

Short papers

Updating UK estimates of age, sex and period specific cumulative constant tar cigarette consumption per adult

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Abstract

Background—In 1993 we presented age and sex specific estimates of cumulative constant tar cigarette consumption (CCTCC) per adult for five year periods to 1986-90. These were derived from annual surveys conducted for the Tobacco Manufacturers' Association (TMA) since 1946, extrapolated back to 1891 for men and to 1921 for women and corrected for the decline in average (machine smoked) tar levels. We now provide estimates for 1991-5.

Methods—TMA surveys having ceased, 1991-5 estimates of manufactured cigarette consumption per adult (MCA) were derived from the General Household Survey (GHS) and corrected for the continuing decline in tar. These estimates were divided by 0.75 (men) and 0.80 (women), based on a comparison of GHS and TMA data for 1971-90, to allow accumulation with the TMA derived estimates prior to 1991.

Results—For both sexes the GHS/TMA ratio of MCA varied little by age or five year period, justifying the use of the correction factors when adjusting GHS estimates for 1991-95. TMA estimates were higher than GHS estimates as only TMA sales-corrected their data for understatement of smoking and the surveys differed in questions on handrolled cigarette smoking. The 1991-95 data confirm the continuing decline in CCTCC at all ages in men. Women show a less steep decline for ages 30-64 and an increase for ages 65-84.

Conclusion—The GHS data can validly be used to update the CCTCC estimates. Some reservations about the use of CCTCC are discussed.

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Keywords: cumulative constant tar cigarette consumption; adult; UK

1941-85.¹ To index lifetime cigarette consumption we computed age, sex, and period specific estimates for the UK of cumulative constant tar cigarette consumption (CCTCC) obtained by aggregating annual age and sex specific data on manufactured cigarette consumption per adult, and correcting for the decline since 1965 in tar level measured under standard smoking conditions. The annual data came from surveys conducted since 1946 for the Tobacco Manufacturers' Association (TMA) or its predecessors,^{2,3} extrapolated back to 1891 for men and to 1921 for women using an age cohort model.

Approached in 1993 by the Lung and Asthma Information Agency (LAIA) for CCTCC figures updated to 1990, we noted an error in the method used to derive them. Although not materially affecting our estimates or conclusions,¹ we wrote to *Thorax* to present corrected and updated CCTCC data.⁴ Estimates were tabulated by five year age groups from 15-19 to 80-84, and five year periods from 1901-5 to 1986-90 for men and from 1926-30 to 1986-90 for women. We also made available full details of the data and methods used.⁵ Updated graphs appeared in an LAIA factsheet.

The LAIA recently approached us again for CCTCC estimates updated to 1995. As the TMA have not conducted any surveys since 1989, we used General Household Survey (GHS) data. Here we describe differences between the TMA and GHS data, explain and justify how we modified our estimation procedure to account for them, and present updated CCTCC estimates.

Methods**TMA DATA UP TO 1990**

Available separately⁵ are (1) estimates of manufactured cigarette consumption per adult per year by age and sex for five year periods from 1941-45 to 1986-90 derived from annual surveys, (2) estimates derived by backward extrapolation to 1891-95 for men and 1921-25 for women, and (3) estimates of manufactured cigarette consumption per adult per year adjusted using tar factors of 1, 0.804, 0.613, 0.544, 0.477 and 0.423, respectively, for 1961-65, 1966-70, 1971-75, 1976-80,

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In *Thorax* in 1990 we presented a study relating trends in cigarette smoking to trends in lung cancer, chronic obstructive lung disease, and emphysema in England and Wales for

Table 1 Basic age and sex specific GHS cigarette smoking data used in estimation

		Year													
Sex	Age	1972	1973	1974	1975	1976	1978	1980	1982	1984	1986	1988	1990	1992	1994
Prevalence of cigarette smoking															
Men	16-19	43	.	42	.	39	35	32	31	29	30	28	28	29	28
	20-24	55	.	52	.	47	45	44	41	40	41	37	38	39	40
	25-34	56	.	56	.	48	48	47	40	40	37	37	36	34	34
	35-49	55	.	55	.	50	48	45	40	39	37	37	34	32	31
	50-59	54	.	53	.	49	48	47	42	39	35	33	28	28	27
	60+	47	.	44	.	40	38	36	33	30	29	26	24	21	18
Women	16-19	39	.	38	.	34	33	32	30	32	30	28	32	25	27
	20-24	48	.	44	.	45	43	40	40	36	38	37	39	37	38
	25-34	49	.	46	.	43	42	44	37	36	35	35	34	34	30
	35-49	48	.	49	.	45	43	43	38	36	34	35	33	30	28
	50-59	47	.	48	.	46	42	44	40	39	35	34	29	29	26
	60+	25	.	26	.	24	24	24	23	23	22	21	20	19	17
Cigarette consumption per week															
Men	16-19	102	.	110	.	106	98	99	87	87	86	84	89	81	71
	20-24	123	.	132	.	135	122	113	114	107	108	109	110	92	94
	25-34	129	.	136	.	138	134	135	121	114	110	120	115	100	107
	35-49	132	.	138	.	141	138	140	137	130	133	136	135	130	126
	50-59	124	.	127	.	130	137	130	129	126	120	132	121	129	142
	60+	96	.	100	.	108	104	102	109	103	103	102	106	102	99
Women	16-19	76	.	86	.	89	90	84	76	80	77	79	80	70	70
	20-24	91	.	99	.	110	101	102	100	91	85	95	92	88	90
	25-34	97	.	108	.	109	113	111	109	105	101	103	103	97	97
	35-49	94	.	104	.	112	109	115	108	107	112	113	106	111	104
	50-59	87	.	91	.	103	101	105	101	98	99	102	107	105	106
	60+	60	.	68	.	75	79	73	77	80	84	81	81	81	89
% mainly hand rolled (among cigarette smokers)															
Men	16-19	3.2	3	2	3	.	4	6	11	7	5	10 ¹	10 ¹	11 ¹	11 ¹
	20-24	5.7	6	5	8	.	7	8	15	16	13				
	25-29	10.7	10	9	12	.	14	15	19	16	14	14 ²	16 ²	15 ²	20 ²
	30-34	14.4	12	12	12	.	13	12	24	18	19				
	35-49	14.5	13	16	14	.	16	16	22	18	19	20	17	20	23
	50-59	15.0	15	16	15	.	14	17	24	19	20	21	20	19	22
Women	60+	16.5	17	18	20	.	18	18	21	19	22	22	26	22	25
	16-19	0	1	0	0	.	0	1	2	2	2	1 ¹	2 ¹	3 ¹	3 ¹
	20-24	0.6	1	0	0	.	1	3	3	4	4				
	25-29	0.5	1	1	0	.	1	2	4	3	3	3 ²	3 ²	3 ²	5 ²
	30-34	1.1	1	1	1	.	0	1	3	3	2				
	35-49	0.7	1	1	1	.	1	1	2	3	2	3	2	3	4
	50-59	1.3	1	1	1	.	1	1	2	2	2	2	1	1	3
	60+	1.2	1	2	1	.	1	2	3	2	3	2	2	1	3

¹ Estimates for age 16-24.² Estimates for age 25-34.

1981-85 and 1986-90, based on sales weighted average tar (SWAT) data calculated by the TMA using results from surveys by the Laboratory of the Government Chemist issued as leaflets by the Health Departments of the United Kingdom. The source⁵ also describes how these tar adjusted estimates were corrected and cumulated to obtain the CCTCC data presented in 1993.⁴

UPDATING CCTCC DATA TO 1995

CCTCC data for 1991-95 used the same TMA derived estimates of manufactured cigarette consumption per adult per year up to 1990, GHS derived estimates for 1991-95, and a tar factor of 0.358 for 1991-95.

DERIVING ESTIMATES FROM GHS DATA

GHS data were available every other year from 1972, with some data for 1973 and 1975. Averaging data available within each five year period provided estimates from 1971-75 to 1991-95. Data on cigarettes per adult per year (CPA) were estimated by multiplying data on cigarettes per smoker per week by 52 and then by prevalence. Data provided were in age groups such as 16-19, 20-24, 25-34, 35-49, 50-59 and 60+. CPA estimates for age 16-19 were taken as applicable to age 15-19 (assuming 15 year olds did not smoke at all produced estimates markedly lower than TMA). CPA estimates were assumed to be equal in each five

year age group within any broader age group in the range 20-59. Using age and sex specific GHS data on the percentages of smokers who smoked mainly plain, mainly filter, or mainly hand rolled cigarettes, CPA estimates were adjusted to estimate manufactured cigarette consumption by excluding those who smoked mainly hand rolled cigarettes.

ADJUSTING GHS ESTIMATES

Manufactured cigarette consumption estimates derived from GHS data were compared with TMA estimates for 1971-75 to 1986-90, TMA data for age 60+ being estimated from five year age data by age weighting to the UK population.⁶ The ratio of GHS to TMA estimates then provided approximate sex specific factors to correct GHS estimates for 1991-95 when calculating the final CCTCC estimate. For five year age groups within the 60+ age group CPA estimates were then derived using the same ratio to 60+ age group estimates as for TMA 1986-90 data.

Results

Table 1 presents the original GHS data on cigarette smoking prevalence, weekly consumption per smoker, and percentage of mainly handrolled cigarette consumption among cigarette smokers.

Table 2 compares GHS and TMA estimates of manufactured cigarette consumption per

Table 2 Manufactured cigarette consumption per adult per year. Comparison of TMA and GHS estimates for 1971–90 and adjustment of GHS estimate for 1991–95

Sex	Year	Source	Age										Mean
			15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60+	
Men	1971–75	GHS	2281	3354	3479	3350	3272	3272	3272	2950	2950	1918	0.77
		TMA	2664	4520	4310	4310	4440	4200	4570	4260	3570	2629	
		Ratio	0.86	0.74	0.81	0.78	0.74	0.78	0.72	0.69	0.83	0.73	
	1976–80	GHS	1782	2690	2904	2948	2933	2933	2933	2798	2798	1683	0.77
		TMA	2352	3850	3790	3840	3780	3810	3670	3930	3200	2221	
		Ratio	0.76	0.70	0.77	0.77	0.78	0.77	0.80	0.71	0.87	0.76	
	1981–85	GHS	1234	1968	2015	1929	2192	2192	2192	2105	2105	1390	0.73
		TMA	1824	2880	2980	2920	3080	2870	2890	2680	2700	1648	
		Ratio	0.68	0.68	0.68	0.66	0.71	0.76	0.76	0.79	0.78	0.84	
	1986–90	GHS	1222	1906	1871	1836	2049	2049	2049	1649	1649	1089	0.72
		TMA	1840	2850	2667	2850	2733	2467	2717	2400	2083	1515	
		Ratio	0.66	0.67	0.70	0.64	0.75	0.83	0.75	0.69	0.79	0.72	
	1991–95	GHS	1071	1662	1508	1508	1647	1647	1647	1538	1538	782	0.79
		Adjusted ¹	1428	2216	2011	2011	2196	2196	2196	2051	2051	1043 ²	
		TMA	1620	2261	2508	2501	2477	2477	2477	2174	2174	836	
Women	1971–75	GHS	2040	3110	3090	3060	2920	3240	3430	2950	2340	1090	0.79
		Ratio	0.79	0.73	0.81	0.82	0.85	0.76	0.72	0.74	0.93	0.77	
		TMA	1501	2289	2456	2465	2518	2518	2518	2334	2334	932	
	1976–80	GHS	1928	3100	2960	3130	3200	2890	3140	3190	2700	1177	0.80
		Ratio	0.78	0.74	0.83	0.79	0.79	0.87	0.80	0.73	0.86	0.79	
		TMA	1233	1826	1960	1970	2017	2017	2017	2003	2003	915	
	1981–85	GHS	1208	2360	2380	2450	2550	2740	2560	2450	2410	1125	0.82
		Ratio	1.02	0.77	0.82	0.82	0.79	0.74	0.79	0.82	0.83	0.81	
		TMA	1213	1744	1789	1795	1906	1906	1906	1710	1710	875	
	1986–90	GHS	1587	2317	2150	2350	2450	2533	2483	1967	2133	1065	0.79
		Ratio	0.76	0.75	0.83	0.76	0.78	0.75	0.77	0.87	0.80	0.82	
		TMA	927	1666	1551	1551	1567	1567	1567	1479	1479	778	
	1991–95	GHS	1159	2083	1939	1939	1959	1959	1959	1849	1849	973 ⁴	
		Adjusted ³											
		TMA											

¹ Adjusted by dividing GHS estimate by 0.75.² Estimates are 1434, 1090, 874, 715 and 477 for ages 60–64, 65–69, 70–74, 75–79, 80+.³ Adjusted by dividing GHS estimates by 0.80.⁴ Estimates are 1583, 1188, 746, 574 and 325 for ages 60–64, 65–69, 70–74, 75–79, 80+.

adult per year for 1971–75, 1976–80, 1981–85 and 1986–90. GHS estimates were lower by a factor averaging about 0.75 for men and 0.80 for women. Such a difference is expected because TMA, but not GHS, adjust data (upwards) to match known sales data and so correct for understatement of smoking. Also, excluding mainly handrolled cigarette consumption in the GHS estimation omits those who smoke mainly but not exclusively handrolled cigarettes included in the TMA data. As no age or time related patterns were seen in the GHS/TMA factors, 1991–95 data to include in CCTCC estimates were obtained by dividing GHS estimates by the factors of 0.75 or 0.80, as is also shown in table 2.

Table 3 gives updated CCTCC estimates for 1991–95 and also, for comparison, for 1981–85 and 1986–90. In men the estimates are declining at all ages, with the percentage reduction between 1981–85 and 1991–95

steeper at younger ages. In women, though relatively marked declines are seen at young ages, lesser declines are seen in middle age with increases seen at older ages.

An updated graphical display of the full CCTCC data will appear in LAIA factsheets and is not reproduced here.

Discussion

CCTCC was developed by Todd⁷ to be a simple index of lifetime tobacco exposure with some predictive value for risk of lung cancer and other chronic smoking associated diseases. Anyone using CCTCC should understand its possible limitations which include the following:

(1) CCTCC ignores the smoking of pipes, cigars or handrolled cigarettes.

(2) CCTCC assumes that exposure early and late in life are equally important in determining risk.

Table 3 Cumulative constant tar cigarette consumption (in thousands) by sex, age and period¹

Age	Men				Women			
	1981–85	1986–90	1991–95	% change ²	1981–85	1986–90	1991–95	% change ²
15–19	3	2	2	–40.3	2	2	1	–31.8
20–24	10	8	6	–41.5	8	6	5	–38.3
25–29	23	17	13	–44.5	17	13	10	–42.3
30–34	38	29	21	–43.5	27	23	18	–35.2
35–39	56	44	34	–39.7	37	33	27	–27.0
40–44	75	63	49	–34.6	45	43	37	–18.6
45–49	92	81	67	–26.7	52	51	47	–9.0
50–54	113	98	86	–23.7	62	57	55	–10.8
55–59	140	118	102	–27.2	74	67	61	–17.9
60–64	163	145	122	–25.0	78	79	71	–9.1
65–69	179	167	149	–17.2	75	81	82	+9.4
70–74	194	183	169	–12.9	67	77	73	+23.7
75–79	206	197	185	–10.2	57	69	78	+37.2
80–84	213	208	199	–6.7	47	58	70	+49.6

¹ For data for earlier periods see reference 4.² 1991–95 compared with 1981–85.

(3) CCTCC may not reflect changes which occur in the relative distribution of heavy and light smokers if the underlying risk-response is non-linear.

(4) Early data had to be estimated by backward extrapolation (although as surveys go back 50 years this is less of a problem now than formerly).

(5) Data had to be estimated from two surveys—the TMA until 1990 and the GHS subsequently—although the relatively consistent ratios in table 2 and the relatively small contribution of 1991–95 data to total CCTCC estimates suggest this is of minor importance.

(6) Changes in tar levels are assumed to be independent of age and sex, however available data⁷ suggest this may not be a major difficulty.

(7) There is some uncertainty over tar levels prior to 1965. We used TMA data suggesting that SWAT was constant at 31.4 mg/cig before 1965. Wald *et al.*,⁸ based on chemical analyses conducted around 1980 of old cigarettes sent in by the public, claimed that SWAT declined before 1965. In fact, the pre-1965 SWAT levels they cited (32.9, 32.2, 29.4 and 30.4 mg/cig for 1934–40, 1941–47, 1948–54, and 1955–61, respectively) were close to the TMA figure of 31.4 mg/cig, and their lower figure of 25.5 mg/cig for 1962–68 was based on an unrepresentative sample of brands sold, predominantly towards the end of the period, when the TMA data also showed a marked decline (23.9 mg/cig in 1968). The use of Wald's SWAT data would have little effect on CCTCC levels or trends in any case.

The most important problem with CCTCC may lie in using tar yield data, based on machine smoking under standard conditions, to index exposure to tar. Although it is reasonably clear that lower tar yields are associated with reduced mortality from lung cancer,⁹ and that smokers switching to lower tar brands do reduce average tar intake,^{10 11} smokers do appear to “compensate” for reduced tar (and nicotine) delivery by modifying how they smoke.¹² It has been estimated that the reduction in tar intake is only about half the reduction predicted based on the published tar yields.^{10 11}

In additional analyses to study effects of adjustment for compensation (data not shown), we recalculated CCTCC assuming either (1) that tar levels had not reduced since 1965 (“complete compensation”) or (2) that tar levels had reduced by the square root of the observed decline in machine yields (“partial compensation”). The decline in CCTCC in men at all ages over the period 1981–85 to 1991–95 was confirmed under both assumptions. However, the decline in CCTCC in women was only really evident below the age of 40 in the complete compensation analysis and below the age of 45 in the partial compensation analysis, compared with below the age of 65 in the analyses in table 3 which ignore compensation.

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