The incidence of cervical cancer has been increasing in women aged 40 since the early 2000s (Figure 1). There have been several explanations for this rising trend, including a downward trend in cervical screening coverage in women of this age (10) and generational changes in sexual activity resulting in a greater risk of infections with HPV and other sexually transmitted disease (11). This analysis investigates whether immigration may also be causing an increase in incidence in women of working age, as anecdotal evidence suggests there may be increasing numbers of women of Eastern European origin being treated for cervical cancer in England.

Two approaches were taken:

**Patient Level:** A dataset of patient level cervical cancer registrations was created using the NCDR 2010. This dataset included women diagnosed with cervical cancer (ICD-25) under the age of 40 in England between 1998 and 2010 (n=11,477). There is no country of origin data readily available in the cancer registration database so this information was created using Mosaic Origins software. This software uses the first and surname of each person in the dataset to assign a country of origin. The software was deemed suitable for this purpose as accuracy rates are in excess of 90% in identifying South Asians, 70% in identifying black Africans and those from East and South East Europe. However, lower accuracy rates are achieved with people of Nordic or French origin or those from black Caribbean background. This technique has been used since the 1990's in epidemiological and genetic studies to subdivide populations (12). Once a country of origin was assigned, cases were grouped according to immigration trends and/or region of the world that other immigrant groups could be affecting cervical cancer incidence rates could be identified.

**Ecological:** A dataset of Local Authority (LA) (n=324) level data was created using a variety of different variables associated with cervical cancer incidence. These variables were then modelled to quantify the exploratory relationship to the change in incidence rates between 2004-2006 and 2008-2010. Incidence rates were calculated using the most recently published LA population figures based on the Census 2001 registration of populations from 2001 to 2011. The regressive command in STATA was used to fit a model of these variables onto the change in incidence rates using linear regression. The model was also used to explore interactions between these variables. The variables were:

- % of population that are Accession country born
- % of population that are of Asian ethnicity  (13)
- Asian communities are a lower risk group (14)
- % in increase in screening coverage trends between 2007-2008 and 2009-2010 to account for increasing incidence due to the ‘Jade Goody Effect’
- Teenage pregnancy and STI rates (15) - both indicators of sexual behavior that increase exposure to HPV
- Quintile of Deprivation, Income Domain of the 2010 Index of Multiple Deprivation (16) - associated with poorer coverage rates and increased risk
- Government Office Region

The results in the model also indicate a significantly higher increase in the incidence rate in both the North East and North West, after adjusting for all other factors. This may warrant further investigation.

![Figure 1. Trends in the age-specific incidence rate of cervical cancer by five year age group in women aged 20-39, England, 1999 to 2010](image)

**DISCUSSION**

Caution should be taken when interpreting these results for several reasons:

- The use of the Mosaic Origins software in attributing country of origin is not exact and therefore the number of cases in each group may be under or over estimated.
- Although country of origin may be somewhat accurate for Eastern European women, it still does not tell us when the patient entered the UK and therefore how much of an effect poorer screening programmes in the country of origin may have had on increasing risk of developing cervical cancer.
- The ecological study only shows significant results when LAS in London are removed from the model. This means that the effect of immigration on increasing cervical cancer rates can only be posited for LAS elsewhere in England.
- Immigration may only be a small factor in increasing incidence rates. Screening coverage is decreasing in young English women and the number of cases has already decreased since the late 1990s.
- Although trends are increasing in immigrant populations, rates may not be increasing to any greater degree than in the general population.
- There are also interesting related findings that are consistent with other research and information:

- Low numbers in women from ‘India & Pakistan’ are consistent with research that points to a lower risk of cervical cancer in these groups (16).
- The increasing trends in cases in ‘Accession’ countries reflect increasing immigration figures from ONS (17). The increasing trends do not appear to reflect the ‘Jade Goody effect’ seen in other populations that may be more aware of British media.
- Several studies of cervical cancer have repeated results with London areas removed from the analysis as the screening characteristics of the population are so different to elsewhere in the country (18). Indeed, in the group of LAS with the highest proportion of Accession born population, only those LAS within the London region showed an increase in case numbers.

The results suggest the need for further investigation and ‘surveillance’ of the effect of immigration on cervical cancer incidence rates as immigration trends change over time. Emphasis needs to be placed on understanding the characteristics of screening and treatment in these populations using linked treatment and cervical screening data.

**CONCLUSIONS**

Both the ecological and the patient level analysis show for the first time that increasing incidence rates may be influenced by young, immigrant females of working age from countries with poorer screening programmes or increased exposure to risk factors.

Further Patient level analysis is planned to explore any differences in treatment and screening amongst groups of women using additional data sources.