Overview of potentially modifiable risk factors of cancer

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Conflicts of interest

- None

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Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States, 2019

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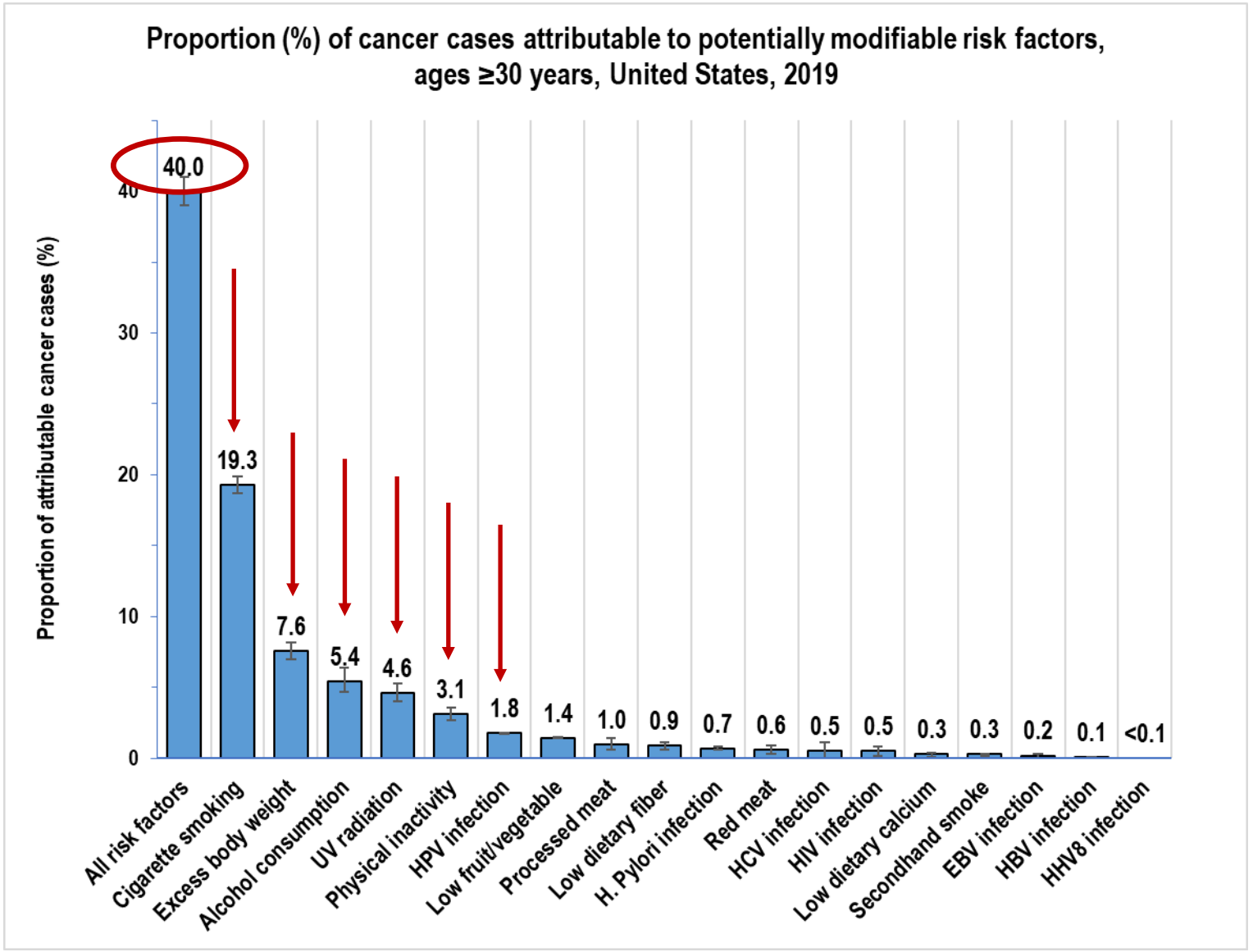
- Population attributable fraction (PAF): a measure to estimate the proportion of a cancer attributable to a given risk factor
  - e.g., PAF of 85% for cigarette smoking and lung cancer death → 85% of lung cancer deaths are attributable to cigarette smoking

- PAF is based on:
  - Risk factor prevalence
  - Relative risk (magnitude of the association between risk factor and cancer)
    - Also used in calculations: number of cancer cases/deaths

Cancer cases attributable to potentially modifiable risk factors



Results exclude nonmelanoma skin cancers.

EBV, Epstein-Barr virus; HBV, hepatis B virus; HCV, hepatitis C virus, HHV8, human herpes virus type 8 (Kaposi sarcoma herpes virus); HIV, human immunodeficiency virus; HPV, human papillomavirus.

Cancer cases attributable to potentially modifiable risk factors, ages ≥30 years, United States, 2019

Potentially modifiable risk factor	PAF	Attributable *N* of cancer cases (95% CI)	% of total
All evaluated risk factors	40.0%	**713,340** (694,320-732,170)	100%
Top 3 risk factors			
1. Cigarette smoking	19.3%	**344,070** (335,540-352,230)	48%
2. Excess body weight	7.6%	**135,910** (126,660-146,130)	19%
3. Alcohol consumption	5.4%	**96,730** (80,830-117,180)	14%

Overall results exclude nonmelanoma skin cancers.

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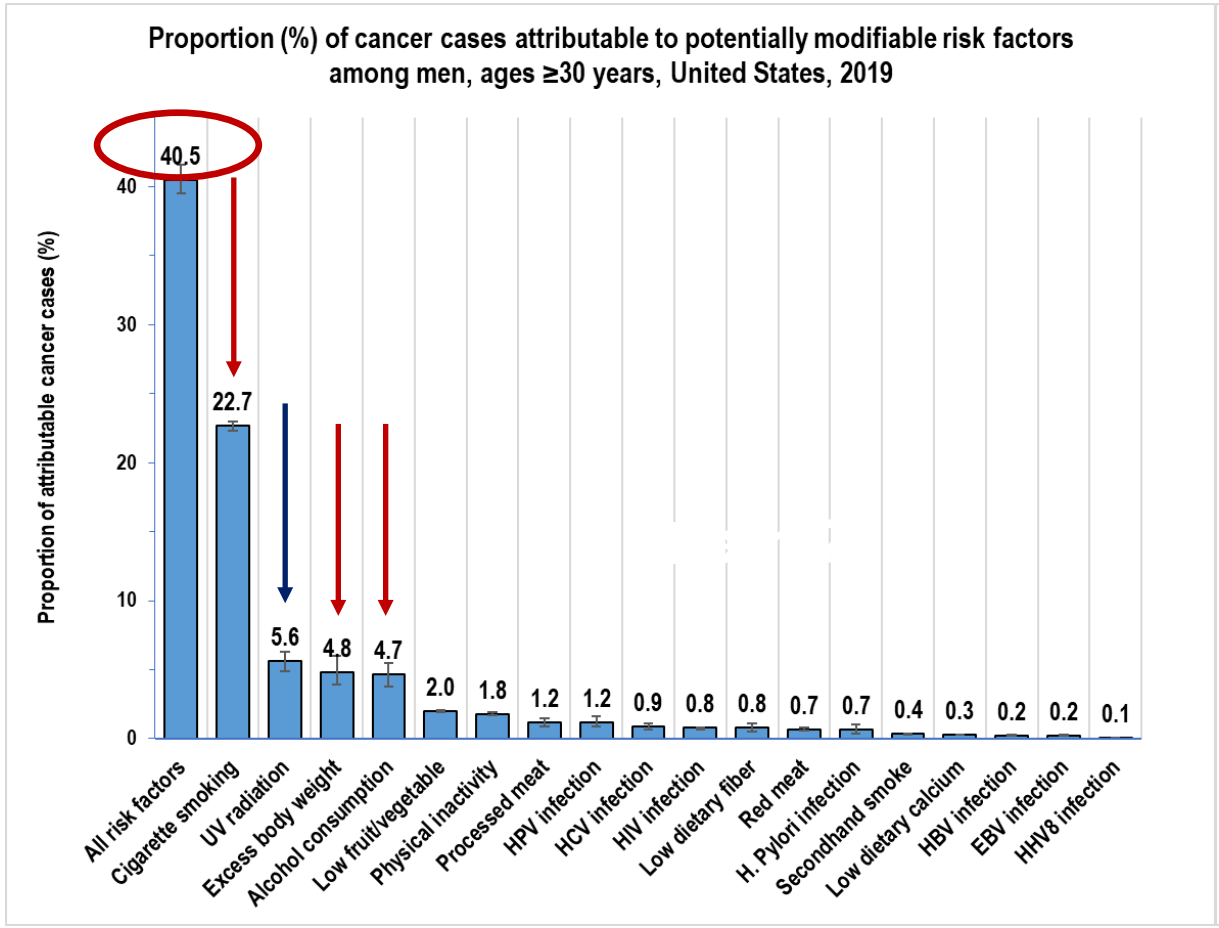
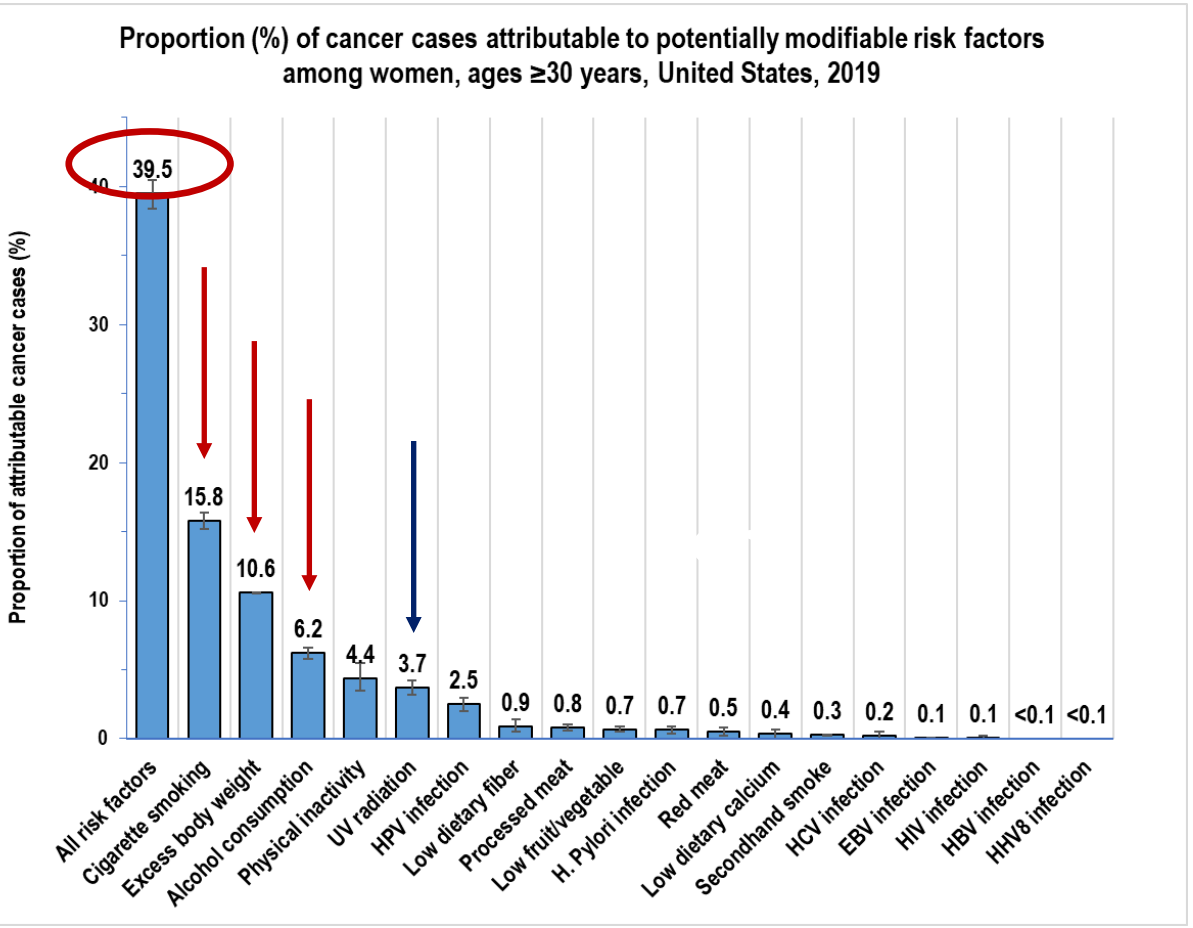
Men



Women



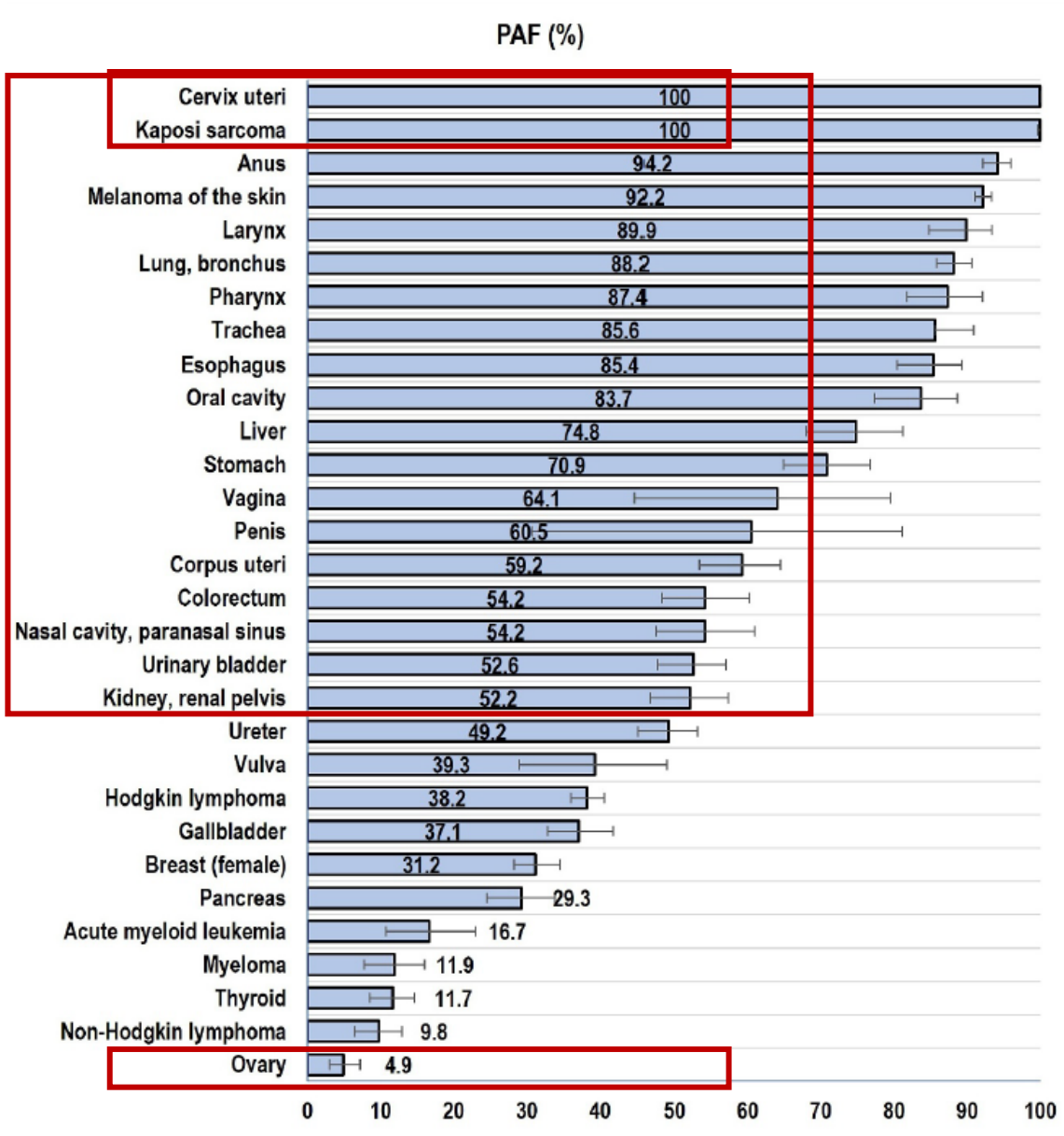
Total *N* of cases attributable to evaluated risk factors: **368,600 in men**, **344,740 in women**.

Excluding nonmelanoma skin cancers.

EBV, Epstein-Barr virus; HBV, hepatis B virus; HCV, hepatitis C virus, HHV8, human herpes virus type 8 (Kaposi sarcoma herpes virus); HIV, human immunodeficiency virus; HPV, human papillomavirus.

Modifiable risk factors of cancer

Number and proportion of cancers attributable to risk factors



Attributable cases	Total cases
12,690 (12,690-12,690)	12,690
890 (890-890)	893
7800 (7630-7950)	8278
82,710 (81,630-83,740)	89,716
11,170 (10,540-11,610)	12,428
201,660 (196,120-207,380)	228,571
15,620 (14,620-16,470)	17,882
160 (160-170)	187
16,630 (15,650-17,390)	19,473
25,980 (24,050-27,560)	31,055
22,340 (20,310-24,260)	29,880
17,700 (16,210-19,150)	24,965
900 (630-1120)	1410
940 (480-1260)	1553
35,790 (32,320-39,000)	60,485
78,440 (69,920-87,130)	144,723
1360 (1190-1530)	2507
40,720 (36,980-44,170)	77,452
36,430 (32,640-40,080)	69,828
1100 (1010-1190)	2236
2250 (1660-2810)	5734
2240 (2110-2380)	5868
1640 (1450-1850)	4421
83,840 (76,070-93,080)	268,937
16,340 (13,700-18,850)	55,725
2600 (1670-3580)	15,543
3470 (2280-4680)	29,234
4920 (3570-6170)	42,009
7060 (4580-9310)	71,979
970 (580-1420)	19,582

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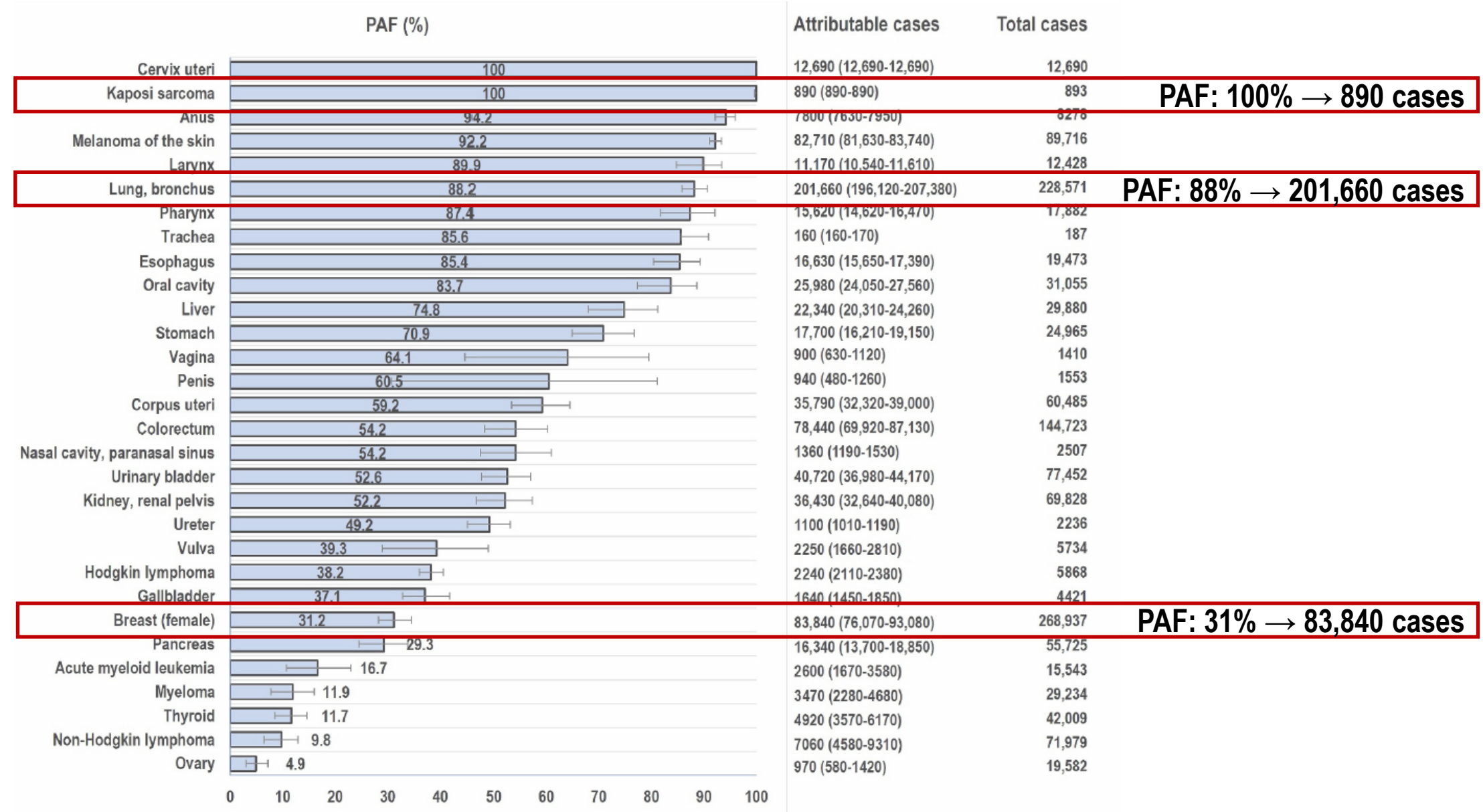
Modifiable risk factors of cancer | **Number and proportion of cancers attributable to risk factors**



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Cancers with highest numbers of cases attributable to potentially modifiable risk factors, ages ≥30 years, United States, 2019

Cancer	PAF	Attributable *N* of cancer cases
1. Lung	88.2%	201,660
2. Breast (female)	31.2%	83,840
3. Melanoma (skin)	92.2%	82,710
4. Colorectum	54.2%	78,440
5. Urinary bladder	52.6%	40,720
6. Kidney, renal pelvis	52.2%	36,430
7. Corpus uteri	59.2%	35,790

44,180 attributable to alcohol

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Cancer deaths attributable to potentially modifiable risk factors

Cancer deaths attributable to potentially modifiable risk factors, ages ≥30 years, United States, 2019

Potentially modifiable risk factor	PAF	Attributable *N* of cancer deaths (95% CI)	% of total
All evaluated risk factors combined	**44.0%**	**262,120** (255,940-268,270)	100%
Top 3 risk factors			
1. Cigarette smoking	**28.5%**	**169,810** (166,490-173,100)	65%
2. Excess body weight	**7.3%**	**43,520** (40,150-47,160)	17%
3. Alcohol consumption	**4.1%**	**24,410** (19,960-30,230)	9%

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Cancer deaths attributable to potentially modifiable risk factors by sex, ages ≥30 years, United States, 2019

Potentially modifiable risk factor	PAF, men	PAF, women
All evaluated risk factors combined	**47.1%**	**40.5%**
Top 3 risk factors		
1. Cigarette smoking	32.2%	24.4%
2. Excess body weight	6.5%	8.2%
3. Alcohol consumption	4.6%	3.6%

Total *N* of cancer deaths attributable to evaluated risk factors: **147,810 in men**, **114,300 in women**.

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TABLE 2 Estimated cancer cases in adults 30 years and older attributable to potentially modifiable risk factors by sex, risk factor, and cancer type: United States, 2019.

	Men		Women		Both sexes combined	
Cancer	Attributable cases, No. (95% CI)	PAF (95% CI), %	Attributable cases, No. (95% CI)	PAF (95% CI),%	Attributable cases, No. (95% CI)	PAF (95% CI), %
Cigarette smoking						
Lung, bronchus	101,010 (100,260–101,770)	87.2 (86.6–87.9)	94,580 (93,750–95,440)	83.9 (83.1–84.6)	195,590 (194,010–197,210)	85.6 (84.9–86.3)
Trachea	100 (100–100)	88.6 (86.8–89.5)	60 (60–60)	84.9 (83.6–86.3)	160 (160–170)	85.6 (85.6–90.9)
Larynx	8000 (7240–8580)	80.7 (73.1–86.5)	1960 (1740–2120)	77.8 (69.2–84.4)	9960 (8980–10,700)	80.1 (72.3–86.1)
Pharynx	8390 (7380–9340)	58.0 (50.9–64.5)	1770 (1520–2000)	52.0 (44.8–58.8)	10,160 (8900–11,340)	56.8 (49.8–63.4)
Oral cavity	11,840 (10,410–13,180)	57.1 (50.3–63.6)	5200 (4480–5900)	50.3 (43.3–57.1)	17,030 (14,890–19,090)	54.8 (47.9–61.5)
Nasal cavity, paranasal sinus	860 (750–960)	56.8 (50.0–63.4)	500 (430–570)	50.2 (43.3–57.1)	1360 (1190–1530)	54.2 (47.5–61.0)
Esophagus	8510 (7800–9170)	55.5 (50.8–59.8)	1990 (1800–2170)	48.2 (43.7–52.7)	10,500 (9600–11,350)	53.9 (49.3–58.3)
Urinary bladder	30,990 (28,370–33,330)	52.6	8300 (7490–9030)	44.8	39,280 (35,850–42,360)	50.7

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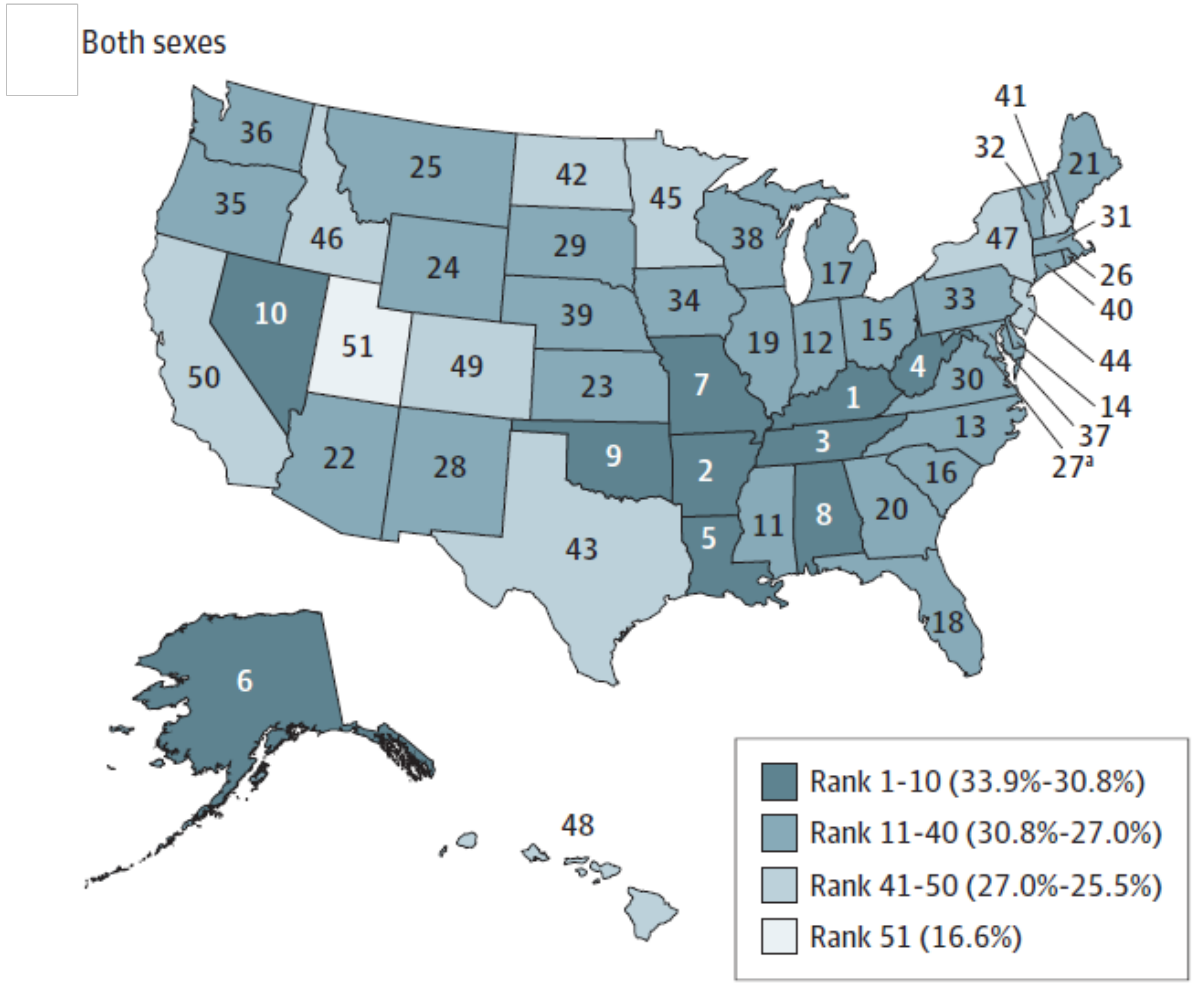
Other considerations

Select risk factors NOT included in the study

Risk factors not considered	Associated cancer types
Indoor and outdoor air pollution other than secondhand smoke	Lung cancer
Smokeless tobacco	Oral cavity, esophagus, pancreas
Aflatoxins	Liver
Arsenic in drinking water	Lung, skin, urinary bladder
Foods preserved by salting	Stomach
Human T-cell lymphotropic virus type 1	Adult T-cell lymphoma/leukemia
Clonorchis sinensis and *Opisthorchis viverrini*	Cholangiocarcinoma
Schistosoma hematobium	Bladder cancer
Ionizing radiation (other than ultraviolet)	Multiple cancer types
Occupational carcinogens or professions	Multiple cancer types

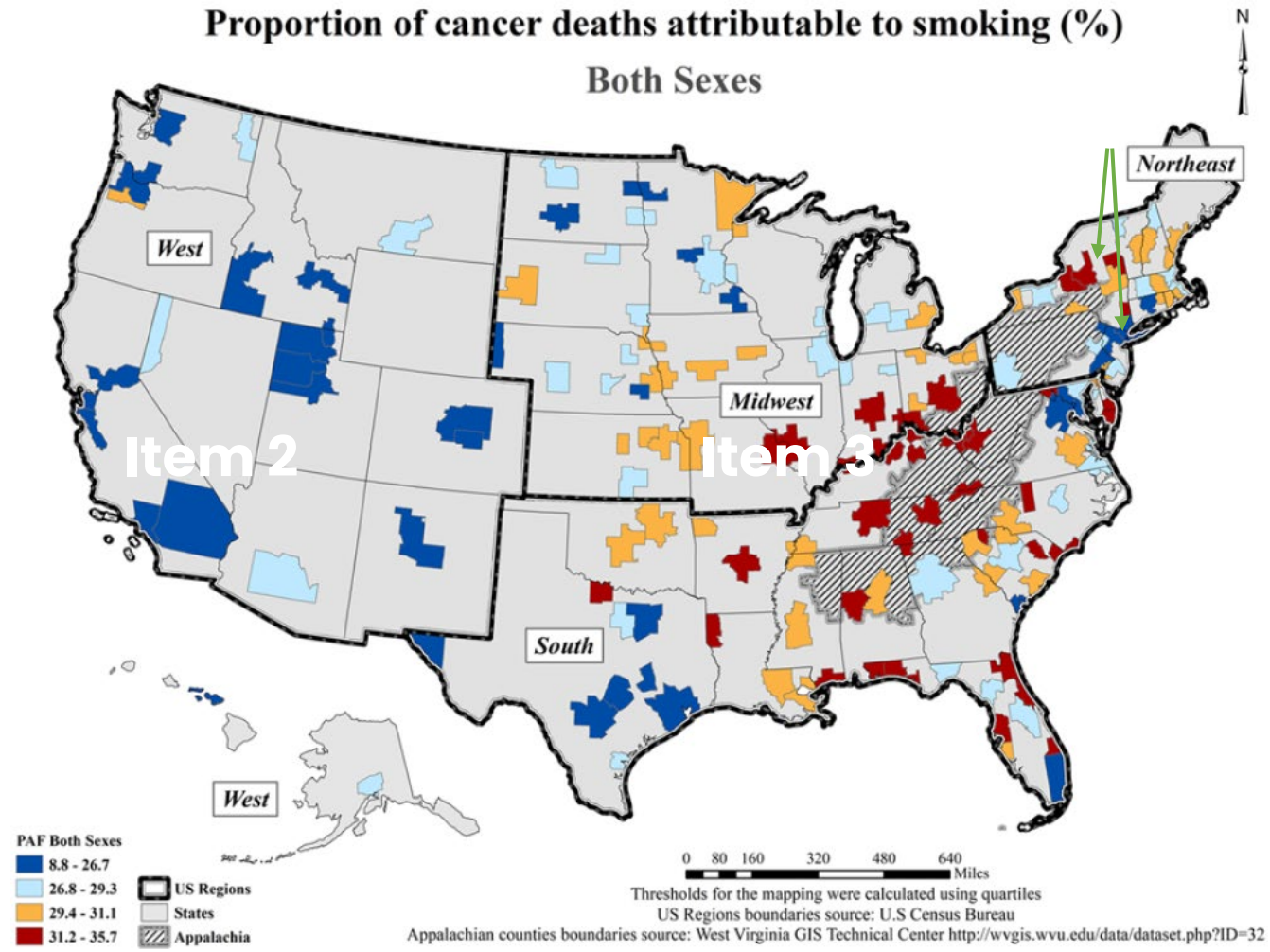
IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Volume 100. 2012.

Proportion of cancer deaths attributable to cigarette smoking by state, ages ≥30 years, 2014



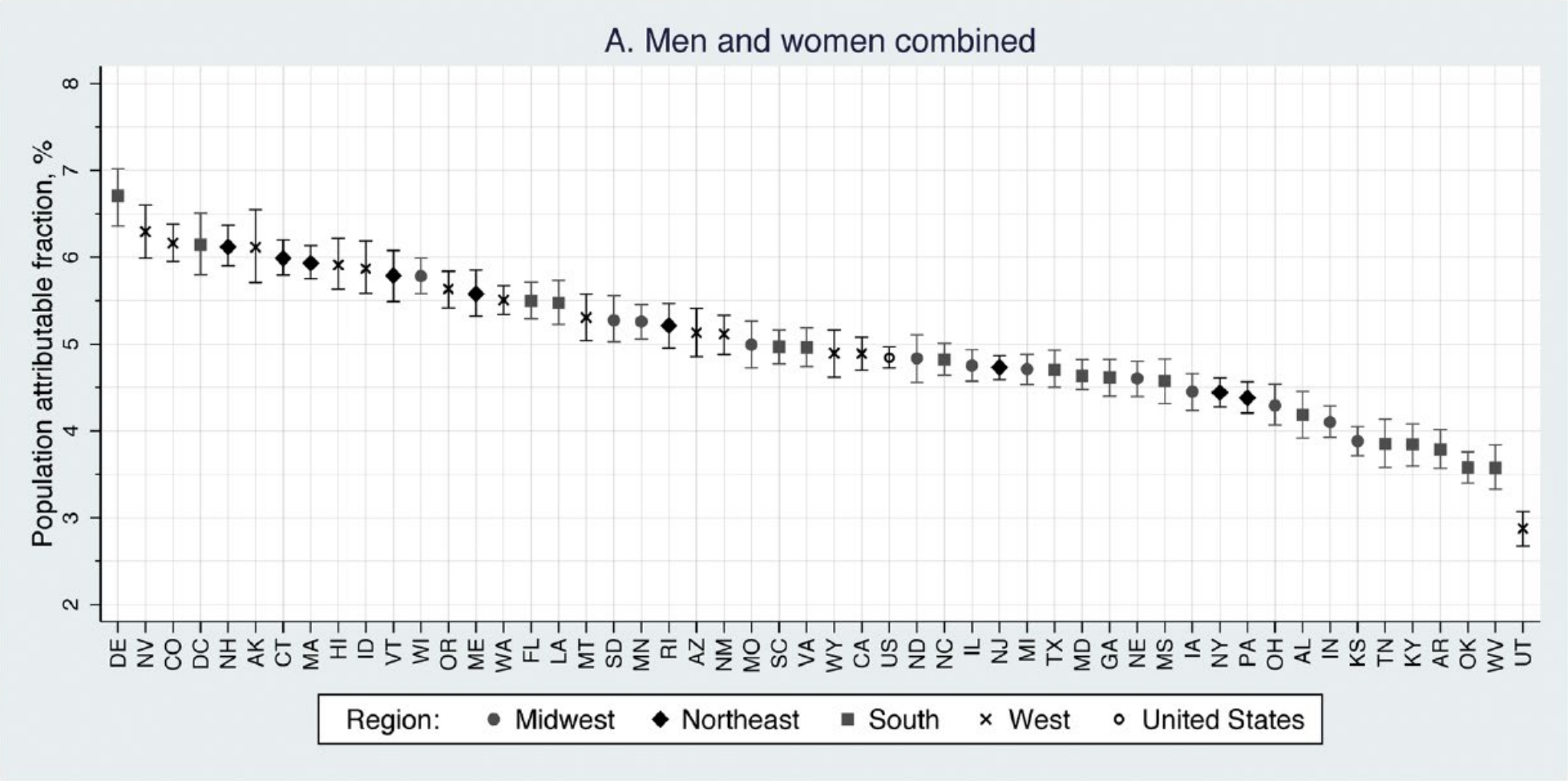
Lortet-Tieulent et al. State-level cancer mortality attributable to cigarette smoking in the United States. *JAMA Intern Med*. 2016;176:1792-1798.

Proportion of cancer deaths attributable to cigarette smoking by metropolitan area, ages ≥30 years, 2013-2017



Islami et al. Cancer deaths attributable to cigarette smoking in 152 U.S. metropolitan or micropolitan statistical areas, 2013–2017. *Cancer Causes Control*. 2021; 32:311-316.

Proportion of cancer cases attributable to alcohol consumption by state, ages ≥30 years, 2013-2016



Goding Sauer et al. Proportion of cancer cases and deaths attributable to alcohol consumption by US state, 2013-2016. *Cancer Epidemiol*. 2021;71:101893.

Conclusions

- A substantial proportion of cancer cases and deaths in the US are attributable to potentially modifiable risk factors
- Vast opportunity to substantially reduce morbidity and premature mortality from cancer in the US by preventive initiatives

Potentially modifiable risk factor	Attributable cases*		Attributable deaths*	
	%	*N*	%	*N*
All evaluated risk factors	40.0	713,340	44.0	262,120
Top 3 risk factors				
1. Cigarette smoking	19.3	344,070	28.5	169,810
2. Excess body weight	7.6	135,910	7.3	43,520
3. Alcohol consumption	5.4	96,730	4.1	24,410

*Estimates for 2019

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Thank You!