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After-effects reported by women having follow-up cervical cytology tests in primary care:

a cohort study within the TOMBOLA trial

Abstract

Background
Although it is recognised that some women experience pain or bleeding during a cervical cytology test, few studies have quantified physical after-effects of these tests.

Aim
To investigate the frequency, severity, and duration of after-effects in women undergoing follow-up cervical cytology tests, and to identify subgroups with higher frequencies in Grampian, Tayside, and Nottingham.

Design
Cohort study nested with a multi-centre individually randomised controlled trial.

Method
The cohort included 1120 women, aged 20–59 years, with low-grade abnormal cervical cytology who completed a baseline sociodemographic questionnaire and had a follow-up cervical cytology test in primary care 6 months later. Six weeks after this test, women completed a postal questionnaire on pain, bleeding, and discharge experienced after the test, including duration and severity. The adjusted prevalence of each after-effect was computed using logistic regression.

Results
A total of 884 women (79%) completed the after-effects questionnaire; 30% of women experienced one or more after-effect: 15% reported pain, 16% bleeding, and 7% discharge. The duration of discharge was ≤2 days for 66%, 3–6 days for 22%, and ≥7 days for 11% of women. Pain or bleeding lasted ≤2 days in more than 80% of women. Severe after-effects were reported by <1% of women. The prevalence of pain decreased with increasing age. Bleeding was more frequent among nulliparous women. Discharge was more common among oral contraceptive users.

Conclusion
Pain, bleeding, and discharge are not uncommon in women having follow-up cervical cytology tests. Informing women about possible after-effects could better prepare them and provide reassurance, thereby minimising potential non-adherence with follow-up or non-participation with screening in the future.

Keywords
after-effects; bleeding; complications; cervical smears; cytology; pain; primary care; vaginal discharge.

INTRODUCTION

Every year in the NHS cervical screening programmes (CSPs), over 250 000 cytology tests are reported as showing a low-grade abnormality.[1,2] There has been considerable debate about the most appropriate management of these women.[3] The two main options are repeat cytology tests in primary care or referral for colposcopy with further intervention if the transformation zone is abnormal. It has recently been shown that there is little difference between these policies in terms of the detection of high-grade cervical intraepithelial neoplasia (CIN) over 3 years.[4] In evaluating the relative effectiveness of the policies, other outcomes should be considered, including the consequences of follow-up for women, such as physical after-effects like pain or bleeding. These are likely to be important from an individual, population, and health service perspective. When a woman has a negative experience during screening, such as pain, this may impact on her future participation and adherence to follow-up,[5,6] affecting her risk of developing high-grade disease, and impacting, in turn, on the effectiveness of the screening programme. Such women may also seek advice from health professionals, thus contributing to primary care providers' workload.

The present authors, and others, have shown that colposcopic examination, punch biopsies, and large loop excision carry a risk of after-effects for women,[7–9] but, to date, the physical consequences of cervical cytology tests have received little attention. The fear or perception of pain has been identified as a barrier to participation in screening in the UK and elsewhere.[10–16] In addition, it is recognised that a proportion of women experience pain, discomfort, or bleeding during cervical cytology tests. One study of women screened in Scotland reported that 20% experienced pain during a test,[17] and a study in London found that 54% had experienced pain or discomfort.[18] However, little is known about the prevalence and duration of after-effects in the days following screening, or about which groups of women are more likely to experience after-effects.

The aims of the study were to investigate in women with low-grade abnormal cervical cytology being managed by follow-up cervical cytology tests in primary care:

- the frequency, duration, and severity of pain, bleeding, and discharge following the test; and
- sociodemographic factors associated with the reported frequency of pain, bleeding, and discharge.

METHOD

Study cohort

The study was nested within the cytological

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How this fits in

Pain and bleeding are recognised consequences of cervical cytology tests for a proportion of women. Despite this, little is known about the prevalence, severity, and duration of such physical after-effects in women having these tests. Among women undergoing cytological follow-up in primary care following previous low-grade abnormal cervical cytology, 15% reported pain, 16% experienced bleeding, and 7% reported discharge. The prevalence of pain and discharge, but not bleeding, was higher in younger women. Most after-effects lasted ≤2 days and severe after-effects were rare. These after-effects represent an important consequence of cervical screening and should be taken into consideration when comparing the costs and benefits of different screening and follow-up policies.

surveillance arm of the TOMBOLA trial (Trial Of Management of Borderline and Other Low-grade Abnormal smears), a UK multicentre randomised controlled trial, full details of which are described elsewhere.[19] Women aged 20–59 years, resident in Grampian, Tayside, or Nottingham, with recent low-grade abnormal cytology (mild dyskaryosis or borderline nuclear abnormalities [BNA]) taken as part of routine screening between October 1999 and October 2002, were invited to participate in TOMBOLA. Women who consented completed a sociodemographic questionnaire and were randomised to either cytological surveillance (follow-up cervical cytology tests in primary care) or a colposcopy examination. Within the cytological surveillance arm, women were invited to attend for a cervical cytology test at 6-monthly intervals for up to 3 years, with return to routine recall if they had three consecutive negative tests, and referral to colposcopy after a single test showing moderate or more severe dyskaryosis. The cohort for the current study comprised women who attended for the first follow-up cervical cytology tests, after the point at which the questionnaire on after-effects (see later) had been implemented within the trial. Women were sent questionnaires between February 2002 and January 2004.

After-effects questionnaire

The content of the self-completion questionnaire was informed by extensive review of the literature and augmented by clinical opinion. The draft questionnaire was pretested among TOMBOLA participants for acceptability, ease of completion, and face validity, following Blazeby *et al*,[20] and modified as required prior to use. The final questionnaire collected details of any pain/discomfort, bleeding, and discharge experienced following the first follow-up cytology test, together with the duration (in days) and severity. The severity of pain was recorded on a five-point scale ranging from 'very mild' to 'very severe'. The severity of bleeding and discharge were also recorded on a five-point scale ranging from 'very light' to 'very heavy'.

The questionnaire was sent to women approximately 6 weeks after the first follow-up cervical cytology test. The decision on timing was driven by several factors. First, TOMBOLA staff were only able to ascertain that a woman had attended for a test when the cytology laboratory reported the result: the reporting time varied between centres and over time, but the overwhelming majority of results were expected to be reported within 6 weeks. Secondly, the study aimed to ensure consistency with a parallel assessment of after-effects within the colposcopy arm of TOMBOLA;[9] in that arm, it was anticipated that while some after-effects may be of reasonably long duration, most would have ceased within 6 weeks. Thirdly, other outcomes were being assessed at around 6 weeks, and to minimise the burden on women and maximise response, the assessments were combined into a single questionnaire. Women who did not respond were sent a maximum of two reminders, 2 weeks apart. During 2003, part-way through the current study, the researchers started sending a pen with all postal questionnaires in TOMBOLA, to maximise response rates.[21]

A copy of the questionnaire is available from the authors on request.

Statistical analysis

Analyses were carried out in STATA (version 10). For each individual after-effect (that is, pain, bleeding, and discharge), crude frequency rates were computed. Logistic regression methods were used to adjust the frequencies for factors significantly associated with each after-effect. The factors considered included age, trial centre, recruitment cytology status (mild, BNA), and a range of sociodemographic (for example, education, and employment status) and lifestyle (for example, smoking, parity, and contraception) variables from the recruitment questionnaire. Variables were

Table 1. Numbers of women reporting pain, bleeding, and discharge, crude and adjusted prevalence, overall and by sociodemographic characteristics

	Pain	Bleeding	Discharge
All women			
Number of women reporting after-effect	136	149	74
Crude prevalence, %; (95% CI)	15.4 (13.1 to 17.9)	16.9 (14.4 to 19.5)	8.4 (6.6 to 10.4)
Adjusted prevalence, % (95% CI)[a]	14.8 (12.5 to 17.5)	16.1 (13.7 to 18.7)	7.1 (5.5 to 9.2)
Adjusted prevalence, % (95% CI)[a] by subgroup			
Age, years			
20–29	19.1 (15.1 to 23.7)	15.2 (11.4 to 20.1)	10.4 (7.2 to 14.7)
30–39	16.3 (12.1 to 21.4)	19.5 (14.7 to 25.1)	6.1 (3.7 to 9.8)
40–49	12.3 (8.4 to 17.6)	13.9 (9.5 to 20.0)	6.4 (3.6 to 11.0)
50–59	6.6 (3.0 to 13.9)	14.7 (8.7 to 24.0)	3.4 (1.1 to 10.2)
Smoking status			
Non-smokers	13.4 (10.5 to 17.0)	18.7 (15.2 to 22.7)	7.5 (5.4 to 10.5)
Current smokers	14.0 (10.4 to 18.6)	11.9 (8.6 to 16.3)	9.7 (6.7 to 14.0)
Ex-smokers	20.6 (14.9 to 27.7)	17.5 (12.3 to 24.2)	3.5 (1.6 to 7.7)
Current oral contraceptive use			
Yes	15.6 (11.7 to 20.6)	17.9 (13.7 to 22.9)	9.6 (6.5 to 14.1)
No	14.4 (11.6 to 17.7)	15.1 (12.3 to 18.5)	6.0 (4.3 to 8.5)
Ever had children			
Yes	15.2 (12.0 to 19.1)	13.5 (10.7 to 16.9)	8.3 (5.7 to 11.9)
No	14.3 (10.8 to 18.7)	19.8 (16.1 to 24.2)	5.7 (3.6 to 9.0)
Physical activity			
<1 per week	13.4 (10.2 to 17.5)	16.0 (12.4 to 20.4)	7.0 (4.7 to 10.2)
1–3 times per week	12.2 (8.5 to 17.1)	15.8 (11.5 to 21.2)	5.3 (3.0 to 9.1)
>3 times per week	19.2 (15.0 to 24.1)	17.0 (13.1 to 21.8)	8.8 (6.0 to 12.7)
Post-secondary school education			
No degree	14.5 (12.0 to 17.5)	14.8 (12.3 to 17.8)	7.0 (5.2 to 9.4)
Degree	16.0 (11.6 to 21.8)	20.8 (15.6 to 27.0)	7.7 (4.6 to 12.3)
Employment status			
Full-time	14.2 (11.2 to 17.8)	16.3 (13.0 to 20.3)	6.4 (4.4 to 9.2)
Part-time	12.6 (8.7 to 18.1)	14.8 (10.3 to 20.9)	6.6 (3.8 to 11.0)
Student	14.8 (8.3 to 25.1)	15.9 (9.0 to 26.7)	4.5 (1.8 to 10.9)
Not in paid employment	20.2 (14.3 to 27.9)	17.2 (11.4 to 25.1)	13.7 (8.8 to 20.7)

[a]Pain — adjusted for age and physical activity; bleeding — adjusted for smoking status, post-school education, and ever had children; discharge — adjusted for age, smoking status, employment status, and current pill use.

included in the models if they were significant ($P<0.05$) on likelihood ratio tests. Model goodness of fit was checked using the Hosmer and Lemeshow test.[22] Duration was computed as the percentage of women still experiencing the after-effect 1, 2, 3, and so on, days after the cervical cytology test.

RESULTS

Characteristics of responders

Of the 1120 women sent the questionnaire, 884 (79%) completed it. Six hundred and sixty-four women (59%) returned the questionnaire following the initial administration; 154 (14%) returned it after the first reminder, and 66 (6%) after the second reminder. Overall, 38% of responders were aged 20–29 years, 28% were aged 30–39 years, 23% were aged 40–49 years, and 11% were aged 50–59 years. Just under one-quarter had had a test showing mild dyskaryosis at recruitment to TOMBOLA, and 76% a BNA test. Six per cent had had another test showing BNA in the 3 years before recruitment. One-quarter of women had had no post-school education or training, 20% had completed training through work, and 55% had attended college or university. Fifty-six per cent of women were parous. Just over one-third were current users of the oral contraceptive pill. Half of women had never smoked, 19% were ex-smokers, and the remainder were current smokers.

Frequency of after-effects

Table 1 shows the numbers reporting and prevalence of pain, bleeding, and discharge. After adjusting for confounders, 14.8% (95% confidence interval [CI] = 12.5 to 17.5%) reported pain following the cytology test, 16.1% (95% CI = 13.7 to 18.7%) experienced bleeding, and 7.1% (95% CI = 5.5 to 9.2%) experienced discharge.

Two hundred and sixty-four women (30%) experienced one after-effect or more. Of these, 69% ($n = 183$) had experienced only one (pain: 24%; bleeding: 30%; discharge: 15%), 25% ($n = 67$) had experienced two, and 5% of women ($n = 14$) had experienced all three. Pain plus bleeding was the most common combination, reported by 18% of women.

Of those women who reported an after-effect, 8% ($n = 22$) stated that they had either spoken to, or seen in person, their GP or a practice nurse, in relation to the after-effect.

Age and level of physical activity were significantly associated with reporting of pain. Post-school education, smoking status, and parity were significant related to bleeding. Discharge was associated with age, employment status, smoking status, and current use of oral contraceptives. The reported prevalence of pain and discharge, but not of bleeding, decreased with increasing age (Table 1): the adjusted prevalence was approximately three times higher in the 20–29 years age group (pain: 19.1%; discharge: 10.4%) than in the 50–59 years age group (pain: 6.6%; discharge: 3.4%). For bleeding, current smokers had a lower prevalence than ex- and never smokers, while for discharge, the prevalence was highest among current smokers. Women who were current users of the oral contraceptive pill had a higher frequency of discharge than non-users (9.6% versus 6.0%). Nulliparous women had a higher frequency of bleeding than parous women (19.8% versus 13.5%).

Severity and duration

Figure 1 shows, for each after-effect,

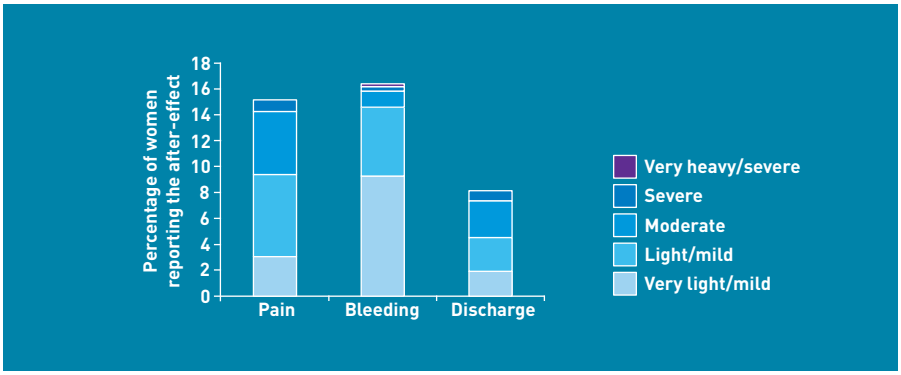

Figure 1. Severity of after-effects reported by women.

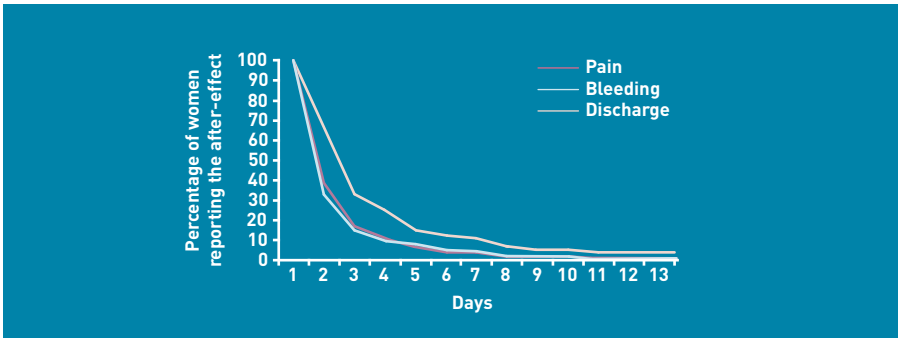

Figure 2. Duration of after-effects reported by women.

severity expressed on a five-point scale ranging from very mild/light to very severe/heavy. The majority of after-effects were very mild or mild (pain) or very light or light (bleeding, discharge). Severe after-effects were rare, reported by less than 1% of women.

The duration of each after-effect is shown in Figure 2. In general, discharge tended to last somewhat longer than pain or bleeding. Two-thirds of women who experienced discharge reported a duration of ≤2 days, 22% a duration of 3–6 days, and 11% a duration of 1 week or longer. For pain and bleeding, the overwhelming majority of women who reported the after-effect (83% and 85% respectively) described the duration as ≤2 days. For pain, 14% reported a duration of 3–6 days and 3% a duration of 1 week or longer. Of those who experienced bleeding, the duration was 3–6 days for 10% and 1 week or longer for 4%.

DISCUSSION

Summary

Almost one-third of women reported having experienced one after-effect or more, of a follow-up cervical cytology test. Pain and bleeding were reported twice as frequently as discharge. For most women, the duration was short (≤2 days), although discharge tended to persist for slightly longer than pain or bleeding. Severe after-effects were uncommon. The reported prevalence varied by sociodemographic factors.

Strengths and limitations

To the authors' knowledge, this is the first study of the frequency of physical after-effects experienced by women undergoing follow-up cervical cytology tests after a low-grade abnormal cytology result. The study was undertaken within a population-based, pragmatic trial, itself nested within the NHS CSPs. The questionnaire response rate was high and the age distribution of responders was very similar to that of all women who had a low-grade cytology test in the English CSP in 2000/2001 (the midpoint for recruitment to TOMBOLA).[23] These factors mean that it is likely that the results are generalisable across the CSPs with respect to women with low-grade abnormal cytology. Whether they entirely generalise to women attending for primary cervical screening (that is, without a previous low-grade result) is somewhat less certain, but the high frequency of women reporting after-effects in the present study (almost one-third) would tend to suggest that the prevalence of after-effects among the primary screening population is likely to be substantial.

A further strength was that the after-

effects were assessed from the perspective of women themselves, rather than from the perspective of the doctor or nurse performing the test, as was the case in some studies of women treated by loop excision.[24,25] Although different women may have reported similar after-effects differently (for example, what one woman reported as mild pain may have been moderate for another), the impact of a cervical cytology test and any associated after-effect(s) on a woman's life (and, potentially, her future screening participation) probably depends on her own perception of the experience.

The major potential limitation of the study is that it was retrospective, which may have affected accuracy of recall, or reporting, of after-effects. The timing of the questionnaire (6 weeks after the cervical cytology test) may have meant that mild after-effects of short duration were under-reported. Similarly, although the response rate was high, around 20% of women did not return the questionnaire, and it is possible that non-responders did not take part because they had not experienced any after-effects. However, the questions on after-effects were integrated into a single questionnaire with instruments assessing other outcomes that may have been relevant to women even if they had not experienced after-effects. Moreover, even if all of the non-responders had not experienced any after-effects, this would only have slightly reduced the overall crude prevalence (from 30% to 24% [264/1120]).

The overwhelming majority of study participants would have received the result of their follow-up cytology test before completing the questionnaire. Whether this impacted on recollection or reporting of after-effects is unclear. While the reported prevalence of discharge was significantly lower in women with a negative smear result (6.3%) compared to those with a non-negative result (inadequate or abnormal; 11.5%), there was no difference in the prevalence of pain and bleeding by test result.

The follow-up tests conducted in this cohort were a mixture of conventional tests (taken with a spatula) and liquid-based cytology tests (taken with a cervix brush). Although it is not known for certain which women were tested with which device, based on the dates of roll-out of liquid-based cytology, it is likely that a substantial proportion of the tests conducted in Grampian and Tayside participants, but very few of those in Nottingham participants, involved use of the cervix brush. When the prevalence of after-effects in Grampian and Tayside was compared with Nottingham there were no notable differences.

Comparison with existing literature

As would be expected, the reported frequency of after-effects following a cervical cytology test is much lower than that observed in women who have had punch biopsies or large loop excision.[7–9] The reported frequency of bleeding in this study was slightly higher than that observed in the authors' companion study of women undergoing colposcopy examination without biopsy or treatment (16.1% versus 14.1%),[9] possibly because a cytology test involves direct contact with the cervix. In contrast, the reported frequencies of pain, and especially discharge, were somewhat lower in the current study, the latter possibly because a colposcopy involves the use of acetic acid and Lugol's iodine, which may be viewed by some women as discharge.

Various sociodemographic factors were associated with the reported prevalence of after-effects. The observed inverse association between age and pain might have been anticipated. Age is likely to be a marker of the number of previous cervical cytology tests and other gynaecologic and obstetric investigations and interventions, and women who have had more such procedures might be less likely to consider a cervical cytology test to be painful. Alternatively, women who were more anxious about the test might be more likely to recall it as having been painful,[17] and it has previously been shown that levels of anxiety were higher in younger women in this cohort.[26] The lack of an inverse association between age and post-cytology bleeding may be a consequence of the atrophic vaginal mucosa and vaginal dryness in peri- and post-menopausal women, which sometimes results in bleeding when a speculum is inserted.[5] The observed positive association between current use of oral contraceptives and reported discharge may be a function of the effects of hormones on the cervical environment and, specifically, vaginal fluid.

Implications for practice and research

The high frequency of after-effects reported by women having a follow-up cervical cytology test is noteworthy and important. Although most after-effects were mild and of short duration, the present results suggest that almost one in three women will experience some pain, bleeding, or discharge. Given the number of low-grade

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Ethics committee

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Provenance

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Competing interests

The authors have declared no competing interests.

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abnormal cervical cytology tests each year in the NHS CSPs (250 000), a substantial proportion of which will pertain to women who go on to have follow-up cytology, this represents significant morbidity. Extrapolating from the present findings, it is likely that substantial proportions of women attending for primary cervical screening also experience these physical after-effects, though it would be helpful to confirm this in a prospective study of women undergoing primary screening. Thus, after-effects constitute an important consequence of both cervical cytology tests and screening, and should be taken into consideration when comparing the costs and benefits of different screening and follow-up policies.

Another issue that deserves consideration is the potential consequences of these after-effects on participation in cervical screening. Studies have shown that a previous negative experience during screening impacts adversely on women's future participation.[6,27] Specifically as regards pain, a US study found that women who perceived that cervical cytology tests were painful were five times more likely not to adhere to screening recommendations than those who did not have this perception.[5] It is therefore plausible that the experience of pain (or other after-effects) might impact negatively on adherence to follow-up among women with low-grade cytology or, more generally, on future participation in routine screening. In support of this, it has been reported elsewhere that default rates from follow-up cervical cytology tests are highest among young women,[28] the group in whom after-effects are most common. Given that cervical cancer is the second most common cancer in women under 35 years in the UK,[29] it is important that strategies are developed to ensure that young women are not discouraged from attending screening or follow-up because of concerns about, or experiences of, pain or other after-effects.

From the perspective of primary care, one of the important findings of this study was that 8% of women who reported an after-effect (2.4% of all women) consulted their primary care team regarding this. Thus, the resource implications of after-effects of cervical cytology in primary care are not insubstantial. While there may be little that can be done to prevent some women from experiencing after-effects of cervical cytology tests, consideration might be given to ways to manage women's expectations. Current NHS CSP leaflets focus only on the possibility that women might experience pain during a cervical cytology test.[30] Providing information on the likely prevalence and duration of pain, bleeding, and discharge following such tests might help ensure that women are better prepared and more reassured, thereby lessening the burden in primary care.

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REFERENCES

1. The NHS Information Centre. *Cervical Screening Programme 2005–06.* Leeds: The Health and Social Care Information Centre, 2006. www.ic.nhs.uk/pubs/csp0506 (accessed 23 Mar 2011).
2. ISD Scotland. *Cervical cytology workload statistics.* Edinburgh: ISD Scotland, 2009. http://www.isdscotland.org/isd/1673.html (accessed 23 Mar 2011).
3. TOMBOLA Group. Refining the management of low-grade cervical abnormalities in the UK National Health Service and defining the potential for human papillomavirus testing: a commentary on emerging evidence. *J Low Genit Tract Dis* 2006; **10(1):** 26–38.
4. TOMBOLA Group. Cytological surveillance compared with immediate referral for colposcopy in management of women with low grade cervical abnormalities: multicentre randomised controlled trial. *BMJ* 2009; **339:** b2546.
5. Hoyo C, Yarnell KSH, Skinner CS, *et al.* Pain predicts non-adherence to pap smear screening among middle-aged African American women. *Prev Med* 2005; **41(2):** 439–45.
6. Blomberg K, Ternestedt BM, Tornberg S, Tishelman C. How do women who choose not to participate in population-based cervical cancer screening reason about their decision? *Psychooncology* 2008; **17(6):** 561–569.
7. Lopes A, Beynon G, Robertson G, *et al.* Short term morbidity following large loop excision of the cervical transformation zone. *J Obstet Gynaecol* 1994; **14:** 197–199.
8. Williams J, Jess C, Johnson N. Bleeding, discharge, pain and dysmenorrhoea after large loop excision of the transformation zone (LLETZ). *J Obstet Gynaecol* 2004; **24(2):** 167–168.
9. TOMBOLA (Trial Of Management of Borderline and Other Low-grade Abnormal smears) Group. After-effects reported by women following colposcopy, cervical biopsies and LLETZ: results from the TOMBOLA trial. *BJOG* 2009; **116(11):** 1506–1514.
10. Fylan F. Screening for cervical cancer: a review of women's attitudes, knowledge and behaviour. *Br J Gen Pract* 1998; **48(433):** 1509–1514.
11. Kahn JA, Chiou V, Allen JD,*et al.* Beliefs about Papanicolaou smears and compliance with Papanicolaou smear follow-up in adolescents. *Arch Pediatr Adolesc Med* 1999; **153(10):** 1046–1054.
12. Hislop TG, Deschamps M, Teh C, *et al.* Facilitators and barriers to cervical cancer screening among Chinese Canadian women. *Can J Public Health* 2003; **94(1):** 68–73.
13. Guilfoyle S, Franco R, Gorin SS. Exploring older women's approaches to cervical cancer screening. *Health Care Women Int* 2007; **28(10):** 930–950.
14. Wong LP, Wong YL, Low WY, *et al.* Cervical cancer screening attitudes and beliefs of Malaysian women who have never had a pap smear: a qualitative study. *Int J Behav Med* 2008; **15(4):** 289–292.
15. Kietpeerakool C, Phianmongkhol Y, Jitvatcharanun K, *et al.* Knowledge, awareness, and attitudes of female sex workers toward HPV infection, cervical cancer, and cervical smears in Thailand. *Int J Gynaecol Obstet* 2009; **107(3):** 216–219.
16. Waller J, Bartoszek M, Marlow L, Wardle J. Barriers to cervical cancer screening attendance in England: a population-based survey. *J Med Screen* 2009; **16(4):** 199–204.
17. Crombie IK, Orbell S, Johnston G, *et al.* Women's experiences at cervical screening. *Scott Med J* 1995; **40(3):** 81–82.
18. Schwartz M, Savage W, George J, Emohare L. Women's knowledge and experience of cervical screening: a failure of health education and medical organization. *Community Med* 1989; **11(4):** 279–289.
19. Cotton SC, Sharp L, Little J, *et al.* Trial of management of borderline and other low-grade abnormal smears (TOMBOLA): Trial design. *Contemp Clin Trials* 2006; **27(5):** 449–471.
20. Blazeby J, Sprangers M, Cull A, *et al. EORTC Quality of Life Group Guidelines for Developing Questionnaire Modules. 3rd edn.* EORTC Working Document. Brussels: EORTC, 2001. http://groups.eortc.be/qol/downloads/l200208module_development_guidelines.pdf(accessed 23 Mar 2011).
21. Sharp L, Cochran C, Cotton SC, *et al.* Enclosing a pen with a postal questionnaire can significantly increase the response rate. *J Clin Epidemiol* 2006; **59(7):** 747–754.
22. Hosmer DW, Lemeshow S. *Applied logistic regression.* New York: Wiley, 1989.
23. Department of Health. *Cervical Screening Programme, England: 2000–01.* London: Department of Health, 2001. http://www.dh.gov.uk/en/Publicationsandstatistics/Statistics/StatisticalWorkAreas/Statisticalhealthcare/DH_4015769 (accessed 23 Mar 2011).
24. Spitzer M, Chernys AE, Seltzer VL. The use of large-loop excision of the transformation zone in an inner-city population. *Obstet Gynecol* 1993; **82(5):** 731–735.
25. Dunn T, Killoran K, Wolf D. Complications of outpatient LLETZ procedures. *J Reprod Med* 2004; **49(2):** 76–78.
26. Gray NM, Sharp L, Cotton SC, *et al.* Psychological effects of a low-grade abnormal cervical smear test result: anxiety and associated factors. *Br J Cancer* 2006; **94(9):** 1253–1262.
27. Orbell S. Cognition and affect after cervical screening: the role of previous test outcome and personal obligation in future uptake expectations. *Soc Sci Med* 1996; **43(8):** 1237–1243.
28. Sharp L, Cotton S, Thornton A, *et al*, on behalf of the TOMBOLA Group. Which women default from follow-up cervical cytology tests? A cohort study within the TOMBOLA trial. Cytopathology 2011; **22:** DOI: 10.1111/j.1365–2303.2011.00848.x
29. Cancer research UK. *Cervical cancer — UK incidence statistics.* London: Cancer Research UK, 2010. http://info.cancerresearchuk.org/cancerstats/types/cervix/incidence/ (accessed 23 Mar 2011).
30. NHS Cancer Screening Programmes. *Cervical screening. The facts.* London: Department of Health, 2009. http://www.cancerscreening.nhs.uk/cervical/publications/nhscsp-the-facts.pdf (accessed 23 Mar 2011).