

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
					Colon cancer	Rectal cancer	Colorectal cancer	
Terry et al. (2002), USA, Canadian National Breast Screening Study (NBSS)	Multicenter randomized controlled trial of mammography screening. 89835 women aged 40-59 years. Follow-up 1982-1993. Incident colorectal cancer or death was ascertained by computerized record linkage to the National Mortality Database and the Canadian Cancer Database. Participants completed a self-administered questionnaire.	363 colon, 164 rectal incident cases	Never smokers	274	1.0	1.0	Adjusted for age (in 5-year age groups), BMI (quartiles), educational level, vigorous physical activity, hormone replacement therapy, menopausal status and alcohol intake	
			Ex smokers	145	1.03 (0.80-1.33)	1.44 (1.00-2.06)		
			Current smokers	108	0.93 (0.71-1.24)	1.17 (0.78-1.75)		
			<i>Cigarettes/d</i>					
			1-9	56	0.89 (0.61-1.28)	1.31 (0.80-2.14)		
			10-19	78	0.94 (0.67-1.32)	1.98 (1.32-2.96)		
			20-29	93	1.16 (0.87-1.53)	0.97 (0.61-1.56)		
			30-39	12	0.87 (0.44-1.69)	0.72 (0.23-2.29)		
			40+	8	0.63 (0.26-1.52)	0.90 (0.28-2.85)		
			<i>p trend</i>		0.99	0.82		
			<i>Years smoked</i>					
			1-9	42	0.93 (0.61-1.40)	1.31 (0.75-2.28)		
			10-19	53	0.90 (0.62-1.30)	1.24 (0.75-2.05)		
			20-29	83	1.04 (0.77-1.42)	1.37 (0.89-2.11)		
			30-39	61	1.16 (0.83-1.63)	1.12 (0.65-1.94)		
			40+	12	0.68 (0.25-1.86)	3.14 (1.33-7.42)		
			<i>p trend</i>		0.66	0.07		
			<i>Years since smoking commenced</i>					
1-9	12	1.50 (0.74-3.05)	1.76 (0.64-4.82)					
10-19	24	0.84 (0.50-1.40)	0.97 (0.47-2.02)					
20-29	85	0.91 (0.67-1.24)	1.11 (0.72-1.73)					
30-39	105	1.05 (0.79-1.39)	1.52 (1.01-1.26)					
40+	22	1.12 (0.62-2.04)	2.27 (1.06-4.87)					
<i>p trend</i>		0.98	0.03					
Tiemersma et al. (2002), Netherlands, Monitoring Project on Cardiovascular Disease Risk Factors	Nested case-control study, controls frequency matched for age and gender. Using data from the prospective Monitoring Project on Cardiovascular Disease Risk Factors conducted in Amsterdam, Maastricht and Doetinchen. Including persons aged 20-59 years.	102 incident cases, 537 controls	Never smokers	30		1.0	Adjusted for age, sex, center, coffee and alcohol consumption and body mass index.	
			Former smokers	43		1.01.4 (08-2.5)		
			Current smokers	29		0.9 (0.5-1.7)		
			<i>p trend</i>			0.27		
			<i>Smoking duration (years)</i>					
			<i>Former smokers</i>					
			1-15	13		1 (ref.)		
			16-30	23		2.7 (1.03-7.4)		
			>30	7		3.2 (1.04-9.8)		
			<i>p trend</i>			0.04		
<i>Current smokers</i>								
1-15	3		1 (ref.)					
16-30	7		0.4 (0.1-1.9)					

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments	
					Colon cancer	Rectal cancer	Colorectal cancer		
Tiemersma et al. (2002), (contd)	Follow-up 1987-1998. Incident cancer was obtained by record linkage with the Netherlands Cancer Registry and with the three regional cancer registries. Participants completed a self-administered questionnaire.		>30	19			1.9 (0.5-8.2)	Adjusted for age, sex, center, coffee and alcohol consumption and body mass index.	
			<i>p</i> trend				0.28		
			<i>Cigarettes/d</i>						
			<i>Former smokers</i>						
			1-10	12			1 (ref)		
			11-20	21			2.1 (0.9-5.0)		
			>20	10			1.7 (0.6-4.6)		
			<i>p</i> trend				0.15		
			<i>Current smokers</i>						
			1-10	10			1 (ref.)		
			11-20	14			1.1 (0.4-2.8)		
			>20	5			1.2 (0.3-4.0)		
<i>p</i> trend				0.75					
<i>Time since quit smoking</i>									
>18 years	18			1 (ref.)					
9-18 years	16			2.6 (1.0-6.5)					
0-8 years	9			2.2 (0.8-5.5)					
<i>p</i> trend				0.10					
Limburg et al. (2003); USA; Iowa Women's Health Study	Baseline questionnaire was mailed in January 1986 to randomly selected women aged 55-69 years, 41836 (42.7%) responded. Incident CRC cases were identified through the IOWA Cancer Registry, Follow-up continued through December 1999	869 incident CRC cases and 249 fatal CRC cases	<i>CRC incidence</i>					Adjusted for age, BMI, waist-hip ratio, physical activity level, hormone replacement therapy, alcohol consumption, intake of methionine, total calories, fat, sucrose, red meat, calcium, folate, and vitamin E.	
			Never smokers	558			1.0		
			Current smokers	122			1.10 (0.89-1.37)		
			Former smokers	189			1.21 (1.01-1.45)		
			<i>p</i> trend				0.14		
			<i>Age at initiation</i>						
			≤30 years	287			1.20 (1.02-1.40)		
			>30 years	24			0.90 (0.59-1.39)		
			<i>p</i> trend				0.03		
			<i>Total duration (yrs)</i>						
			1-19	71			1.16 (0.89-1.52)		
			20-39	129			1.08 (0.88-1.32)		
≥40	111			1.30 (1.04-1.63)					
<i>p</i> trend				0.03					
<i>Cigarettes/d</i>									
1-19	163			1.15 (0.95-1.38)					
20	99			1.23 (0.97-1.54)					
>20	49			1.12 (0.82-1.54)					
<i>p</i> trend				0.08					
<i>Pack-years</i>									
1-19	123			1.15 (0.93-1.41)					

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
					Colon cancer	Rectal cancer	Colorectal cancer	
Limburg et al. (2003); (contd)			20-39	105			1.16 (0.92-1.45)	Adjusted for age, BMI, waist-hip ratio, physical activity level, hormone replacement therapy, alcohol consumption, intake of methionine, total calories, fat, sucrose, red meat, calcium, folate, and vitamin E.
			≥40	83			1.21 (0.94-1.56)	
			<i>p</i> trend				0.06	
			CRC Mortality					
			Never	158			1.0	
			Current smokers	45			1.58 (1.09-2.29)	
			Former smokers	46			1.14 (0.80-1.62)	
			<i>p</i> trend				0.02	
			<i>Age at initiation</i>					
			≤30 years	81			1.34 (1.00-1.80)	
			>30 years	10			1.04 (0.48-2.22)	
			<i>p</i> trend				0.14	
			<i>Total duration (yrs)</i>					
			1-19	24			1.53 (0.96-2.43)	
			20-39	32			1.02 (0.67-1.53)	
			≥40	35			1.55 (1.04-2.31)	
			<i>p</i> trend				0.07	
			<i>Cigarettes/d</i>					
			1-19	47			1.27 (0.89-1.80)	
			20	33			1.50 (0.99-2.28)	
		>20	11			1.07 (0.57-2.00)		
		<i>p</i> trend				0.14		
		<i>Pack-years</i>						
		1-19	36			1.30 (0.88-1.91)		
		20-39	27			1.08 (0.69-1.70)		
		≥40	28			1.63 (1.05-2.49)		
		<i>p</i> trend				0.05		

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases			Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
				C	R	CRC	Colon cancer	Rectal cancer	Colorectal cancer	
Otani et al. (2003), Japan, The Japan Public Health Center-based prospective study on cancer and cardiovascular disease (JPHC study)	Cohort I started 1990 in 5 areas in 5 prefectures (Iwate, Akita, Nagano, Okinawa, Tokyo) and covered all residents aged 40-59. Cohort II started 1993 in 6 areas in 6 prefectures (Ibaraki, Niigata, Kochi, Nagasaki, Okinawa, Osaka) and covered all residents aged 40-69. 57591 men and 59103 women. Active follow-up 1990-1999, 1993-1999 using data of Ministry of Health, Labor and Welfare for deaths and the JPHC cancer registry for incidence. Participants completed a self-administered questionnaire.	447 incident cases (299 colon cancers, 148 rectal cancers)	Never smokers	53	25	78	1.0	1.0	1.0	Adjusted for age (5 year groups), family history of colorectal cancer, BMI, alcohol consumption, physical exercise and 9 Public Health Center areas
			Former smokers	86	38	124	1.4 (0.96-1.9)	1.2 (0.7-2.0)	1.3 (0.98-1.7)	
			Current smokers	160	85	245	1.4 (0.99-1.9)	1.4 (0.9-2.3)	1.4 (1.1-1.8)	
			<i>Pack years</i>							
			<20	17	16	33	0.9 (0.5-1.5)	1.6 (0.9-3.0)	1.1 (0.8-1.7)	
			20-29	31	19	50	1.2 (0.8-2.0)	1.5 (0.8-2.7)	1.3 (0.9-1.9)	
			30-39	55	18	73	1.7 (1.1-2.4)	1.0 (0.6-1.9)	1.4 (1.05-2.0)	
40+	54	29	83	1.3 (0.9-2.0)	1.4 (0.8-2.3)	1.4 (0.99-1.8)				
<i>p trend</i>				0.16	0.48	0.47				

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases			Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
							Colon cancer	Rectal cancer	Colorectal cancer	
Shimizu et al. (2003), Japan	Cohort study with 31152 residents in Takayama, Japan who were 35 years old or older. Follow up 1993-2000. Participants completed a self-administered questionnaire.	198 colon and 97 rectal cancer incident cases	<i>Men</i> Never ≤20 pack-years >20 pack-years <i>p</i> trend	<i>C</i>	<i>R</i>	<i>CRC</i>	1.0	1.0		Adjusted for age, height, BMI, alcohol intake and years of education.
							1.36 (0.79-2.33)	1.33 (0.57-3.12)		
							1.37 (0.81-2.32)	2.44 (1.12-5.30)		
							0.19	0.04		
							1.0	1.0		
							0.59 (0.21-1.62)	1.76 (0.60-5.14)		
							0.77 (0.30-1.96)	0.94 (0.21-4.16)		
							0.54	0.63		
van der Hel et al. (2003), Netherlands, Diagnostisch Onderzoek Mammacarcinoom (DOM)	Nested case-control study in a population-based screening program with 27722 women. Baseline assessment by questionnaire.	191 colon and 67 rectal cancer incident cases, 871 controls	Never Ever smoked	119 64	43 23	162 87	1.0	1.0	1.0	Adjusted for age and BMI.
							1.36 (0.97-1.92)	1.31 (0.76-2.25)	1.35 (0.99-1.83)	

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases		Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
						Colon cancer	Rectal cancer	Colorectal cancer	
Wakai et al. (2003), Japan, Japan Collaborative Cohort (JACC)	110792 inhabitants aged 40-79 completed a baseline questionnaire. They were enrolled from 45 study areas throughout Japan, total 59879 eligible subjects from 24 study areas with cancer registries Follow-up 1988-1997 by cancer registries.	408 colon cancer (219 men, 189 women) and 204 rectal cancer cases (147 men and 57 women)	<i>Men</i>						Adjusted for age, area, education, family history of colorectal cancer, BMI, alcohol drinking, walking time, sedentary work and consumption of green leafy vegetables and beef.
			Never smoker	39	34	1.0	1.0		
			Former smokers	67	44	1.07 (0.72-1.59)	0.88 (0.56-1.39)		
			Current smokers	113	69	1.23 (0.85-1.78)	0.83 (0.55-1.26)		
			<i>Women</i>						
			Never	175	55	1.0	1.0		
			Former smokers	4	1	1.07 (0.39-2.92)	1.05 (0.14-7.69)		
			Current smokers	10	1	1.06 (0.55-2.02)	0.36 (0.05-2.65)		
			<i>Men</i>						
			<i>Cigarettes/d</i>						
			0-19	59	44	1.05 (0.70-1.58)	0.95 (0.60-1.50)		
			20-39	102	55	1.30 (0.89-1.89)	0.79 (0.51-1.22)		
			40+	9	9	0.69 (0.33-1.43)	0.80 (0.38-1.69)		
			p trend			0.56	0.26		
			<i>Age at starting smoking (yrs)</i>						
			26+	18	10	1.10 (0.62-1.93)	0.73 (0.36-1.49)		
			23-25	34	16	1.54 (0.97-2.44)	0.84 (0.46-1.53)		
			20-22	97	56	1.13(0.78_1.64)	0.77 (0.50-1.18)		
			<20	24	25	1.04 (0.62-1.74)	1.18 (0.69-1.99)		
			p trend			0.76	0.91		
			<i>Years of smoking</i>						
			0-19	13	6	0.99 (0.53-1.87)	0.58 (0.24-1.39)		
			20-39	92	61	1.31 (0.89-1.92)	1.01 (0.65-1.56)		
40+	67	39	1.07 (0.71-1.61)	0.72 (0.45-1.16)					
p trend			0.52	0.35					
<i>Pack-years</i>									
0-19	26	22	0.92 (0.56-1.52)	0.96 (0.56-1.66)					
20-39	89	48	1.43 (0.98-2.10)	0.89 (0.57-1.40)					
40-59	41	24	1.11 (0.71-1.73)	0.72 (0.42-1.22)					
60+	10	10	0.68 (0.34-1.37)	0.78 (0.38-1.59)					
p trend			0.90	0.23					
<i>Years since smoking cessation (yrs)</i>									
0-9	31	16	1.09 (0.68-1.75)	0.68 (0.37-1.24)					
10-19	23	20	1.29 (0.77-2.17)	1.47 (0.84-2.57)					
20+	12	6	0.79 (0.41-1.52)	0.53 (0.22-1.28)					
p trend			0.29	0.80					

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
					Colon cancer	Rectal cancer	Colorectal cancer	
Colangelo et al. (2004), USA, The Chicago Heart Association Detection Project in Industry (CHA)	Screening program on cardiovascular disease. The CHA cohort was screened between 1967 and 1973. 39522 men and women from 84 cooperating companies and organizations in the Chicago area underwent baseline assessment. 22295 men and 17004 women remained for analyses. Active follow-up until 1979, after 1979 follow-up until 1997 by the National Death Index.	349 CRC deaths, 208 among men, 141 among women	<i>Men</i>	CRC				Adjusted for age, race, categories of education, body mass index, gender, and height.
			Never smoked	56			1.0	
			Past smoker	74			0.96 (0.68-1.36)	
			<i>Cigarettes/d</i>					
			1-10 cigs/d	10			0.75 (0.38-1.48)	
			11-20 cigs/d	35			1.09 (0.71-1.68)	
			>20 cigs/d	33			1.36 (0.88-2.11)	
			<i>p trend</i>				0.19	
			<i>Women</i>					
			Never smoked	70			1.0	
Past smoker	18			0.91 (0.54-1.53)				
<i>Cigarettes/d</i>								
1-10 cigs/d	17			1.23 (0.72-2.09)				
11-20 cigs/d	28			1.43 (0.91-2.23)				
>20 cigs/d	8			1.25 (0.59-2.62)				
<i>p trend</i>				0.13				

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
					Colon cancer	Rectal cancer	Colorectal cancer	
Jee et al. (2004), Korea, The Korean Cancer Prevention Study (KCPS)	1307275 Koreans from 30 to 95 years who received health insurance from the Korean Medical Insurance Corporation and who had biennial medical evaluations in 1992-1995. 1212209 participants were the final sample. For information on cancer mortality a computerized search for death certificate data from the National Statistical Office in Korea was performed. Active follow up 1993-2001.	511 colon cancer cases in men	<i>Men</i> Never smoker Former smokers Current smoker	Colon 91 139 281				Adjusted for age.

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases			Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments			
							Colon cancer	Rectal cancer	Colorectal cancer				
Sanjoaquin et al. (2004), United Kingdom, The Oxford Vegetarian Study	11140 vegetarians and nonvegetarians who were recruited in the UK between 1980 and 1984 completed a questionnaire. Each participant was flagged at the UK National health Service central register for information on cancer registration and death. A total of 10998 participants were included in the analysis. Follow up 1980-1999.	95 incident colorectal cancer cases	Never smoker Former smokers Current smokers	CRC			1.0 1.80 (1.13-2.85) 1.70 (0.92-3.15)			Adjusted for age, sex, and alcohol.			
				36	43	16							
Doll et al. (2005) United Kingdom	34439 male British doctors, who reported their smoking habits in November 1951 were follow-up periodically through mailed questionnaire; 50 year for mortality 1951-2001; 272 deaths from pancreatic cancer	Never smoker Cigarette smokers Former Current <i>Current cigarettes/d</i> 1-14 15-24 ≥25					1.0	1.0	1.0	Standardized indirectly for age and study year			
							1.43	1.55	1.45				
							1.33	2.39	1.56				
							1.39	1.44	1.39				
							1.13	1.76	1.29				
							1.52	4.73	2.22				
Yun et al. (2005), Republic of Korea,	733134 Korean men, 30 years old or older	417 colon, 453 rectum	Never	C 99	R 106	CRC	1.0	1.0		Adjusted for age, place of residence, BMI,			
											1.54	1.62	1.55
											1.27	2.25	1.48

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases		Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
						Colon cancer	Rectal cancer	Colorectal cancer	
National Health Insurance Corporation Study	who were insured by the National Health Insurance Corporation and had a medical evaluation in 1996. Follow-up through 2000. Incident cancer cases were identified from the Korean Central Cancer Registry (KCCR) and six regional cancer registries (RCRs).	cancer cases	Former smokers	148	131	1.37 (1.06-1.77)	1.17 (0.91-1.52)		
			Current smokers	170	216	0.81 (0.63-1.05)	0.97 (0.76-1.24)		
			<i>Cigarettes/d</i>						
			1-9	36	38	0.97 (0.66-1.43)	0.95 (0.65-1.39)		
			10-19	102	131	0.78 (0.59-1.04)	0.95 (0.73-1.24)		
			≥20	32	47	0.76 (0.51-1.15)	1.05 (0.74-1.50)		
			<i>Current smokers</i>						
			<i>Years of smoking</i>						
			1-9	59	62	0.87 (0.62-1.23)	0.80 (0.57-1.13)		
			10-29	45	76	0.61 (0.42-0.88)	1.00 (0.74-1.36)		
			≥30	66	78	0.96 (0.69-1.33)	1.12 (0.82-1.52)		
			<i>p trend</i>				<0.01		
			<i>Former smokers</i>						
			<i>Years of smoking</i>						
1-19	95	89	1.36 (1.02-1.80)	1.21 (0.91-1.61)					
20-29	23	24	1.15 (0.72-1.83)	1.23 (0.78-1.92)					
≥30	21	6	2.08 (1.29-3.37)	0.61 (0.27-1.41)					
<i>p trend</i>			0.06						

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments				
					Colon cancer	Rectal cancer	Colorectal cancer					
Lüchtenborg et al. (2005), Netherlands, The Netherlands Cohort Study on Diet and Cancer	A total of 58279 men and 62573 women between the ages of 55 and 69 years from 204 municipal population registries completed a self-administered questionnaire in 1986. Incident cancer cases are identified through annual record linkage to the Netherlands Cancer Registry and the Pathologisch Anatomisch Landelijk Geautomatiseerd Archief (PALGA). The vital status of a subcohort of 3,500 men and women was biannually examined. Follow up 1989-1994.	2948 subcohort members, 661 colorectal cancer cases	Never smoked	CRC	206		1.0	Adjusted for age (years), sex, family history of colorectal cancer, and BMI.				
									Former smokers	298		1.30 (1.03-1.65)
									Current smokers	146		0.91 (0.71-1.18)
									<i>Cigarettes/day</i>			
									<5	47		1.02 (0.71-1.46)
									5-<10	50		0.91 (0.59-1.30)
									10-<15	84		1.10 (0.80-1.52)
									15-<20	61		1.16 (0.82-1.64)
									20-<25	76		1.15 (0.83-1.59)
									≥25	95		1.59 (1.16-2.17)
									<i>p trend</i>			0.01
									<i>Duration (yrs)</i>			
									<10	17		1.02 (0.59-1.78)
									10-<20	53		1.16 (0.81-1.64)
									20-<30	92		1.15 (0.85-1.55)
									30-<40	128		1.32 (1.00-1.73)
									40-<50	109		0.90 (0.67-1.20)
									≥50	38		1.45 (0.93-2.28)
									<i>p trend</i>			0.49
									<i>Age at first exposure</i>			
									<15	71		1.14 (0.81-1.62)
									15-<17	116		1.41 (1.04-1.92)
									17-<19	103		1.11 (0.83-1.50)
19-<21	65		1.26 (0.90-1.77)									
21-<25	35		1.17 (0.78-1.77)									
≥25	44		0.87 (0.61-1.25)									
<i>p trend</i>			0.32									
<i>Years since cessation</i>												
<1	155		0.94 (0.73-1.22)									
1-<10	101		1.39 (1.03-1.86)									
10-<20	104		1.38 (1.03-1.86)									
20-<30	65		1.25 (0.88-1.77)									
≥30	17		0.75 (0.43-1.29)									
<i>p trend</i>			0.27									

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
					Colon cancer	Rectal cancer	Colorectal cancer	
Kim et al (2006), Korea, Korea Elderly Pharmacepidemiologic Cohort (KEPEC)	Population-based dynamic cohort with 14103 cohort members aged 65 years or more and living in Busan Metropolitan City from 1993-1998. The participants were beneficiaries of the Korean Medical Insurance Corporation (KIMIC). Baseline information was surveyed by a self-administered questionnaire. Follow up for a mean of 8.7 person years.	100 incident colorectal cancer cases	Non-smoker	CRC				Adjusted for age at baseline, gender precancerous lesion of CRC, medication history of NSAID & antibiotics, alcohol drinking and BMI.
				57		1.0		
				14		2.03 (1.02-4.03)		
				26		1.36 (0.80-2.32)		
						0.26		

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
					Colon cancer	Rectal cancer	Colorectal cancer	
Akhter et al. (2007), Japan	Prospective cohort study in 14 municipalities of Miyagi Prefecture in rural northern Japan. 47605 Participants aged 40-64 years (22836 men and 24769 women). Information was obtained by self-administered questionnaire. Follow-up 1990-1997. Record linkage with the Miyagi Prefectural Cancer Registry for information on incident cases. Analysis was limited to 21,695 men due to small prevalence of smoking in women.	188 incident colorectal cancer cases	Never smoker	22			1.0	Adjusted for age in years, family history of colorectal cancer; education level, BMI, walking time, alcohol drinking and current drinkers, consumption frequencies of meat, green-yellow vegetables and fruits.
			Former smokers	50			1.73 (1.04-2.87)	
			Current smokers	116			1.74 (0.93-2.34)	
			<i>Cigarettes/d</i>					
			1-19	29			1.32 (0.75-2.31)	
			≥20	82			1.60 (0.99-2.58)	
			<i>p</i> trend				0.04	
			<i>Age started smoking</i>					
			>22	37			1.36 (0.80-2.32)	
			19-22	60			1.56 (0.95-2.55)	
≤18	16			1.86 (0.97-3.58)				
<i>p</i> trend				0.03				
			<i>Smoking duration (yrs)</i>					
			1-29	33			1.46 (0.82-2.60)	
			30-39	50			1.52 (0.91-2.53)	
			≥40	30			1.59 (0.89-2.86)	
			<i>p</i> trend				0.08	
Huxley (2007) Asia Pacific Cohort Studies Collaboration, Asia Pacific Cohort Studies Collaboration (APCSC)	Collaboration of 33 cohort studies in the region. 539201 participants (35% female, 65% male). Studies were included if they had continued follow-up for at least 5000 person-years and had recorded vital status at the end of follow-up. Data on cigarette smoking were based on self-report.	751 colorectal cancers (454 men, 297 women)	Cigarette smoking (Yes/No)				1.43 (1.09-1.88)	Adjusted for diabetes, BMI, and alcohol.
			<i>p</i> value				0.01	
			Cigarette smoking (5 per day)				1.00 (0.92-1.09)	
			<i>p</i> value				0.99	

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
					Colon cancer	Rectal cancer	Colorectal cancer	
Paskett et al. (2007), USA, Women's Health Initiative (WHI)	The WHI includes an observational study and three clinical trials. 146877 women. Clinical outcomes were reported semi annually for the clinical files and annually for the observation study. Follow-up 1998-2005.	1075 colon, 176 rectal cancer cases (461 right-sided and 296 left-sided)	Former smokers		1.12 (0.97-1.29)	1.15 (0.80-1.67)	Adjusted for age ethnicity, study arm, family history of colorectal cancer, total physical activity metabolic equivalents, duration of nonsteroidal anti-inflammatory drug use, alcohol, hormone therapy use, colonoscopy, history of diabetes, total dietary calcium, total dietary fibre, percent energy from fat, haemoglobin, waist circumference, red meat intake, and stratified by study (observational study, clinical trial-non-hormone trial, hormone trial treatment assignment).	
			Current smokers		1.03 (0.77-1.38)	1.95 (1.10-3.47)		
			<i>p</i> trend		0.28	0.05		
			<i>Age at smoking initiation</i>					
			<20		1.13 (0.96-1.33)	1.14 (0.75-1.75)		
			≥20		1.08 (0.91-1.29)	1.39 (0.91-2.10)		
			<i>p</i> value for trend		0.27	0.13		
			<i>Cigarettes/d</i>					
			<25		1.05 (0.90-1.21)	1.29 (0.90-1.86)		
			≥25		1.47 (1.16-1.85)	1.14 (0.59-2.18)		
			<i>p</i> trend		0.01	0.31		
			<i>Duration of smoking</i>					
			<20		0.95 (0.79-1.15)	0.87 (0.52-1.43)		
			20-29		1.27 (1.02-1.58)	1.95 (1.20-3.17)		
			30-39		1.18 (0.93-1.50)	1.24 (0.68-2.27)		
			≥20		1.19 (0.93-1.54)	1.53 (0.83-2.83)		
			<i>p</i> trend		0.03	0.05		
			<i>Age at smoking cessation</i>					
			<30		0.95 (0.72-1.27)	0.79 (0.36-1.73)		
			30-39		0.87 (0.67-1.14)	0.84 (0.42-1.70)		
40-49		1.24 (0.98-1.56)	1.39 (0.78-2.46)					
≥50		1.24 (1.02-1.52)	1.53 (0.93-2.52)					
Current smoker		1.04 (0.78-1.39)	1.93 (1.08-3.44)					
<i>p</i> trend		0.06	0.01					
<i>Time since cessation</i>								
Current smoker		1.05 (0.78-1.40)	1.98 (1.11-3.52)					
<10		1.15 (0.76-1.75)	1.81 (0.77-4.26)					
10-19		1.32 (1.06-1.64)	1.45 (0.84-2.50)					
20-29		1.16 (0.92-1.46)	1.27 (0.71-2.28)					
30-39		0.90 (0.70-1.17)	1.10 (0.59-2.06)					
≥50		0.97 (0.73-1.29)	0.53 (0.19-1.46)					
<i>p</i> trend		0.69	0.90					

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases			Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
				C	R	CRC	Colon cancer	Rectal cancer	Colorectal cancer	
Tsong et al. (2007), Singapore, Singapore Chinese Health Study	Citizens of Singapore who resided in government-built housing estates, 45-74 years old, Hokkiens and Cantonese. 61,321 subjects. Baseline information collection by in-person interview. Linkage with the Singapore Cancer Registry and Singapore Registry of Births and Deaths. Follow-up 1993-2004	845 incident cases (516 colon and 329 rectal)	Never smokers	338	157		1.0	1.0	Adjusted for age, gender, dialect group, year of recruitment, level of education, BMI, history of diabetes, family history of colorectal cancer, alcohol consumption, and physical exercise	
			Former smokers	75	63		0.96 (0.73-1.27)	1.45 (1.04-2.01)		
			Current smokers	103	109		0.83 (0.64-1.06)	1.63 (1.23-2.17)		
			<i>Cigarettes/day</i>							
			<13	68	58		0.84 (0.64-1.11)	1.38 (0.99-1.90)		
			13+	110	114		0.91 (0.71-1.17)	1.71 (1.28-2.28)		
			<i>p</i> trend				0.38	0.0003		
			<i>Age at starting to smoke</i>							
			15+ years	148	126		0.89 (0.71-1.12)	1.40 (1.07-1.84)		
			<15 years	30	46		0.80 (0.54-1.18)	2.34 (1.63-3.36)		
<i>p</i> trend				0.19	<0.0001					
<i>Duration of smoking</i>										
<40 years	94	83		0.88 (0.68-1.14)	1.37 (1.01-1.84)					
40+ years	84	89		0.87 (0.66-1.14)	1.85 (1.36-2.52)					
<i>p</i> trend				0.27	<0.0001					
Batty et al. (2008), UK, The Whitehall study	17322 London-based government employees, aged 40-69 years, participated in a medical examination in the 1960s (response rate 74%). 74% response. Cancer mortality ascertained by using procedures of the National Health Service Central Registry until 2005	52 colon cancer deaths, 16 rectum cancer deaths	Never	52	16		1.0	1.0	Adjusted for age, employment grade, physical activity, BMI, marital status, systolic and diastolic blood pressure, cholesterol forced expiratory volume in 1s, height, impaired glucose tolerance, diabetes and disease at entry.	
			Former smokers	118	58		1.11 (0.80-1.55)	1.94 (1.11-3.39)		
			Current smokers	129	40		1.33 (0.96-1.86)	1.51 (0.84-2.74)		
			<i>Former smokers</i>							
			Effect per 10 cigarettes/d				1.03 (0.88-1.22)	1.31 (1.08-1.38)		
			Effect per 10 years of smoking				1.04 (0.88-1.23)	1.13 (0.87-1.45)		
<i>Current smokers</i>										
Effect per 10 cigarettes/d				1.05 (0.87-1.27)	1.25 (0.93-1.70)					
Effect per 10 years of smoking				1.09 (0.83-1.43)	1.26 (0.77-2.05)					

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
					Colon cancer	Rectal cancer	Colorectal cancer	
Kenfield et al. (2008), USA, The Nurses Health Study	Established 1976, 121700 female US registered nurses, aged 30 up to 55 years, residing in 11 states. Baseline information obtained by mailed questionnaire. Deaths were usually reported by families and deaths among nonrespondents were identified by searching the National Death Index. Follow up 1980-2004.	578 colorectal cancers deaths	Never	CRC	238			Adjusted for age (months), follow-up period, history of hypertension, diabetes, high cholesterol levels, BMI, change in weight from age 18 years to baseline (1980), alcohol intake, physical activity, previous use of oral contraceptives, postmenopausal estrogen therapy use and menopausal status, parental history of myocardial infarction at age 65 years or younger and age at starting smoking, servings of beef, pork, lamb or processed meat, total calcium and folate intake, and duration of aspirin use.
			Former smokers		214			
			Current smokers		126			
			<i>Cigarettes/d smoked by current smokers</i>					
			1-14		36		1.37 (0.95-1.96)	
			15-24		55		1.73 (1.27-2.35)	
			≥24				1.83 (1.26-2.64)	
			<i>p trend</i>				0.23	
			<i>Starting age among current smokers,</i>					
			≤35		19		1.25 (0.77-2.02)	
			18-21		83		1.73 (1.32-2.27)	
			≥21		32		1.55 (1.01-2.39)	
			<i>p trend</i>				0.95	
<i>Years since quitting in former smokers,</i>								
<5		32		0.87 (0.59-1.29)				
5-<10		22		0.64 (0.40-1.01)				
10-<15		32		0.96 (0.65-1.43)				
15-<20		33		0.93 (0.63-1.38)				
≥26		95		0.70 (0.53-0.93)				
<i>p trend</i>				0.40				

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases			Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
				C	R	CRC	Colon cancer	Rectal cancer	Colorectal cancer	
Gram et al. (2009), Norway, The Norwegian Women and Cancer Study	68160 women aged 30-69 years who completed a questionnaire in 1996 or 1998. Follow-up by linkages to national registers through 2005.	425 incident cases of histological confirmed primary invasive colorectal cancers, 284 colon (137 proximal, 108 distal) and 141 rectal cancer cases	Never	97	53		1.0	1.0	Adjusted for age, menopausal status, hormonal contraceptive and postmenopausal hormonal therapy use, BMI and alcohol consumption, all at enrolment.	
			Former smokers	107	40		1.4 (1.1-1.9)	0.9 (0.6-1.4)		
			Current smokers	80	48		1.1 (0.8-1.6)	1.2 (0.8-1.8)		
			Ever smokers	187	88		1.3 (1.0-1.7)	1.1 (0.7-1.5)		
			<i>Smoking initiation</i>							
			≥20	98	42		1.3 (1.0-1.7)	1.0 (0.6-1.5)		
			<20	89	46		1.3 (1.0-1.8)	1.2 (0.8-1.8)		
			<i>p trend</i>				0.05	0.5		
			<i>Cigarettes/d</i>							
			1-9	114	51		1.3 (1.0-1.7)	1.0 (0.7-1.5)		
			10-14	53	28		1.4 (1.0-1.9)	1.2 (0.8-2.0)		
			≥ 15	20	9		1.2 (0.7-2.0)	0.9 (0.4-1.9)		
			<i>p trend</i>				0.11	0.7		
			<i>Years smoked</i>							
			1-19	55	23		1.2 (0.9-1.7)	0.9 (0.5-1.5)		
			20-29	47	19		1.4 (1.0-2.0)	0.9 (0.5-1.6)		
			≥30	85	46		1.3 (1.0-1.8)	1.3 (0.8-1.9)		
			<i>p trend</i>				0.07	0.3		
			<i>Pack-years smoked</i>							
			0-9	78	35		1.1 (0.8-1.5)	0.9 (0.6-1.3)		
10-19	75	28		1.7 (1.2-2.3)	1.1 (0.7-1.7)					
≥ 20	34	25		1.2 (0.8-1.8)	1.5 (0.9-2.5)					
<i>p trend</i>				0.03	0.13					
<i>Time since quitting smoking (years)</i>										
≥20	36	16		1.2 (0.8-1.7)	0.9 (0.5-1.6)					
10-19	24	5		1.7 (1.2-2.6)	1.1 (0.6-2.1)					
1-9	33	13		1.5 (1.0-2.4)	0.5 (0.2-1.3)					
0	84	4		1.2 (0.9-1.6)	1.2 (0.8-1.8)					
<i>p trend</i>				0.16	0.5					
<i>Proximal colon cancer</i>										
Never	44			1.0						
Former smokers	53			1.6 (1.1-2.4)						
Current smokers	40			1.4 (0.9-2.1)						
Ever smokers	93			1.5 (1.0-2.2)						
<i>Distal colon cancer</i>										
Never	36			1.0						
Former smokers	46			1.7 (1.1-2.7)						
Current smokers	26			1.0 (0.6-1.6)						

Table 2.42. Cohort studies on smoking and risk of colorectal cancer

Reference, location, name of study	Cohort description	No. of subjects	Smoking categories	No of cases	Relative risks (95%CI or <i>p</i> value)			Adjustment factors/ comments
					Colon cancer	Rectal cancer	Colorectal cancer	
Hannan et al. (2009) U.S.	Participants were drawn from the Cancer Prevention Study II Nutrition Cohort, a subcohort of the CPS II mortality cohort, including residents in 21 states with population-based state cancer registries and 50 to 74 years of age in 1992. Participants completed a mailed questionnaire. Follow-up questionnaires were sent in 1997, 1999, 2001, 2003, and 2005, with response rate among living participants at least 89%. The follow-up period ended on June 30, 2005. 51365 men and 73386 women were included in the analysis. Incident cases of colorectal cancer were identified by ICD-9 codes 153-154.1 or by ICD 10 codes C18-C20	Self-reported cases were verified from medical records (n = 1227) or through linkage to state cancer registries (n = 422). Additional cases (n = 313) were identified through linkage with the National Death Index (NDI).	Ever smokers	72	1.3 (0.9-2.0)			Adjusted for age , BMI, education, family history of colorectal cancer, physical activity, race, aspirin use, alcohol intake, vegetable consumption, fibre/whole grain consumption, red and processed meat consumption, history of endoscopy
			CRC					
			Never smokers	813			1.0	
			Former smokers	993			1.23(1.11-1.36)	
			Current smokers	156			1.27(1.06-1.52)	
			Former smokers					
			Age at cessation					
			Before age 40	261			1.05(0.91-1.22)	
			40-49 yrs of age	242			1.31(1.13-1.52)	
			50-59 yrs of age	260			1.44(1.24-1.66)	
			Age 60 or elder	160			1.29(1.08-1.54)	
			p trend				0.0014	
			Years since cessation					
			≥ 31 yrs ago	239			1.03(0.89-1.19)	
21-30 yrs ago	238			1.28(1.10-1.49)				
11-20 yrs ago	232			1.33(1.14-1.55)				
1-10 yrs ago	214			1.48(1.27-1.73)				
p trend				0.0003				
Current smokers								
Duration of smoking								
< 40 years	29			1.02(0.69-1.49)				
40-49 years	71			1.32(1.02-1.72)				
50+ years	56			1.38(1.04-1.84)				
p trend				0.052				