Cigarette smoking by socioeconomic group, sex, and age: effects of price, income, and health publicity

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Abstract

Objective—To assess effects of price, income, and health publicity on cigarette smoking by age, sex, and socioeconomic group.

Design—Econometric multiple regression analysis of data on cigarette smoking from the British general household survey.

Subjects—Random sample of adult population in Britain interviewed for biennial general household surveys 1972-90.

Main outcome measures—Changes in cigarette consumption and prevalence of smoking.

Results—Price elasticities of demand for cigarettes (percentage change in cigarette consumption for a 1% change in price) were significant at -0·5 (95% confidence interval -0·8 to -0·1) for men and -0·6 (-0·9 to -0·3) for women, were highest in socioeconomic group V (-1·0 for men and -0·9 for women), and lowest (not significantly different from zero) in socioeconomic groups I and II. The gradient in price elasticities by socioeconomic group was significant for men (F=5·6, P=0·02) and for women (F=6·1, P=0·02). Price was a significant factor in cigarette consumption by age for women in every age group and for men aged 25-34. Cigarette consumption by young men aged 16-34 increased with income. There was a significant decrease in smoking over time by women in socioeconomic groups I and II and by men in all age and social groups except socioeconomic group V attributable to health publicity. Price significantly affected smoking prevalence in socioeconomic group V (-0·6 for men and -0·5 for women) and for all women (-0·2).

Conclusions—Men and women in lower socioeconomic groups are more responsive than are those in higher socioeconomic groups to changes in the price of cigarettes and less to health publicity. Women of all ages, including teenagers, appear to have been less responsive to health publicity than have men but more responsive to price. Response to health publicity decreased linearly with age. Real price increases in cigarettes could narrow differences between socioeconomic groups in smoking and the related inequalities in health, but specific measures would be necessary to ameliorate effects on the most deprived families that may include members who continue to smoke. The use of a policy to steadily increase cigarette tax is likely to help achieve the government's targets for smoking and smoking related diseases.

Introduction

The government's health strategy set out in the *Health of the Nation* includes specific targets for reducing mortality from lung cancer, coronary heart disease, and cerebrovascular disease.[1] Ambitious targets have also been set for reducing the prevalence of smoking, a major risk factor for these and other diseases.

Total cigarette consumption in Britain has fluctuated widely in the past 20 years, around a general downward trend, in a mirror image of the real price of cigarettes (fig 1). Short term changes were often substantial and

indicate the power of pricing policy to determine smoking levels; for example, between 1977 and 1979, a time of rapid inflation, cigarette prices fell by 13% in real terms and smoking rose by 10%. This was repeated to a lesser extent in the late 1980s when cigarette tax did not keep up with inflation. During this time smoking rates in different socioeconomic groups have diverged, particularly for men, while smoking rates of men and women have converged (fig 2). Table I shows mortality ratios by socioeconomic group for diseases for which smokers are known to be at high risk. For lung cancer and heart disease these differences are relatively new,[4] and for lung cancer, coronary heart disease, and chronic bronchitis the inequalities widened in both sexes between 1971 and 1981.[5-7] Smoking is acknowledged to be a contributor to differences in mortality and morbidity between socioeconomic groups,[8-10] especially in key diseases targeted in the *Health of the Nation*. Policies are therefore needed that will both reduce smoking and narrow differences between socioeconomic groups; otherwise inequalities in health outcomes will remain, and the mortality targets may not be achieved.
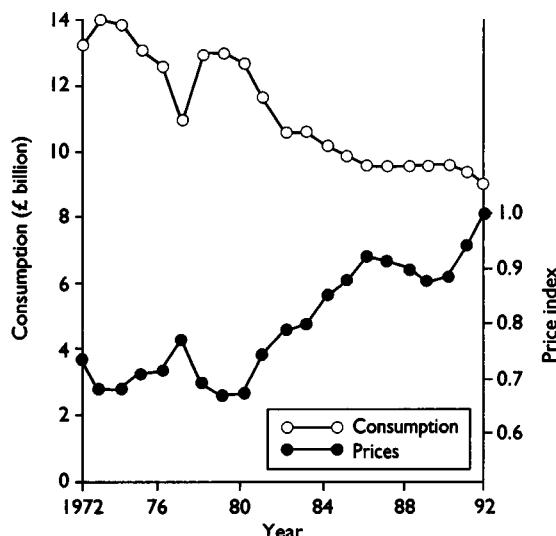
The main determinants of smoking behaviour

FIG 1—Relation between consumption (£ billion at 1992 prices) and real price (1992 = 1·0) of cigarettes in Britain during 1972-92. (From Office of Population Censuses and Surveys[2])
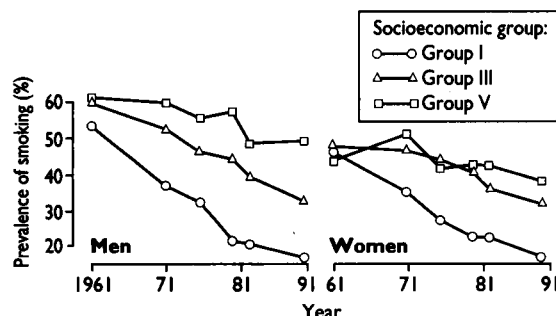

FIG 2—Prevalence of smoking in British men and women during 1961-91 by socioeconomic group. (From Wald and Nicolaides Bouman[3])

TABLE I—*Standardised mortality ratios from smoking related diseases in British men and women aged 15-64 by socioeconomic group during 1980-2. (From Office of Population Censuses and Surveys[3])*

Socioeconomic group	Men	Women
Lung cancer		
I	43	48
III*	120	115
V	178	149
Coronary heart disease		
I	70	43
III*	109	113
V	144	161
Chronic obstructive airways disease		
I	34	34
III*	110	102
V	211	170

*Manual and non-manual groups.

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in different social groups must be considered if appropriate policies are to be devised to achieve these aims. Individual influences on smoking (such as parental, sibling, and peer group smoking) and expectation of satisfaction from smoking have been extensively researched,[11 12] but for the most part these are not directly amenable to policy interventions. National factors such as price, health information and promotion, advertising, and restriction on where smoking is allowed can also be powerful influences. There has been less research of these factors, although there is evidence that they may lead to more effective interventions.[13] One way to try to explore some of these national effects is by econometric multiple regression analysis.

Price is recognised as a major determinant of cigarette consumption,[14-16] and the government is committed to a tobacco tax policy for the smoking targets.[1] With smoking becoming concentrated in lower socioeconomic groups, there are the dual concerns of the increasing burden of smoking related diseases on low income groups and the implications of price rises for low income smokers. In previous work using data for British men in 1961-77 the price elasticity of demand for cigarettes in different socioeconomic groups was studied.[17] (Elasticity is the standard economic measure of response to change in an economic variable, such as price or income, and is defined as the percentage change in quantity bought for a 1% change in that variable.) Price elasticity of demand ranged from zero for professional men to -0.5 for clerical workers and skilled manual workers to -1.4 for unskilled manual workers, suggesting that tax increases would have greatest impact on men with the highest smoking rates and mortality. Atkinson et al[18] and Fry and Pashardes[19] also reported different responses to price in households with different incomes and by factors related to socioeconomic group, such as house ownership. However, another study of data from the Tobacco Advisory Council reported a significant and relatively high price response by men and women in the higher socioeconomic groups and the lowest price response by men and women in the lowest socioeconomic groups.[20]

There is particular interest in the response to price of young smokers and young potential smokers, especially as there has been an apparent lack of success of health education in reducing teenage smoking.[21] Lewit and Coate studied teenage smoking in the United States and concluded that: "Teenage price elasticities of demand are large. The smoking participation (prevalence) elasticity equals -1.2 and the (total) quantity smoked elasticity -1.4."[22] There are no estimates of British teenagers' or other age groups' responses to changes in cigarette price, and there is now differing evidence from the United States suggesting a much lower price elasticity among teenagers not significantly different from the estimate of -0.23 for American adults.[23]

In this paper we aimed at determining the effects of economic and social factors on cigarette consumption in different socioeconomic, age, and sex groups using British data for 1972-90.

Methods

We used multiple regression analysis[24] to examine how the smoking patterns of different socioeconomic and age groups were influenced by price, income, and a factor (which we have termed the health publicity effect) representing the net effects of health publicity and other social trends including social acceptability and restrictions in workplace and public places. We used a single equation model for each group, making the usual assumption that the consumption (demand)

function is log linear and following the methodology of earlier work[17]:

$$\log q_{ti} = \alpha + \beta_i \log Y_t + \gamma_i \log P_t + \delta_i H + \mu_{ti},$$

where q_{ti} denotes average cigarette consumption per week per adult in group i for year t, Y_t denotes annual real disposable income per head, and P_t denotes real price of cigarettes. H is the health publicity effect including effects of social acceptability and smoking restrictions: these are likely to be cumulative over time, and we have represented it with a vector (1, 2, 3, . . . n). The coefficients β_i and γ_i give the income and price elasticities, δ_i is the biennial change in consumption due to health publicity, α is a constant, and μ_{ti} is random error. Separate equations were fitted by sex for each socioeconomic and age group to estimate price and income responses (β_i and γ_i) by socioeconomic, age, and sex group.

We selected the most appropriate equation by excluding terms that were not significant at the 5% level from the model and examining the R^2 statistic (multiple correlation coefficient), adjusted for degrees of freedom, and the Durbin Watson statistic. The Durbin Watson statistic measures serial correlation of the residual and varies between 0 and 4; with no serial correlation the values would be 2. A low value is an indication of positive serial correlation (if an observation is above the general trend then neighbouring values are also likely to be high). Conversely, a value much above 2 would indicate negative serial correlation (a high value in one year associated with a low value in successive years). The "RESET" test, a general test for omitted variables and incorrect functional form,[25] was used to test the specification of each equation. An extended regression equation is estimated where the squares of the fitted values are also entered into the equation. Problems with the current model are indicated if there is a significant value of the test statistic.

The same form of equation was used to estimate the effects of the variables on smoking prevalence of each group. The significance of coefficients was tested with the t statistic and the significance of including more than one variable by a joint F test. Tests for trend in elasticities over socioeconomic and age groups were performed by analysis of variance, fitting the appropriate linear contrast.[26]

Data

We used biennial data on prevalence of smoking, defined by the proportion of adults currently smoking one or more cigarettes a day, and numbers of cigarettes smoked per smoker for 1972-90 by sex, age, and socioeconomic group from the general household survey.[2] These were combined to give average consumption per adult in each group so that both prevalence of smoking and mean cigarette consumption could be analysed.

Survey data on smoking tend to understate actual consumption (as indicated by sales) by about 15%, but there is no evidence that this has varied over time in a consistent way.[3] Some studies of cigarette consumption and prevalence of smoking have used data from the family expenditure survey,[18 19 27] but these data relate to household expenditure and do not indicate individual consumption or smoking prevalence and so present problems of interpretation.

Data on annual national disposable income were from the annual national income and expenditure accounts[28] and were divided by the population to give per capita disposable real income. All incomes were deflated by the retail price index to give real per capita income. Data on cigarette prices were also from the national income and expenditure accounts.[28]

Results

CHANGES IN SMOKING, INCOME, AND PRICE

In the past two decades real prices of cigarettes (relative to the retail price index) have oscillated but have risen overall by 22%, while real income per head (relative to the retail price index) has risen by 55%. Cigarette prices therefore rose relative to other prices, but fell 20% relative to average incomes. Average cigarette consumption per adult fell by 40% for all men and by 24% for all women. It changed little for women in socioeconomic groups IV and V or aged over 60 but decreased in all other socioeconomic, age, and sex groups. In 1990 average cigarette consumption was higher for men than for women in all socioeconomic and age groups except for women aged 16-19, who smoked marginally (4%) more than men of the same age. Prevalence of smoking fell by 40% for men and by 29% for women and declined in all the subgroups studied (fig 2).

SOCIOECONOMIC GROUP AND SEX

The multiple regression model explained a high proportion of the variation in cigarette consumption (high R^2) over the period except for women in socioeconomic groups IV and V (table II). Price elasticities were significant at -0·47 (95% confidence interval -0·83 to -0·10) for all men and -0·61 (-0·89 to -0·33) for all women. Price elasticity was highest for men and women in socioeconomic group V (-1·0 for men and -0·88 for women) but was not significantly different from zero for men and women in socioeconomic groups I and II. There was a significant linear gradient in price elasticities by socioeconomic group for men ($F=5·6$, $P=0·02$) and for women ($F=6·1$, $P=0·02$). There was a significant underlying downward effect of health publicity for men in each group except for socioeconomic group V and a significant linear gradient by socioeconomic group ($F=6·9$, $P=0·01$). For women health publicity was significant only for socioeconomic groups I and II, but there was also a significant linear gradient by socioeconomic group ($F=10·5$, $P=0·003$). There was no significant income effect and little evidence of serial correlation.

AGE AND SEX

Table III shows the results of the multiple regression analysis of cigarette consumption by age group and sex. The equations again explain a high proportion of the variation over the past 20 years (with the exception of women aged over 60, in whom consumption was static), and there was no evidence of serial

TABLE II—*Price elasticities of cigarette consumption and biennial effects of health publicity on cigarette consumption in Britain 1972-90 by sex and socioeconomic group*

Socioeconomic group	Price elasticity (SE)	Health publicity (SE)	R^2
Men			
I	0·03 (0·42)†	-0·09 (0·01)***	0·91
II	-0·12 (0·32)†	-0·07 (0·01)***	0·93
III non-manual	-0·67 (0·24)*	-0·06 (0·01)*	0·97
III manual	-0·49 (0·19)*	-0·04 (0·01)**	0·96
IV	-0·47 (0·17)*	-0·03 (0·01)**	0·95
V	-1·02 (0·31)*	-0·007 (0·01)	0·86
All men	-0·47 (0·19)*	-0·05 (0·01)***	0·97
Women			
I	0·50 (0·59)†	-0·06 (0·02)**	0·62
II	-0·29 (0·34)†	-0·05 (0·01)***	0·85
III non-manual	-0·75 (0·21)**	-0·02 (0·01)	0·92
III manual	-0·71 (0·22)*	-0·01 (0·01)	0·89
IV	-0·64 (0·26)*	0·01 (0·01)	0·42
V	-0·88 (0·41)*	0·02 (0·02)	0·29
All women	-0·61 (0·14)**	-0·014 (0·006)*	0·94

Significance of difference from zero: *P<0·05; **P<0·01; ***P<0·001.
†Not significantly different from zero and variable omitted when model rerun.

TABLE III—*Price and income elasticities of cigarette consumption and biennial effects of health publicity on cigarette consumption in Britain 1972-90 by sex and age*

Age (years)	Price elasticity (SE)	Income elasticity (SE)	Health publicity (SE)	R^2
Men				
16-19	0·06 (0·32)†	1·99 (0·64)*	-0·17 (0·03)***	0·94
20-24	0·16 (0·26)†	1·17 (0·54)	-0·12 (0·03)**	0·94
25-34	-0·73 (0·16)**	1·25 (0·35)**	-0·11 (0·02)***	0·98
35-49	-0·35 (0·17)	0·59 (0·37)	-0·07 (0·02)**	0·97
50-59	-0·66 (0·37)	-1·41 (0·66)†	-0·05 (0·02)*	0·90
≥60	-0·29 (0·13)	-0·85 (0·27)*	-0·02 (0·01)	0·99
Women				
16-19	-0·86 (0·22)**	1·17 (0·88)†	-0·08 (0·05)†	0·61
20-24	-0·96 (0·20)***	-0·22 (0·33)†	-0·03 (0·05)†	0·71
25-34	-0·85 (0·09)***	0·38 (0·92)†	-0·01 (0·004)**	0·99
35-49	-0·93 (0·13)***	-0·19 (0·22)†	-0·004 (0·03)†	0·84
50-59	-0·92 (0·16)***	-1·27 (0·57)†	0·05 (0·03)†	0·77
≥60	-0·59 (0·26)*	-1·56 (0·56)*	0·09 (0·03)*	0·47

Significance of difference from zero: *P<0·05; **P<0·01; ***P<0·001.
†Not significantly different from zero and variable omitted when model rerun.

TABLE IV—*Price elasticities of smoking prevalence and biennial effects of health publicity on smoking prevalence in Britain 1972-90 by sex and lowest socioeconomic group*

Socioeconomic group	Price elasticity (SE)	Health publicity (SE)	R^2
Men			
All groups	-0·08 (0·08)†	-0·06 (0·002)***	0·99
Group V	-0·61 (0·25)*	-0·02 (0·01)	0·89
Women			
All groups	-0·23 (0·08)*	-0·03 (0·004)***	0·99
Group V	-0·51 (0·14)**	-0·02 (0·04)†	0·57

Significance of difference from zero: *P<0·05; **P<0·01; ***P<0·001.
†Not significantly different from zero and variable omitted when model rerun.

correlation. Price elasticities by age were consistently higher for women than for men. There was no evidence that men aged under 25 responded to changes in cigarette prices, but there was evidence of a considerable response to income changes by men aged under 35. There was a significant underlying downward effect of health publicity for men of all ages (except for those over 60), but particularly for young ages—equivalent to a yearly decrease of 5-8% for men aged 16-34. A significant increasing effect was estimated for women aged over 60. There was a correlation between the effects of price and income for young women aged 16-19: no variables were significant in the full equation (non-significant price elasticity of -0·4), but when the income variable was omitted the price elasticity rose to -0·9 and was significant (P<0·01).

PREVALENCE OF SMOKING

Table IV shows that price was a significant factor in prevalence of smoking for men in socioeconomic group V (prevalence price elasticity of -0·61), for all women (-0·23), and for women in socioeconomic groups III non-manual (-0·3) and V (-0·5). For women in socioeconomic group V the equation for prevalence gave a better fit and a higher price response than did the equation for average consumption. There was a significant gradient in price elasticities by age for men ($F=4·5$, $P=0·04$) and in health publicity for men ($F=29·8$, $P=0·0001$) and women ($F=14·6$, $P=0·0005$). The RESET test showed no evidence of mis-specification in any of the above equations.

Discussion

This analysis was a first attempt to investigate the effects of price and health publicity on smoking behaviour by specific socioeconomic and age groups in Britain using aggregate data. The results suggest a differential response to real cigarette prices by socioeconomic group and some evidence of difference

by sex and age. That significant results should have been obtained from a relatively small data set, albeit spanning 20 years, indicates the strength of the effects and the usefulness of analysing this highly fluctuating data series despite the limitations of the aggregate data and absence of appropriate income series specific to age, sex, or socioeconomic groups.

HEALTH PUBLICITY

The health publicity effects on smoking by men in all socioeconomic groups and women in socioeconomic groups I and II were significant. Effects of advertising were not examined, although they are highly relevant to current policy discussions[29]; they are complex to model[29] and are unlikely to show significant effects as there have been no major changes in policy over the period of analysis. There is need for further research in this area.

AGE

The analysis by age presents some problems as there are cohort effects operating as well as the effects of the economic variables that were modelled. The cohort effects are particularly relevant to the narrow age bands of 16-19 and 20-24, where cohorts were moving through at a faster rate than in the wider, older age bands. There is a further problem with the subgroup of women aged over 60—a large and increasing age group—which consisted of cohorts of women with a low prevalence of smoking that increasingly included cohorts with higher prevalence of smoking. This was reflected in the significant upward trend for this subgroup, which neutralised the fall in smoking expected from the significant price elasticity of −0·6. It is not feasible with the present data set to effectively separate the cohort effects.

For young men income seemed to have been more influential than price. Young people generally have relatively low incomes with a high proportion of it available for discretionary expenditure, so that changes in income are more likely to affect their smoking patterns. The results do not confirm the findings of Lewit and Coate,[22] that American male teenagers have a high response to changes in cigarette prices, and are more compatible with recent results that report a low response to price by American teenagers similar to that of American adults.[23] Our results do, however, suggest that cigarette consumption in teenage women, the only age group in which women smoke more than men, may be more affected by price rises, although for them the effects of price and income appear to be interrelated. Cigarette price rises also have an indirect longer term influence via effects on parents, as it is well established that the probability of a young person becoming a regular smoker is related to parental smoking.[11] [12]

SMOKING PREVALENCE AND PRICE

The estimates of price elasticity were generally higher for lower socioeconomic groups, which confirms previous findings for men and provides new results for women. There has been much debate about whether cigarette price affects the prevalence of smoking as well as consumption,[19] [27] and our analysis suggests that price does have a significant and substantial effect on the prevalence of smoking in men in socioeconomic group V (unskilled workers) and in women, particularly those in socioeconomic group V. These are the groups for whom prevalence of smoking is highest.

Smokers' main response to price changes is to stop (or start) smoking, to change the number of cigarettes smoked, or to change to a differently priced brand. The data for cigarette consumption combine the first two of these effects (giving more power to detect differences), and so the price elasticities of consumption are mostly higher and more significant than the price

Public health implications

● Cigarette smoking is the greatest cause of preventable disease in Britain, and the government is committed to using health publicity and pricing policies to reduce it

● Reductions in cigarette smoking have been least in lower socioeconomic groups (who suffer the highest rates of related diseases), teenagers, and women

● In this study we examined changes in smoking patterns over the past 20 years in relation to health publicity and the real cost of cigarettes

● Health publicity was most effective in reducing smoking in younger people and higher socioeconomic groups; cigarette price changes had most effect on lower socioeconomic groups and women

● These results suggest that increases in the real cost of cigarettes will help reduce differences between socioeconomic groups in the prevalence of smoking and smoking related diseases, although special support may be needed by highly deprived families

elasticities of smoking prevalence. The exception is for women in socioeconomic group V, who showed a greater and more highly significant price elasticity of smoking prevalence. The number of cigarettes smoked by women with low income seemed not to vary with price changes in the expected way. One possible explanation may be that, whereas women with low income are more likely than other groups to respond to price increases by stopping smoking altogether, those who continue smoking may tend to change to smaller (cheaper) or hand rolled cigarettes rather than reduce the number of cigarettes smoked.

IMPLICATIONS OF PRICING POLICIES

Our results suggest that the main effects of increasing the real price of cigarettes (for example, by tax increases) would be to reduce the prevalence of smoking in men and women in lower socioeconomic groups (those with the highest levels of smoking and the greatest mortality from smoking related diseases) and to reduce cigarette consumption by all women and men aged between 25 and 59. The implications of such a pricing policy need to be considered for highly disadvantaged groups in Britain, who have high rates of smoking.[2] [30] [31] Marsh and McKay report a prevalence of smoking as high as 70% for lone parents with no educational qualifications, in local authority housing, and in manual socioeconomic groups, but significantly lower prevalence when any of these "disadvantages" were absent.[31] Their study did not include any data on price or taxation, but they discussed the implications of pricing policy, including the heavy burden it could impose on such families, and concluded that prices should not be reduced.

There is little doubt that price has a major effect on cigarette consumption and thus smoking related diseases, especially in low socioeconomic groups. To use this effective tool of preventive medicine therefore seems the right public health policy. But policies are also needed to address the reasons for high levels of smoking by highly disadvantaged people (most of whom started smoking in their early teens) and to ameliorate their hardship and isolation, especially those bringing up children alone.[32] Further research is necessary to study the effects of price and income in these deprived groups. There is recent evidence of a

relation between stress and smoking, suggesting that smoking relieves the stress of smoking withdrawal but that completely stopping smoking tends to lead to reduced stress, with stress increasing if smoking is resumed.[33][34] This may mean that providing support for stopping smoking, such as nicotine replacement, would be more effective than expected. More direct policies might be considered, to use some of the additional revenue from higher cigarette taxes to compensate poor lone parents for the increased cost of living caused by the taxes. Thus, increased cigarette prices could provide a good incentive to stop smoking, while the increased income support would prevent penalisation of those unable to stop smoking. The increased support given to people who continued to smoke would be clawed back in cigarette tax.

CONCLUSION

Changes in cigarette prices seem to have had a strong impact on smoking; the greatest impact is on groups that are least responsive to health publicity measures but have the highest prevalence of smoking. This suggests that real increases in the price of cigarettes will both reduce smoking and help to reduce the differences in the prevalence of smoking and smoking related diseases between socioeconomic groups. Special measures are necessary to ameliorate any effects on the cost of living of the most deprived families.

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Promotion of family planning services in practice leaflets

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General practitioners provide about three quarters of the family planning services in the United Kingdom, so potential users should be aware of the services offered by their practice. All general practices are now required to produce leaflets to describe the contraceptive services provided.[1] As leaflets are generally well received by patients[2] and influence patient behaviour,[3] they could be a useful information source for many aspects of family planning. We analysed the information about family planning in practice leaflets.

Methods and results

The leaflets are held by the Devon Family Health Services Authority and were assessed by one of us (MNM). We used criteria representing quality indicators for assessment (table), allocating one equally weighted point for each of the criteria mentioned and adding them together to give a score for each practice. These scores were related to the number of partners, the presence of female partners, and whether the practice was approved to train general practitioners.

Overall, 175 (88%) practice leaflets from 198 practices in Devon were available for analysis. Of these, 50 (29%) were from training practices and 82 (47%) from practices with one or more female partners. For the 10 criteria the leaflets achieved a median score of 2. Large practices had higher scores than small ones. The most commonly mentioned criteria were reference to the service and encouragement to use it, mention of when and what services were available, and the offer of a choice of provider within the practice. Few practice leaflets referred to postcoital contraception, confidentiality, or other sexual health issues.

Large practices were significantly more likely than small ones to mention family planning (χ^2 for trend 5·94, $P < 0·02$), to encourage the use of the service (16·74, $P < 0·001$), and to advertise a range of services (5·98, $P < 0·02$). Practices with female partners were significantly more likely to score above the median than all-male partnerships (χ^2 9·3, $P < 0·01$). There was no significant difference between the scores for training and non-training practices.

Comment

The findings suggest that leaflets are not being best used to advertise the range and potential of family planning services, which are separately contracted