

Supplement

A cohort analysis of residential radon exposure and melanoma incidence in Switzerland

Seçkin Boz^{1,2}, Marek Kwiatkowski^{1,2}, Marcel Zwahlen³, Murielle Bochud⁴, Jean-Luc Bulliard^{4,8}, Isabelle Konzelmann⁵, Yvan Bergeron⁶, Elisabetta Rapiti⁷, Manuela Maspoli Conconi⁸, Andrea Bordini⁹, Martin Rööslı^{1,2}, Danielle Vienneau^{1,2*}

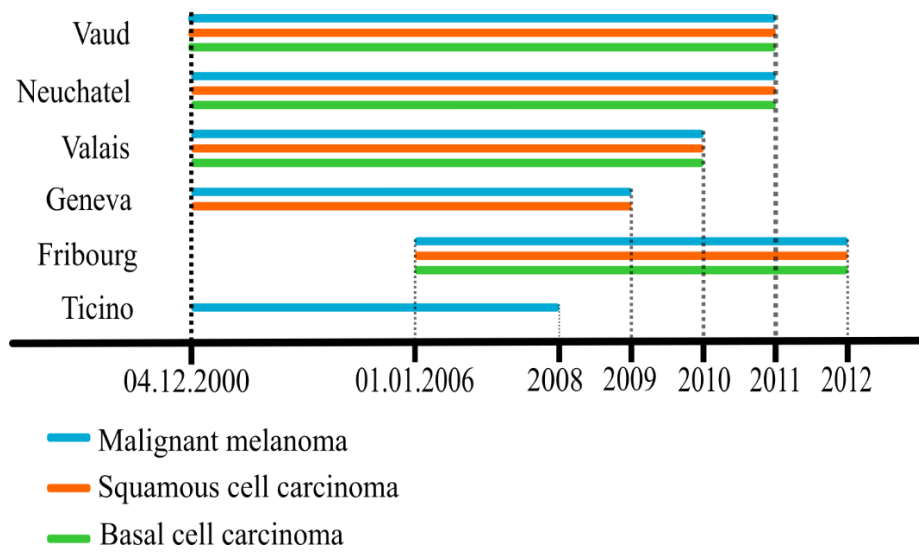


Figure S1: Study start and end dates for each canton and outcome.

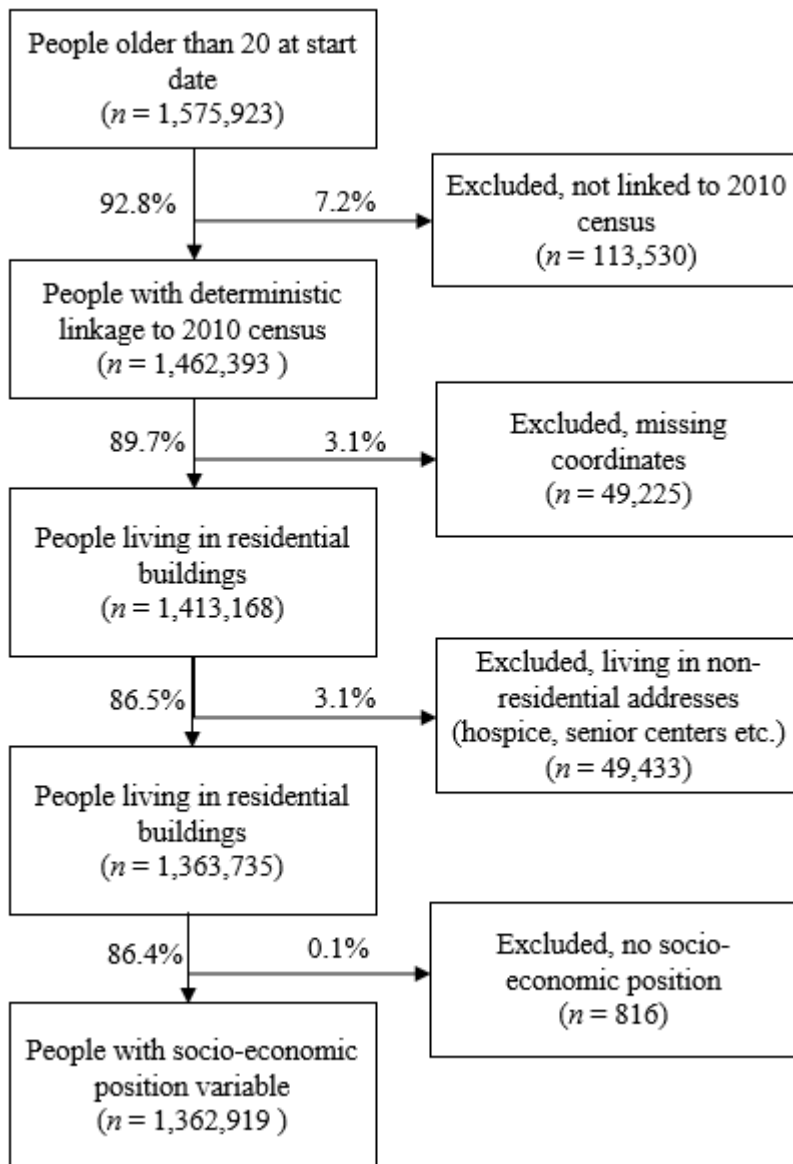


Figure S2: Flow chart of population included/excluded in the study. Percentages based on the total number of adult population living in the cantons studied.

Table S1: Population characteristics of the full cohort by age groups.

Characteristics	All ages	20-29	30-44	45-59	60-74	75 +
Participants ^a , <i>n</i> (%)	1,362,919 (100)	192,806 (14.1)	428,551 (34.4)	371,815 (27.3)	246,726 (18.1)	123,021 (9.0)
Cases ^{a,b} , <i>n</i> (%)						
MM cases	4,937 (100)	110 (2.2)	861 (17.4)	1,273 (25.8)	1,578 (32.0)	1,115 (22.6)
SCC cases	10,269 (100)	6 (0.1)	112 (1.1)	857 (8.3)	3,184 (31.0)	6,110 (59.5)
Age						
Mean (SD)	48.6 (17.2)	25.4 (2.9)	37.6 (4.2)	52.3 (4.3)	67.0 (4.3)	81.4 (4.9)
Sex, <i>n</i> (%)						
Men	645,158 (47.3)	95,761 (49.7)	209,601 (48.9)	181,193 (48.7)	113,139 (45.9)	45,464 (37.0)
Women	717,761 (52.7)	97,045 (50.3)	218,950 (51.1)	190,622 (51.3)	133,587 (54.1)	77,557 (63.0)
Civil status, <i>n</i> (%)						
Single	294,986 (21.6)	139,982 (72.6)	92,287 (21.5)	34,796 (9.4)	17,901 (7.3)	10,020 (8.1)
Married	861,766 (63.2)	50,917 (26.4)	304,264 (71.0)	279,126 (75.1)	172,031 (69.7)	55,428 (45.1)
Widowed	98,344 (7.2)	102 (0.1)	2,193 (0.5)	10,787 (2.9)	34,003 (13.8)	51,259 (41.7)
Divorced	107,823 (7.9)	1,805 (0.9)	29,807 (7.0)	47,106 (12.7)	22,791 (9.2)	6,314 (5.1)
Mother tongue, <i>n</i> (%)						
German	162,863 (11.19)	16,053 (8.3)	44,446 (10.4)	48,604 (13.1)	36,473 (14.8)	17,287 (14.1)
French	844,628 (62.0)	128,036 (66.4)	259,100 (60.5)	225,526 (60.7)	149,474 (60.6)	82,492 (67.1)
Italian	223,588 (16.4)	27,288 (14.2)	63,944 (14.9)	62,577 (16.8)	49,723 (20.2)	20,056 (16.3)
Other	131,840 (9.7)	21,429 (11.1)	61,061 (14.2)	35,108 (9.4)	11,056 (4.5)	3,186 (2.6)
Education level, <i>n</i> (%)						
Low (compulsory school)	369,464 (27.1)	42,919 (22.3)	77,104 (18.0)	90,188 (24.3)	92,300 (37.4)	66,953 (54.4)
Medium (upper secondary)	652,357 (47.9)	106,974 (55.5)	214,432 (50.0)	182,970 (49.2)	106,798 (43.3)	41,183 (33.5)
High (tertiary)	300,348 (22.0)	30,688 (15.9)	116,310 (27.1)	95,245 (25.6)	45,337 (18.4)	12,768 (10.4)
Not known	40,750 (3.0)	12,225 (6.3)	20,705 (4.8)	3,412 (0.9)	2,291 (0.9)	2,117 (1.7)
Outdoor occupation, <i>n</i> (%)						
No	1,308,650 (96.0)	183,947 (95.4)	405,156 (94.5)	354,150 (95.2)	242,501 (98.3)	122,896 (99.9)
Yes	54,269 (4.0)	8,859 (4.6)	23,395 (5.5)	17,665 (4.8)	4,225 (1.7)	125 (0.1)
Swiss-SEP						
Mean (SD)	60.0 (10.5)	59.0 (10.4)	59.7 (10.6)	60.6 (10.7)	60.3 (10.4)	60.14 (10.2)
Range	5.9 – 97.3	5.9 – 97.3	5.9 – 97.3	5.9 – 97.3	5.9 – 97.3	20.2 – 94.4
Interquartile range	14.4	14.1	14.5	14.8	14.3	13.8
Radon exposure, Bq/m ³						
Mean (SD)	76.4 (40.6)	72.7 (37.3)	75.3 (39.4)	76.4 (41.2)	79.1 (42.9)	80.1 (42.9)
Range	25.6 – 1154.1	26.4 – 1032.6	26.2 – 1116.8	25.6 – 1116.8	26.7 – 1154.1	26.9 – 1065.4
Interquartile range	43.3	38.0	42.5	44.2	46.1	44.5
UV exposure, mW/m ²						
Mean (SD)	20.3 (0.8)	20.3 (0.7)	20.3 (0.8)	20.3 (0.7)	20.3 (0.8)	20.3 (0.8)
Range	18.2 – 29.1	18.2 – 29.1	18.2 – 29.1	18.2 – 26.6	18.2 – 26.6	18.2 – 26.6
Interquartile range	0.6	0.5	0.65	0.6	0.6	0.7

^a Percentages calculated for the row.

^b MM cases: Primary invasive cutaneous melanomas (ICD-O-3: C43, 8720-8790). SCC cases: Primary squamous cell carcinoma (ICD-O-3: C44, 8050-8084, 8560-8574) No in situ cases.

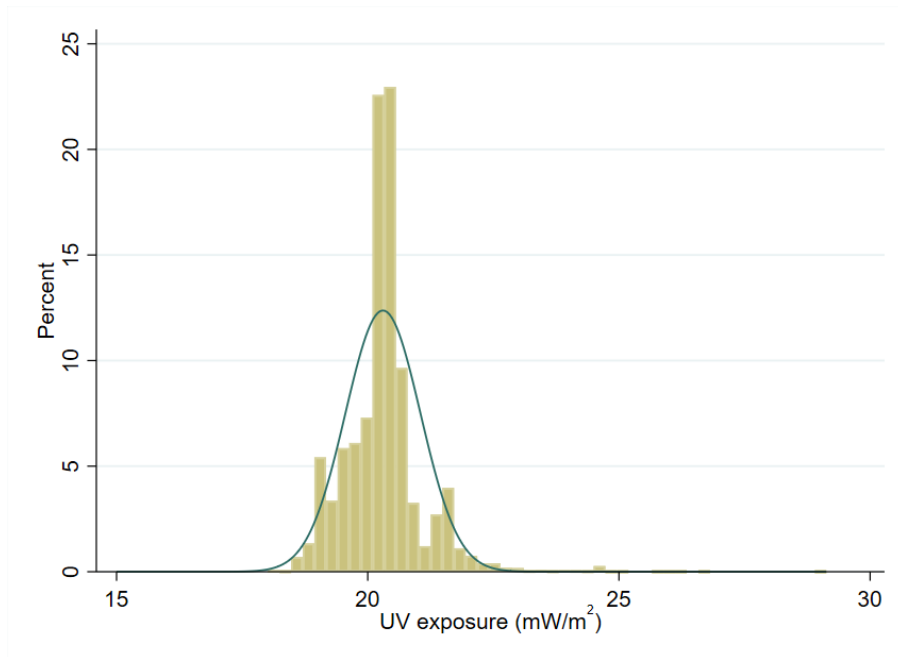
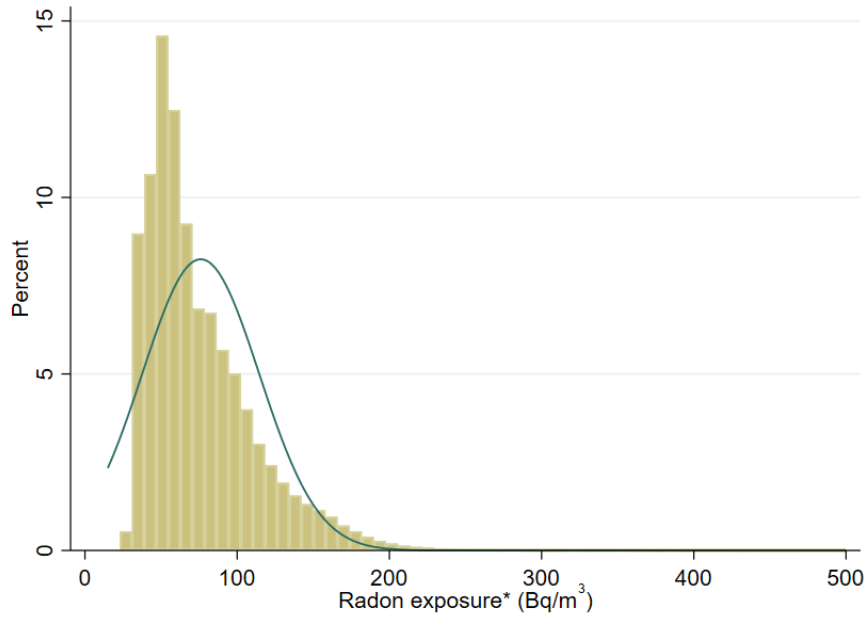


Figure S3: Exposure distributions of residential radon in Bq/m³ (top) and long-term average ambient UV exposures in mW/m² (bottom) at baseline. (* radon exposure values above 500 Bq/m³ were omitted to obtain clear visualization.)

Table S2: Secondary analysis: Association between residential radon exposure and squamous cell carcinoma (SCC) incidence among the full cohort and non-movers, by age

	Full cohort		Non-movers ^a	
	Cases	HR (95% CIs) ^b	Cases	HR (95% CIs) ^b
All ages	10,269	0.98 (0.92, 1.05)	2,174	1.00 (0.86, 1.17)
Age groups				
20-29	6	1.30 (0.20, 8.60)	1	0.07 (0.00, 27.2)
30-44	112	0.53 (0.24, 1.17)	26	0.63 (0.25, 1.59)
45-59	857	0.99 (0.81, 1.21)	504	1.07 (0.77, 1.50)
60-74	3,184	0.92 (0.82, 1.03)	2,405	0.97 (0.78, 1.22)
75+	6,110	1.01 (0.94, 1.10)	5,159	1.03 (0.84, 1.25)

Note: For entire cohort, models used age as time scale, included radon exposure, and adjusted for ambient UV exposure, sex, canton, socio-economic position, education, marital status, mother tongue, and outdoor occupation. For different age group, an interaction term between radon exposure and age groups was introduced. Full study population consist of 1,138,552 individuals, while non-movers include 590,586 people.

^a Non-movers: Same residential location at 1990 and 2000 censuses.

^b Hazard ratios (95% confidence intervals) are expressed per 100 Bq/m³ radon increase.

Table S3: Sensitivity analysis including censoring on first diagnosis of other types of skin cancers: Association between residential radon exposure and melanoma incidence among the full cohort and non-movers, by age

	Full cohort		Non-movers ^a	
	Cases	HR (95% CIs) ^b	Cases	HR (95% CIs) ^b
All ages	4,625	1.03 (0.94, 1.13)	2,900	1.00 (0.84, 1.19)
Age groups				
20-29	110	1.68 (1.29, 2.19)	56	1.73 (1.34, 2.25)
30-44	852	0.99 (0.81, 1.21)	212	0.93 (0.64, 1.34)
45-59	1,226	1.08 (0.93, 1.25)	669	1.05 (0.88, 1.28)
60-74	1,457	0.99 (0.85, 1.14)	1,113	0.95 (0.80, 1.13)
75+	980	0.99 (0.83, 1.16)	830	0.98 (0.81, 1.17)

Note: For entire cohort, models used age as time scale, included radon exposure, and adjusted for ambient UV exposure, sex, canton, socio-economic position, education, marital status, mother tongue, and outdoor occupation. For different age group, an interaction term between radon exposure and age groups was introduced.

^a Non-movers: Same residential location at 1990 and 2000 censuses.

^b Hazard ratios (95% confidence intervals) are expressed per 100 Bq/m³ radon increase.