

Attributable mortality of smoking

Young Sik Park

Seoul National University Hospital

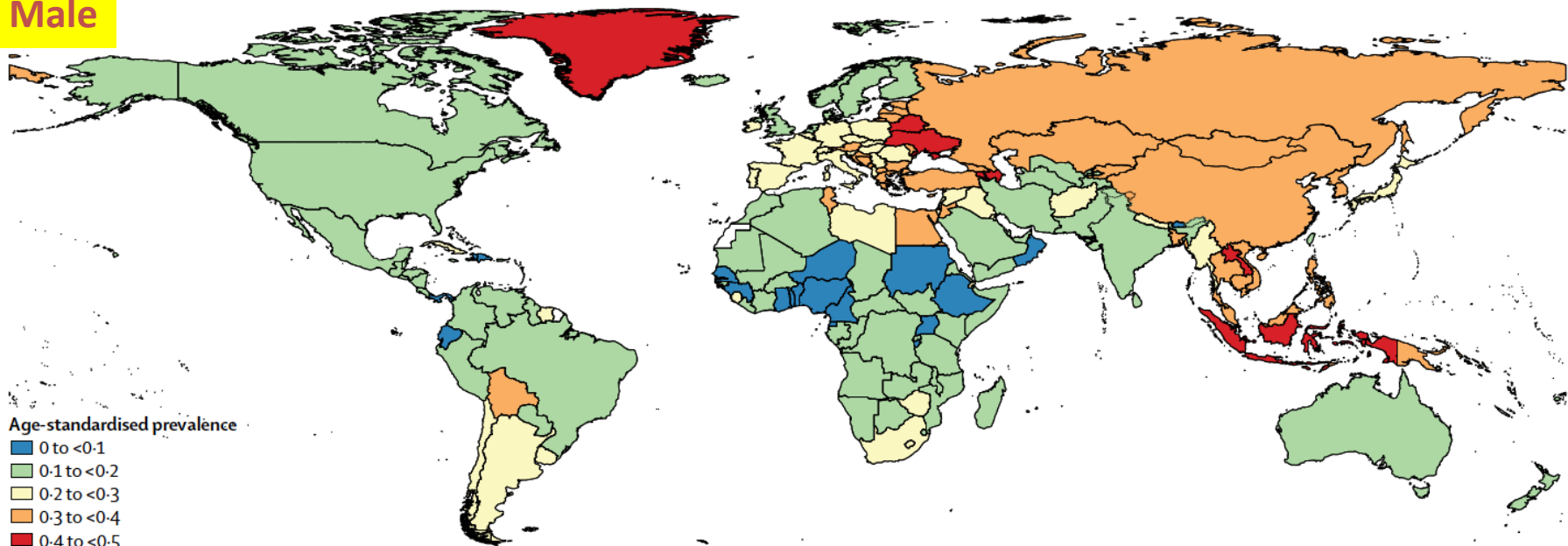
Attributable risk

- In epidemiology, attributable risk or excess risk is a term synonymous to risk difference, that has also been used to denote attributable fraction among the exposed and attributable fraction for the population.
- **$AR = I_e - I_u$**

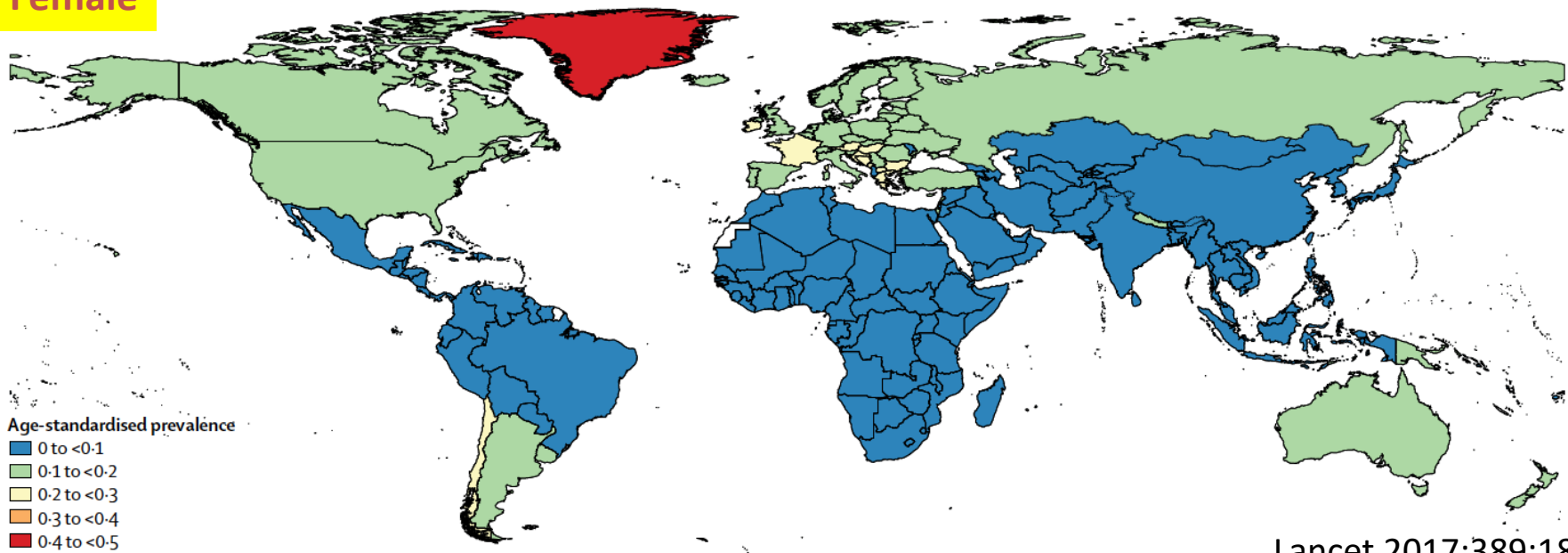
Smoking: Key facts by WHO

- Tobacco kills up to half of its users.
- Tobacco kills more than 8 million people each year. More than 7 million of those deaths are the result of direct tobacco use while around 1.2 million are the result of non-smokers being exposed to second-hand smoke.
- Around 80% of the world's 1.1 billion smokers live in low- and middle-income countries.

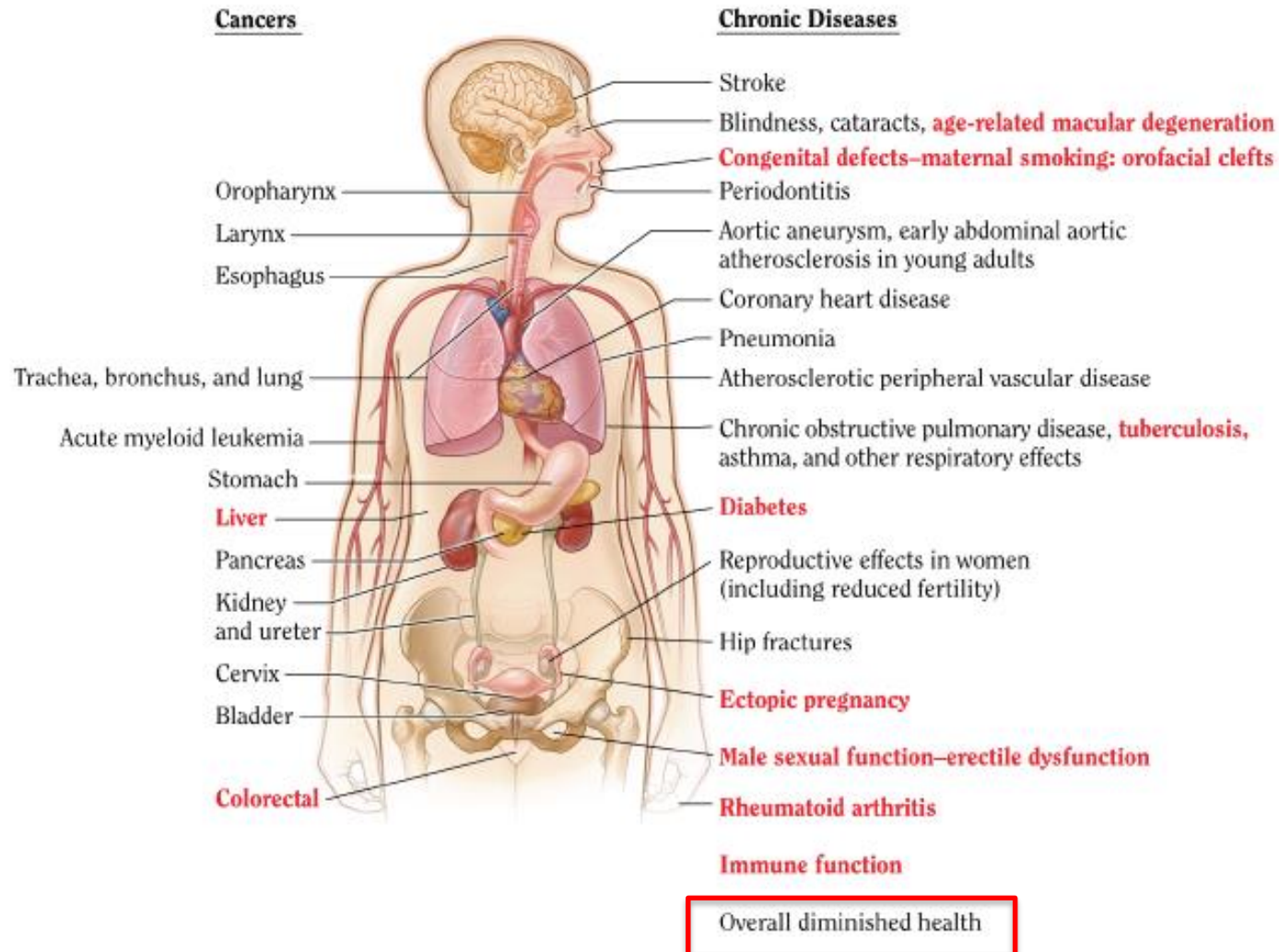
Male



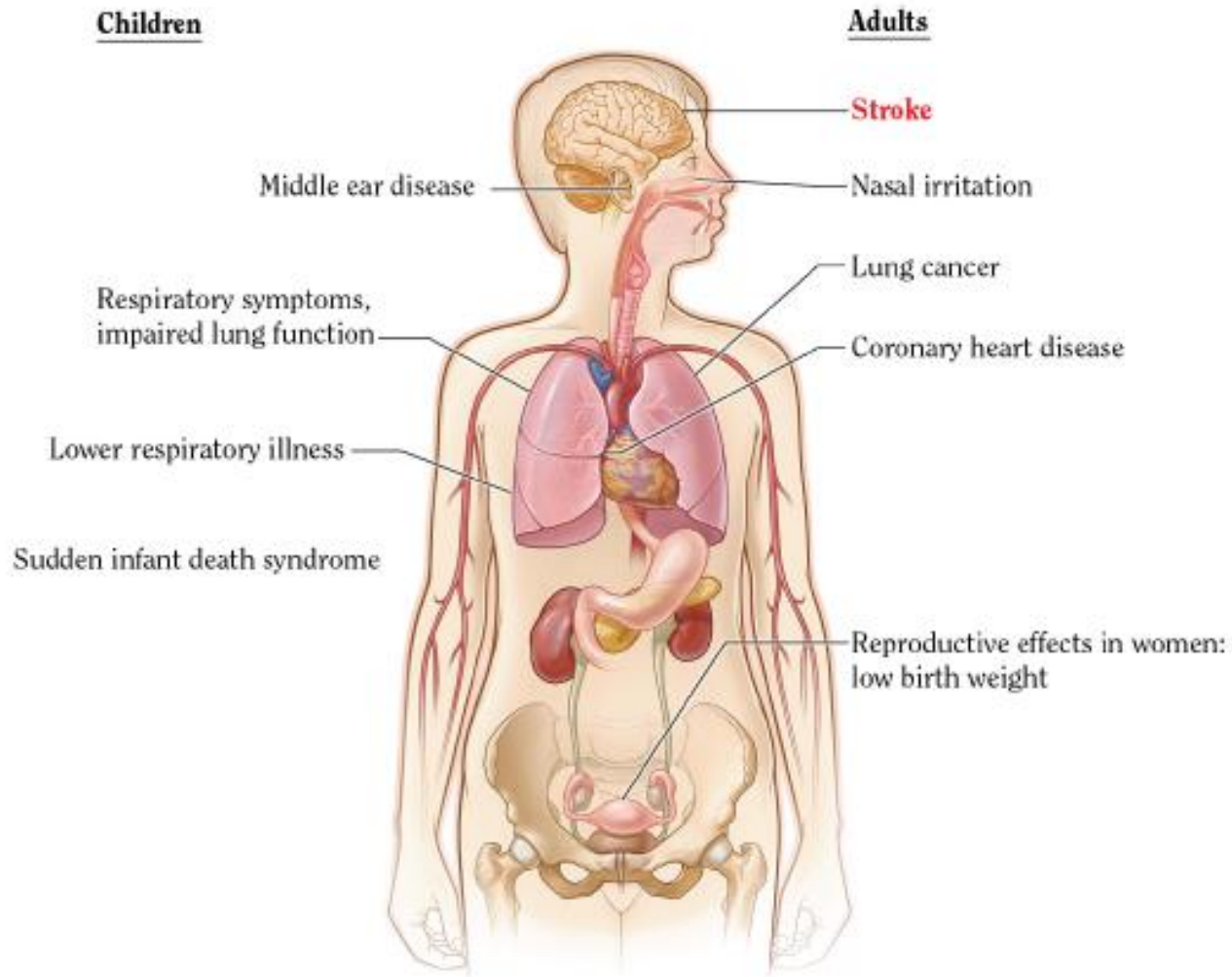
Female



Health consequences causally linked to smoking



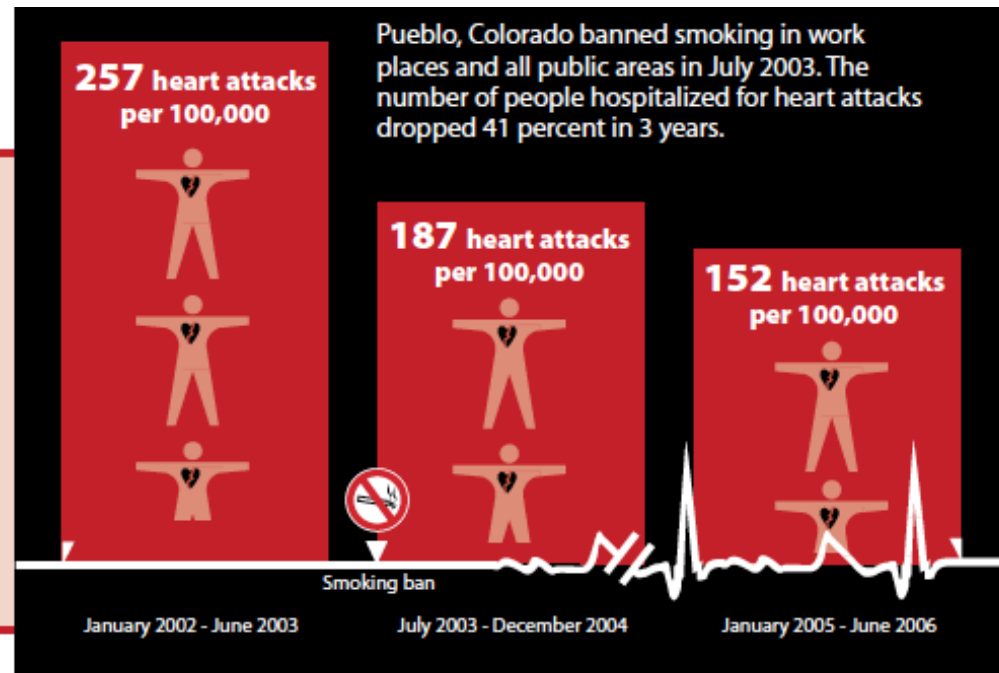
Health consequences causally linked to SHS



Public smoking ban drastically cut heart attacks in Colorado.

... what it means to YOU

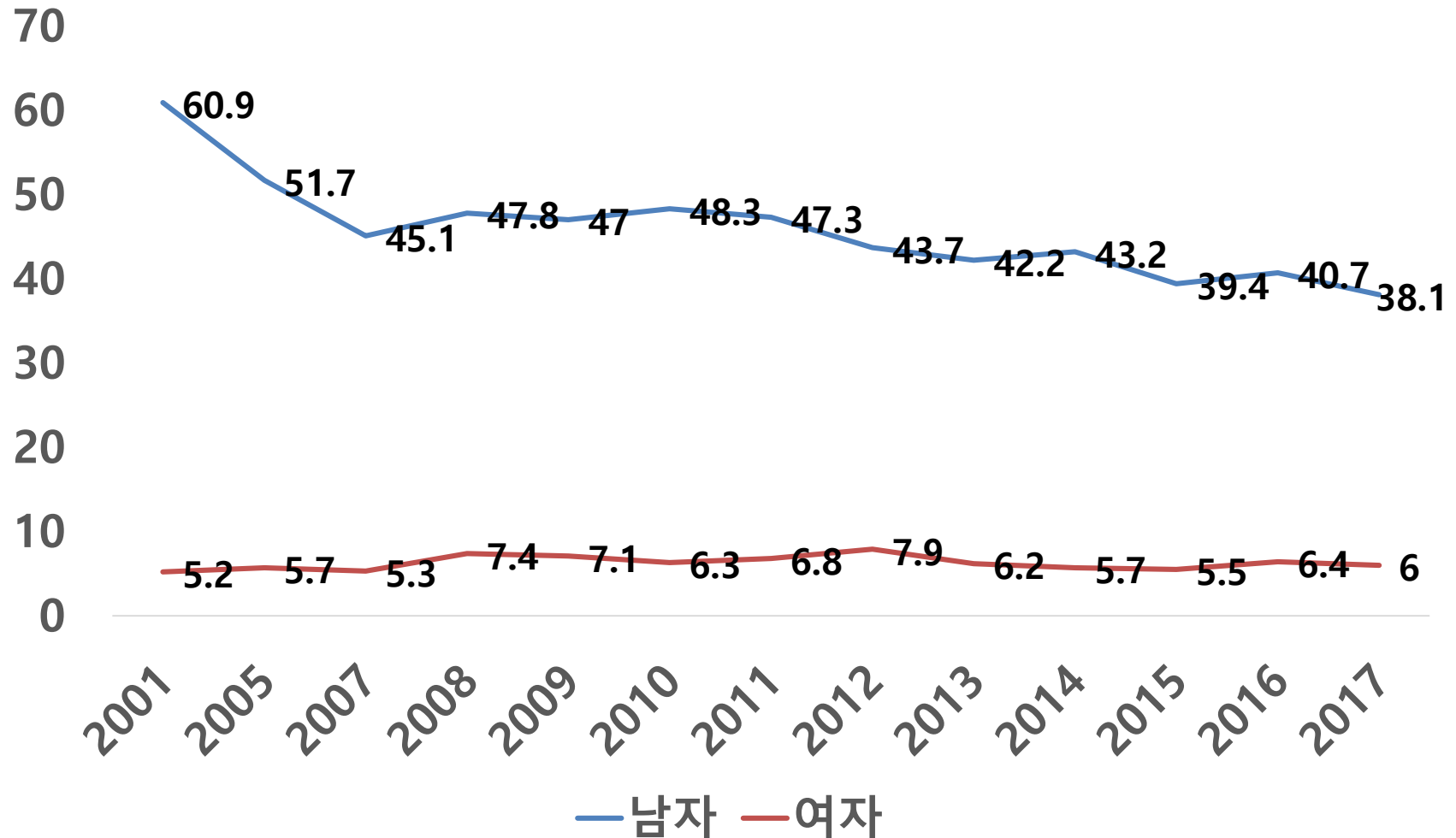
Smoking around others increases their risk for heart attack and death. By not smoking, you help protect your family, friends, and coworkers.



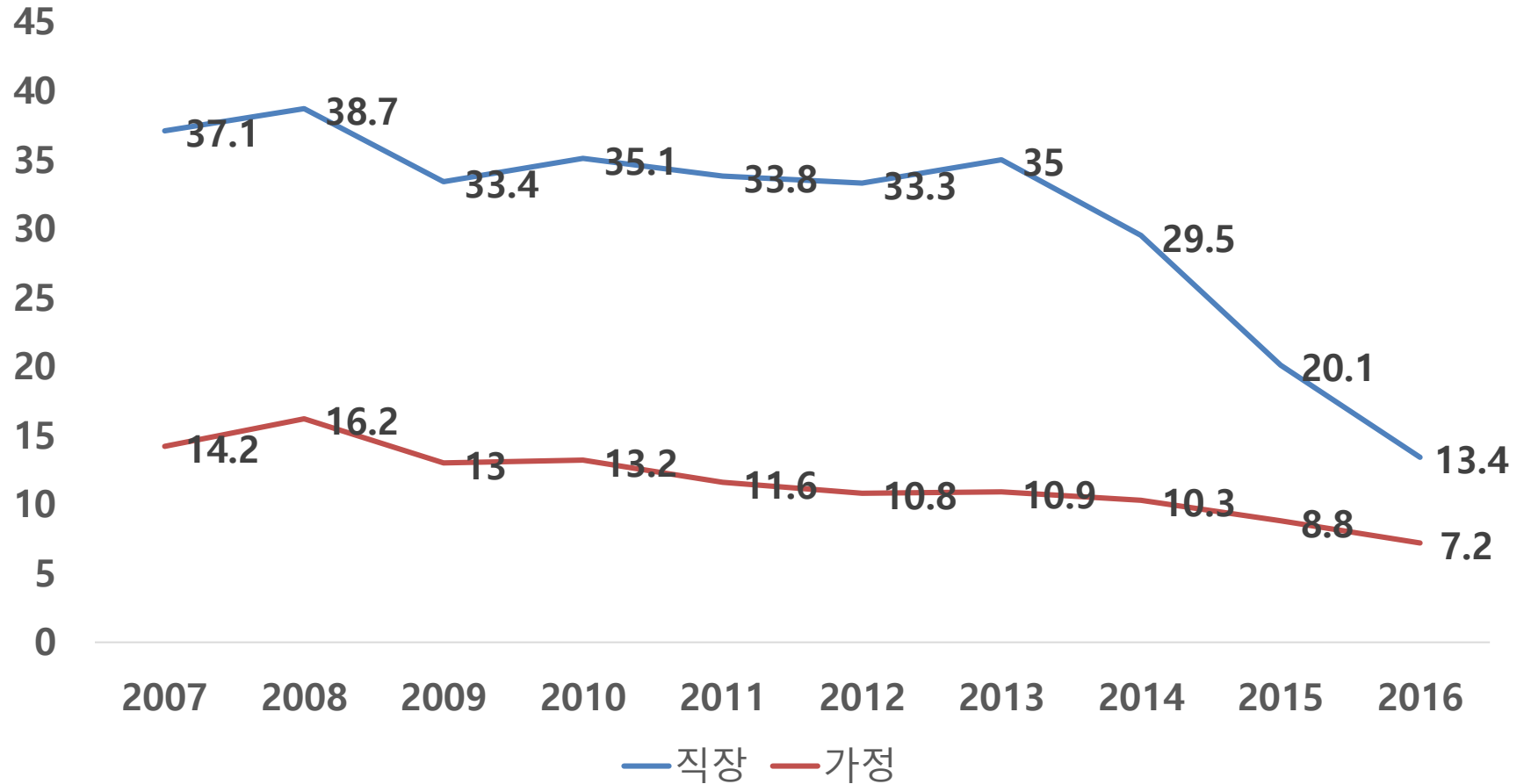
Annual smoking related mortality in USA, 2005-2009

Disease	Male	Female	Total
Cancer	100,300	63,400	163,700
Lung cancer	74,300	53,400	127,700
Cardiovascular & metabolic disease	95,600	65,000	160,000
Respiratory disease	58,200	54,900	113,100
Perinatal condition	582	431	1,013
Residential fire	336	284	620
SHS	23,526	17,758	41,284
Total	278,544	201,773	480,317

Trend of smoking in Korea



Trend of SHS in Korea



한국인 성인 남녀의 흡연 관련 사망에 관한 연구

맹 광 호

가톨릭의대 예방의학교실

흡연율 세계 7위

30세 이상 남녀 흡연율

남자 71.7%

여자 10.7%

1988년 사망자수: 235,779명

Attributable risk of smoking in Korea

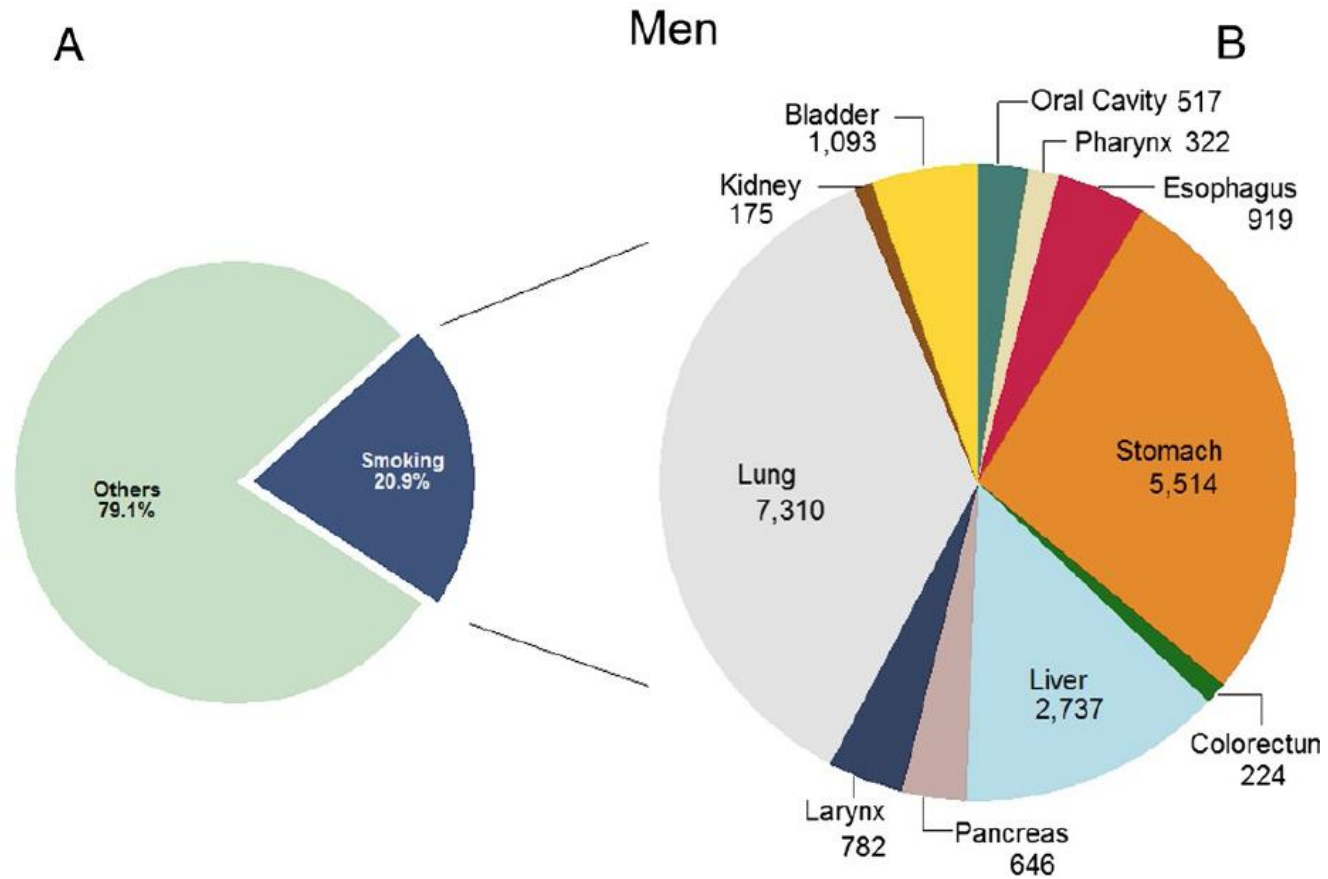
Male

질 병 명	분류가능 신고 사망수	추정 사망수	비교 위험도	인구기여 위험도%	흡연관련 사망자수
전체사인	101,435	127,808	1.28	16.60	21,216
악성신생물전 부위	18,108	22,816	1.65	31.61	6,896
구강, 인후암	166	209	4.58	71.79	150
식도암	653	823	2.08	43.44	358
위 암	7,086	8,928	1.47	25.05	2,236
소장, 대장암	19	24	1.19	11.90	3
직장, 결장암	234	295	1.22	13.53	40
간 암	4,886	6,156	1.65	31.61	1,946
췌장암	408	514	1.49	25.84	133
후두암	323	407	20.33	93.22	379
폐 및 기관지암	2,095	2,640	4.13	69.00	1,822
방광암	178	224	1.64	31.27	70
뇌혈관질환	14,101	17,767	1.26	15.60	2,772
고혈압성심질환	284	358	1.69	32.91	118
기타 고혈압성질환	9,725	12,254	1.26	15.60	1,912
허혈성심질환	852	1,074	1.71	33.54	360
기타 심질환	7,393	9,315	1.29	17.09	1,592
폐 염	817	1,029	1.20	12.45	128
기관지염, 기타 호흡기질환	3,829	4,825	1.31	18.06	871
위, 십이지장궤양	735	926	2.07	43.21	400
위, 십이지장염	320	403	1.03	2.09	8
간경변	7,936	9,999	1.29	17.09	1,709
노쇠	12,987	16,364	1.13	8.46	1,384
진폐증, 기관지확장증	140	176	2.22	46.45	82

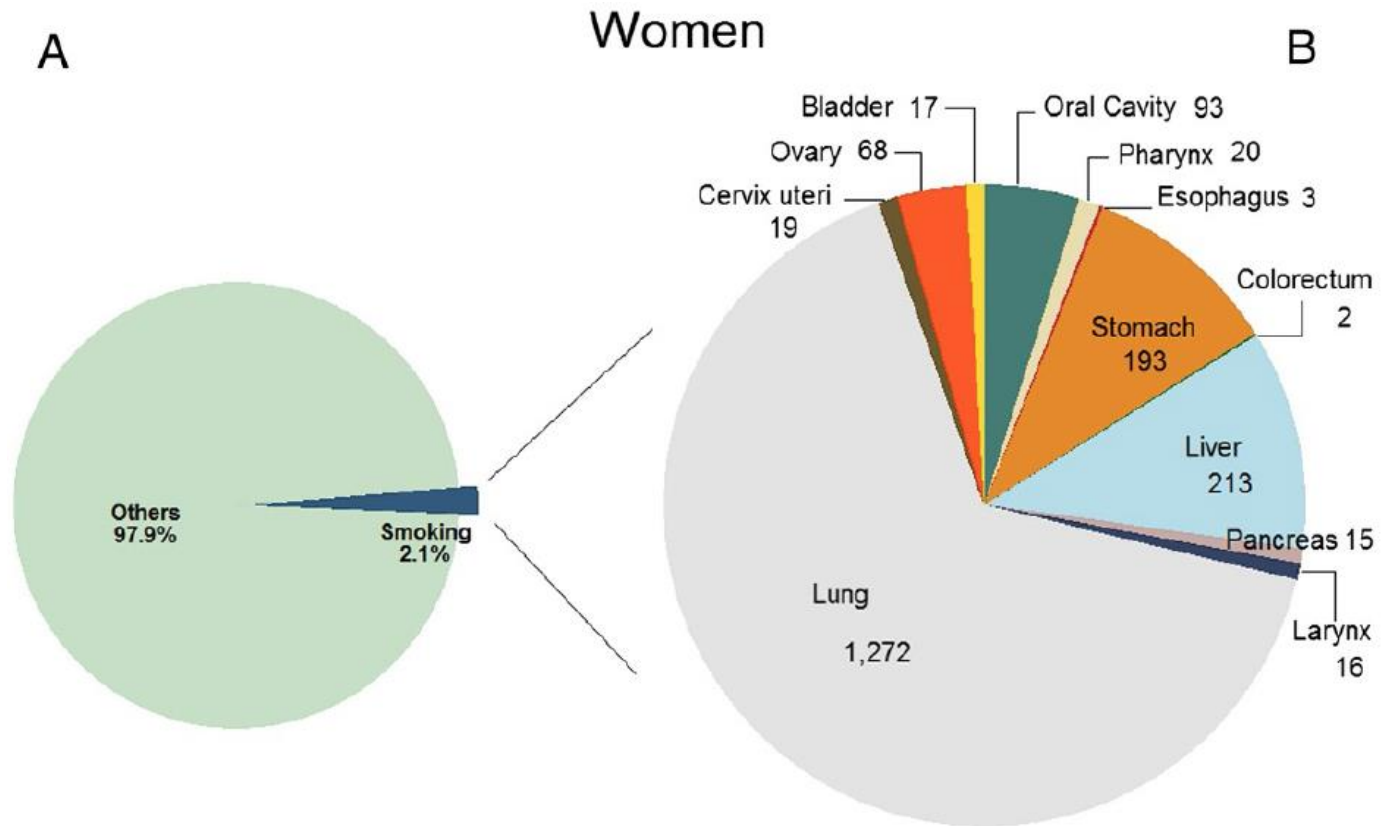
Female

분류가능 신고 사망수	추정사망수	비교 위험도	인구기여 위험도%	흡연관련 사망자수
70,595	88,950	1.34	3.51	3,122
10,058	15,208	1.36	3.71	564
56	71	1.31	3.21	2
124	158	1.39	4.01	6
4,043	5,094	1.25	2.61	133
7	9	—	—	—
201	253	—	—	—
1,480	1,865	1.73	7.25	135
218	275	1.45	4.59	17
95	120	3.43	20.64	25
699	881	2.10	10.53	93
38	48	1.17	1.79	1
398	501	1.17	1.79	9
1,257	1,584	1.72	7.15	113
87	110	1.17	1.79	2
12,139	15,295	1.22	2.30	352
321	405	1.29	3.01	12
6,433	8,106	1.28	2.91	236
469	591	1.78	7.70	46
6,006	7,568	1.44	4.50	341
577	727	1.37	3.81	28
2,910	3,667	1.14	1.48	54
351	442	2.33	12.46	55
321	405	1.03	0.32	2
1,704	2,147	1.44	4.50	97
17,056	21,491	1.54	5.46	1,173
7	9	2.72	15.54	1

AR of smoking on cancer incidence in Korea



AR of smoking on cancer incidence in Korea



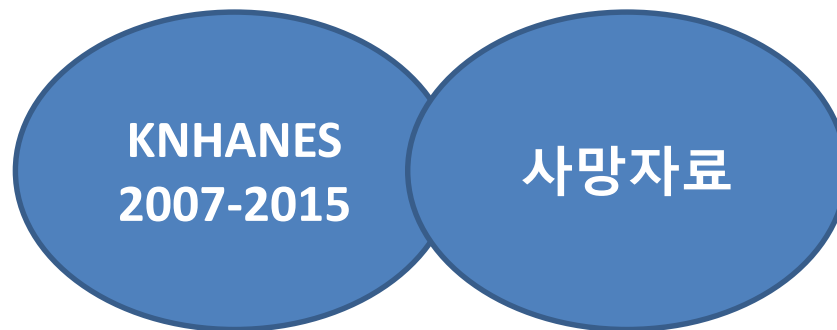
International comparison of cancer death

Cancer site (ICD-10)	Republic of Korea				Japan [7]				China [8]				France [5]				United Kingdom [6]			
	Men		Women		Men		Women		Men		Women		Men		Women		Men		Women	
	RR	PAF	RR	PAF	RR	PAF	RR	PAF	RR	PAF	RR	PAF	RR	PAF	RR	PAF	RR	PAF	RR	PAF
Oral Cavity (C00-C09)	3.3	62.0	3.3	8.2	2.4	50.0	1.8	8.5	1.5 ^b	24.6	1.5 ^a	2.8	4.2	63.1	1.6	17.0	10.9	70	5.1	55
Pharynx (C10-C14)													6.8	76.0	3.3	44.1				
Esophagus (C15)	2.6	54.8	0.9	0.2	3.0	58.9	2.4	14.7	1.3 ^c	17.9	1.3 ^a	1.9	2.5	51.1	2.3	34.4	6.8	63	7.8	71
Stomach (C16)	1.6	31.6	1.0	0.2	1.4	23.5	1.3	3.4	1.7 ^c	30.9	1.7 ^a	3.8	1.7	31.1	1.5	14.3	2.2	26	1.5	15
Colorectum (C18-C20)	1.1	1.2	1.1	0.4	1.4	20.4	1.4	4.5									1.24	7	1.3	10
Liver (C22)	1.4	23.5	2.6	6.1	1.7	35.1	1.6	6.8	1.4 ^b	18.7	1.2 ^b	1.0	1.9	37.5	1.5	17.1	2.3	27	1.5	15
Pancreas (C25)	1.5	26.8	1.1	0.4	1.4	23.9	1.9	9.5	1.9 ^c	35.5	1.9 ^a	4.6	1.6	24.9	1.6 ^d	17.0	2.2	26	2.2	31
Larynx (C32)	4.5	71.9	3.6	9.2	4.5	71.9	4.5	30.1	1.5 ^b	24.6	1.5 ^a	2.8	5.2	75.9	5.2 ^d	64.8	14.6	79	13	79
Lung (C33-C34)	4.4	71.5	3.2	8.1	3.6	67.5	3.6	23.9	5.7 ^c	75.0	5.0 ^c	18.4	9.9	83.0	7.6	69.2	21.3	87	12.5	84
Cervix (C53)	-	-	1.8	3.1	-	-	2.0	10.9	-	-	1.8 ^e	4.5	-	-	1.8	22.9	-	-	1.5	7
Ovary (C56)	-	-	2.1	4.0	-	-	0.9	-									-	-	2.1	3
Kidney (C64)	1.1	6.6	1.1	2.3	1.5	27.9	0.9	-					1.6	26.4	1.4	11.5	2.5 ^g	29 ^g	1.5 ^g	15 ^g
Bladder (C67)	2.1	44.9	2.0	3.8	4.3 ^f	70.7 ^f	1.3 ^f	3.6 ^f	1.9 ^b	36.8	1.7 ^b	3.6	2.8	52.8	2.7	39.3	3	38	2.4	34
Myeloid leukemia (C92)	-	-	-	-	1.7	33.5	1.0	-									1.9	19	1.2	6
Prevalence (%)	70.8 (11.7) ^h		3.9 (0.3) ^h		53.1 (19.8) ⁱ		9.7 (2.6) ^j		64.0 ^j		5.6 ^j		48.2 ^k		30.4 ^k		22 ^l		21 ^l	
% of all cancers	32.9		5.2		34.4		6.2		32.7		5.0		33.4		9.6		23.0		15.6	

^aReplaced by men's RR

「국민건강영양조사·사망원인통계 연계자료」 시범연구 과제공모

질병관리본부는 「국민건강영양조사·사망원인통계 연계자료」를 2019년부터 국내 연구자에게 공개할 예정이며, 이에 앞서 연계자료 공개와 관련된 구체적인 관리지침을 마련하고자 다음과 같이 시범연구를 실시하고자 하오니 관심 있는 연구자들의 적극적인 참여 바랍니다.



Study population

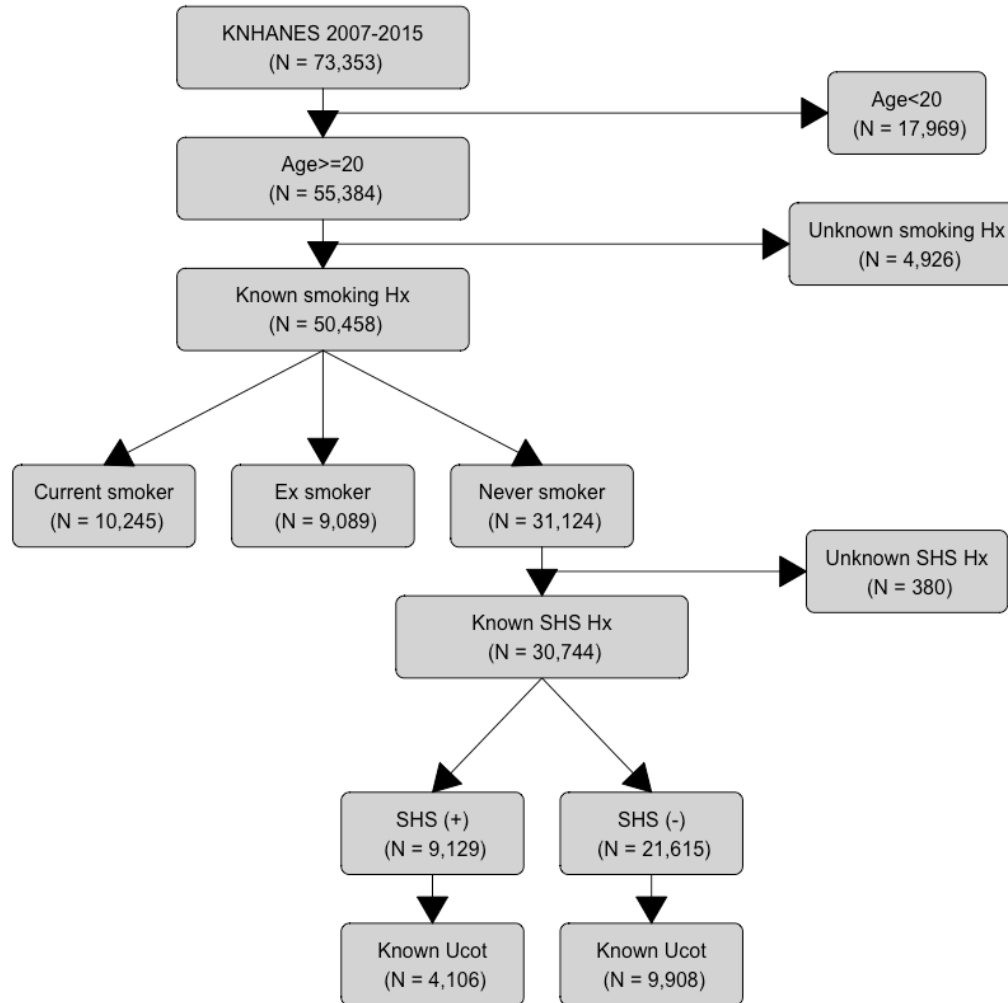


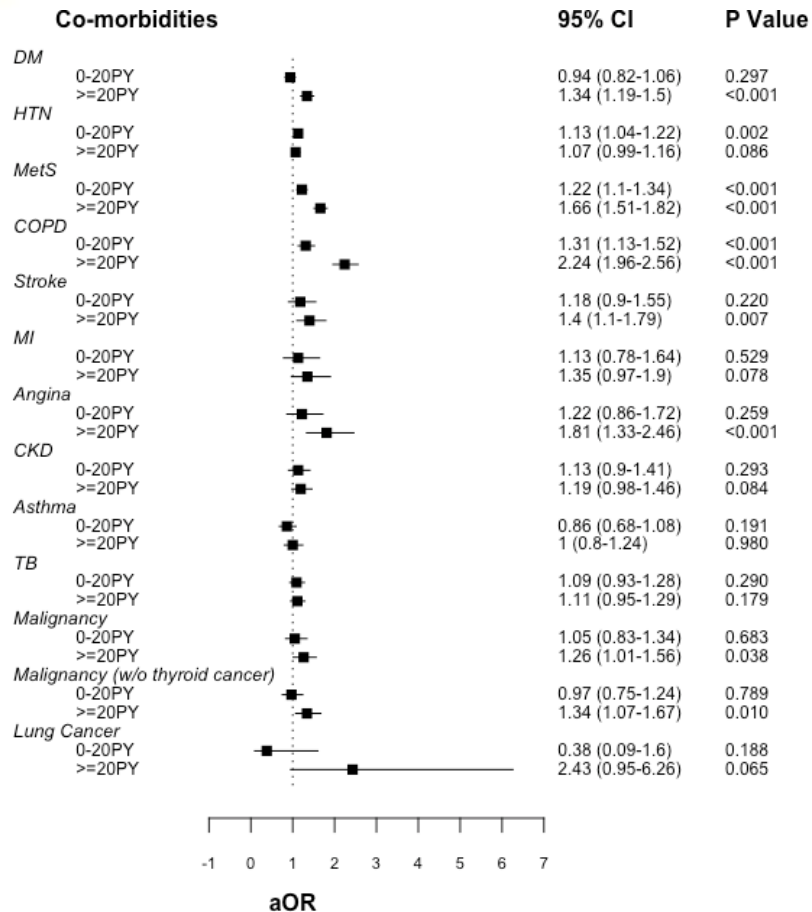
Table 1. Baseline characteristic based on questionnaire

Variables	Male					Female				
	NS (n=4727)	0-20PY (n=8081)	≥20PY (n=8566)	P value	SMD	NS (n=26397)	0-20PY (n=2126)	≥20PY (n=561)	P value	SMD
Age, years	46.6±17.5	46.2±16.1	56.7±13.5	<0.001	0.458	50.8±16.3	45.1±17.8	54.9±18.1	<0.001	0.370
Weight, kg	69.7±11.2	70.2±11.2	68.2±10.9	<0.001	0.123	57.3±9.0	57.8±10.6	57.1±11.2	0.030	0.047
Height, cm	169.9±7.1	170.6±6.7	168.3±6.4	<0.001	0.230	156.3±6.6	157.8±6.9	155.8±7.4	<0.001	0.191
WC, cm	84.0±9.1	84.3±8.8	85.6±8.8	<0.001	0.124	79.0±9.8	78.6±10.8	80.5±11.3	<0.001	0.114
BMI, kg/m ²	24.1±3.2	24.1±3.2	24.0±3.1	0.273	0.016	23.5±3.5	23.2±3.9	23.5±4.1	0.002	0.048
Smoking dose, PY		8.8±5.6	37.2±18.5	<0.001			4.9±4.7	33.1±15.2	<0.001	
Alcohol intake				<0.001	0.483				<0.001	0.491
Never drinker	11.2	2.8	4.5			21.9	7.6	12.7		
Former drinker	12.4	9.7	14.0			17.9	18.2	20.0		
≤1/week	54.0	50.3	35.4			52.6	51.5	39.4		
2-3/week	16.9	26.6	24.8			6.0	16.3	16.8		
≥4/week	6.0	10.7	21.3			1.6	6.4	11.2		
Physical activity				<0.001	0.169				<0.001	0.161
No	43.7	42.7	53.3			60.2	61.9	69.5		
Medium or High	29.1	28.3	27.4			26.0	23.7	21.4		
Medium and High	27.2	29.0	19.3			13.8	14.3	9.1		
Education				<0.001	0.353				<0.001	0.391
Below middle school	13.4	12.5	27.0			32.5	26.0	49.3		
Middle school	9.3	9.0	16.1			10.4	9.7	10.6		
High school	35.4	38.1	33.5			30.6	41.1	27.2		
Above high school	41.9	40.4	23.4			26.6	23.2	13.0		
Personal economic status				<0.001	0.112				<0.001	0.299
1Q	22.7	22.9	26.9			23.4	34.1	40.1		
2Q	23.2	25.3	25.7			25.1	26.4	27.7		
3Q	25.3	25.5	25.0			25.6	21.4	18.8		
4Q	28.8	26.3	22.4			25.9	18.4	13.5		
Occupation				<0.001	0.105				<0.001	0.079
Employed	72.4	78.0	71.3			47.7	44.1	45.4		
Unemployed	27.6	22.0	28.7			52.3	55.9	54.6		
Comorbidities										
Diabetes	19.3	19.7	30.7	<0.001	0.241	19.3	19.7	27.1	<0.001	0.306
Hypertension	55.3	57.7	64.7	<0.001	0.129	44.1	36.1	49.7	<0.001	0.199
MetS	25.4	27.5	39.3	<0.001	0.197	31.6	26.3	42.1	<0.001	0.291
COPD	13.0	14.7	29.4	<0.001	0.325	6.1	9.7	16.7	<0.001	0.222
Stroke	1.9	2.0	3.9	<0.001	0.081	1.8	2.2	3.4	0.003	0.081

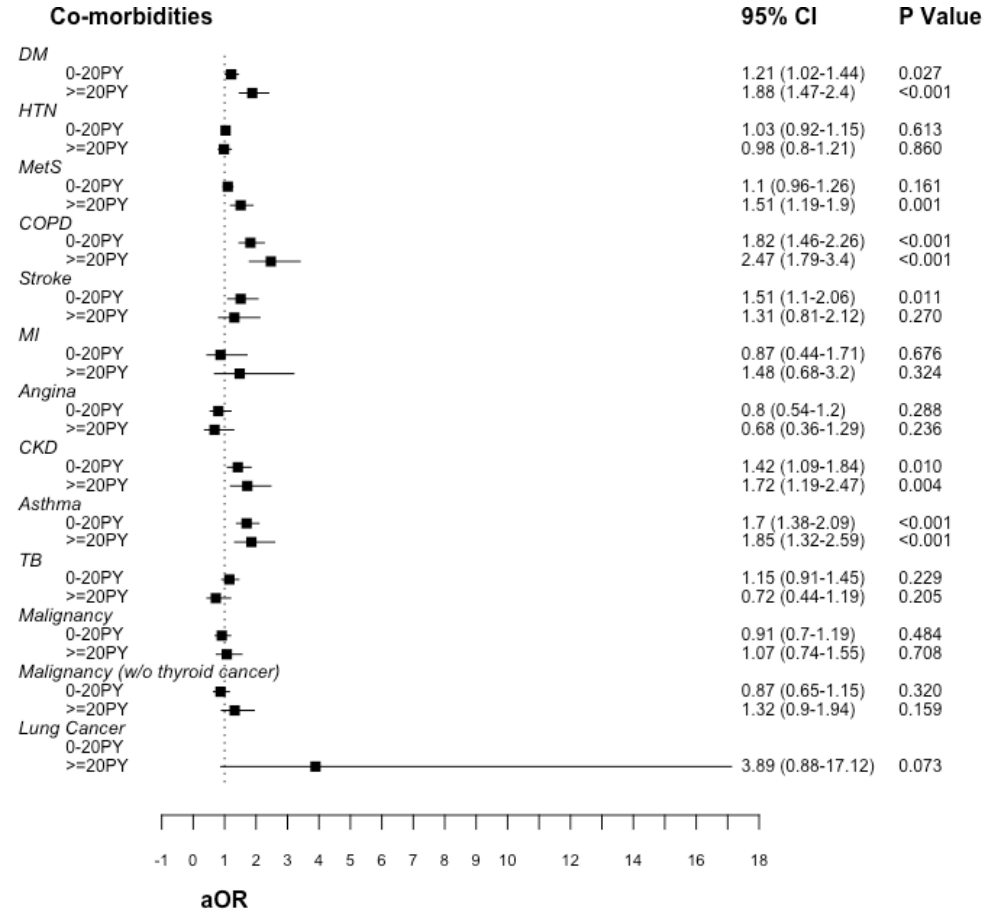
Table 1. Baseline characteristic based on questionnaire

Variables	Male					Female				
	NS (n=4727)	0-20PY (n=8081)	≥20PY (n=8566)	P value	SMD	NS (n=26397)	0-20PY (n=2126)	≥20PY (n=561)	P value	SMD
Comorbidities										
Diabetes	19.3	19.7	30.7	<0.001	0.241	19.3	19.7	27.1	<0.001	0.306
Hypertension	55.3	57.7	64.7	<0.001	0.129	44.1	36.1	49.7	<0.001	0.199
MetS	25.4	27.5	39.3	<0.001	0.197	31.6	26.3	42.1	<0.001	0.291
COPD	13.0	14.7	29.4	<0.001	0.325	6.1	9.7	16.7	<0.001	0.222
Stroke	1.9	2.0	3.9	<0.001	0.081	1.8	2.2	3.4	0.003	0.081
MI	1.0	1.0	1.9	<0.001	0.055	0.6	0.4	1.3	0.006	0.086
Angina	1.1	1.2	2.8	<0.001	0.085	1.8	1.2	1.8	0.011	0.070
CKD	3.3	3.2	5.9	<0.001	0.090	3.3	4.0	8.3	<0.001	0.196
Hypercholesterol	5.7	7.2	8.4	<0.001	0.072	9.2	9.8	9.7	<0.001	0.141
Asthma	2.7	2.3	3.1	0.029	0.035	3.4	5.0	6.9	<0.001	0.119
Tuberculosis	5.6	5.9	8.0	<0.001	0.064	3.7	3.9	2.9	0.034	0.068
Malignancy (w/o thyroid cancer)	2.3	2.1	4.4	<0.001	0.090	3.4	2.5	5.3	<0.001	0.112
Lung cancer	0.1	0.0	0.4	<0.001	0.053	0.1	0.0	0.4	0.002	0.085

Co-morbidities of smoking

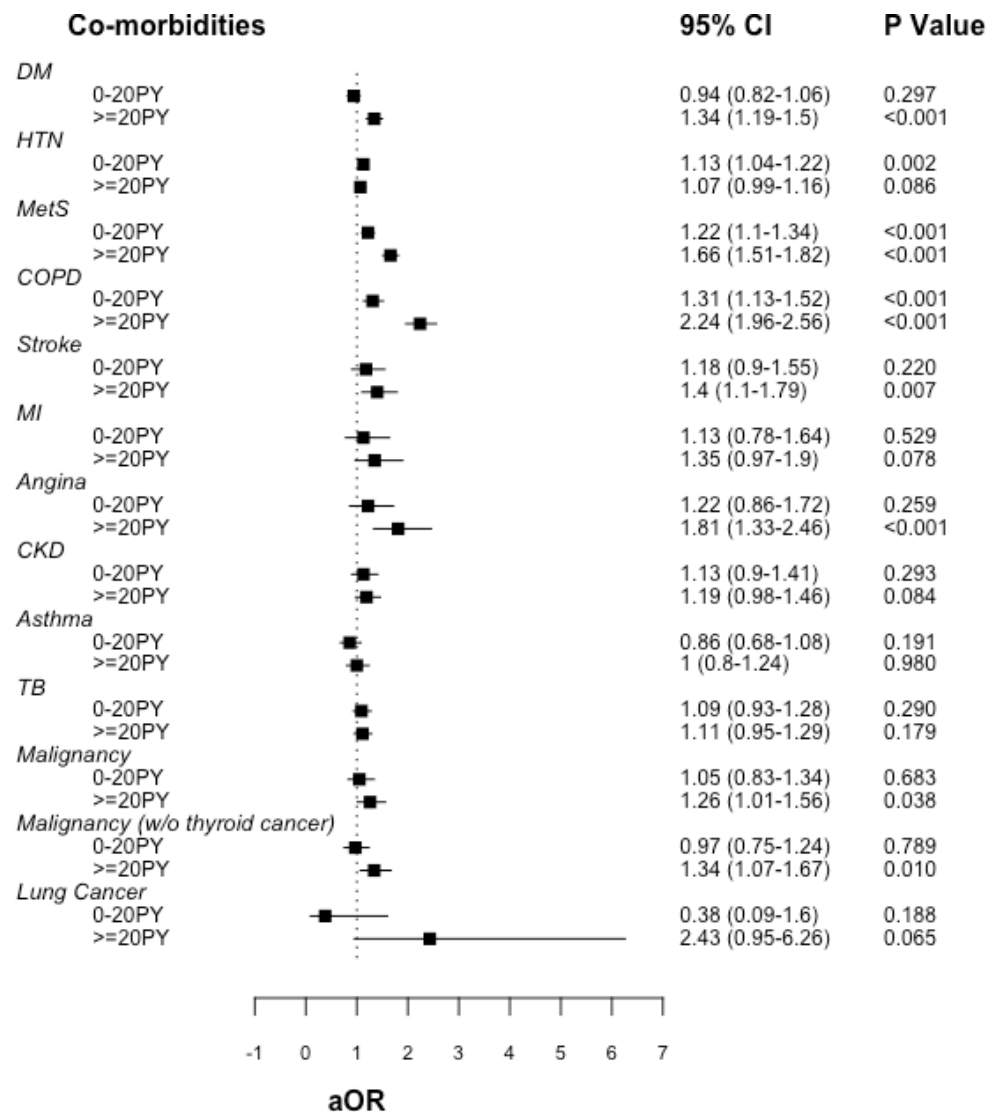


Male

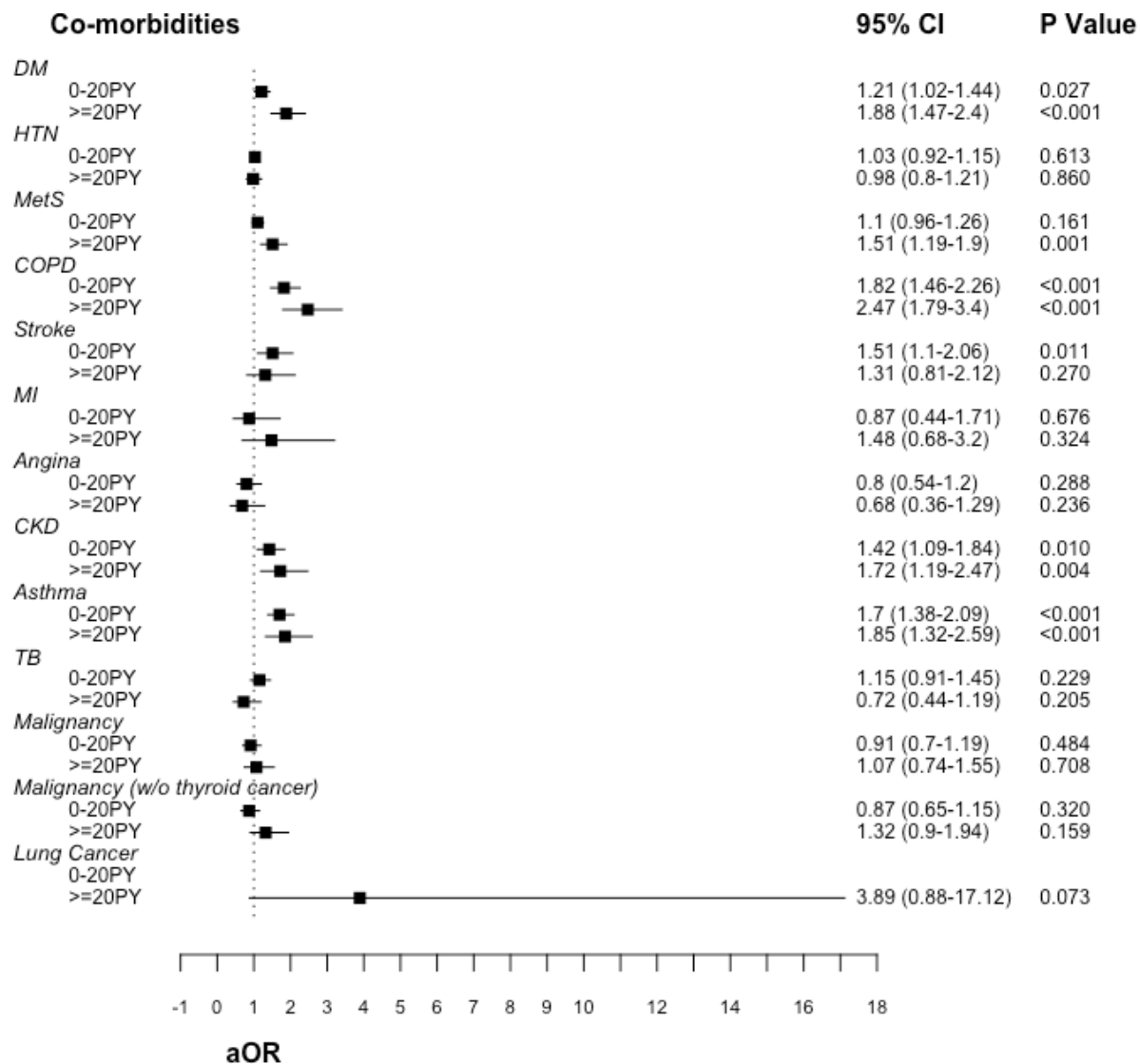


Female

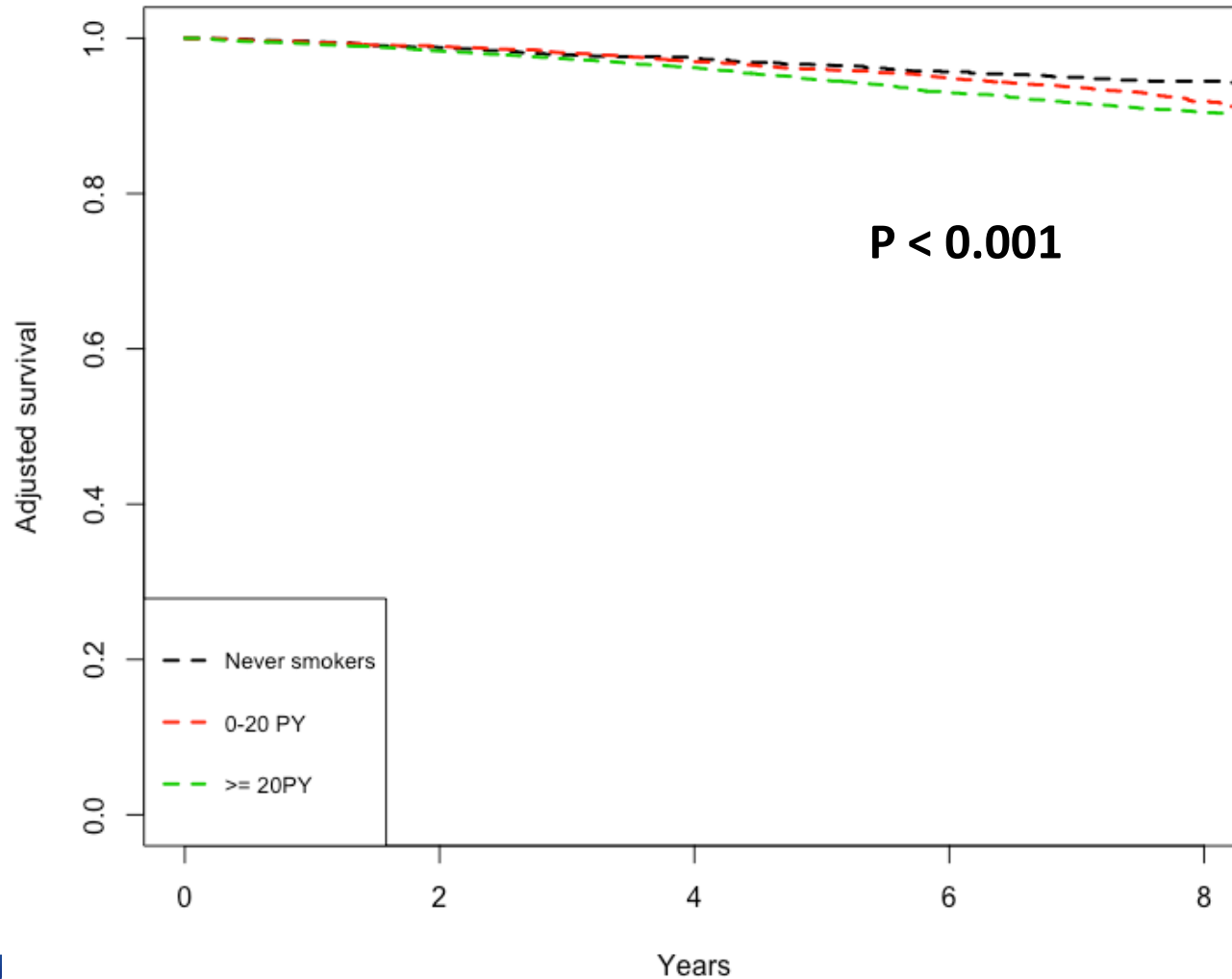
Co-morbidities of smoking, male



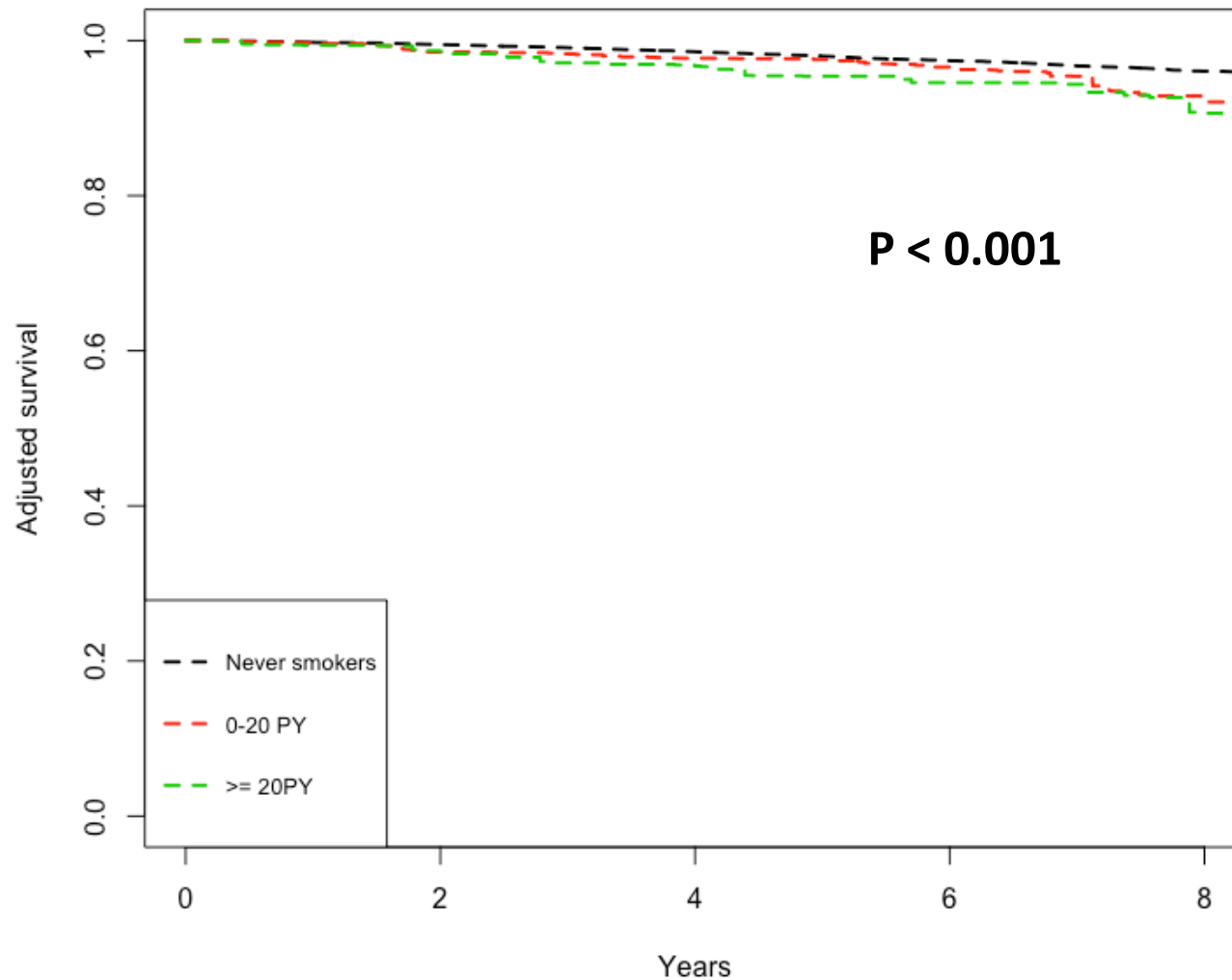
Co-morbidities of smoking, female



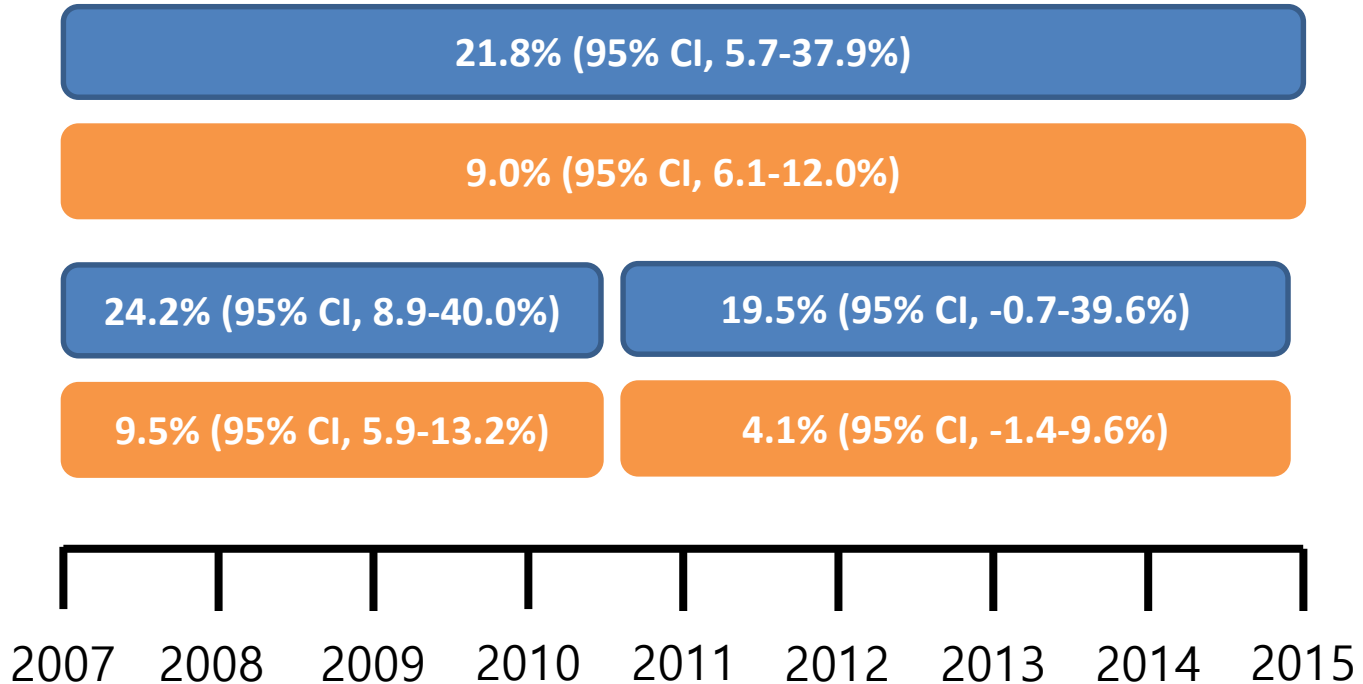
Adjusted KM curve, male



Adjusted KM curve, female



Attributable risk assessment





당신은 오늘
몇 번의 **흡연갑질**을
하셨습니까?

“여기서 한 대 피워도 괜찮지?”

흡연갑질 #09
직장동료를 발암물질에 노출시키는 일

FILTER CIGARETTES
TOBACCO
20 CLASS A CIGARETTES



당신은 오늘
몇 번의 **흡연갑질**을
하셨습니까?

“양치했으면 된 거 아냐?”

흡연갑질 #16
가족을 유해물질에 노출시키는 일

FILTER CIGARETTES
TOBACCO
20 CLASS A CIGARETTES

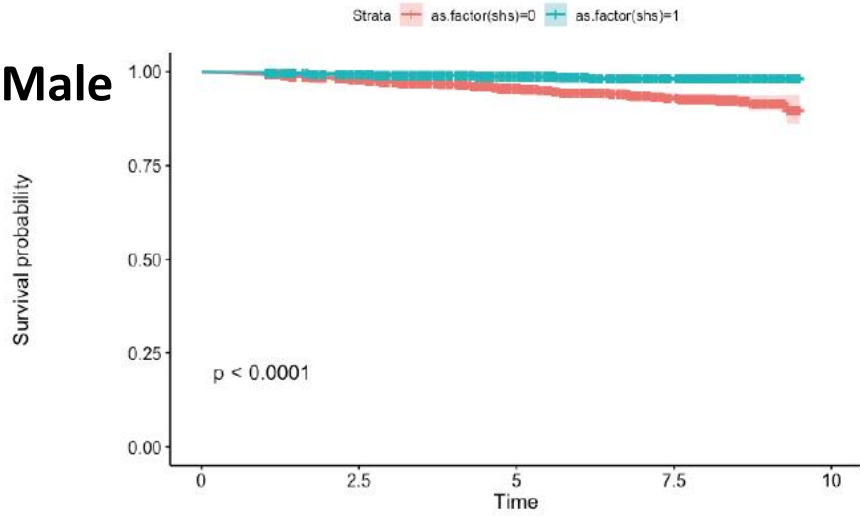
Table 1. Baseline characteristics of Never smokers.

Variables	Male				Female			
	NS SHS- (n=2,759)	NS SHS+ (n=1,934)	P value	SMD	NS SHS- (n=18,856)	NS SHS+ (n=7,195)	P value	SMD
Age, years	49.5±18.8	42.4±14.6	<0.001	0.425	52.5±16.5	46.3±14.6	<0.001	0.402
Weight, kg	69.0±11.1	70.8±11.2	<0.001	0.156	57.1±8.9	57.7±9.2	<0.001	0.068
Height, cm	169.5±7.3	170.7±6.8	<0.001	0.173	156.0±6.7	157.1±6.4	<0.001	0.172
WC, cm	84.0±9.1	83.9±9.1	0.543	0.018	79.3±9.8	78.4±9.9	<0.001	0.091
BMI	24.0±3.2	24.3±3.3	0.005	0.083	23.5±3.4	23.4±3.5	0.055	0.027
Alcohol intake			<0.001	0.375			<0.001	0.337
Never drinker	14.1	7.0			24.5	14.7		
Former drinker	15.6	7.5			19.2	14.2		
≤1/week	50.1	59.7			50.0	59.5		
2-3/week	14.5	19.1			4.9	8.9		
≥4/week	5.6	6.5			1.3	2.4		
Unknown	0.1	0.2			0.1	0.3		
Physical activity			<0.001	0.253			<0.001	0.159
No	47.8	36.0			61.3	54.4		
Medium or High	27.2	31.1			24.9	27.8		
Medium and High	23.5	31.7			12.5	16.8		
Unknown	1.4	1.1			1.3	0.9		
Education			<0.001	0.258			<0.001	0.246
Below middle school	16.2	8.6			34.6	25.4		
Middle school	10.1	7.9			9.9	11.3		
High school	33.2	37.4			27.6	37.0		
Above high school	39.0	44.8			26.5	25.2		
Unknown	1.5	1.4			1.4	1.0		
Personal economic status			0.001	0.134			0.016	0.048
1Q	24.5	19.4			22.7	24.0		
2Q	22.6	23.4			24.5	25.3		
3Q	24.0	26.3			25.5	24.8		
4Q	27.4	29.9			25.9	24.4		
Unknown	1.4	1.0			1.3	1.5		
Employment			<0.001	0.723			<0.001	0.729
Employed	59.5	88.7			38.2	72.1		
Unemployed	39.0	9.8			60.3	26.7		
Unknown	1.5	1.5			1.5	1.2		

Table 3. Baseline characteristics of Never smokers after PS matching

Variables	Male				Female			
	NS SHS- (n=1876)	NS SHS+ (n=1876)	P value	SMD	NS SHS- (n=6916)	NS SHS+ (n=6916)	P value	SMD
Age, years	44.8±16.5	42.4±14.6	<0.001	0.153	46.8±14.9	46.1±14.5	0.008	0.045
Weight, kg	70.0±11.0	70.7±11.2	0.061	0.061	57.4±8.9	57.8±9.3	0.014	0.042
Height, cm	170.4±7.0	170.6±6.8	0.251	0.038	157.1±6.4	157.2±6.3	0.640	0.008
Alcohol intake			<0.001	0.209			0.198	0.046
Never drinker	10.7	7.1			15.1	14.3		
Former drinker	11.7	7.4			13.9	14.1		
≤1/week	55.8	59.9			60.8	60.1		
2-3/week	16.3	18.9			8.0	8.8		
≥4/week	5.4	6.5			2.0	2.4		
Unknown	0.1	0.2			0.2	0.3		
Physical activity			0.001	0.133			0.070	0.045
No	41.6	35.9			55.6	53.9		
Medium or High	29.2	31.6			27.8	28.0		
Medium and High	27.6	31.4			15.7	17.2		
Unknown	1.7	1.1			0.9	0.8		
Education			0.012	0.117			0.057	0.051
Below middle school	11.7	8.7			25.9	24.8		
Middle school	8.7	7.8			12.0	11.5		
High school	35.2	37.5			34.8	37.3		
Above high school	42.4	44.6			26.3	25.5		
Unknown	1.9	1.4			1.0	0.9		
Personal economic status			0.620	0.053			0.724	0.024
1Q	21.4	19.6			22.9	23.8		
2Q	22.9	23.2			25.8	25.3		
3Q	25.2	26.3			24.9	24.8		
4Q	29.4	30.0			25.0	24.6		
Unknown	1.1	0.9			1.4	1.4		
Employment			<0.001	0.193			0.731	0.013
Employed	82.0	88.7			71.8	72.4		
Unemployed	16.1	9.8			27.0	26.5		
Unknown	1.9	1.5			1.2	1.1		
Comorbidities			0.907	0.014			0.846	0.010
Diabetes		Yes	8.0	8.4	7.3	7.1		
		No	88.3	88.1	87.9	88.3		
		Unknown	3.6	3.5	4.7	4.6		
			0.258	0.054			0.650	0.016

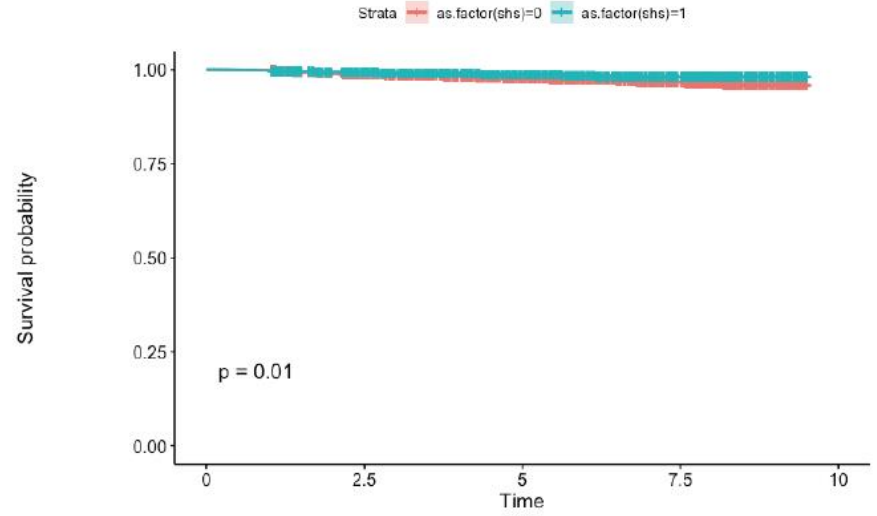
Male



Number at risk

Strata	0	2.5	5	7.5	10
as.factor(shs)=0	2640	2068	1292	569	0
as.factor(shs)=1	1876	1656	1100	522	0

Time

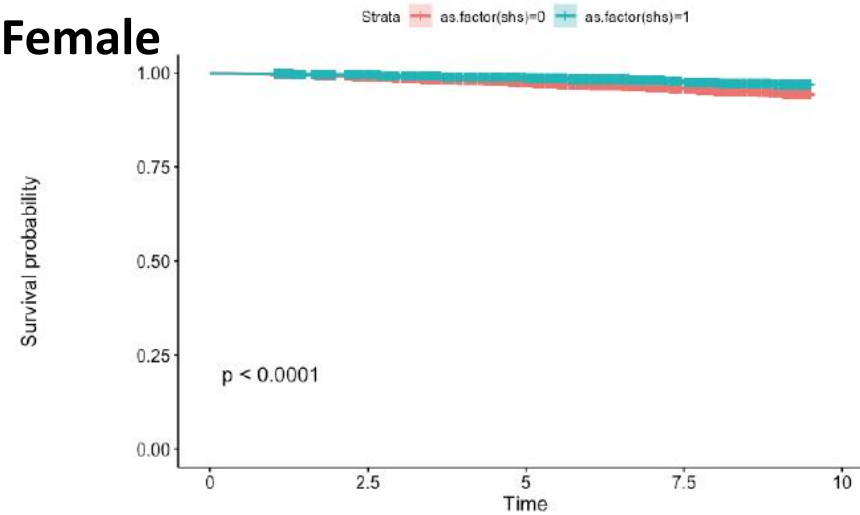


Number at risk

Strata	0	2.5	5	7.5	10
as.factor(shs)=0	1876	1494	957	436	0
as.factor(shs)=1	1876	1656	1100	522	0

Time

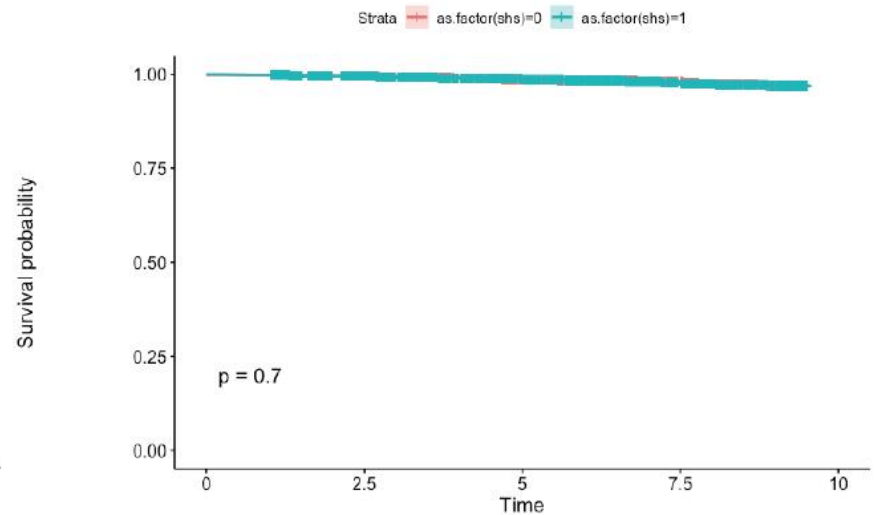
Female



Number at risk

Strata	0	2.5	5	7.5	10
as.factor(shs)=0	17949	14867	9544	4137	0
as.factor(shs)=1	6916	6198	4385	2118	0

Time



Number at risk

Strata	0	2.5	5	7.5	10
as.factor(shs)=0	6916	5779	3829	1707	0
as.factor(shs)=1	6916	6198	4385	2118	0

Time

CoxPH model for never smokers

Model		Male			Female		
		HR	95% CI	P value	HR	95% CI	P value
Before PS matching							
	without adjustment	0.26	0.17 – 0.39	<0.001	0.50	0.41 – 0.62	<0.001
	With adjustment	0.77	0.48 – 1.25	0.299	1.14	0.91 – 1.42	0.249
After PS matching							
	Without adjustment	0.53	0.32 – 0.87	0.012	1.06	0.80 – 1.40	0.705
	With adjustment	0.79	0.48 – 1.31	0.355			

Adjusted variables: smd > 0.1

Summary

- Smoking rate is decreasing.
- Tobacco kills up to half of its users. (WHO)
- Attributable mortality of smoking is
 - Still significant, 21.8% in male, 9.0% in female.
 - Decreasing on 2011-2015 vs. 2007-2010
- Significant effects of SHS on mortality were not found in both men and women.