BMJ

RESEARCH

Sunbed use in children aged 11-17 in England: face to face quota sampling surveys in the National Prevalence Study and Six Cities Study

Catherine S Thomson, head of statistical information,[1] Sarah Woolnough, head of policy,[1] Matthew Wickenden, statistical information officer,[1] Sara Hiom, director of health information,[1] Chris J Twelves, professor of clinical cancer pharmacology and oncology[2]

[1]Cancer Research UK, London WC2A 3PX

[2]Leeds Institute of Molecular Medicine, St James's Institute of Oncology, Leeds LS9 7TF

Correspondence to: C S Thomson
catherine.thomson@cancer.org.uk

Cite this as: *BMJ* 2010;340:c877
doi:10.1136/bmj.c877

ABSTRACT

Objectives To quantify the use of sunbeds in young people across England, identify geographical variation, and explore patterns of use, including supervision.

Design Two random location sampling surveys.

Setting National Prevalence Study in England; Six Cities Study in Liverpool, Stoke/Stafford, Sunderland, Bath/Gloucester, Oxford/Cambridge, and Southampton.

Participants 3101 children aged 11-17 in the National Prevalence study and 6209 in the Six Cities study.

Results In the National Prevalence Study 6.0% (95% confidence interval 5.1% to 6.8%) of those aged 11-17 had used a sunbed. Use was higher in girls than in boys (8.6% (7.2% to 10.0%) *v* 3.5% (2.6% to 4.4%), respectively), in those aged 15-17 compared with those aged 11-14 (11.2% (9.5% to 12.9%) *v* 1.8% (1.2% to 2.4%), respectively), and in those from lower rather than higher social grades (7.6% (5.7% to 9.5%) *v* 5.4% (4.5% to 6.3%), respectively). Sunbed use was higher in the "north" (11.0%, 8.9% to 13.0%) than in the "midlands" (4.2%, 2.5% to 5.8%) and the "south" (4.2%, 3.3% to 5.2%). In the Six Cities Study, sunbed use was highest in Liverpool and Sunderland (20.0% (17.5% to 22.4%) and 18.0% (15.6% to 20.3%), respectively), with rates especially high in girls, those aged 15-17, or from lower social grades. Mean age of first use was 14, and 38.4% (34.7% to 42.1%) of children used a sunbed at least once a week. Nearly a quarter (23.0%, 19.8% to 26.1%) of children had used a sunbed at home (including home of friends/relatives), and 24.7% (21.0% to 28.4%) said they had used sunbeds unsupervised in a tanning/beauty salon or gym/leisure centre.

Conclusions Sunbed use by children is widespread in England, is often inadequately supervised, and is a health risk. National legislation is needed to control sunbed outlets.

INTRODUCTION

The incidence of malignant melanoma is rising faster than that of any other cancer in the United Kingdom, rates having more than quadrupled since the 1970s.[1] Although this is partly because of earlier detection and better diagnosis, increased exposure to risk factors is also believed to be important.[2] Natural or artificial ultraviolet radiation is an important factor, and the International Agency for Research on Cancer recently upgraded exposure to ultraviolet radiation to level 1—that is, "carcinogenic to humans."[3] Sunbed use before the age of 35 increases the risk of developing malignant melanoma by 75%[4] and has been implicated in an estimated 100 deaths from the disease annually in the UK.[5] Sunbeds might also accelerate skin ageing and cause eye damage or immune suppression, while their purported health benefits are unproved.[6]

As proposed by the Cancer Reform Strategy,[7] the National Cancer Action Team, supported by the Department of Health, commissioned Cancer Research UK to investigate sunbed use in those aged under 18. Market research companies undertook the National Prevalence and the Six Cities studies, the latter focusing on areas with differing access to tanning salons. We report the frequency, location, and supervision of sunbed use by those aged 11-17; geographical variation; and the effects of age, sex, and social class. Unless stated otherwise, data refer to England.

METHODS

Cancer Research UK commissioned BMRB Omnibus and LVQ Research to carry out interviews using questions developed after extensive consultation with researchers.

National Prevalence Study

Children were interviewed[8] as part of the Youth Omnibus Survey after the weekly Adult BMRB Face-to-Face Omnibus interview of a representative sample of adults across Great Britain.[9] This uses a random location sampling technique,[10] based on an amalgamation of output areas, the basic building block used for outputs from the 2001 census in Great Britain. Output areas were grouped into sample units of about 300 households, by using their ACORN profiles based on both demographic and purchasing consumer details.[11] Target quotas were set for interviews for age/sex and

employment status for the adults to take into account the likelihood of being available at home for interview.

If more than one child aged 11-17 was available in the house, the one with the most recent birthday was selected. Written permission was obtained from both parent and child if the child was aged under 15, or from the child alone if they were older. Trained interviewers carried out interviews using a computer assisted personal interviewing (CAPI) system. A minimum of 10% of respondents were contacted again by phone or letter to confirm classification and answers to key questions.

Initial "scoping" in 988 children between 21 February 2008 and 23 April 2008 across Great Britain gave a 5.8% prevalence of sunbed use with 95% confidence interval of 4.3% to 7.3%. Powered on this figure, we calculated that a final sample size of 3500 children would give a prevalence estimate with 95% confidence intervals of +/−1%, estimates of sunbed use by region with 95% confidence intervals of +/−5%, and allow exploratory subgroup analyses.

An additional 2521 interviews across Great Britain between 9 October 2008 and 21 April 2009 gave a total sample size of 3509; the 3101 conducted in England form the basis of subsequent analyses, except where stated, to answer questions posed in the Cancer Reform Strategy.

Six Cities Study

LVQ Research undertook a bespoke survey[8] questioning children in six targeted "cities" in England, focusing on geographical variation in sunbed use and density of sunbed outlets (for instance, in a tanning/beauty salon or gym/leisure centre). They used a random location approach sampling technique, based on agreed postcode sectors in each "city." The number of interviews carried out in each postcode sector was determined by the proportion of domestic households in that postcode district relative to the total in the city. From a list of given streets within the postcode sector, interviews were conducted by using an interlocking age within sex quota, aiming for an equal number of boys and girls in each year of age for each city. These were undertaken face to face at home or a convenient location within the postcode sector; written parental permission was obtained for children aged under 14. Revalidation was performed on 12% of respondents.

Liverpool, Stoke/Stafford, and Sunderland were selected as having high densities of sunbed outlets, while Bath/Gloucester, Oxford/Cambridge, and Southampton have low densities; the former cities also have a higher proportion of those who are more socially deprived (social grade D or E) than the latter.[6 12]

Between 19 April and 12 May 2008, a "pilot" study of 2506 children aged 11-17 established that we needed a total of 1000 interviewees a city to provide estimates of variations in sunbed use with acceptable confidence intervals. A further 3703 interviews between 17 October and 16 November 2008 gave a total sample size of 6209.

Questionnaires and analyses

The two studies included the same core questions. An extra question was added to both questionnaires after the pilot study to ascertain if/how sunbed use was supervised in staffed premises. The Six Cities Study also recorded average duration of sunbed sessions.

We included pilot data from both studies in the final analyses after confirming there was no double counting of interviewees. "Rim weighting"[13] was performed by BMRB Omnibus to correct for differential sample rates across the age/sex/social grade and region range to match the marginal totals in the National Readership survey[14] in the National Prevalence Study (done separately for Great Britain and England alone) and by LVQ Research to correct for differential sample rates across the age and sex range in the Six Cities Study. All analyses are presented on the weighted samples, with a design effect taken to be 1, given the size of the samples and the numbers of weeks over which the interviewing

Table 1 | National Prevalence Study: unweighted and weighted total sample numbers* by sex, age group, and social grade in England

				Age (years)		Social class				
	Total	Boys	Girls	11-14	15-17	AB	C1	C2	D	E
Total (unweighted)	3101	1620	1481	1844	1257	560	867	716	510	448
Total (weighted)	3101	1589	1512	1725	1376	823	845	655	508	269
Sex:										
Male	1589	1589	—	879	710	416	434	336	264	139
Female	1512	—	1512	845	667	407	411	319	244	130
Age (years):										
11-14	1725	879	845	1725	—	521	452	350	243	158
15-17	1376	710	667	0	1376	302	393	304	265	112
Social grade:										
AB	823	416	407	521	302	823	—	—	—	—
C1	845	434	411	452	393	—	845	—	—	—
C2	655	336	319	350	304	—	—	655	—	—
D	508	264	244	243	265	—	—	—	508	—
E	269	139	130	158	112	—	—	—	—	269

*Weighted numbers are rounded and thus marginal totals might not add up. Analyses are based on weighted sample.

Table 2 | National Prevalence Study: unweighted and weighted total sample numbers* by standard region in England

	Total	London	South east	South west	East Anglia	East Midlands	West Midlands	Yorks/ Humberside	North west	North
Total (unweighted)	3101	543	853	261	94	243	332	270	316	189
Total (weighted)	3101	534	701	327	116	215	360	304	368	174
Sex:										
Male	1589	288	365	168	58	113	175	157	166	99
Female	1512	246	336	159	58	102	184	147	203	75
Age:										
11-14	1725	284	390	187	70	127	207	170	202	88
15-17	1376	250	312	140	47	88	153	134	165	86
Social grade:										
AB	823	127	222	82	36	65	92	79	89	32
C1	845	135	186	99	29	63	100	76	108	50
C2	655	95	151	82	19	50	87	66	69	36
D	508	112	98	50	24	24	56	51	60	35
E	269	66	45	16	8	13	27	32	43	21

*Weighted numbers are rounded and thus marginal totals might not add up. Analyses are based on weighted sample.

was carried out. Confidence intervals were assumed to follow a normal approximation to the binomial distribution. We tested for significance between proportions using sunbeds in different groups by calculating the difference in the proportions, along with an estimate of the standard error; this was calculated with the square root of the sum of the squared standard errors obtained for each group.

RESULTS

We have reported prevalence data and reasons for using or not using a sunbed primarily from the National Prevalence Study to give an unbiased England-wide estimate. Variations in use between cities, and responses specifically from sunbed users, are reported principally from the Six Cities Study to more accurately describe patterns of activity in urban areas with higher sunbed use. Full data from both studies are available on line.[8]

National Prevalence Study

Of the 3509 children aged 11-17 interviewed across Great Britain, 6.8% had used a sunbed. There was considerable variation, at 13.6% (95% confidence interval 9.7% to 17.5%) in Scotland, 10.6% (6.0% to 15.2%) in Wales, and 5.9% (5.0% to 6.7%) in England. Subsequent analyses are based on the 3101 children interviewed across England (855 in the pilot study, 2246 in the full study). Tables 1 and 2 show their characteristics, after we reweighted data to the age/sex/social grade and region profiles for England (leading to a slightly different weighted estimate of sunbed use for England).

Q1: "Have you ever used or are you considering using a sunbed?" (all respondents, weighted baseline = 3101)

Overall, 6.0% of children aged 11-17 in England had used a sunbed at least once; a further 14.9% said they might do so in the future (table 3).

Sunbed use was significantly higher in those aged 15-17 than those aged 11-14 (11.2% and 1.8%, respectively) and in girls than in boys (8.6% and 3.5%, respectively). Significantly more girls than boys also said that, although they had not used a sunbed, they might do in the future (17.5% and 12.5%, respectively).

There was also considerable variation in sunbed use across the social grades (fig 1). Use was significantly higher in children from the lower (D and E combined) than the higher (A, B, C1, and C2 combined) social grades (7.6% (5.7% to 9.5%) and 5.4% (4.5% to 6.3%), respectively) and was highest in those from social grade E (10.4% (6.8% to 14.1%)). There was also significant variation in sunbed use across the English regions (table 3), being higher in the "north" (11.0%) than in the "midlands" and "south" (4.2%); use was lowest in London (3.2%).

Q2: "For what reason have you not used a sunbed?" (weighted baseline=2882 who said they had not used a sunbed; respondents could select multiple options)

Table 4 shows the reasons given for not using a sunbed, grouped into five main categories. Half of all non-users were not interested in getting a suntan, and two out of five believed sunbeds to be a health risk. Less frequently, respondents cited practical reasons (13.5%),

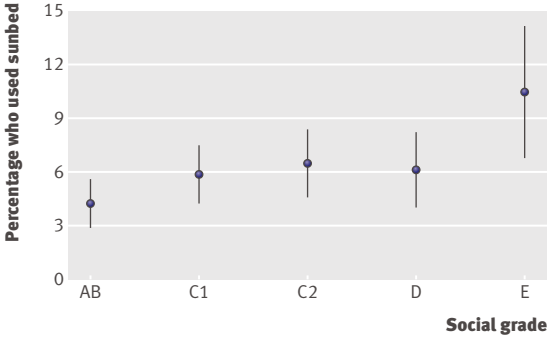

Fig 1 | National Prevalence Study: use of sunbeds by social class

including expense, lack of access, and not being allowed/advised not to (4.3%). Other reasons each accounted for <1% of responses.

The main reason for not using sunbeds differed between the sexes and age groups (table 5). For girls, "health risk" was more important than for boys (51.3% and 33.0%, respectively); while for boys "not interested/use other tan option" was more common than for girls (63.9% and 43.6%, respectively). Older children were significantly more likely to give "health risk" as a reason for not using a sunbed than those aged 11-14 (46.0% and 38.7%, respectively). By contrast, younger children were significantly more likely to respond "not being allowed/advised not to use" sunbeds than older children (6.3% and 1.6%, respectively). Reasons for not using sunbeds did not differ significantly by social grade or English region (data not shown).

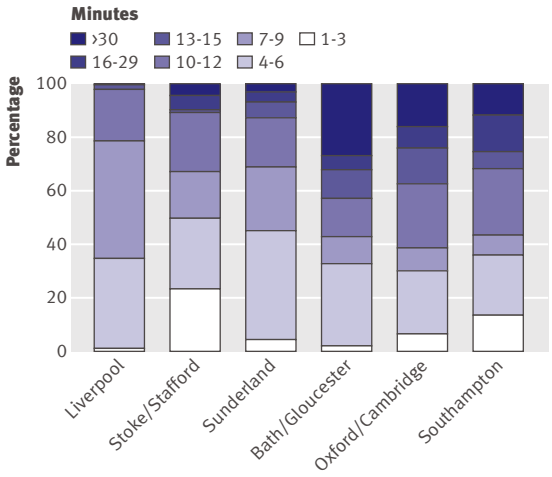

Fig 2 | Time spent on a sunbed per session by city in Six Cities Study

Table 3 | Use of sunbeds* nationally, by age, sex, region, and city. Figures are percentages (95% confidence intervals)

	Weighted No	I have used sunbeds	I have never used a sunbed but may do	I have never used a sunbed and would not want to
National Prevalence Study†				
Overall	3101	6.0 (5.1 to 6.8)	14.9 (13.7 to 16.2)	78.0 (76.6 to 79.5)
By age (years):				
11-14	1725	1.8 (1.2 to 2.4)	15.6 (13.9 to 17.3)	81.6 (79.7 to 83.4)
15-17	1376	11.2 (9.5 to 12.9)	14.1 (12.3 to 15.9)	73.5 (71.2 to 75.9)
By sex:				
Boys	1589	3.5 (2.6 to 4.4)	12.5 (10.8 to 14.1)	82.8 (80.9 to 84.6)
Girls	1512	8.6 (7.2 to 10.0)	17.5 (15.6 to 19.4)	73.1 (70.8 to 75.3)
By region:				
North overall	846	11.0 (8.9 to 13.1)	—	—
North	174	10.9 (6.3 to 15.6)	13.2 (8.2 to 18.3)	75.9 (69.5 to 82.2)
North west	368	14.1 (10.6 to 17.7)	12.2 (8.9 to 15.6)	73.9 (69.4 to 78.4)
Yorkshire and Humber	304	7.2 (4.3 to 10.1)	11.2 (7.6 to 14.7)	81.6 (77.2 to 85.9)
Midlands overall	575	4.2 (2.5 to 5.8)	—	—
East Midlands	215	3.7 (1.2 to 6.3)	19.1 (13.8 to 24.3)	75.8 (70.1 to 81.5)
West Midlands	360	4.4 (2.3 to 6.6)	16.7 (12.8 to 20.5)	75.6 (71.1 to 80.0)
South overall	1678	4.2 (3.3 to 5.2)	—	—
East Anglia	116	7.8 (2.9 to 12.6)	12.1 (6.1 to 18.0)	80.2 (72.9 to 87.4)
London	534	3.2 (1.7 to 4.7)	15.7 (12.6 to 18.8)	79.0 (75.6 to 82.5)
South east	701	4.6 (3.0 to 6.1)	16.7 (13.9 to 19.5)	77.9 (74.8 to 81.0)
South west	327	4.0 (1.9 to 6.1)	13.5 (9.8 to 17.2)	82.6 (78.5 to 86.7)
Six Cities Study				
High density of sunbeds‡:				
Liverpool	1034	20.0 (17.5 to 22.4)	14.7 (12.5 to 16.8)	64.7 (61.8 to 67.6)
Stoke/Stafford	1035	6.8 (5.2 to 8.3)	19.1 (16.7 to 21.5)	72.3 (69.6 to 75.0)
Sunderland	1035	18.0 (15.6 to 20.3)	19.2 (16.8 to 21.6)	62.4 (59.5 to 65.4)
Low density of sunbeds‡:				
Bath/Gloucester	1035	6.6 (5.1 to 8.1)	13.2 (11.1 to 15.2)	74.3 (71.6 to 77.0)
Oxford/Cambridge	1034	7.5 (5.9 to 9.1)	18.3 (15.9 to 20.6)	71.2 (68.4 to 74.0)
Southampton	1035	6.2 (4.7 to 7.7)	17.7 (15.4 to 20.0)	70.7 (67.9 to 73.5)

*Weighted numbers are rounded.
†33 respondents (after weighting) said they "did not know" in National Prevalence Study.
‡Cities defined according to high or low density of sunbed salons per population.

Six Cities Study

Table 6 shows characteristics of the 6209 children aged 11-17 interviewed and table 7 shows those of the 673 children who had used a sunbed.

Compared with the National Prevalence Study, sunbed use was higher overall (question 1) in the predominantly urban "Six Cities" population (10.8%, 10.1% to 11.6%; data not shown[8]). There was also wide variability in use between the cities, being significantly higher in Liverpool and Sunderland than the other four cities, both overall (table 3) and across both age groups and sexes (data not shown[8]). This was especially high in girls aged 15-17 in these cities (51.0% (44.6% to 57.4%) and 48.2% (41.3% to 55.1%), respectively; data not shown[8]).

There were significant differences across the cities in why children had not used sunbeds (question 2). Practical reasons deterred more children in both Bath/Gloucester (12.2%, 10.2% to 14.3%) and Southampton (11.2%, 9.2% to 13.2%) than in Liverpool (3.4%, 2.2% to 4.7%), Stoke/Stafford (5.9%, 4.4% to 7.4%), Sunderland (5.3%, 3.8% to 6.8%), or Oxford/Cambridge (6.6%, 5.0% to 8.1%); the most common reason given was expense; data not shown.[8]

Q3: "When was the last time you used a sunbed?" (weighted baseline=673 children who said they had used a sunbed for Q3-7)

Significantly more children in Liverpool and Sunderland had used sunbeds in the past month than in the other four cities (table 8), as had those aged 15-17 (48.7%, 44.4% to 53.0%) compared with younger children (38.3%, 30.6% to 46.0%). In contrast, boys were more likely than girls to have last used a sunbed more than a year ago (16.5% (11.7% to 21.3%) and 8.2% (5.6% to 10.7%), respectively). There were no significant differences across the social grades (data not shown). Of note, three respondents aged 11-14 said

Table 4 | National Prevalence Study: reasons children had not used sunbeds* (weighted baseline=2882)

	No	% (95% CI)
Not interested/use other tan option†:		
Overall	1565	54.3 (52.5 to 56.1)
Not interested in getting tan	1482	51.4 (49.6 to 53.2)
No need (no detail)	20	0.7 (0.4 to 1.0)
No need because already dark skinned/already have tan	14	0.5 (0.2 to 0.7)
Not interested	15	0.5 (0.3 to 0.8)
Health risk†	1202	41.7 (39.9 to 43.5)
Practical reason†:		
Overall	390	13.5 (12.3 to 14.8)
Expense	215	7.5 (6.5 to 8.4)
No access to a sunbed/no salons near by	168	5.8 (5.0 to 6.7)
Not allowed/advised not to†:		
Overall	123	4.3 (3.5 to 5.0)
Too young	62	2.2 (1.6 to 2.7)
Not allowed	38	1.3 (0.9 to 1.7)
Salon staff advised against use	23	0.8 (0.5 to 1.1)
Other‡	179	6.2 (5.3 to 7.1)

*Weighted numbers are rounded; respondents could select multiple options.
†Options in each group selected by less than 0.5% are not shown.
‡6.2% chose other reasons but these each accounted for fewer than 1% of responses.

they last used a sunbed more than five years ago, when aged between 6 and 9.

Q4: "How often do you use a sunbed?"

Overall, 38.4% (34.7% to 42.1%) used a sunbed at least weekly, although this was largely driven by high use in Sunderland and Liverpool. In addition, children aged 15-17 were more likely than younger children to use sunbeds weekly; more boys than girls used a sunbed once a year or less (table 9).

Q5: "How long do you usually spend on a sunbed per session?"

The mean time on a sunbed was 10 minutes a session (median 9), but 16.2% of children spent more than 12 minutes a session. There were significant differences between the cities (figs 2 and 3); children in cities with a high density of sunbeds spent less time per session on a sunbed than those in low density cities.

Q6: "How old were you the first time you used a sunbed?"

The mean age at first sunbed use was 14 for both sexes and all cities except Sunderland, where it was 15. Of note, 7.0% (5.0% to 8.9%) of sunbed users had first done so before the age of 12.

Q7: "Where have you used a sunbed?" (Respondents could select multiple options)

Nearly a quarter of children (23.0%, 19.8% to 26.1%) had used a sunbed at home, but most had used a sunbed in an outlet with staff supervision (57.9%, 54.1% to 61.6%). Of those children using tanning equipment in an outlet, however, 24.7% (21.0% to 28.4%) said they were unsupervised.

There were significant differences in location of sunbeds used by sex and age (table 10). Boys were more likely than girls to use a sunbed at home (31.2% and 18.8%, respectively); they were also more likely to

Table 5 | National Prevalence Study: reasons children had not used sunbeds* by age and sex (weighted baseline=2882)

	Age (years)				Sex			
	11-14		15-17		Boys		Girls	
	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)
Not interested/use other tan option	895	53.4 (51.0 to 55.8)	672	55.8 (53.0 to 58.6)	966	63.9 (61.5 to 66.3)	597	43.6 (41.0 to 46.2)
Health risk	648	38.7 (36.3 to 41.0)	554	46.0 (43.2 to 48.8)	499	33.0 (30.6 to 35.4)	703	51.3 (48.7 to 54.0)
Practical reason	225	13.4 (11.8 to 15.1)	163	13.5 (11.6 to 15.5)	197	13.0 (11.3 to 14.7)	192	14.0 (12.2 to 15.9)
Not allowed/advised not to	106	6.3 (5.2 to 7.5)	19	1.6 (0.9 to 2.3)	44	2.9 (2.1 to 3.8)	79	5.8 (4.5 to 7.0)
Other	127	7.6 (6.3 to 8.8)	50	4.1 (3.0 to 5.3)	102	6.7 (5.5 to 8.0)	78	5.7 (4.5 to 6.9)

*Weighted numbers are rounded; respondents could select multiple options.

Table 6 | Six Cities Study: unweighted and weighted total sample numbers* and percentages by sex, age, and social grade

	Age group (years)			Boys by age			Girls by age			Social grade				
	11-14	15-17	Total	11-14	15-17	Total	11-14	15-17	Total	AB	C1	C2	DE	Total
Total (unweighted)	3132	3077	6209	1551	1395	2946	1581	1682	3263	1046	2017	1515	1631	6209
Total (weighted)	3549	2660	6209	1775	1330	3105	1775	1330	3105	1071	1985	1520	1634	6209
City (%):														
Liverpool	55.4	44.6	100.0	27.1	21.7	48.8	28.3	22.9	51.2	10.3	31.3	25.2	33.3	100.0
Stoke/Stafford	59.0	41.0	100.0	30.2	21.2	51.3	28.9	19.8	48.7	9.5	35.7	25.2	29.7	100.0
Sunderland	60.4	39.6	100.0	31.6	20.3	51.9	28.8	19.3	48.1	7.1	34.9	23.2	34.8	100.0
Bath/Gloucester	56.1	43.9	100.0	28.1	20.9	49.0	28.0	22.9	51.0	26.2	33.5	21.1	19.2	100.0
Oxford/Cambridge	52.9	47.1	100.0	25.2	23.2	48.4	27.7	23.9	51.6	28.3	27.1	26.0	18.6	100.0
Southampton	59.1	40.9	100.0	29.3	21.2	50.5	29.8	19.7	49.5	22.1	29.4	26.2	22.3	100.0

*Weighted numbers are rounded and thus marginal totals might not add up. Analyses are based on weighted sample.

Table 7 | Six Cities Study: weighted numbers* of children who had used sunbeds

	Age group (years)			Boys by age			Girls by age			Social grade				
City	11-14	15-17	Total	11-14	15-17	Total	11-14	15-17	Total	AB	C1	C2	DE	Total
Total	153	520	673	57	170	227	96	350	446	81	208	171	213	673
City:														
Liverpool	40	166	207	13	46	59	27	121	148	17	60	53	78	207
Stoke /Staff	18	52	70	8	17	25	10	36	45	3	22	23	23	70
Sunderland	40	146	186	14	50	64	26	96	122	11	67	45	64	186
Bath/Gloucester	11	58	69	7	24	31	4	34	38	14	23	18	14	69
Oxford/Cambridge	23	55	78	8	21	29	15	34	49	22	16	22	18	78
Southampton	21	43	64	7	13	20	14	31	45	16	21	11	17	64

*Weighted numbers are rounded and thus marginal totals might not add up.

Table 8 | Six Cities Study: last time respondents used sunbed by city* (weighted baseline = 673)

		≤1 month		1-6 months		6-12 months		>12 months	
City	Overall No	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)
Liverpool	207	129	62.6 (56.0 to 69.2)	42	20.3 (14.8 to 25.7)	15	7.2 (3.7 to 10.7)	15	7.3 (3.8 to 10.9)
Stoke/Stafford	70	25	36.5 (25.2 to 47.7)	20	28.7 (18.1 to 39.3)	12	17.1 (8.2 to 25.9)	11	16.0 (7.4 to 24.6)
Sunderland	186	102	55.0 (47.8 to 62.1)	50	27.0 (20.7 to 33.4)	20	10.9 (6.4 to 15.3)	9	4.9 (1.8 to 8.0)
Bath/Gloucester	69	21	30.5 (19.6 to 41.4)	16	22.6 (12.7 to 32.5)	13	19.6 (10.2 to 29.0)	16	23.9 (13.8 to 34.0)
Oxford/Cambridge	78	16	21.1 (12.0 to 30.2)	23	29.6 (19.5 to 39.8)	26	33.0 (22.5 to 43.5)	9	11.7 (4.5 to 18.8)
Southampton	64	17	26.9 (16.0 to 37.7)	18	27.8 (16.9 to 38.8)	14	21.4 (11.4 to 31.5)	13	20.5 (10.6 to 30.3)

*Weighted numbers are rounded and thus marginal totals might not add up; 19 interviewees (after weighting) said they did not know how long it had been since they last used sunbed.

use a sunbed at a gym/leisure centre (16.1% (11.3% to 20.8%) and 9.0% (6.3% to 11.7), respectively), whereas girls were more likely to use a tanning/beauty salon (73.6% (69.5% to 77.6%) and 49.5% (43.0% to 56.0%), respectively). There was also substantial variability between cities in site of sunbed use; in Liverpool, 94.0% of those aged 11-17 had used a sunbed in an "outlet," significantly more than in any other city and with lower use in the home (table 11).

Older children were more likely to have used a sunbed in an outlet without supervision (21.8%, 18.2% to 25.3%) than younger children (9.4%, 4.8% to 14.1%). Across the cities, unsupervised sunbed use by children in an outlet varied between 16.2% and 25.9%.

Q8: "*When your sunbed use was supervised, did a person show you how to use a sunbed, and did they give you information about the harm that sunbeds can cause?*" *(Six Cities study weighted baseline=213 interviewees between October and November 2008 only who had used a sunbed in a supervised setting)*

Of those asked this question in the October-November 2008 interviews, 19.9% (14.5% to 25.2%) said they were not shown how to use the sunbed or given information on the harm sunbeds can cause (table 12).

DISCUSSION

Around 6% of young people aged 11-17 in England have used a sunbed. Applied to projected 2008

Table 9 | Six Cities Study: frequency of sunbed use by city, age, and sex* (weighted baseline=673)

		At least once/week		At least once/month		Every 2-6 months		Once/year or less	
	Overall No	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)
Liverpool	207	88	42.6 (35.8 to 39.3)	56	27.2 (21.1 to 33.3)	23	11.3 (6.9 to 15.6)	33	16.0 (11.0 to 21.0)
Stoke/Stafford	70	23	32.4 (21.5 to 43.4)	8	11.8 (4.3 to 19.4)	10	13.9 (5.8 to 22.0)	27	39.0 (27.5 to 50.4)
Sunderland	186	115	61.6 (54.6 to 68.6)	33	17.5 (12.0 to 22.9)	16	8.4 (4.4 to 12.4)	18	9.4 (5.2 to 13.6)
Bath/Gloucester	69	14	19.9 (10.4 to 29.3)	7	10.2 (3.0 to 17.3)	11	16.8 (7.9 to 25.6)	34	49.8 (38.0 to 61.6)
Oxford/Cambridge	78	10	12.3 (5.0 to 19.6)	9	11.0 (4.0 to 18.0)	27	34.7 (24.1 to 45.3)	27	35.0 (24.4 to 45.6)
Southampton	64	10	15.4 (6.6 to 24.3)	10	15.9 (7.0 to 24.9)	11	17.8 (8.5 to 27.2)	30	47.4 (35.2 to 59.6)
Age group (years):									
11-14	153	33	21.9 (15.4 to 28.5)	25	16.2 (10.3 to 22.0)	37	24.1 (17.3 to 30.9)	47	30.8 (23.4 to 28.1)
15-17	520	225	43.2 (39.0 to 47.5)	98	18.8 (15.5 to 22.2)	62	11.9 (9.1 to 14.6)	122	23.5 (19.9 to 27.2)
Sex:									
Boys	227	81	35.6 (29.3 to 41.8)	39	17.2 (12.3 to 22.1)	25	10.8 (6.8 to 14.9)	74	32.7 (26.6 to 38.8)
Girls	446	178	39.8 (35.3 to 44.4)	84	18.8 (15.1 to 22.4)	74	16.6 (13.1 to 20.0)	95	21.4 (17.5 to 25.2)

*Weighted numbers are rounded and thus marginal totals might not add up; 24 respondents (after weighting) said they "did not know" how often they used sunbed.

Table 10 | Six Cities Study: places where children use sunbeds overall, by age, and sex* (weighted baseline=673)

	Overall	At home/friend's home		At tanning/beauty salon with staff to help		At tanning/beauty salon without staff to help		At gym/leisure centre with staff to help		At gym/leisure centre without staff to help	
	No	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)	No	% (95% CI)
Age group (years):											
11-14	152	63	41.0 (33.2 to 48.8)	59	38.3 (30.6 to 46.0)	9	5.7 (2.0 to 9.4)	7	4.7 (1.3 to 8.0)	6	3.7 (0.7 to 6.7)
15-17	633	92	17.7 (14.4 to 20.9)	292	56.2 (51.9 to 60.5)	81	15.5 (12.4 to 18.7)	31	6.0 (4.0 to 8.1)	32	6.2 (4.2 to 8.3)
Sex:											
Boys	235	71	31.2 (25.2 to 37.3)	92	40.5 (34.1 to 46.9)	20	9.0 (5.3 to 12.7)	16	7.0 (3.7 to 10.3)	21	9.1 (5.4 to 12.8)
Girls	550	84	18.8 (15.1 to 22.4)	259	58.1 (53.5 to 62.6)	69	15.5 (12.1 to 18.9)	23	5.1 (3.1 to 7.1)	17	3.9 (2.1 to 5.7)

*Weighted numbers are rounded; respondents could select multiple options; 43 respondents (after weighting) said they "did not know" whether they used sunbed in place with or without supervision or at home.

populations from the Government Actuary Department,[15] this equates to around a quarter of a million children in England potentially at increased risk of developing malignant melanoma. Worryingly, 15% of children who had not used a sunbed said they might do so in the future.

Sunbed use was not uniform, being more common in older than in younger children, though 7% of children in the Six Cities Study said they first used a sunbed while at primary school; the proportion was even higher across the whole of England at 16% (data not shown). Sunbed use was consistently higher in girls than in boys and in those from lower rather than higher social grades. There was also geographical variation; sunbed use by 11-17 year olds was higher in Scotland and Wales than in England; and across England, use was more common in children from the north than the rest of the country. Use was particularly high in Liverpool and Sunderland, where around half of girls aged 15-17 used sunbeds.[8 16]

Supervision of children using sunbeds was inadequate. In the Six Cities Study more than one in five said they had used a sunbed at home and almost a quarter of children using sunbeds in a tanning/beauty salon or gym/leisure centre said they had not been supervised. Where "supervision" was provided it was unsatisfactory, with only 37% of children saying they were informed of the risks; nationally the figure was even lower (11%).[8 16]

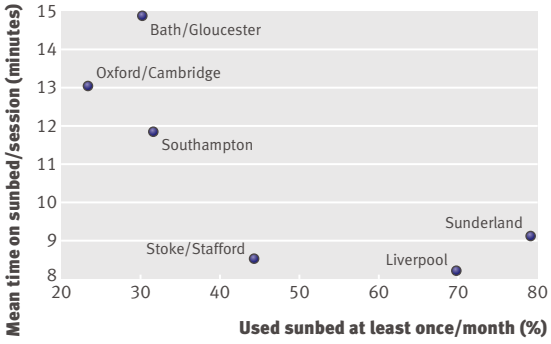

Fig 3 | Time spent on a sunbed session *v* frequency of use in Six Cities Study

Strengths and limitations of study

The strength of both studies lies in their size and robust design. Although differences in data collection precluded a joint analysis, the studies were large enough to produce reliable estimates of the English (within 1%), regional (within 5%), and city (within 3%) prevalence of sunbed use by children. Data were collected in a robust manner in face to face interviews, with revalidation of at least 10% of participants to ensure the correct classification and answers to key questions. Bias in selection of the study populations is a potential weakness, but the random location sampling technique largely overcomes the usual flaws of quota sampling. We used the normal approximation to the binomial

Table 11 | Six Cities Study: places where children use sunbeds by city* (weighted baseline = 673)

	Overall No	At home/friend's home		At tanning/beauty salon/ gym/leisure centre with staff to help		At tanning/beauty salon/ gym/leisure centre without staff to help	
		No	% (95% CI)	No	% (95% CI)	No	% (95% CI)
Liverpool	207	21	10.0 (5.9 to 14.1)	153	74.5 (68.5 to 80.4)	40	19.5 (14.1 to 25.0)
Stoke/Stafford	70	21	30.3 (19.5 to 41.1)	38	54.6 (43.0 to 66.3)	12	16.2 (7.6 to 24.9)
Sunderland	186	59	31.6 (24.9 to 38.2)	106	56.9 (49.8 to 64.0)	30	16.3 (11.0 to 21.6)
Bath/Gloucester	69	19	28.0 (17.3 to 38.6)	25	36.3 (24.9 to 47.7)	16	23.6 (13.5 to 33.6)
Oxford/Cambridge	78	18	23.2 (13.8 to 32.6)	39	49.9 (38.8 to 61.1)	13	16.4 (8.1 to 24.6)
Southampton	64	17	26.1 (15.4 to 36.9)	27	43.3 (31.2 to 55.4)	17	25.9 (15.2 to 36.6)

*Weighted numbers are rounded; respondents could select multiple options; 43 respondents (after weighting) said they "did not know" whether they used sunbed in place with or without supervision or at home.

Table 12 | Six Cities Study: "level" of supervision for those children who used sunbed in tanning/beauty salon or gym/leisure centre when they said they had been supervised (weighted baseline=213)*

	No	% (95% CI)
Shown how to use and given information	78	36.6 (30.1 to 43.1)
Shown how to use but not given information	84	39.3 (32.7 to 45.8)
Not shown how to use but given information	9	4.2 (1.5 to 7.0)
Not shown or given any information	42	19.9 (14.5 to 25.2)

*Only children who said they had used sunbed in supervised setting in either tanning/beauty salon or gym/leisure centre who were interviewed in full study (October-November 2008) were included in this analysis; question not asked in pilot study.

distribution for the proportions, rather than the *t* test because of the relatively large numbers in the groups. The design effect was assumed to be 1 in both studies because of the relatively small numbers of interviews undertaken each week; making significant clustering effects unlikely.

Comparison with other studies

Previous studies of sunbed use in UK children have been small or less geographically diverse,[17-19] but it has previously been reported as being high in teenagers from Merseyside.[20] International studies report similar effects of sex and age on sunbed use by children.[21] Reports from parts of Europe[22] and the United States[23-25] suggest higher rates of use than in England, with 30% of Swedish and 24% of American adolescents using indoor tanning facilities, often frequently.

Conclusions and policy implications

Our study provides an accurate picture of sunbed use by children in England and highlights a considerable public health issue. Many sunbed salons are in fitness/leisure centres or tanning/beauty salons, spuriously associating them with beauty and health, rather than premature visible ageing effects and cancer.

With sunbeds often located at home, and with no national registration scheme for commercial outlets, it is unclear how many sunbeds there are in England or the rest of the UK. Nevertheless, the number of commercial outlets seems to be increasing,[26] with many in locations such as video rental shops or nail bars that might be unstaffed; in a previous study, 45% of the devices used by children in the West Midlands were coin operated.[19] Sunbed use was highest in Liverpool and Sunderland, and the density of salons is higher in the urban areas of northern England than in the south,[6 12] with a strong correlation between the number of outlets and level of deprivation.

Legislation to control sunbeds is in place in Belgium, Finland, France, Norway, Portugal, Spain, Sweden, US, Australia, New Zealand, and Scotland and is planned for Wales. There is a need for legislation across the UK to mandate licensing and inspection of outlets, outlaw sunbed use by those aged under 18, ban coin operated or unstaffed outlets, and require licensed operators to provide information to adult users on the health risks of sunbeds so they can make informed decisions.

WHAT IS ALREADY KNOWN ON THIS TOPIC

The incidence of malignant melanoma is increasing and exposure to ultraviolet radiation, including that from tanning beds and lamps, is the single most important avoidable cause

Earlier small studies have shown that teenagers in the UK use sunbeds, but the prevalence and reasons for their use have not been quantified nationally

WHAT THIS STUDY ADDS

Across England 6% of teenagers have used a sunbed, but this figure rises to around 50% in girls aged 15-17 in Liverpool and Sunderland

Nearly a quarter of children said their sunbed use had been unsupervised in a tanning/beauty salon or gym/leisure centre

We thank Ana Gomez and Clare Flach for analytical support; Caroline Cerny and Katy Scammell for helping to organise, coordinate, and commission the surveys; and Ed Yong and Lucy Boyd for assistance with the references.

Contributors: CST was involved in the analysis, design, and writing of the study and is guarantor. SW and SH were involved in the design and writing of the study. MW was involved in the analysis of the results. CJT was involved in the writing up of the paper. The authors had full access to the study and accept responsibility for the accuracy of the analyses.

Funding: Cancer Research UK was commissioned by the National Cancer Action Team, supported by the Department of Health to undertake this research. The Department of Health funded the pilot studies; the National Cancer Action Team funded the full studies.

Competing interests: None declared.

Ethical approval: Not required.

Data sharing: No additional data available.

1 Cancer Research UK. Skin cancer statistics—key facts. 2009. http://info.cancerresearchuk.org/cancerstats/types/skin/.
2 Cancer Research UK. CancerStats report—malignant melanoma UK. 2006. http://publications.cancerresearchuk.org/WebRoot/crukstoredb/CRUK_PDFs/CSMM06.pdf.
3 Ghissassi FE, Bann R, Straif K, Grosse Y, Secretan B, Bouvard V, et al. Special report: policy A, review of human carcinogens—part D: radiation. *Lancet Oncol* 2009;10:751-2.
4 IARC Working Group. The association of use of sunbeds with cutaneous malignant melanoma and other skin cancers: a systematic review. *Int J Cancer* 2006;120:1116-22.
5 Diffey BL. A quantitative estimate of melanoma mortality from ultraviolet A sunbed use in the UK. *Br J Dermatol* 2003;149:578-81.
6 Committee on Medical Aspects of Radiation in the Environment (COMARE). Thirteenth report. The health effects and risks arising from the exposure to UV radiation from artificial tanning devices. Health Protection Agency, 2009.
7 Department of Health. Cancer reform strategy. DH, 2007.
8 Cancer Research UK. Cancer Research UK study of sunbed use in 11-17 year olds in England. 2009. http://info.cancerresearchuk.org/cancerstats/types/skin/sunbeds/index.htm.
9 British Market Research Bureau (BRMB). BMRB omnibus. 2010. www.bmrb-omnibus.co.uk/.
10 Crouch S, Housden M. Marketing research for managers. 3rd ed. Butterworth-Heinemann, 2003.
11 ACORN. Welcome to the new ACORN. 2003. www.caci.co.uk/acorn/.
12 Walsh A, Harris S, Bowtell N, Verne J. Sunbed outlets and area deprivation in the UK. South West Public Health Observatory, 2009. www.swpho.nhs.uk/skincancerhub/resource/item.aspx?RID=48408.
13 Sharot T. Weighting survey results. *J Mark Res Soc* 1986;28:269-84.
14 National Readership Survey. Homepage. 2010. www.nrs.co.uk/.
15 Government Actuary Department. Population projections by the Office for National Statistics. 2006. www.gad.gov.uk/Demography%20Data/Population/2006/england/weng06singyear.xls.

16 Thomson CS, Twelves C. Legislation is needed to stop children using sunbeds [letter]. *BMJ* 2009;339:b4643.
17 Diffey BL. Use of UV-A sunbeds for cosmetic tanning. *Br J Dermatol* 1986;115:67-76.
18 Hamlet N, Kennedy K. Reconnaissance study of sunbed use by primary school children in Lanarkshire. *J Public Health (Oxf)* 2004;26:31-3.
19 Suchak R, Pinto A, Devlin J, Limb P, Cerio R. Exposure to artificial tanning devices by young teenagers at a science college in Dudley, West Midlands. *Br J Dermatol* 2008;159(suppl 1):129S.
20 Mackay H, Lowe D, Edwards D, and Rogers SN. A survey of 14 to 16 year olds as to their attitude toward and use of sunbeds. *Health Educ J* 2007;66:141-52.
21 Lazovich D, Forster J. Indoor tanning by adolescents: prevalence, practices and policies. *Eur J Cancer* 2005;41:20-7.
22 Boldeman C, Branstrom R, Dal H, Kristjansson S, Rodvall Y, Jansson B, Ullen H. Tanning habits and sunburn in a Swedish population age 13-50 years. *Eur J Cancer* 2001;37:2441-8.
23 Demko CA, Borawski EA, Debanne SM, Cooper KD, Stange KC. Use of indoor tanning facilities by white adolescents in the United States. *Arch Pediatr Adolesc Med* 2003;157:854-60.
24 Geller AC, Colditz G, Oliveria S, Emmons K, Jorgensen C, Aweh GN, et al. Use of sunscreen, sunburning rates, and tanning bed use among more than 10 000 US children and adolescents. *Pediatrics* 2002;109:1009-14.
25 O'Riordan DL, Field AE, Geller AC, Brooks DR, Aweh G, Colditz GA, et al. Frequent tanning bed use, weight concerns, and other health risk behaviors in adolescent females (United States). *Cancer Causes Control* 2006;17:679-86.
26 Oliver H, Ferguson J, Moseley H. Quantitative risk assessment of sunbeds: impact of new high power lamps. *Br J Dermatol* 2007;157:350-6.

Accepted: 3 January 2010