduction in skin cancers is unclear. Furthermore, this study was undertaken in Australia.

Harms from interventions were not reported and thus remain unknown

Finally, the majority of studies were undertaken in locations with higher sun exposure than the UK. Setting aside issues around the quantity and quality of the evidence, it is not clear whether messages used in such studies and the effects from them would translate to the UK setting. There are a few UK studies but these are not free of the issues highlighted regarding the quality of the evidence in this field.

Table A Study Characteristics: Verbal advice vs. Current provision of information/do nothing - School based studies in children aged four to seven years

Study	**Population** (n for analysed participants, not clusters)	Intervention	Comparator	Outcome				Quality	Comments
				Knowledge	Behaviour	Sunburn	Naevi		
Buller 2006a, cluster RCT	elementary schools with at least 75% Caucasian children; Arizona, USA; (n not clear)	*"Sunny Days, Healthy Ways"* age-appropriate curriculum taught over six weeks in four 1-hour class periods; content: limiting time in the sun, covering-up clothes, using sunscreen	no intervention	February (baseline) to April/ May - the same year	February (baseline) to April/ May - the same year			-	
Loescher, cluster RCT	four to five year old children able to understand English; classes with at least 15 children (n=150)	three sessions of 45-50 minutes; content not clear (sun safe messages)	no intervention	baseline; 7 weeks				+	
Kidskin, cluster CBA	schools within 30 km of the centre of Perth, Australia with 50 or more first grade students (n=1221)	Age-appropriate curriculum taught over four years which included four to six 40-minute sessions each spring; content: limiting time in the sun, wearing protective clothing, using sunscreen	standard Australian health education curriculum		baseline; 2 years; 4 years		baseline, 4 years, 6 years	+	

Table B Outcomes Assessed: Verbal advice vs. Current provision of information/do nothing - School based studies in children aged four to seven years

Study	Knowledge		Behaviour		Sunburn		Naevi	
	Measure used	Data format	Measure used	Data format	Measure used	Data format	Measure used	Data format
Buller 2006a; cluster RCT	4-item photographic test, and 11 questions assessing sun safety behaviours	Mean baseline and follow-up scores, no SD	Skin tone measured using 3 colorimeter scales: light-dark: (lower scores = more skin darkening and UVR exposure); blue-yellow (higher scores = more skin darkening and UVR exposure); red (higher scores = more skin redness and UVR exposure).	Mean baseline and follow-up scores, no SD				
Loescher, cluster RCT	Assessed by ability to recall or remember the information	Mean and SD baseline and follow-up scores						
Kidskin, cluster CBA			Reflectance measurements on each site with reflectance spectrophotometers. (reflectance is inversely related to degree of skin pigmentation).	Adjusted post-test mean, no SD			Naevi measured in winter to limit confusion with freckling; slides were taken using photographic equipment and a blind observer to count naevi.	Baseline and follow-up means, no SD
			Sun exposure index created using parental questionnaires about their child's sun-related activities.	Baseline and follow-up mean and SD				
			Winter freckling levels on face, arms and shoulders were estimated and scored between 0 (none) and 10 (very heavy).	Baseline and follow-up mean and 95% CI scores				

Table C Study Characteristics: Verbal advice vs. Current provision of information/do nothing - School based studies in children aged seven to 11 years

Study	**Population** (n for analysed participants, not clusters)	Intervention	Comparator	Outcome				Quality	Comments
				Knowledge	**Behaviour**	**Sunburn**	**Naevi**		
Buller 1994, cluster RCT	children from elementary schools in Arizona, USA (n=139)	*"Sunshine and Skin Health"* - earlier version of *"Sunny Days, Healthy Ways"* curriculum - five multidisciplinary units (approximately an hour); cause and consequence approach to skin cancer	not reported	baseline (1 week before intervention), immediate post-test, 8 weeks later	baseline (1 week before intervention), immediate post-test, 8 weeks later			-	
Buller 1997, cluster RCT	children from public elementary schools in Arizona, USA; 75% of children in enrolled schools were white or Caucasian (n=209)	Sun safety fair in a school (classes visited for 45 to 90 minutes); content: sun blocks, effects of sun overexposure, unsafe clothes, skin cancer detection	not reported	baseline, immediate post-test, 3 months	baseline, immediate post-test, 3 months			-	Prevention and detection study
Buller 2006a, cluster RCT	elementary schools with at least 75% Caucasian children; Arizona, USA; (n not clear)	*"Sunny Days, Healthy Ways"* age-appropriate curriculum taught over six weeks in four 1-hour class periods; content: limiting time in the sun, covering-up clothes, using sunscreen	no intervention	February (baseline) to April/ May - the same year	February (baseline) to April/ May - the same year			-	
Hornung, cluster RCT	children in a public elementary school in North Carolina, USA (n=130)	teachers were asked to teach about skin cancer as per normal protocol; since there was no teaching standard they were asked to use information they received from researchers (skin cancer prevention pamphlets); intervention period was not reported; content: no detail	no intervention	immediate post-test; 7 months	immediate post-test; 7 months			+	
Hewitt, cluster CBA	state maintained primary and junior schools in	*"Sun-safe"*: age-appropriate workbook-based (duration not provided) or computer-based	no intervention	baseline, 6 weeks				-	

	Nottinghamshire Health District, UK; schools had to have at least two Acorn computers (n=454)	(approximately 20 minutes) resource; content: clarifying messages on skin cancer prevention, effects of UV radiation on skin cancer; encouraging responsible attitudes and behaviours;							

Table D Outcomes Assessed: Verbal advice vs. Current provision of information/do nothing - School based studies in children aged seven to 11 years

	Knowledge		Behaviour		Sunburn		Naevi	
Study	**Measure used**	**Data format**	**Measure used**	**Data format**	**Measure used**	**Data format**	**Measure used**	**Data format**
Buller 1994, cluster RCT	Knowledge of relationship between exposure to sunlight, preventive behaviour, and skin cancer (35 items); measured as part of larger questionnaire	Mean post-test score; no SD	Implementation of favourable behaviour (14 child-behaviour and 8 parent-behaviour items) measured as part of larger questionnaire	Mean post-test scores for individual behaviours (not all items), - no SD				
Buller 1997, cluster RCT	Knowledge of environmental factors (i.e. UVR radiation), skin (type, moles etc), and skin cancer assessed	Adjusted post-test score, no SD	13 questions assessing behaviours to reduce sun exposure through sunscreen use, lip balm use, and hat use. Children reported parental preventive behaviour on an eight-item scale, which was summed into a single index.	Adjusted follow-up scores for individual behaviours; no SD Adjusted mean follow-up scores; no SD				

Buller 2006a, cluster RCT	Questionnaire: 30 items for children in grades 2-3, and 35 items for children in grades 4-5:	Mean baseline and follow-up score, no SD.	Self-reported solar protection: 13 questions. Protection behaviours by parents: 8 questions.	Mean baseline and follow-up score, no SD. Mean baseline and follow-up score, no SD.	Skin tone measured with colorimeter on 3 scales: light-dark (lower scores indicating more skin darkening and UVR exposure), blue-yellow (higher scores indicating more skin darkening and UVR exposure), red (higher scores indicating more skin redness and UVR exposure.	Mean baseline and follow-up score, no SD.	
Hornung, cluster RCT	Questionnaire: responses assessed on 3-point Likert scale or formulated as “fill in the blank”.	Adjusted post-test score (no SD)	Questionnaire: responses assessed on 3-point Likert scale or formulated as “fill in the blank”.	Adjusted mean composite post-test score; no SD			
Hewitt, cluster CBA	Questionnaire; no further details provided	Baseline mean and SD; within-group increase and 95%CI. No follow-up scores.					

Table E Study Characteristics: Verbal advice vs. Current provision of information/do nothing - School based studies in children aged 11 to 16 years

Study	**Population** (n for analysed participants, not clusters)	Intervention	Comparator	Outcome				Quality	Comments
				Knowledge	Behaviour	Sunburn	Naevi		
Buller 2006b, cluster RCT	students in schools in Colorado, New Mexico and Arizona, USA (n=1788)	"Sunny Days, Healthy Ways" curriculum - six 50-minute lessons (possible to present in 15-30 minute segments over several classes); content: increasing perceived risk and positive expectations for sun protective behaviours; teaching sun-protective skills (selecting and applying sunscreen, clothing, hats, sunglasses and minimising time in the sun)	not reported	February/ March (baseline) and May	February/ March (baseline) and May	February/ March (baseline) and May		+	
Girgis, cluster RCT	students from the largest government primary schools in the region; Australia (n=612)	SKIN SAFE - programme incorporated into curriculum during 4 weeks; number of hours depended on teachers; content: problems associated with solar exposure, encouraging responsible behaviours	no intervention	5 weeks post-test and 8 months	baseline, 5 weeks post-test and 8 months			-	
Hughes, cluster RCT	schools from different parts of England (Liverpool, Rotherham, Rugby, London, Essex, Kent), UK (n=543)	"Suncool" - educational sessions using different materials (workbook, (leaflet, video) and activities (additional discussion) - probably within one - two sessions; content: sun, skin cancer, preventive measures	no intervention	July	September			-	Study started in May
Kristjansson, cluster RCT	schools in Stockholm County, Sweden (n=184)	one educational session (45 minutes) - probably using overhead transparencies and a video; content unclear	no intervention	baseline, 3 months				+	

Mermelstein, cluster RCT	Chicago area, USA suburban schools (n=1703)	One-session class (45 minutes) with the use of a video and worksheet to assess personal risk; content: dangers of skin cancer, risk factors, preventive measures	no intervention	one week before and after intervention	one week before and after intervention			-	
Syson-Nibbs, cluster RCT	secondary school in a rural area of Derbyshire, UK	"Suncool" leaflet, video and workbook used; 3 40-minute sessions; content: sun, skin cancer, preventive measures	no intervention	baseline, 3 months				-	

Table F Outcomes Assessed: Verbal advice vs. Current provision of information/do nothing - School based studies in children aged 11 to 16 years

	Knowledge		Behaviour		Sunburn		Naevi	
Study	Measure used	Data format	Measure used	Data format	Measure used	Data format	Measure used	Data format
Buller 2006b, cluster RCT	Sun-safety knowledge assessed with 10 true-false questions.	Post-test number of correct answers and SE.	Diary reports of time exposed to the sun and sun protective measures taken, i.e. clothing, sunscreen. Weighted body coverage measure was created for each time outdoors, ranging from 0 to 15.	Diary for different times of day adjusted post-test and SE.	Sunburn during the past month and in the last summer.	Participants (%) in previous month, OR and 95% CI.		
			5-point frequency items assessed how often children applied sunscreen (SPF ≥15), wore sun-protective clothing, and limited time in the sun. A mean composite rating was calculated.	Adjusted composite mean post-test and SE.				
			Frequency of sunbathing, and using a self-tanning cream, and SPF of sunscreen used	For each item mean post-test and SE.				
Girgis, cluster RCT	Part of a questionnaire: 19 items.	Regression to identify predictors of solar protection - no data on outcomes.	Solar Protection Behaviour Diary completed by students over 5 consecutive school days during recess, first and second half of lunch (a total of 15 possible opportunities). Score calculated for every opportunity available for protection (maximum 16 points).	Regression to identify predictors of solar protection - no data on outcomes.				

Hughes, cluster RCT	33-item questionnaire; (maximum score 33). Score classed as missing when <6 questions answered.	Post-test mean scores and SD.	September questionnaire asked about sun-protective behaviour during summer holidays	Not reported; only stated that there was no difference		
Kristjánsson, cluster RCT	Knowledge of skin cancer risk factors, UVR exposure and sun-protection assessed using 15 statements; score based on number of correct answers.	Baseline and post-test mean score and SD.				
Mermelstein, cluster RCT	Knowledge scores – at baseline derived from a nine-item questionnaire assessing risk factors, sunscreen use, and seriousness and prevalence of skin cancer. 5 items were added to the follow-up questionnaire (no details provided)	% of correct answers and p-values for difference.	Sunscreen use: how often sunscreen/sun block used when outside, and its SPF. Indoor tanning frequency: 1 for 0 times to 5 for 21 times Sun exposure: average number of daylight hours spent outside during the summer – weighed combination of questions asking about summer holidays, weekends and weekdays.	Not reported. Not reported Not reported.		
Syson-Nibbs, cluster RCT	Questionnaire (29 items).	Mean baseline and post-test score and SD.				

Table G Study Characteristics: Verbal advice vs. Current provision of information/do nothing - Adults - University Setting

Study	**Population** (n for analysed participants, not clusters)	Intervention	Comparator	Outcome				Quality	Comments
				Knowledge	Behaviour	Sunburn	Naevi		
Jackson, RCT	non-Hispanic Caucasian women; introductory psychology students (n=211)	educational session by a trained presenter (35 minutes) for a group; content: threat of skin cancer and photo aging, sun protection, image norms	session on stress management	baseline, immediate post-test				++	participants given sunscreen after post-test therefore 2-week follow-up (including assessment of behaviours) not analysed
Katz, RCT	college students, USA; (n=40)	presentation (25-30 minutes) and a question and answer session for a group; content: skin, skin cancer, preventive measures, self-examination	no intervention	immediate post-test				-	study very poorly reported; before a 2-week follow-up the intervention was delivered to the control group; prevention and detection
Mickler, RCT	undergraduate psychology students; USA (n=69)	individual session with nurse (15 to 20 minutes); content: how to perform self-examination (opportunity to practice), participants received brochures; content: skin cancer, prevention and detection	information about peer-leadership	immediate post-test; 3 weeks				++	some participants had a personal history of skin cancer; prevention and detection

Table H Outcomes Assessed: Verbal advice vs. Current provision of information/do nothing - Adults - University Setting

Study	Knowledge		Behaviour		Sun exposure		Naevi	
	Measure used	Data format	Measure used	Data format	Measure used	Data format	Measure used	Data format
Jackson, RCT	Questionnaire: number of correct answers to 10 items.	Mean baseline and post-test score, no SD.						
Katz, RCT	Questionnaire: 29 questions mainly true-false or multiple choice, possible scores ranged from 0 to 37.	Mean post-test score and SD.						
Mickler, RCT	20-item (7 multiple choice, 13 true/false) questionnaire measuring knowledge of the seriousness and prevalence of skin cancer, skin cancer risk factors, and prevention techniques.	Mean post-test score and SD.						

Table I Study Characteristics: Mass media vs. Current provision of information/do nothing - Adults - University Setting

Study	**Population** (n for analysed participants, not clusters)	Intervention	Comparator	Outcome				Quality	Comments
				Knowledge	Behaviour	Sunburn	Naevi		
Cody, cluster RCT	first year psychology students, University of Newcastle, Australia (n=114)	one group was given an *informational video* "Skin Deep" (12 minutes) covering causes, consequences, incidence rates of skin cancer, suggested skin protection, examination and treatment-seeking; the second group watched an *emotional video* (8 minute interviews with two local people - one dying of melanoma, one fully recovered) and last four minutes of "Skin Deep" summarising its content	video (12 minutes) on dietary recommendations to prevent heart disease	baseline, immediate post-test, 10 weeks	baseline			-	After baseline behaviour was not measured, but behavioural intentions; prevention and detection
Mahler 2007, RCT	undergraduate students from University of California, San Diego, USA (n=68)	11-minute videotaped slideshow on photo aging and ways to prevent it (e.g. sunscreen use)	not reported					+	no primary outcomes assessed; sunscreen distributed after immediate post-test (participants followed-up for one year)
Mickler, RCT	undergraduate psychology students; USA (n=75)	video which informed about skin cancer, how to recognise it, different skin types, ways to detect and prevent skin cancer (15-20 minutes)	information about peer-leadership	immediate post-test; 3 weeks				++	Some participants had a personal history of skin cancer; prevention and detection

Table J Outcomes Assessed: Mass media vs. Current provision of information/do nothing - Adults - University Setting

	Knowledge		Behaviour		Sun exposure		Naevi	
Study	**Measure used**	**Data format**	**Measure used**	**Data format**	**Measure used**	**Data format**	**Measure used**	**Data format**
Cody, cluster RCT	Knowledge: 10 items devised by New South Wales Cancer Council.	Mean baseline and post-test score and SD.	Behaviour using modified version of New South Wales Cancer Council: sun exposure while at the beach (2 items); at risk behaviour: spending >2 hrs at the beach for three or more times a week, skin protection and examination behaviour (10 items).	Mean and SD only baseline.				
Mahler 2007, RCT								
Mickler, RCT	20-item (7 multiple choice, 13 true/false) questionnaire measuring knowledge of the seriousness and prevalence of skin cancer, skin cancer risk factors, and prevention techniques.	mean post-test score and SD						

Table K Study Characteristics: Printed materials vs. Current provision of information/do nothing - Adults - Workplace setting

Study	Population (n for analysed participants, not clusters)	Intervention	Comparator	Outcome				Quality	Comments
				Knowledge	Behaviour	Sunburn	Naevi		
Hanrahan, RCT	male employees over 45 years; Newcastle, Australia (n=368)	two brochures - one designed especially for men over the age of 45 years; contained facts about melanoma and detection	no information	baseline; post-test at 10-11 weeks and at 20 weeks				+	prevention and detection
Rasmussen, RCT	staff of industrial companies in central Scotland, UK (n=171)	*positive information group:* description of efficacy of sunscreen, different types and how they can reduce skin cancer; *negative information group:* problems with using sunscreens and information that they do not provide perfect protection	information about the common cold		baseline and post-test			-	duration of the study not reported

Table L Outcomes Assessed: Printed materials vs. Current provision of information/do nothing - Adults - Workplace setting

Study	Knowledge		Behaviour		Sun exposure		Naevi	
	Measure used	Data format	Measure used	Data format	Measure used	Data format	Measure used	Data format
Hanrahan, RCT	Questionnaire which contained: general questions about melanoma and 8 photographs which tested ability to distinguish between pigmented skin lesions which required to be seen by a doctor and harmless ones.	Mean baseline and post-test score; no SD.						
Rasmussen, RCT			Participant rating of likelihood of sunscreen use (expressed as reflected logs, therefore a lower score represents higher sunscreen use).	Only p-values provided for likelihood of using sunscreen.				

Table M Study Characteristics: Printed materials vs. Current provision of information/do nothing - Adults - University setting

Study	**Population** (n for analysed participants, not clusters)	Intervention	Comparator	Outcome				Quality	Comments
				Knowledge	Behaviour	Sunburn	Naevi		
Castle, RCT	female students from a College of Further Education on the south coast of England, UK (n=97)	Health Education Authority leaflet "If you worship the sun don't sacrifice your skin"; content: identifying skin type, appropriate SPF, advice on sensible sun exposure and information on melanoma	not reported	baseline, 1 week follow-up	baseline, 1 week follow-up			+	

Mahler 2007, RCT	undergraduate students from University of California, San Diego, USA (n=69)	UV facial photograph showing damage to the skin caused by exposure to UV radiation invisible in natural light; for comparison a photograph in natural light was also taken	not reported					+	no primary outcomes assessed; sunscreen distributed after immediate post-test (participants followed-up for one year)
Mickler, RCT	undergraduate psychology students; USA (n=71)	brochures containing information on melanoma detection and prevention	information about peer-leadership	immediate post-test; 3 weeks				++	some participants had a personal history of skin cancer; prevention and detection
Greene, CBA	Caucasian female students of a South-Eastern University in the USA (n=141)	messages aiming at reduction of tanning bed use presented in either a *statistical* or *narrative* format	no intervention		baseline and 3-4 weeks follow-up			-	study mainly on tanning bed use

Table N Outcomes Assessed: Printed materials vs. Current provision of information/do nothing - Adults - University setting

Study	Knowledge		Behaviour		Sun exposure		Naevi	
	Measure used	Data format	Measure used	Data format	Measure used	Data format	Measure used	Data format
Castle, RCT	Knowledge about skin cancer – 19 questions (yes/no, multiple choice and open-ended); possible scores 0-30.	Mean baseline and post-test score and SD.	Self reported behaviour (sun tanning, sunburns, protective measures)	Not reported.				
Mahler 2007, RCT								
Mickler, RCT	20-item (7 multiple choice, 13 true/false) questionnaire measuring knowledge about the seriousness and prevalence of skin cancer, skin cancer risk factors, and prevention techniques.	Mean post-test score and SD.						
Greene, CBA			Tanning behaviour change, and tanning bed use.	Only change from baseline and p-value.				

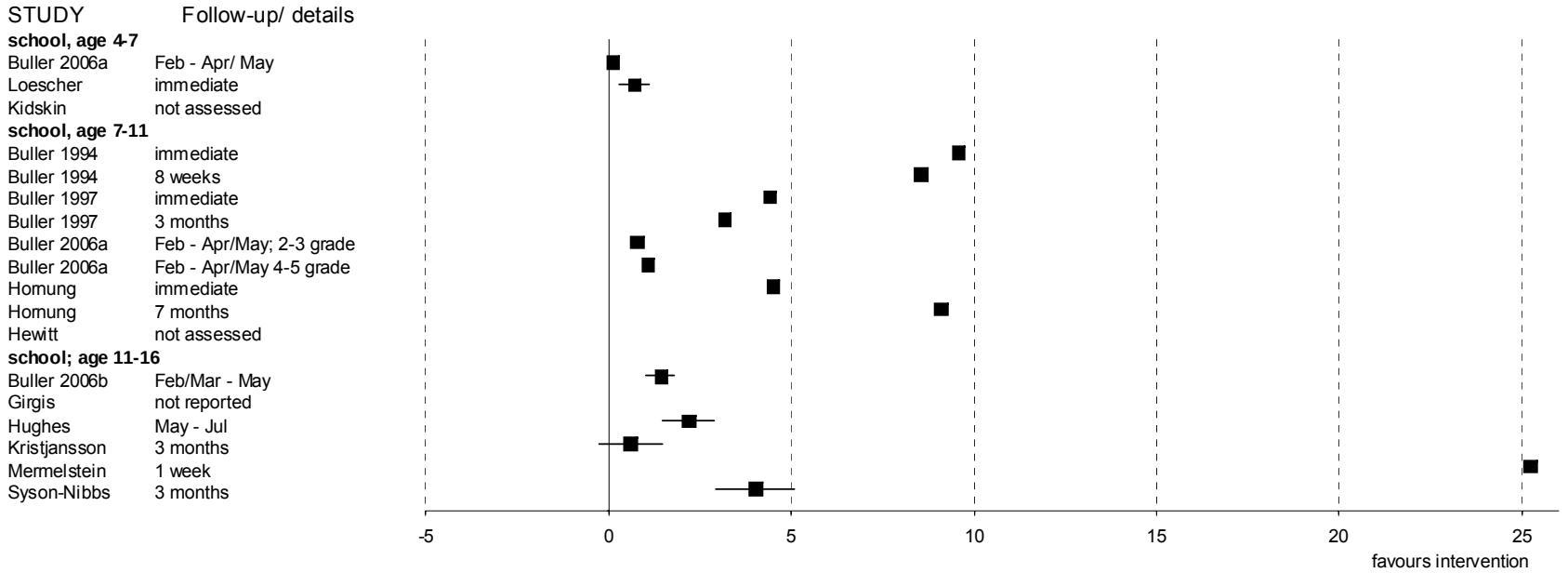
Table O Study Characteristics: Printed materials vs. Current provision of information/do nothing - Adults - Airport/flight setting

Study	**Population** (n for analysed participants, not clusters)	Intervention	Comparator	Outcome				Quality	Comments
				Knowledge	Behaviour	Sunburn	Naevi		
Dey, cluster RCT	holidaymakers on Air UK Leisure flights from Manchester, UK (n=12385)	Health Education Authority leaflet "If you worship the sun don't sacrifice your skin" placed in the seat pockets; content not reported - using information in another study: identifying skin type, appropriate SPF, advice on sensible sun exposure and information on melanoma	no intervention			post-test		-	only a cross-sectional sample analysed; study duration not reported
Segan, cluster RCT	tourists recruited in gate lounges at Melbourne Airport across 21 flights to the southern or northern coast of Queensland (for a spring holiday in November) (n=373)	leaflet on methods of sun-protection during holidays; suggested limiting time in the sun during peak UV radiation hours	not reported		post-test	post-test		-	follow-up unclear; questionnaires sent to participants to wait for them after holidays

Table P Outcomes Assessed: Printed materials vs. Current provision of information/do nothing - Adults - Airport/flight setting

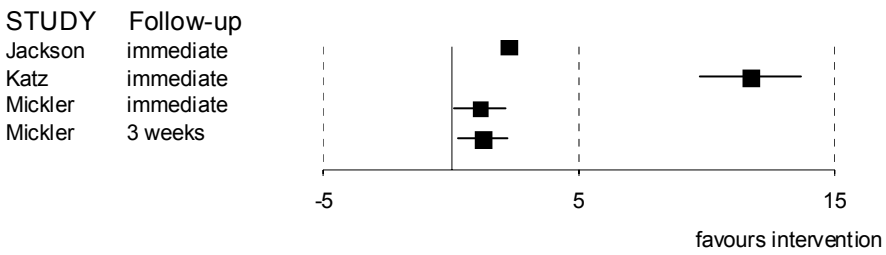
Study	Knowledge		Behaviour		Sun exposure		Naevi	
	Measure used	Data format	Measure used	Data format	Measure used	Data format	Measure used	Data format
Dey, cluster RCT					Questionnaire assessing experience of sunburn. Adults completed the questionnaire for children. Severe sunburn was defined as any episode of sunburn which was either painful for more than a day or resulted in blistering	Post-test % of severe sunburns in groups, and p-values and 95% CI for differences in proportions.		
Segan, cluster RCT			Number of days with more than two hours in the sun between 10am and 2pm Frequency of sun protection and exposure behaviours (clothing, sunscreen use, using shade, wearing less clothing to deliberately expose the skin) When outside for more than 15 minutes between 10am and 2pm – measured on a 5 point scale. mean outdoor sun protection calculated after reversing the deliberate skin exposure measure.	Post-test scores for individual behaviours; no SD; p-value for differences.	Frequency of sunburn (any amount of reddening of the skin after being in the sun) and location,	Post-test frequency score (no SD) and p-value for differences.		
			Suntan acquired (none, light, moderate, dark)	Not reported	8-point sunburn measure: number of times burnt (range 0 – no burn to 3 – 3+ burns), extent (strip 0, in-between area 1, large area 2) and severity of the worst burn (red not tender 0, red and tender 1, blistered 2),	Not reported		

Figure B Forest plot of mean difference between verbal advice interventions and control in children in a school setting



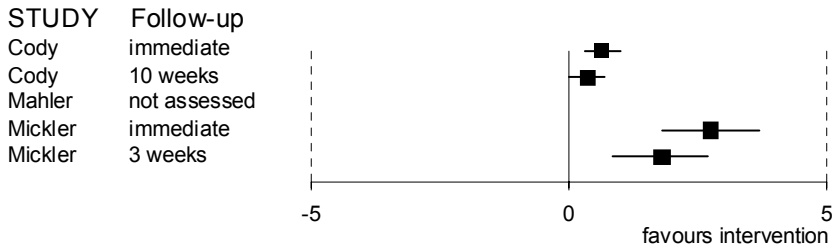
NB: The outcome was measured in each study using different tools and scales, therefore the magnitude of any effects are not comparable between studies.

Figure C Forest plot of mean difference in knowledge between verbal advice interventions and control in adults in a university setting



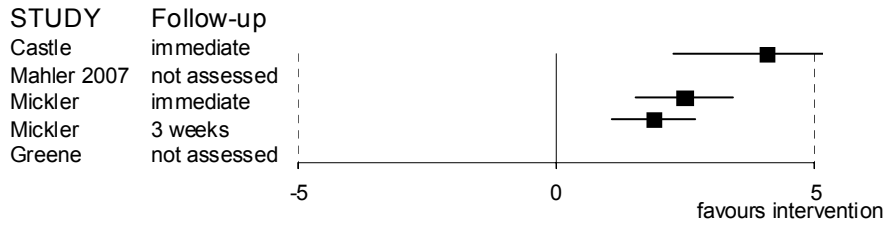
NB: The outcome was measured in each study using different tools and scales, therefore the magnitude of any effects are not comparable between studies.

Figure D Forest plot of mean difference in knowledge between mass media interventions and control in adults in a university setting



NB: The outcome was measured in each study using different tools and scales, therefore the magnitude of any effects are not comparable between studies.

Figure E Forest plot of mean difference in knowledge between printed material interventions and control in adults in a university setting



NB: The outcome was measured in each study using different tools and scales, therefore the magnitude of any effects are not comparable between studies.