Influence of rurality, deprivation and distance from clinic on uptake in men invited for abdominal aortic aneurysm screening

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Background: Effective abdominal aortic aneurysm (AAA) screening requires high uptake. The aim was to assess the independent association of screening uptake with rurality, social deprivation, clinic type, distance to clinic and season.

Methods: Screening across Grampian was undertaken by trained nurses in six community and three hospital clinics. Men aged 65 years were invited for screening by post (with 2 further reminders for non-responders). AAA screening data are stored on a national call–recall database. The Scottish postcode directory was used to allocate to all invited men a deprivation index (Scottish Index of Multiple Deprivation), a Scottish urban/rural category and distance to clinic. Multivariable analysis was undertaken.

Results: The cohort included 5645 men invited for screening over 12 months (October 2012 to October 2013); 42.6 per cent lived in urban areas, 38.9 per cent in rural areas and 18.5 per cent in small towns (uptake 87.0, 89.3 and 90.8 per cent respectively). Overall uptake was 88.6 per cent with 76 new AAAs detected: 15.2 (95 per cent c.i. 11.8 to 18.6) per 1000 men screened. Aberdeen city (large urban area) had the lowest uptake (86.1 per cent). Uptake declined with increasing deprivation, with the steepest decline in urban areas. On multivariable analysis, a 1-point increase in deprivation deciles was associated with a 0.08 (95 per cent c.i. 0.06 to 0.11) reduction in the odds of being screened (P < 0.001). Clinic type (community versus hospital), distance to clinic and season were not associated independently with uptake.

Conclusion: Both urban residence and social deprivation were associated independently with uptake among men invited for AAA screening.


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Introduction

A challenge for population-based screening programmes is ensuring high uptake1. Evidence concerning factors that influence uptake relate predominantly to the screening of women for cervical cancer and breast cancer1–3. Women living in socially deprived areas have generally been found to have a lower uptake, but little previous research has been undertaken on the independent influence of rurality on uptake3. The majority of evidence relating to the uptake of screening derives from North America (82 per cent of published research in a previous review)2; its applicability to other countries, such as the UK, which have very different healthcare systems, is uncertain2,3. Although information is available concerning some of the factors that influence women’s participation in cancer screening programmes, research relating to the participation of men in population-based screening programmes is currently limited1,2.

Screening for abdominal aortic aneurysm (AAA) in men aged 65 years using portable ultrasonography has been launched recently in Scotland and elsewhere in the UK. The effectiveness of AAA screening in men is supported by evidence from four randomized clinical trials, which have demonstrated that screening reduces AAA-related deaths, but without any impact on overall mortality4–7. Uptake among invited men in these four clinical trials ranged from...
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70 to 80 per cent\(^6\). AAA screening in the Grampian region of north-east Scotland was launched in October 2012 as part of a national population-based screening programme.

A particular advantage of this study in Scotland is the availability of postcode-linked small-area statistics created specifically for the evaluation of deprivation, rurality and geographical remoteness\(^8,9\). The Grampian region (population 555,000) includes 11 per cent of the Scottish population and has a higher proportion of rural settlements than the rest of Scotland, and the UK. Within Grampian, 40 per cent of the population lives in the city of Aberdeen. The remainder live in the neighbouring rural administrative areas of Aberdeenshire (45 per cent) and Moray (15 per cent).

Concerns about uptake of screening in rural and remote areas have been expressed around the world\(^10\)--\(^12\), in particular disentangling the interlinked influences of social deprivation, rurality and geographical remoteness\(^13\),\(^14\). The aim of this study was to assess the independent influence of rurality, social deprivation, clinic type (hospital versus community), distance to the screening clinic and season on the uptake of AAA screening by men aged 65 years.

**Methods**

Screening for AAA in men aged 65 years began in Grampian on 25 October 2012. The programme provides men with up to three postal invitations for screening (initial appointment letter, reminder letter and final reminder) before categorizing them as having defaulted. Screening is undertaken at nine clinics across Grampian (Fig. 1) and is delivered by trained nurses (working in pairs) using portable ultrasound machines that link electronically with the national Scottish AAA screening database (call–recall management system). The screening sites in Grampian include six community clinics (based in community hospitals) and three clinics based in three major hospitals: Woodend Hospital and Royal Infirmary (both in Aberdeen city; population 220,000), along with Dr Gray’s Hospital (in the town of Elgin; population 21,000) in Moray.

**Scottish abdominal aortic aneurysm screening database**

For this study the details of all men resident in Grampian who were invited for screening (between 25 October 2012 and 31 October 2013) were extracted from the Scottish AAA screening database. The cohort included an initial allocation of 3853 men aged 65 years in October 2012, plus Grampian men who subsequently turned 65 during subsequent months. Men over the age of 65 years who self-referred for screening were excluded.

The data extracted from the Scottish AAA screening database included: unique community health index number, date of birth, home postcode, date of first screening appointment and subsequent invitations, screening clinic location, date of screening assessment and aortic measurements recorded. ‘Not screened’ included men defaulting on three screening appointments, or who contacted the Grampian AAA screening office to opt out of the programme.

The Postcode Directory from the National Records of Scotland (NRS) was used to allocate Scottish urban/rural categories and Scottish Index of Multiple Deprivation (SIMD) rankings to all men aged 65 years invited for screening\(^8,9\). The NRS Postcode Directory was also used to assign map coordinates to postcodes, which were used to calculate the straight line distance between home address and clinic location.

**Scottish Urban Rural Classification**

The current version of the Scottish Urban Rural Classification (SURC6, August 2012) was used to distinguish between urban, rural and remote areas in Grampian (Table 1). SURC6 is produced by the NRS based on small-area population estimates combined with the national postcode address file\(^8\). The approach adopted identifies areas of high/low-density contiguous postcodes with a population of 500 (or more) that make up a settlement\(^8\). The only large urban area in Grampian

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**Fig. 1** Location of abdominal aortic aneurysm screening clinics in Grampian

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is Aberdeen city. There are six other urban areas and 16 smaller towns across Grampian.

Scottish Index of Multiple Deprivation

Deprivation was measured using the current version of the SIMD (2012), which ranks datazones, small areas of around 800 people, relative to one another across the whole of Scotland. Datazones are ranked numerically from 1 (most affluent) to 6505 (most deprived) in Scotland. A higher score indicates a higher level of multiple social deprivation. SIMD is an area-based measure of relative deprivation that includes multiple dimensions of deprivation across seven domains. SIMD assesses deprivation based on 38 items that contribute to these seven domains. SIMD conceptualizes deprivation in relative terms and assigns the largest weightings to income and employment. The SIMD domains (and weights) are: income (28 per cent), employment (28 per cent), education (14 per cent), health (14 per cent), access (9 per cent), crime (5 per cent) and housing (2 per cent). The seven weighted domains are combined to produce an overall deprivation score for each datazone, which is then ranked across Scotland.

Data analysis

The relationship of AAA screening uptake with five factors – SIMD, SURC6, distance to clinic, season and clinic type (community versus hospital-based) – was investigated using logistic regression. SIMD was ranked from least deprived to most deprived for men invited for screening and converted to deciles (1, least deprived; 10, most deprived). Age at first invitation to screening was not included in the multivariable analysis, as screened and non-screened men were of a similar age. Distance to clinic and multiple deprivation (SIMD) were not normally distributed and are summarized as median (i.q.r.). Because distance to clinic appeared to have a curvilinear relationship with uptake, distance-squared was included in the multivariable model. Goodness of fit of the model was assessed using the Wald statistic, Hosmer–Lemeshow test and the omnibus test of model coefficients $\chi^2$. Screening status (yes/no) was cross-checked against the availability of aortic measurements. All $P$ values are two-sided and statistical significance was assumed at the 0.05 level. All data analysis was undertaken in SPSS® version 22 (IBM, Armonk, New York, USA).

The study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. The study involved the analysis of data routinely collected as part of the national AAA screening programme in Scotland, undertaken by the National Health Service (NHS) team responsible for screening in Grampian. All men provided informed verbal consent before being screened. The analysis was undertaken as part of the quality assurance process for the delivery of the AAA screening in Grampian. The study adheres to the NHS Scotland Caldicott Guardians: Principles into Practice (November 2010) and the NHS Scotland Code of Practice on Protecting Patient Confidentiality (July 2003). The initial data set included patient identifiers (such as postcode), but these were removed from the study data set once the relevant variables (SIMD, SURC6, distance to clinic) had been derived.

Results

A cohort of 5692 male Grampian residents on the national Scottish AAA screening call–recall database who had been invited for screening between 25 October 2012 and 31 October 2013 was identified. Some 47 men (0.8 per cent) were excluded for the following reasons: six had died (none of the deaths was AAA-related), four were medically unfit for screening, two were unable to provide informed verbal consent, and ten were no longer resident in Grampian. A further five men were already under the care of a vascular surgeon for AAA. Also excluded were 20 men who had defaulted on their first screening appointment, but had not had the opportunity to respond to further screening invitations (19 of these 20 men were subsequently screened after 31 October 2013). The quality of the data extracted was exceptionally high, with only eight duplicate records. There were minimal missing data and 5537 (98.1 per cent) of 5645 invited men were included in the fully adjusted analysis.

Among the cohort of 5645 men invited, 5002 (88.6 per cent) underwent ultrasound screening and 643 (11.4 per cent) defaulted by not responding to three postal
Table 2  Men aged 65 years invited for abdominal aortic aneurysm screening over 12 months

<table>
<thead>
<tr>
<th></th>
<th>Screened (n = 5002)</th>
<th>Not screened (n = 643)</th>
<th>All men (n = 5645)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>65.9 (65.8–66.0)</td>
<td>65.9 (65.8–66.0)</td>
<td>65.9 (65.8–66.0)</td>
</tr>
<tr>
<td>Deprivation index*</td>
<td>10.6 (8.8–15.6)</td>
<td>12.9 (7.9–19.7)</td>
<td>10.7 (6.8–16.1)</td>
</tr>
<tr>
<td>Distance to clinic (miles)</td>
<td>5.8 (1.9–12.7)</td>
<td>4.4 (1.9–12.3)</td>
<td>5.7 (1.9–12.6)</td>
</tr>
</tbody>
</table>

Values are median (i.q.r.). *Scottish Index of Multiple Deprivation (2012).

invitations or formally opting out. The cumulative uptake was 79.7 per cent after first invitation, 88-0 per cent after the second invitation, and 88-6 per cent after the third and final invitation. Across the AAA screening sites, uptake ranged from 86-0 to 92.2 per cent. Rates of default in relation to deprivation, rurality of residence and distance from the screening clinic are shown in Fig. S1 (supporting information).

Mean(s.d.) aortic diameter among the 5002 screened men was 1.76(0.35) cm. Screening identified 76 new AAAs (diameter at least 3.0 cm); the detection rate was 15.2 (95 per cent c.i. 11.8 to 18.6) per 1000 men screened. The 12-month prevalence of AAA among men aged 65 years in Grampian (including the 5 men already under the care of a vascular surgeon for AAA) was 16.2 (95 per cent c.i. 12.7 to 19.7) per 1000 men.

The characteristics of the 5645 invited men are shown in Table 2. The median distance to clinic was 5.8 (1.9–12.7) miles and only 15 men (0.3 per cent) had a distance to clinic of more than 30 miles. Non-screened men lived closer to the screening clinics (median 4.4 versus 5.8 miles) and had a higher level of SIMD deprivation (score 12.9 versus 10.6).

Urban and rural settlements

Among the 5645 men invited for screening, 42.6 per cent resided in urban areas, 38.9 per cent in rural settlements and 18.5 per cent in small towns (uptake 87.0, 89.3 and 90.8 per cent respectively). Screening took place at nine clinic sites across Grampian, with 3374 men (59.8 per cent) screened at six community-based clinics and 2271 (40.2 per cent) screened at three hospital-based clinics (Tables S1 and S2, supporting information). The relationship between screening uptake and rurality, multiple deprivation and distance to clinic is shown in Table 3, and Tables S3 and S4 (supporting information). The majority of men (99.8 per cent) lived within 30 miles of their allocated screening clinic. Multiple deprivation was lowest in other urban areas and accessible small towns, and highest in remote small towns. The lowest uptake of AAA screening was among men in the large urban area of Aberdeen (86.1 per cent) with the shortest median distance to clinic (2 miles). The highest uptake of AAA screening was in accessible small towns, remote small towns and remote rural areas (91.0, 90.5 and 91.0 per cent respectively).

Remoteness and rurality

The pattern of screening uptake by multiple deprivation in relation to remoteness and rurality of residence is shown in Fig. 2. There was a general trend towards declining uptake with increasing levels of deprivation beyond the second SIMD quintile (Fig. 2a). High levels of uptake of around 91 per cent were generally sustained in the two most affluent SIMD quintiles. In urban and accessible areas uptake declined with increasing deprivation (from the third to fifth quintile). Uptake was lowest (82.2 per cent) among men living in the most deprived urban areas. In remote areas a high level of uptake was maintained, irrespective of increasing deprivation, and uptake was actually highest (93.3 per cent) in the most deprived remote areas.

The pattern in relation to rurality was similar, although more variable (Fig. 2b). Uptake again declined with increasing deprivation beyond the second SIMD quintile. The decline in uptake was steepest for men living in urban areas; it was less marked for men in small towns and rural areas. In the most deprived SIMD quintile uptake in rural areas

Table 3  Screening for abdominal aortic aneurysm in men aged 65 years by urban/rural area of residence

<table>
<thead>
<tr>
<th></th>
<th>Invited men*</th>
<th>Screened men†</th>
<th>Deprivation index‡§</th>
<th>Distance (miles)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large urban</td>
<td>1589 (28.1)</td>
<td>1368 (86.1)</td>
<td>12.3 (4.6–24.8)</td>
<td>2.1 (1.4–3.1)</td>
</tr>
<tr>
<td>Other urban</td>
<td>813 (14.4)</td>
<td>721 (88.7)</td>
<td>9.6 (5.4–18.3)</td>
<td>5.5 (0.7–15.3)</td>
</tr>
<tr>
<td>Accessible small towns</td>
<td>645 (11.4)</td>
<td>587 (91.0)</td>
<td>9.0 (5.1–14.7)</td>
<td>9.5 (2.4–15.8)</td>
</tr>
<tr>
<td>Remote small towns</td>
<td>401 (7.1)</td>
<td>363 (90.5)</td>
<td>14.7 (8.7–17.7)</td>
<td>9.1 (0.6–13.7)</td>
</tr>
<tr>
<td>Accessible rural</td>
<td>1443 (25.6)</td>
<td>1277 (88.5)</td>
<td>10.3 (7.9–13.5)</td>
<td>9.8 (6.9–15.6)</td>
</tr>
<tr>
<td>Remote rural</td>
<td>754 (13.4)</td>
<td>686 (91.0)</td>
<td>12.3 (9.7–14.5)</td>
<td>10.4 (5.6–14.3)</td>
</tr>
<tr>
<td>All men combined</td>
<td>5645 (100)</td>
<td>5002 (88.6)</td>
<td>10.7 (6.8–16.1)</td>
<td>5.7 (1.9–12.6)</td>
</tr>
</tbody>
</table>

Values in parentheses are percentage of *all invited men and †men screened; ‡values are median (i.q.r.). §Scottish Index of Multiple Deprivation (2012); a higher value indicates greater deprivation.
Uptake of abdominal aortic aneurysm (AAA) screening in relation to social deprivation and remoteness (a) and social deprivation and rurality (b).

Distance from screening clinic

Uptake had a U-shaped relationship with distance to clinic irrespective of residential location (urban, rural, or small town) (Fig. 3). Uptake was relatively high among men living within 1 mile of the clinic, declined between 1·0 and 4·9 miles, before rising again beyond 5 miles with a higher level of uptake sustained beyond 10–15 miles. Uptake was consistently lower at all distances from the clinic in urban areas compared with small towns and rural areas.

Unadjusted and adjusted analyses

The results of crude and adjusted analyses of factors potentially associated with uptake are shown in Table 4. Unadjusted and adjusted odds ratios (ORs) were very similar, the main exception being the higher uptake associated with community clinics (versus hospital clinics) on unadjusted analysis (OR 1·22, 95 per cent c.i. 1·04 to 1·44; \( P = 0.017 \)), which disappeared on multivariable adjustment (OR 1·00, 0·74 to 1·34; \( P = 0.985 \)).

Multiple deprivation was strongly and independently associated with a lower uptake of AAA screening. A 1-point increase in SIMD decile was associated with an adjusted 0·08 (95 per cent c.i. 0·06 to 0·11) times reduction in the relative odds of being screened (\( P < 0.001 \)). Compared with men living in the large urban area of Aberdeen city, the uptake of screening was higher in all the other urban/rural categories. The largest relative differences (with a statistically significant adjusted OR greater than 1·50) were observed for men living in accessible small towns, remote small towns and remote rural areas. Uptake was also higher in other urban and accessible rural areas, although these differences did not reach statistical significance. Summer was associated with a higher uptake than winter (OR 1·22, 0·95 to 1·56; \( P = 0.128 \)), but this difference was not statistically significant. Distance to the clinic was not associated with uptake on multivariable analysis.
Uptake of abdominal aortic aneurysm screening

Table 4 Unadjusted and adjusted logistic regression analyses of men’s uptake of abdominal aortic aneurysm screening by urban/rural residence, deprivation index, distance to clinic, clinic type and season

<table>
<thead>
<tr>
<th>Urban/rural category</th>
<th>Unadjusted analysis</th>
<th>Adjusted analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds ratio</td>
<td>P</td>
</tr>
<tr>
<td>Large urban</td>
<td>1·00 (reference)</td>
<td>0·001</td>
</tr>
<tr>
<td>Other urban</td>
<td>1·27 (0·98, 1·64)</td>
<td>0·075</td>
</tr>
<tr>
<td>Accessible small towns</td>
<td>1·64 (1·21, 2·22)</td>
<td>0·002</td>
</tr>
<tr>
<td>Remote small towns</td>
<td>1·54 (1·07, 2·21)</td>
<td>0·020</td>
</tr>
<tr>
<td>Accessible rural</td>
<td>1·24 (1·00, 1·54)</td>
<td>0·048</td>
</tr>
<tr>
<td>Remote rural</td>
<td>1·63 (1·22, 2·17)</td>
<td>0·001</td>
</tr>
<tr>
<td>Deprivation index (deciles)*</td>
<td>0·91 (0·89, 0·94)</td>
<td>&lt; 0·001</td>
</tr>
<tr>
<td>Clinic type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major hospital</td>
<td>1·00 (reference)</td>
<td>0·001</td>
</tr>
<tr>
<td>Community-based</td>
<td>1·22 (1·04, 1·44)</td>
<td>0·017</td>
</tr>
<tr>
<td>Distance to clinic (miles)</td>
<td>1·01 (1·00, 1·02)</td>
<td>0·155</td>
</tr>
<tr>
<td>Distance to clinic (miles²)</td>
<td>1·00 (1·00, 1·00)</td>
<td>0·793</td>
</tr>
<tr>
<td>Season</td>
<td></td>
<td></td>
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<tr>
<td>Winter</td>
<td>1·00 (reference)</td>
<td>0·001</td>
</tr>
<tr>
<td>Spring</td>
<td>1·08 (0·85, 1·38)</td>
<td>0·529</td>
</tr>
<tr>
<td>Summer</td>
<td>1·23 (0·96, 1·58)</td>
<td>0·094</td>
</tr>
<tr>
<td>Autumn</td>
<td>1·00 (0·80, 1·24)</td>
<td>0·966</td>
</tr>
</tbody>
</table>

Values in parentheses are percentages. *Scottish Index of Multiple Deprivation (2012). Hosmer–Lemeshow test: $\chi^2 = 6·1$, 8 d.f., $P = 0·636$; Wald statistic 2341·2, 1 d.f., $P < 0·001$; omnibus test of model coefficients: $\chi^2 = 6·1$, 20 d.f., $P < 0·001$.

Discussion

A high uptake among men aged 65 years was achieved during the first year of AAA screening in north-east Scotland. On multivariable analysis only social deprivation and urban/rural residence were independently associated with the uptake of screening. Distance to the screening clinic and season were not independently associated with uptake. Being invited for screening at a community-based clinic was associated with a higher uptake on crude analysis, but this association disappeared on fully adjusted analysis.

This study has several important strengths. AAA screening in Grampian is undertaken as part of a national population-based programme which employs a bespoke call–recall electronic database that is integrated with both administrative and clinical software. The quality of the data extracted was exceptionally high and 98·1 per cent of invited men were included in the fully adjusted analysis. Because of the large number of participants available from the initial 12 months of screening in Grampian, it was possible to undertake a robust multivariable analysis. Age was not included in the multivariable analysis because the programme invites men aged 65 years, and the median ages of screened and unscreened men were identical. The median age of invited men was close to 66 years (65·9 years) owing to the backlog of 3853 men who were already 65 years old at the inception of screening in Grampian in October 2012.

The analysis was limited to five factors that are available from the AAA screening database. Other factors such as marital status, which may be associated with uptake, were not assessed. Anecdotally, there may be an important influence of both wives and supportive social networks (such as golfing buddies and retirement groups) on uptake. Area-based measures were used to ascribe a level of multiple social deprivation to individual men. This is prone to the ecological fallacy of assuming that those living in an area all share the same level of a characteristic such as social deprivation. This is mitigated somewhat by the SIMD being based on small-area datazones of around 800 people, rather than larger areas such as wards or local government administrative areas. Scotland has a higher prevalence of smaller rural settlements than the rest of the UK, and the SIMD was developed specifically to identify areas of deprivation accurately in both rural and urban locations. It was striking that uptake in Grampian was highest (93·3 per cent) in the most remote areas (which also had the highest levels of deprivation). The reasons for this are unclear, but people in deprived rural communities highly value services provided by their local community hospitals (with close links to general practice) and are prepared to travel greater distances to use such services than those in urban areas. The North Sea oil industry has brought considerable affluence to the Grampian region and the high uptake of AAA screening may partly be attributable to the engineering-oriented culture of north-east Scotland. The influence of ethnicity on uptake was not explored as north-east Scotland lacks ethnic diversity; based on the 2011 National Census, the
majority of the population is of white ethnicity (Aberdeen 92 per cent, Aberdeenshire 99 per cent, Moray 99 per cent).

Uptake of AAA screening in Grampian was higher than that among men aged 65–74 years in both the Viborg\textsuperscript{15} and Multicentre Aneurysm Screening Study (MASS)\textsuperscript{17} trials, at 76 and 80 per cent respectively. In the Danish Viborg trial\textsuperscript{15}, lower uptake was associated with lower social class and travel distance exceeding 12.5 miles. Higher uptake was also associated with being married. In the UK-based MASS trial, increasing deprivation was associated with lower uptake. Neither trial found season to be associated with uptake\textsuperscript{15,17}.

AAA screening has been undertaken in the neighbouring Highland region among men aged 65–74 years since 2001\textsuperscript{18,19}. After two invitations overall uptake was 90 per cent across 51 sites (mainly general practice surgeries and a single city hospital) over 10 years\textsuperscript{18}. A higher uptake in rural areas (based on SURC6) was also observed, but the association disappeared after adjusting for multiple deprivation (using the earlier 2009 version of the SIMD)\textsuperscript{18}. A limitation of the Highland data was missing postcodes for 9 per cent of men, and their analysis did not include distance to clinic, season or clinic type. The high uptake achieved in both Highland and Grampian may relate to AAA screening being offered predominantly in community-based settings; Highland has a higher proportion of remote rural communities than Grampian.

A recent Swedish study\textsuperscript{20} (overall uptake 80 per cent) found low socioeconomic status to be associated with a lower uptake of AAA screening among men aged 65 years. In Northern Ireland uptake was disappointingly low (only 52 per cent) across 51 sites (mainly general practice surgeries and a single city hospital) over 10 years\textsuperscript{18}. A higher uptake in rural areas (based on SURC6) was also observed, but the association disappeared after adjusting for multiple deprivation (using the earlier 2009 version of the SIMD)\textsuperscript{18}. The Swedish and Irish studies did not undertake a multivariable analysis.

Having achieved an initially high level of uptake in the first year of screening in Grampian, a major challenge is to sustain this level of uptake and also to increase uptake among men who default on screening. As uptake was lowest among men living in the city, a further screening site based in a newly established urban community hospital (Aberdeen Community Health and Care Village) has been added. The health village is located in the city centre with easier access from the more deprived areas of the city centre by bus.

Acknowledgements

This study received no specific funding. The study involved the analysis of data collected routinely as part of the national AAA screening programme in Scotland.

Disclosure: The authors declare no conflict of interest.

References


**Supporting information**

Additional supporting information may be found in the online version of this article:

**Fig. S1** Defaulting on abdominal aortic aneurysm screening: relationship with deprivation, urban/rural residence and distance from clinic (Word document)

**Table S1** Type of screening clinic by urban/rural residential location of 5645 men in Grampian aged 65 years who were invited for abdominal aortic aneurysm screening over 12 months (Word document)

**Table S2** Breakdown of screening clinic location by urban/rural residential classification of 5645 men in Grampian aged 65 years who were invited for abdominal aortic aneurysm screening over 12 months (Word document)

**Table S3** Abdominal aortic aneurysm screening data for 5645 Grampian men aged 65 years by type of clinic (Word document)

**Table S4** Breakdown of abdominal aortic aneurysm screening data for 5645 Grampian men aged 65 years by clinic location (Word document)