

Supplementary Online Content

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eMethods. Supplementary Methods

eTable 1. Study Characteristics

eTable 2. Results of Sensitivity Analyses

eFigure. Results of Meta-Regressions of Past-Year Exposure Prevalence and Year of Data Collection

eReferences

eMethods

SUPPLEMENTARY METHODS

DATA SOURCES AND LITERATURE SEARCH

Searches of electronic databases were performed using the following search text.

Pubmed: *"indoor tanning" or "sunbed*" or "tanning bed*" or "tanning booth*" or "tanning salon*" or "solarium*" or "solaria" or "sunlamp*" or "artificial tanning" or "UV tanning" or "non-solar ultraviolet radiation" or "non-solar UV radiation" or "nonsolar ultraviolet radiation" or "nonsolar UV radiation."*

Scopus: *TITLE-ABS-KEY("indoor tanning" OR "sunbed*" OR "tanning bed*" OR "tanning booth*" OR "tanning salon*" OR "solarium*" OR "solaria" OR "sunlamp*" OR "artificial tanning" OR "UV tanning" OR "non-solar ultraviolet radiation" OR "non-solar UV radiation" OR "nonsolar ultraviolet radiation" OR "nonsolar UV radiation").*

Web of Science: *TS=("indoor tanning" OR "sunbed*" OR "tanning bed*" OR "tanning booth*" OR "tanning salon*" OR "solarium*" OR "solaria" or "sunlamp*" OR "artificial tanning" OR "UV tanning" OR "non-solar ultraviolet radiation" OR "non-solar UV radiation" OR "nonsolar ultraviolet radiation" OR "nonsolar UV radiation").*

Additionally, we reviewed the articles identified in our database search and relevant review articles to locate published articles missed by the database searches and to locate publicly available data not yet published in the scientific literature. Publicly available data were located by noting named surveys used in the published literature. We searched online for nine named surveys (American Cancer Society Sun Survey, Growing Up Today Survey, National Longitudinal Study of Adolescent Health, National Health Interview Survey Cancer Control Supplement, Youth Risk Behavior Survey, Health Information National Trends Survey, Sunbed-Use: Needs for Action Study, New South Wales Population Health Survey, and New South Wales School Students Health Behaviors Survey) to identify recent iterations of these surveys whose data on indoor tanning prevalence were available publicly but not published in the scientific literature.

STUDY SELECTION

In one case, two studies using the same original data were both included. Choi et al¹ and the United States (US) National Cancer Institute (NCI)² independently reported on the US Health Information National Trends Survey in 2005. The data available from the NCI² reported overall population prevalence, while Choi et al¹ reported gender specific prevalence. These two reports were included in separate meta-analyses (Choi et al¹ when we summarized prevalence according to gender and the NCI² when we summarized prevalence overall) and so were both kept in our review.

DATA EXTRACTION

Because complete data was not consistently available for all studies, and in order to include as many studies as possible, we made several content-specific decisions that applied to individual studies. These decisions were felt to be the most reasonable course of action after detailed review of manuscripts and discussion by two authors (EL and MRW). The following decisions were made during data abstraction:

- Nielsen et al³ stated that "the overall use of sunbeds" was "approximately 50%." We used 50% as the ever exposure prevalence estimate.

- For one publicly available record⁴, the number of participants was not available. We obtained this through electronic correspondence with the US National Cancer Institute.
- Koster et al⁵ presented prevalences for four distinct data points in an adolescent population but only the total number of adolescent participants was available. We divided that total number of participants by four in order to estimate the number of participants for each data point.
- Savona et al⁶ presented a figure showing the prevalence of indoor tanning as a bar graph without any numbers reported. Two reviewers independently visually estimated the prevalence. In one data point out of four, the estimates differed by 2% and the mean was used as the final estimate.
- Zhang et al⁷ asked participants if they had ever been exposed to indoor tanning during certain periods of their lives (high school through college and age 25 through 35). We used the higher of the two prevalences reported (that for age 25 through 35) in ever prevalence analyses.
- Veierod et al⁸ asked participants aged 30 to 50 about ever exposure to indoor tanning between the ages of 10 and 39, which we used in ever prevalence analyses.
- Unverricht et al⁹ asked participants about whether they were exposed to indoor tanning during different seasons in the past year. We used the winter season's estimate, which was the highest prevalence estimate, as the best estimate of exposure in the past year.
- For studies with prevalence results and participant numbers available for females and males separately or for a range of age groups separately¹⁰⁻¹⁸, we calculated the prevalence for the overall population ourselves using the gender or age group specific prevalences and numbers of participants in each group. In one study¹⁹, the prevalences for males and females were calculated using the number of participants in each group and the percentages of females and males in participants reporting exposure.

DATA SYNTHESIS AND STATISTICAL METHODS

Primary analyses

When separating studies into categories for analysis (adults, university students, and children), we prioritized separating study populations into adult and child categories over retaining any age-adjustment or weighting used. Age-adjusted data was available and used for 10 out of 84 records.

We calculated the standard error for each study assuming probability to be a Bernoulli random variable, p , with variance= $p(1-p)$ in all but three records. In three instances of extremely low prevalences (0% and 3%,²⁰ 0.3%,²¹ all in males) and in one instance of very low prevalence with a small number of participants (7.9% in 38 males)²² this calculation yielded negative lower confidence intervals. Because negative prevalences are impossible, we used an exact confidence interval calculation as the input into the analyses for these four prevalence data points.

Sensitivity analyses

In the first sensitivity analysis, six studies were included that did not report exposure measures that specifically fit our 'ever exposure' nor 'past year exposure' definitions. A study that reported "use"²³ was included in an ever exposure sensitivity analysis. Studies that reported "regular" use,²⁴ use at least once per year,^{25,26} use in the past six months,^{27,28} and use at least once per month,⁹ were included in the past year exposure sensitivity analyses.

In the second sensitivity analysis, records of specific occupational groups not representative of the general population were included: pilots and flight attendants,¹³ indoor office workers,²⁹ outdoor workers,⁹ and healthcare workers.^{7,17,30}

In the third sensitivity analysis, seven studies^{5,12,25,31-34} that reported combined results of teenagers (> 15 years old or > 16 years old) and adults that could not be split into child and adult

subgroups were excluded from the adult category. One study³⁵ reported results from a population of university students and high school students and was excluded from the university students category.

In the fourth sensitivity analysis, we excluded studies of potentially lower methodologic quality. These studies had unclear sampling methods, used convenience sampling, or had a sample size less than 500. Two studies^{36,37} had unclear sampling and six studies^{6,32,33,38-40} were specifically reported as convenience samples. We also considered analyses of parents or caregivers whose children were enrolled in a study or children whose parents were enrolled in a study,^{36,41-44} participants recruited in healthcare settings,^{12,22,31,45} pilot studies,^{46,47} and school based studies that did not sample more than two schools^{21,47-50} as convenience samples. Two studies not excluded for the sampling reasons above were excluded for sample size less than 500.^{5,10} This sensitivity analysis was not performed in the university student category because the records in this category almost all contained fewer than 500 participants.

eTable 1: Study characteristics

Reference	Year published	Year(s) of data collection ^a	Participants in study (N)	% female	Population description	Ever prevalence			Past-year prevalence		
						Males	Females	Overall	Males	Females	Overall
USA											
Bagdasarov ⁵¹	2008	2005	745	--	Undergraduates <25 years old and not dark skinned			95.0%			
Baker ⁵²	2010	2008-2009	227	100%	Undergraduates 18-30 years old		69.2%				
Bandi ⁴²	2010	1998	1187	--	Parents of adolescents in the American Cancer Society Sun Survey I ^b						8.6%
		2004	1931	76%	Parents of adolescents in the American Cancer Society Sun Survey II ^b				5.3%	14.8%	12.8%
Banerjee ⁵³	2012	Pre-2012	551	--	Undergraduates <25 years old			39.6%			
Banks ⁴⁵	1992	1989	96	42%	16-19 year old patients at a general pediatric clinic ^b	16.1%	32.5%	22.9%			
Basch ⁵⁴	2012	2009	139	58%	Undergraduates 18-25 years old			60.4%			
Bolek-Berquist ³⁸	2009	2004	184	53%	18-40 year olds ^b						34.8%
Brooks ³⁹	2006	2004	448	58%	18-30 year olds ^b						33.0%
CDC ^c & NCI ^d ⁵⁵	2012	2010	25233	--	≥18 year olds in the National Health Interview Survey				2.2%	8.9%	5.6%
Choi ¹	2010	2005	2869	--	White 18-64 year olds in the Health Information National Trends Survey				6.3%	18.1%	
					Parents of 9-16 year olds at a general pediatric clinic					49.5%	
Cohen ⁵⁶	2013	2010	301	93%	9-16 year olds at a general pediatric clinic			4.3%			
			301	53%	11-18 year olds in the American Cancer Society Sun Survey I						10.1%
Cokkinides ⁵⁷	2009	1998	1196	--	11-18 year olds in the American Cancer Society Sun Survey II						11.1%
		2004	1613	--	Undergraduates 18-23 years old				15.9%	56.8%	35.0%
Danoff-Burg ⁵⁸	2006	2003	164	50%	White 13-19 year olds in the National Longitudinal Study of Adolescent Health Wave II	11.2%	36.8%	24.1%			
Demko ⁵⁹	2003	1996	6903	51%	University students	58.3%	99.3%	88.2%	52%	94%	83%
Dennis ¹⁵	2009	Pre-2009	162	73%	College students <35 years old						7.3%
Fogel ⁶⁰	2012	2011	576	52%	12-18 year olds in the Growing Up Today Study (children of the participants of the Nurses Health Study II) ^b				2.4%	14.4%	9.5%
Geller ⁴⁴	2002	1999	10079	59%	College students 18-25 years old				11%	22%	17%
Gillen ^e ²⁶	2012	Pre-2012	277	53%	High school students in the Youth Risk Behavior Survey				6.7%	25.4%	15.6%
Guy ⁶¹	2011	2009	14590	50%	Adults in the National Health Interview Survey				10.7%	16.1%	13.4%
Heckman ¹¹	2008	2005	29394	52%	Fair-skinned university students	46.5%	80.0%	68.7%	21.3%	48.5%	39.3%
Hillhouse ¹⁶	1999	Pre-1999	254	66%	University students		55.6%				
Hillhouse ⁶²	2005	Pre-2005	126	100%	College students			53.7%			
Hillhouse ⁶³	2012	2008-2009	296	--	Parents of adolescents in the CITY100 (Controlling Indoor Tanning in Youth) study ^b			23.9%			
Hoerster ⁴¹	2007	2005	5274	78%	14-17 year olds in the CITY100 (Controlling Indoor Tanning in Youth) study ^b				3.5%	18.1%	11.2%
		2005	5274	53%	Undergraduate and graduate students			61.0%			47.0%
Knight ⁶⁴	2002	1999	489	70%	14-17 year olds	12.0%	41.5%	30.3%			
Lazovich ⁶⁵	2004	2000	1273	62%	≥18 year olds	30.2%	44.9%	38.0%			
Lazovich ⁶⁶	2005	2002	802	55%	Unknown ^b			74.0%			
Lazovich ⁴⁶	2008	Pre-2008	24	83%	Junior high and high school students 12-18 years old						18.0%
Lucci ^e ²⁷	2001	1999-2000	210	44%	High school students ^b						12.2%
Ma ⁴⁷	2007	Pre-2007	369	--	Whites >15 years old ^{b†}			34.0%			
Mawn ³²	1993	Pre-1993	477	63%	High school students	7.4%	18.5%	13.3%			
Mermelstein ⁶⁷	1992	Pre-1992	1703	53%							

Reference	Year published	Year(s) of data collection ^a	Participants in study (N)	% female	Population	Ever prevalence			Past-year prevalence		
						Males	Females	Overall	Males	Females	Overall
MMWR ^{g 68}	2012	2010-2011	15425	48%	Adolescents in the Youth Risk Behavior Survey				6.2%	20.9%	13.3%
Moore ²²	2003	2002	106	64%	>18 year old patients at a primary care clinic ^b	7.9%	25.0%	19.0%			
Mosher ⁶⁹	2010	Pre-2010	421	68%	College students			56.3%	24.1%	59.5%	47.7%
NCI ^{d 2}	n/a	2005	5523	--	≥18 year olds in the Health Information National Trends						8.4%
		2007	7424	--	≥18 year olds in the Health Information National Trends						8.8%
NCI ^{d 4}	n/a	2005	3064	49%	14-17 year olds in the National Health Interview Survey-Cancer Control Supplement				2.0%	15.5%	8.7%
		2008	2204	49%	14-17 year olds in the National Health Interview Survey-Cancer Control Supplement				1.1%	10.2%	5.5%
		2010	2751	49%	14-17 year olds in the National Health Interview Survey-Cancer Control Supplement				1.2%	7.9%	4.4%
Neenan ⁷⁰	2012	2010	487	60%	Community college students >18 years old	17.7%	50.4%	37.2%			
Oliphant ⁴⁸	1994	1991	1008	52%	13-19 year olds ^b	15%	51%	34%			
Poorsattar ⁷¹	2007	2005-2006	375	65%	University students <30 years old	17%	42%	33%			
Reynolds ⁴⁹	1996	Pre-1996	465	49%	European-American 6th graders ^b			3.3%			
Robinson ^{e 24}	1997	1986	1012	50%	>18 year olds						2%
		1996	1000	53%	>18 year olds						6%
Robinson ⁷²	1997	Pre-1997	658	48%	11-19 year olds				1.2%	16.4%	8.5%
Sahn ⁴⁰	2012	2007	415	100%	>18 year olds ^b					51.3%	
Savona ⁶	2005	1999-2001	483	47%	13-19 year olds ^b	14%	27%				
Stapleton ⁷³	2008	Pre-2008	174	72%	Undergraduates						42.9%
Stryker ⁴³	2004	2000-2001	1284	100%	Caregivers of adolescents in the Minnesota and Massachusetts Indoor Tanning Study ^b					15.4%	
Woodruff ³⁶	2006	Pre-2006	94	--	Parents of adolescents ^b			22.34			
		Pre-2006	94	--	14-17 year olds ^b			11.7%			
Zhang ^{h 7}	2012	2005	73494	100%	Nurses in the Nurses Health Study		19.8%				
Canada											
Genuis ³¹	2009	2001-2007	1411	74%	Adult and pediatric patients seen in 3 general medical clinics ^b						9.4%
Gordon ¹⁹	2009	2006	1202	54%	Grade 10 students	7.6%	19.4%	14%			
Rhainds ⁷⁴	1999	1996	1003	58%	Whites 18-60 years old				8.6%	12.8%	11.1%
Northern and Western Europe											
UK											
Amir ^{h 30}	2000	1996	470	89%	Adult healthcare employees	29.0%	48.0%	44.0%			
Hamlet ^{e 28}	2004	2003	1405	--	8-11 year olds						6.8%
Jackson ¹²	1999	1995	3105	--	>16 year old patients at 16 general medical practices ^{b f}			17.0%			
Mackay ³⁷	2007	Pre-2007	496	50%	14-16 year olds ^b	25%	60%	43%			
Thomson ⁷⁵	2010	2008-2009	3101	49%	11-17 year olds in the National Prevalence Study in England	3.5%	8.6%	6.0%			
		2008-2009	6209	50%	11-17 year olds in the Six Cities Study	7.3%	14.4%	10.8%			
Ireland											
Pertl ³³	2010	2007-2008	590	60%	16-26 year olds ^{b f}			11.0%			
Iceland											
Rafnsson ^{h 13}	2003	Pre-2003	1095	78%	Pilots and cabin attendants	52.3%	90.5%	82.2%			
		Pre-2003	1918	76%	Sample of general population age and sex matched to the pilots and cabin attendants	64.1%	87.8%	82.2%			

Reference	Year published	Year(s) of data collection ^a	Participants in study (N)	% female	Population	Ever prevalence			Past-year prevalence			
						Males	Females	Overall	Males	Females	Overall	
Denmark												
Bentzen ⁷⁶	2012	2011	5509	50%	14-18 year olds				28%	70%	38%	
Køster ⁵	2011	March 2007	3356	57%	15-59 year olds [†]			62.5%	21.8%	35.9%	29.9%	
		August 2007	3497	59%	15-59 year olds [†]			59.7%	17.2%	35.3%	27.8%	
		2008	3915	52%	15-59 year olds [†]			57.6%	17.5%	35.4%	26.7%	
		2009	3746	50%	15-59 year olds [†]			59.1%	16.7%	30.1%	23.3%	
		March 2007	342.25	--	15-19 year olds							50.3%
		August 2007	342.25	--	15-19 year olds							47.4%
		2008	342.25	--	15-19 year olds						44.2%	
		2009	342.25	--	15-19 year olds						32.9%	
Krarup ⁷⁷	2011	2008	1871	54%	8-18 year olds			20.8%			16.5%	
Savona ⁶	2005	1999-2001	668	53%	13-19 year olds ^b	52%	72%					
Norway and Sweden												
Boldeman ⁷⁸	2001	1999	2684	54%	20-50 year olds	51.3%	74.9%	64.0%				
Boldeman ⁷⁹	2003	1993	1190	--	14-19 year olds	43.0%	70.1%	56.1%				
		1999	2891	--	14-19 year olds	19.3%	44.8%	32.9%				
Brandberg ⁸⁰	1998	1996	2615	--	Adolescents			9.9%				
Bränström ⁸¹	2004	2001	1752	56%	18-37 year olds			35.0%				
Nielsen ³	2012	1990-1992	40,000	100%	25-64 year olds in the Melanoma Inquiry of Southern Sweden		50%					
Veierød ⁸	2010	1991-1992	79042	100%	30-50 year olds in the Norwegian-Swedish Women's Lifestyle and Health Cohort study		52.0%					
Wichstrøm ¹⁸	1994	1992	15169	55%	High school students				34.9%	74.9%	57.1%	
Belgium												
De Vries ⁸²	2006	Pre-2006	602	59%	14-18 year olds			36.5%				
Germany												
Börner ¹⁰	2009	2007	1419	52% ⁱ	18-90 year olds			28.8%				
		2007	81	52% ⁱ	14-17 year olds			18.5%				
Schneider ⁸³	2009	2008	500	49%	18-45 year olds in the SUN-Study (Sunbed-Use: Needs for Action-Study)	34.8%	59.0%	46.7%	16.0%	26.6%	21.0%	
Schneider ¹⁴	2012	2011-2012	4333	49% ⁱ	18-45 year olds in the SUN-Study (Sunbed-Use: Needs for Action-Study)			42.9%			15.7%	
		2011-2012	518	49% ⁱ	14-17 year olds in the SUN-Study (Sunbed-Use: Needs for Action-Study)			8.7%			5.2%	
Unverricht ^{e h 9}	2007	Pre-2007	149	--	20-65 year olds with outdoor occupations						12.8%	
Austria												
Schauberger ^e	1992	1990	1500	--	>16 year olds [†]						9.8%	
France												
Ezzedine ⁸⁴	2008	2001	7200	59%	35-60 year olds	6%	21%	15%				
Isvy ^{h 17}	2012	2010	570	70%	5th or 6th year medical students and first-year medical residents	9.2%	15.4%	13.5%				
Tella ^{b 21}	2012	2011	704	48%	<18 year olds	0.3%	2.7%	1.4%				

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Reference	Year published	Year(s) of data collection ^a	Participants in study (N)	% female	Population	Ever prevalence			Past-year prevalence		
						Males	Females	Overall	Males	Females	Overall
Spain											
Galán ⁸⁵	2011	2007	2007	51%	18-64 year olds in El Sistema de Vigilancia de Factores de Riesgo asociados a Enfermedades No Transmisibles				1.9%	6.6%	4.3%
Italy											
Fabbrocini ⁵⁰	2012	2011	191	61%	16-19 year olds ^b			40.0%			
Monfrecola ³⁵	2000		764	58%	High school and university students 16-21 years old ^f			12.3%			
Slovakia											
Jakusova ^{e 23}	2012	2003	311	--	College students			39%			
		2005	367	--	College students			30%			
		2008	163	--	College students			13%			
Australia											
CER, NSW ^{j 34}	n/a	2005	11241		≥16 year olds in the New South Wales Population Health Survey				2.0%	2.6%	2.3%
CER, NSW ^{j 86,87}	n/a	2005	2618	53%	12-17 year olds in the New South Wales School Students Health Behaviors Survey				11.5%	13.3%	12.4%
		2008	7448	56%	12-17 year olds in the New South Wales School Students Health Behaviors Survey				7.0%	7.5%	7.2%
Francis ²⁰	2010	2003/2004	5073	50%	18-69 year olds	6.5%	15.4%	10.9%	1.3%	3.0%	2.2%
		2006/2007	5085	50%	18-69 year olds	5.5%	15.7%	10.6%	0.9%	2.1%	1.5%
		2003/2004	699	49%	12-17 year olds	2.8%	3.8%	3.4%	0.3%	2.3%	1.2%
		2006/2007	652	49%	12-17 year olds	1.5%	3.4%	2.5%	0.0%	1.3%	0.6%
Gordon ^{h 29}	2012	2009	2867	60%	Indoor office workers						2.5%
Lawler ⁸⁸	2006	2004	9298	50%	20-75 year olds			10.7%	0.5%	1.3%	1.3%
Unknown											
Yoo ⁸⁹	2009	Pre-2009	155	0%	11-18 year olds			9.4%			

Entries listed by region, country, alphabetically by reference, date of publication, and date of data collection.

n/a indicates not applicable (i.e. study not published and has no publication date)

-- indicates data not available

^a 'Pre' indicates that no specific date of data collection was available

^b Unclear or convenience sampling. Excluded in the sensitivity analysis that excluded studies of potentially lower methodologic quality.

^c United States Centers for Disease Control (CDC)

^d United States National Cancer Institute (NCI)

^e Studies that reported exposure measures that did not specifically fit our 'ever exposure' nor 'past year exposure' definitions and were not included in primary analyses but only in sensitivity analyses.

^f Studies that reported combined results of children (> 15 years or > 16 years) and adults or children and university students that could not be split into subgroups. These were included in the adult category or the university student category for primary analysis and were removed in a sensitivity analysis.

^g Morbidity and Mortality Weekly Report Surveillance Summary (MMWR)

^h Studies that assessed specific occupational groups and were not included in primary analyses but only in sensitivity analyses.

ⁱ Percent female of the entire study, not specific to the population subset listed on this row

^j Center for Epidemiology and Research, New South Wales Department of Health (CER, NSW)

eTable 2: Results of sensitivity analyses

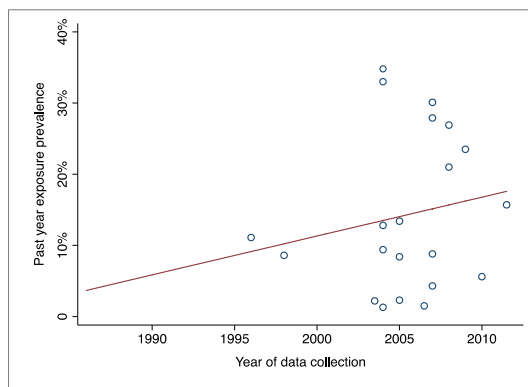
Ever exposure		Summary prevalence (95% CI)	No. of records
Adults	Primary analysis	35.7% (27.5%-44.0%)	22
	<i>Sensitivity - inclusion of occupational group records</i>	38.9% (30.1%-47.8%)	26
	<i>Sensitivity - exclusion of records that included participants <18 years old</i>	32.0% (24.8%-39.2%)	15
	<i>Sensitivity - exclusion of records of lower methodologic quality^a</i>	38.7% (27.4%-49.9%)	14
University students	Primary analysis	55.0% (33.0%-77.1%)	11
	<i>Sensitivity - inclusion of non-standard measures^b</i>	49.1% (29.9%-68.3%)	14
	<i>Sensitivity - exclusion of records that included high school students</i>	59.3% (41.6%-77.0%)	10
Adolescents	Primary analysis	19.3% (14.7%-24.0%)	23
	<i>Sensitivity - exclusion of records of lower methodologic quality^a</i>	19.2% (13.5%-24.8%)	14
Past year exposure			
Adults	Primary analysis	14.0% (11.5%-16.5%)	21
	<i>Sensitivity - inclusion of non-standard measures^b</i>	12.9% (10.7%-15.2%)	25
	<i>Sensitivity - inclusion of occupational group records</i>	13.4% (11.0%-15.8%)	23
	<i>Sensitivity - exclusion of records that included participants <18 years old</i>	11.3% (8.8%-13.8%)	15
	<i>Sensitivity - exclusion of records of lower methodologic quality^a</i>	12.7% (9.8%-15.5%)	16
University students	Primary analysis	43.1% (21.7%-64.5%)	7
	<i>Sensitivity - inclusion of non-standard measures^b</i>	39.8% (21.5%-58.2%)	8
Adolescents	Primary analysis	18.3% (12.6%-24.0%)	23
	<i>Sensitivity - inclusion of non-standard measures^b</i>	17.8% (12.4%-23.2%)	25
	<i>Sensitivity - exclusion of records of lower methodologic quality^a</i>	13.3% (6.4%-20.3%)	17

^a Records with lower methodologic quality were those with unclear sampling, convenience sampling, or sample sizes less than 500.

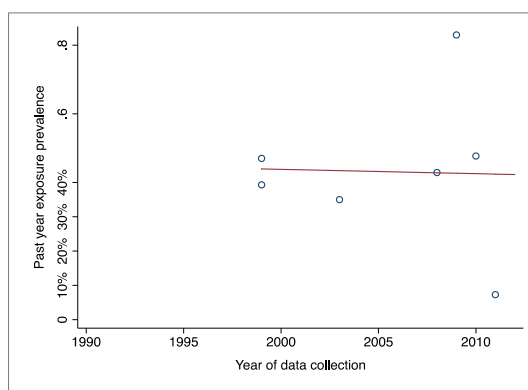
^b Non-standard measures were those that did not specifically fit our 'ever exposure' nor 'past year exposure' categories.

eFigure. Results of meta-regressions of past-year exposure prevalence and year of data collection

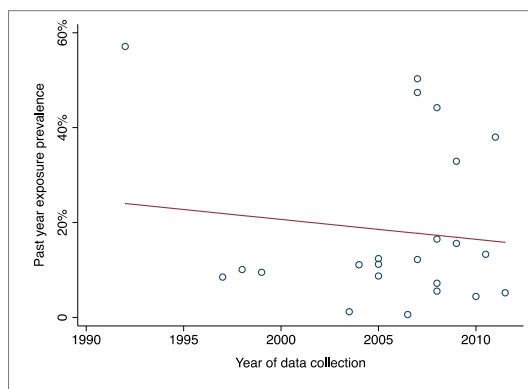
a. Adults



b. University students



c. Adolescents



Each circle represents a data point. Red lines represent the result of a meta-regression. All p-values >0.05.

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