**Delivery and impact of the NHS Health Check in the first eight years: a systematic review**

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**ABSTRACT**

**Background:** Since 2009, all eligible persons in England have been entitled to an NHS Health Check. Uncertainty remains about who attends and the health-related impact.

**Aim:** To review quantitative evidence on coverage (the proportion of eligible individuals who attend), uptake (proportion of invitees who attend) and impact of NHS Health Checks.

**Design:** A systematic review and quantitative data synthesis.

**Data sources:** Eleven databases and additional internet sources were searched to November 2016.

**Inclusion criteria:** Studies or data reporting coverage or uptake and studies reporting any health-related impact which used an appropriate comparison group or before-and-after study design.

**Results:** Twenty-six observational studies and one additional dataset were included. Since 2013, 45.6% of eligible individuals have received an NHS Health Check. Coverage is higher among older people, those with a family history of coronary heart disease, those living in the most deprived areas, and some ethnic-minority groups. Just under half (48.2%) of those invited have taken up the invitation. Data on uptake and impact (especially regarding health-related behaviours) are limited. Uptake is higher in older people and women but lower in those living in the most deprived areas. Attendance is associated with small increases in disease detection, decreases in modelled CVD risk and increased statin and anti-hypertensive prescribing.

**Conclusion:** Published attendance, uptake and prescribing rates are all lower than originally anticipated and data on impact are limited, with very few studies reporting the effect of attendance on health-related behaviours. High-quality studies comparing matched attendees and non-attendees and health economic analyses are required.

**Word count:** 250

**Key words:** NHS Health Check, uptake, coverage, impact, systematic review

**How this fits in:** Simultaneous nationwide rollout in 2009 of the NHS Health Check programme was based on some strong assumptions about the likely impact of the programme. Almost a decade on, there remains much uncertainty about who attends and the overall health benefits. This article presents the first systematic review of quantitative data from the programme. Although we found attendance is much lower than originally anticipated, attendees cannot be readily characterised as the “worried well” or “easiest to reach.”

**INTRODUCTION**

The NHS Health Check programme was launched in England in 2009 as part of a healthcare strategy aimed at “empowering patients and preventing illness”.[1] It offers everyone aged 40-74 years without pre-existing cardiovascular disease (CVD), chronic kidney disease (CKD), type 2 diabetes (T2DM) or dementia an assessment of their risk of having or developing such conditions and advice about relevant medications and lifestyle changes every five years. Since 2013, local authorities have had a statutory responsibility to offer the programme to all eligible individuals, with funding provided by Public Health England (PHE)[2]. Echoing similar efforts in other countries to provide preventive health checks[3, 4], the programme is delivered by various providers, predominantly general practices.

The programme was introduced simultaneously nationwide without robust economic evaluation evidence from a randomised controlled trial (RCT) , and with very limited available evidence on health check strategies implemented in other countries[5, 6]. However, the Department of Health modelled the potential long-term cost-effectiveness of the programme[7]. In that modelling it was envisaged that all those eligible would be invited for an NHS Health Check during the first five year cycle. Based on evidence from a national breast screening programme it was expected that 75% would attend.[7] Of those attendees with high cholesterol or CVD risk (10-year ≥20%), it was hoped that 85% would be prescribed statins (in 50% of cases, this was attributed directly to the health check). Using a time horizon of a lifetime, the cost-effectiveness of the programme was predicted in this modelling to be £2,866 per QALY (quality adjusted life year) (2015/16 prices[8]), well within the limit of what would normally be deemed cost-effective by NICE[9].

The objectives of this study were to systematically identify and synthesize available evidence on: (1) coverage (the proportion of the eligible population who have attended an NHS Health Check) and variation in coverage; (2) uptake (the proportion of those invited who have attended an NHS Health Check) and variation in uptake; and (3) the effect of the programme, in order to provide up-to-date estimates of its delivery and impact.

**METHODS**

**Search strategy and study selection**

Full details of the search strategy are given in Appendix 1 and the study selection process is described in detail elsewhere[10]. Briefly, searches included eleven literature databases and additional internet sources encompassing both peer-reviewed and grey literature relevant to NHS Health Checks published up to November 2016.

**Inclusion criteria**

Quantitative observational data or analyses (cross-sectional or longitudinal) which included people eligible for an NHS Health Check and reported evidence on coverage or uptake were included. Impact studies reporting any health-related outcome which used an appropriate comparison group or a before-and-after study design were also included. Data or analyses relating to other screening or health check services which were not NHS Health Checks were excluded, as were editorials and opinion pieces.

**Data extraction, quality assessment and synthesis**

Data were extracted independently by three researchers (JUS, AM and CS) using forms devised for this study. Reflecting the wide range of study designs, data and methods identified, existing CASP checklists[11] were adapted for the quality assessment of identified studies.

For each objective, we grouped studies according to their design. Since the programme runs in 5 year cycles, where necessary we adjusted reported coverage to a standardised measure of coverage per year per one fifth of the total eligible population (which can lead to coverage exceeding 100% if more than 20% of the eligible population attend in a given year). We categorised the health-related impact studies (objective 3) into four groups (disease detection, health-related behaviours, prescribing and individual-risk factors) and report the results in order of the degree to which observed differences between groups can be attributed to NHS Health Check attendance.

**RESULTS**

**Overview of included studies**

The searches identified 18,524 articles. We reviewed 178 full-text articles and 26 (including five from the grey literature[12–16]) were deemed relevant (Figure 1). All were observational studies. Seven used data from large, routine, consolidated datasets with nationwide reach (including the Clinical Practice Research Datalink (CPRD)[17–20], QResearch[21] and prescribing data[15]); 19 used local data from general practices (n=17) or community settings (n=2) collected in particular geographic areas [12, 16]. Eleven studies were assessed as high quality (Appendix Table A1). In addition to the 26 included observational studies, data identified in the additional internet searches were also extracted from PHE’s website.[22]

**Objective 1: Coverage (n=10)**

The PHE website included data on national-level coverage during the first 3.5 years of the current five year cycle (2013-4, when the NHS Health Check became a statutory requirement, to second quarter (Q2), 2016-7) as well as variation in coverage over time (per quarter) and by area (at the county level). Nine further studies reported data on coverage[13, 18, 21, 23–28] (Table 1).

**1a. Reported coverage**

The PHE website reported coverage of 45.6% for the whole of England (2013-4 to Q2, 2016-7), ranging from 18.9% in Surrey to 109.2% in Newham[22]. Where full-year data were available, national coverage varied between 48.1% in 2014-15 to 45.0% in 2015-6. Three of the nine published studies used national-level data from earlier years. [18, 21, 24] The reported coverage ranged from 8.1% (2011-2012)[24] to 26.7% (2009-2013)[18]. The other six studies reported data from samples of general practices, with coverage ranging from 20% (2010-11 in Hammersmith and Fulham) [23] to 73% (2011-12 in north-east London) [29] (Table 1).

**1b Variation in coverage**

Three studies used multiple regression to identify factors associated with differences in coverage between population groups.[18, 23, 24] The findings from these are summarised in Table 2. Two used patient-level data. Both showed higher coverage among older people and those with a family history of coronary heart disease. The study by Artac *et al*. additionally reported higher coverage amongst non-smokers, those in the most deprived tertile, those without CVD co-morbidities, those registered with larger general practices, and among people from Black and South Asian ethnic groups.[23] By contrast, the study by Chang *et al.* found no significant association between coverage and deprivation and a lower coverage among people from Black African and Other Black ethnic groups.[18] The third study used data from 151 primary care trusts (PCT) and found those in the most deprived tertile were significantly more likely to have attended a health check, but no significant associations for age, ethnicity, population size and other PCT-level measures.[24]

A further five studies reported coverage for different population sub-groups without adjustment for covariates (Appendix Table A2) [18, 21, 23, 26, 27] The two that used data from large datasets with nationwide reach during the programme’s first four years showed higher coverage amongst females, older people and those living in more deprived areas.[18, 21]

**Objective 2: Uptake (n=11)**

The PHE website included data on national-level uptake (2013-4 to Q2, 2016-7) as well as variation in uptake over time (per quarter) and by area (at the county level). Eleven studies reported uptake and socioeconomic factors associated with uptake in general practices (n=9) [12, 14, 16, 26, 27, 30–35] and community-based settings (n=2).[12, 16]) The study samples were different from those used in the coverage studies and generally smaller, ranging from two[30] to 40[31] general practices incorporating between 1,380[34] and 50,485[26] patients.

**2a: Reported uptake**

Table 3 shows the reported uptake across the data sources. The PHE website reported uptake of 48.2% for the whole of England (2013-4 to Q2, 2016-7), ranging from 20.1% in East Riding of Yorkshire to 100% in Leicester. Where full-year data were available, national uptake varied between 47.9% in 2015-6 to 49.0% in 2013-14. Uptake in the general practice studies (n=9) ranged from 27% (four practices in eastern England)[34] to 52.9% (13 practices in north-western England) [27]. Uptake in the community settings was 45.9% (a football ground) [16] and 71.8% (a mental healthcare unit).[12]

**2b: Variation in uptake**

Five studies reported associations between patient characteristics and the likelihood of attending, using multivariable regression (Table 3). These consistently showed that the odds of taking up an invitation increased significantly with age and lower deprivation. Of the five studies reporting associations between uptake and sex, four also showed women were more likely to take up invitations. The fifth, a study of 37 practices in Stoke-on-Trent[32], reported the opposite with men more likely to take-up invitations. Only two studies reported the effects of ethnicity. One was in 29 practices in Ealing (West London) and found invitees of South Asian or mixed ethnicity were more likely to attend than white British, whilst there was no difference for Black or Other groups and those with missing data were less likely to attend. [32] The other was across four general practices in the East of England and found no difference in uptake between participants of white and non-white ethnicity. [34]

Five studies also reported unadjusted comparisons between invited attendees and non-attendees (Appendix Table A3).[26, 27, 32–34] All reported higher uptake in older people, but findings for deprivation were more mixed with two reporting higher uptake in those in the least deprived areas[26, 33], one with higher uptake in the most deprived[34], and two with no significant differences[27, 32]. Notably, the association between deprivation and uptake in the unadjusted analysis of the study across four general practices in the East of England was in the opposite direction to the multivariable analysis which adjusted for GP practice (greater deprivation was associated with a higher odds of attending in unadjusted analysis in the study). As the authors of that study note, the GP practices had different distributions of deprivation and used different invitation methods, highlighting the importance of GP surgery characteristics when assessing uptake. Two studies also reported higher uptake in women and, where reported, uptake was higher in non-smokers, those with higher CVD risk and those with hypertension or raised cholesterol.

**Objective 3: Impact (n=12)**

Twelve studies reported evidence on short-term impact. Five included a comparison group (Table 4). Of these, two used CPRD data to examine individual-level differences over time between matched attendees and non-attendees[19, 20]. The other three reported population-level associations between coverage and outcome[15, 36, 37]. The remaining seven studies were before-and-after studies without comparison groups (Appendix Table A4). No studies of long-term health impacts or economic evaluations were identified.

**3a: Disease detection (n=4)**

The CPRD study by Chang *et al*. showed more frequent diagnosis of familial hypercholesterolemia, hypertension, CKD, peripheral vascular disease and T2DM amongst attendees compared to non-attendees during the two years following attendance, whilst stroke diagnosis was significantly less likely. [20] No significant differences in diagnoses of atrial fibrillation, coronary artery disease, heart failure or transient ischemic attack were observed. [20] The CPRD study by Forster *et al*. also showed more frequent diagnosis of hypercholesterolemia (high cholesterol), and of hypertension amongst men (but not women)[19].

Two further studies used small samples of general practices and reported associations between NHS Health Check coverage and disease detection after controlling for area-level characteristics (e.g. age profile and deprivation).[36, 37] The study by Caley *et al*.[36] identified no statistically significant associations between coverage and change in the prevalence of T2DM, hypertension, coronary heart disease, CKD or atrial fibrillation. However, the study only included 79 general practices and only 13.6% of the eligible population had received an NHS Health Check so it was under-powered to detect small differences. The second study by Lambert *et al.*[37] reported that the number of NHS Health Checks performed explained between 6% and 60% of the variance in incident hypertension across the different practices.

**3b: Health-related behaviour (n=4)**

The only study with a comparison group to report health-related behaviour reported no significant association between change in smoking prevalence (recorded within primary care records over a median of two years) and attendance at a health check.[20] Three studies reported change in smoking amongst individuals after attendance at a health check (Appendix Table A4). Two[17, 38] showed a significant reduction of at least ten percentage points in the proportion of attendees who smoked, whereas in the other the change was not statistically significant[39]. Without a comparison group, however, it is not possible to attribute these changes to the NHS Health Check. No other health-related behaviours were reported.

**3c: Prescribing (n=9)**

The two CPRD studies [19, 20] identified significantly greater increases in statin and anti-hypertensive prescriptions amongst attendees than matched non-attendees. For example, new statin prescriptions were initiated for 5.6% of attendees, versus 1.2% of non-attendees over a median of two-years in one of the studies[20], and by 11.0% and 7.6% over four years in the other.[19] Another study investigated national-level prescribing data and showed a significant association between coverage and high-dose statin prescribing at the PCT level in 2011, however the association was not significant for low-dose statins.[15]

Six before-and-after studies all showed an increased likelihood of a statin prescription following attendance (Appendix Table A4).[17, 18, 21, 27, 32, 39] The proportion prescribed statins after the health check ranged from 18.3% in one of the CPRD studies[17] to 49.9% in Hammersmith and Fulham[39].

**3d: Individual risk factors and CVD risk (n=5)**

The CPRD study by Chang *et al*.[20]showed significant differences in BMI, blood pressure (BP) (systolic and diastolic), modelled CVD risk and total cholesterol between attendees and matched non-attendees during a two-year period.[20] For example, the QRISK2 mean score (% 10-year risk) fell by 0.21 (95% CI: 0.19 to 0.24), from 5.1 to 4.9 amongst non-attendees, compared to 6.7 to 6.2 amongst attendees, which is equivalent to the prevention of one cardiovascular event per 4,762 attendees. However, the sample used in the analysis was limited by missing data: only 2.3% of non-attendees had a follow-up QRISK2 score recorded. The population-level cross-sectional study by Lambert *et al*. also reported a strong negative association between the number of health checks provided in a particular area and incident cases of CVD.[37]

Three further before-and-after studies of attendees[17, 38, 39] identified significant reductions in diastolic BP and cholesterol levels after 12-15 months (Appendix Table A4). Two of these also reported significant reductions in obesity, CVD risk and systolic BP. [17, 39] However, the samples used in the analyses were also limited by missing data (e.g. follow-up data was unavailable for 50% of attendees in one study).[39]

**DISCUSSION**

**Summary of main findings**

In the current five year cycle starting in 2013, the most recent available evidence shows that 45.6% of eligible adults across England have attended an NHS Health Check. This percentage varies substantially across the country, from 18.9% in some areas to over 100% in others. Data from the identified studies shows higher coverage among older people, those with a family history of coronary heart disease, those living in the most deprived areas, and some ethnic groups. Uptake also varies substantially with just under half (48.2%) of all those invited taking up the invitation. In the selected samples of patients and general practices in the identified studies, the proportion accepting the invitation is also higher in older people and women but, in contrast with coverage, is lower in those living in the most deprived areas. The impact studies comparing attendees with matched non-attendees showed that attendance is associated with small increases in disease detection above routine practice, an increased likelihood of statin and anti-hypertensive prescribing (with the percentage of those with a modelled 10-year CVD risk ≥20% prescribed statins following a health check ranging between 18% to 63%), and small decreases in modelled CVD risk (the best current evidence suggests that one cardiovascular event is prevented per 4,762 attendees, equating to over 1,400 events across the country during a five year cycle). Very few studies have reported the impact of attendance on health-related behaviours.

**Strengths and limitations**

Almost a decade since the programme was introduced, and five since it became a statutory responsibility of local authorities, this is the first synthesis of quantitative evidence related to delivery or impact. A strength of our study is the systematic searches, including the OpenGrey database and additional internet-based searches. However, in the absence of randomised trials or a step wedge evaluation of a gradual roll-out of NHS Health Checks, the synthesis is limited by the quality of the included studies. Studies used different populations, time points (including before the programme become statutory in 2013), databases, methods for identifying attendance, and (where multivariable regression was used) adjusted for different observable patient and general practice characteristics. Even for studies using electronic health records, coding was not reliable and so led to some researchers using combinations of entries to classify attendance[20]. This precluded the pooling of data from different studies. Whilst some studies (including the multivariable analyses of uptake (Table 3)) relied on relatively small samples of general practices and patients, even the larger consolidated databases did not include nationally representative samples of patients or general practices. For example, general practices in the North of England are poorly represented in CPRD, and those which contribute data are larger[40] and potentially more engaged with research and preventive medicine than those who do not. Almost all studies relied on routinely collected data for patient characteristics and health outcomes. Missing outcome data is therefore a particular problem as data are likely to be less complete in those people who have not attended a health check. This may be the reason why those who have attended are more likely to have a family history of coronary heart disease recorded, for example. There may also be systematic differences in those who attend health checks and those who don’t, leading to bias in the estimates of the impact of the programme based on studies with control groups. For example, those who have not attended a health check but do have a disease or risk factor recorded may be those in whom healthcare professionals have already clinically suspected disease, or those who consult more often.

**Implications for clinical practice, policy and research**

This study identified data showing that the anticipated coverage and uptake used in the Department of Health model were both too optimistic. When judged against the (ambitious) objective of inviting all eligible individuals in each five year cycle, and the expected aggregate gains in population health arising from high coverage (expected in the model to be 75%), the evidence shows the programme has fallen considerably short of expectations. Since this remains the objective[2], a question needs to be addressed about where the necessary resources and capacity should come from to achieve it. Conversely, when judged against any reasonable value for money criteria, the identified evidence on attendance is insufficient to indicate a lack of cost-effectiveness. In the economic models, lower than anticipated coverage, for example, would merely reduce aggregated costs *and* aggregated health gains, without affecting the cost per QALY estimates[7, 41]. Like other interventions (bariatric surgery for instance) and some pharmaceuticals (which might be subjected to a “budget impact test”[42]), it seems NHS health checks may thus be simultaneously cost-effective *and* unaffordable[41]. A pragmatic response might be to focus attention on targeting the distribution of NHS Health Checks towards those who would benefit most and/or towards reducing health inequalities. The finding that coverage (the proportion of the eligible population who have attended an NHS Health Check) amongst those in the most deprived areas was higher than average despite uptake (the proportion of those invited who have attended an NHS Health Check) amongst those groups being lower and the findings from the study by Attwood *et al.* in which the direction of association between socio-demographic characteristics and uptake was reversed after adjusting for GP practice[34] suggest that this is already happening to some degree. Together with the finding that coverage was higher among older people, who will be at higher risk of CVD than younger people, this may go some way towards alleviating concerns amongst health professionals that attendees are predominantly the ‘worried well’ or those least likely to benefit[43]. However, given that much of the data on coverage and uptake were from different sources, we suggest that this should be the focus of future research. This could be supported, to some degree, through development of a slightly broader PHE dataset for the routine collection of a small number of variables on those invited and those who subsequently attend. In future years it will also be important to distinguish between those attending for the first time and those attending follow-up NHS Health Checks after five years.

Whilst this study also showed statin prescribing to be below expectations, potentially increasing the cost per QALY, there remains a significant shortage of data on the health impacts, particularly longer term, and costs of health checks. Alongside the data on attendance identified in this study, such data is necessary for revising key assumptions in economic models of health checks,[44, 45] not only in England, but potentially also internationally where similar data is also currently limited[46, 5]. There is also a need for further high-quality studies comparing matched attendees and non-attendees, including follow-up studies to quantify the impact of health check attendance on physical activity, diet, alcohol consumption, smoking, and potential harms such as false reassurance and anxiety which are currently unknown.

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**Contributors**

AM screened articles for inclusion, extracted and synthesised the data, interpreted the findings and wrote the first draft of the manuscript. CS extracted the data, interpreted the findings and critically revised the manuscript. EH screened articles for inclusion, interpreted the findings and critically revised the manuscript. CMa interpreted the findings and critically revised the manuscript. SG, JM, CM and FW developed the protocol, interpreted the findings and critically revised the manuscript. JUS developed the protocol, screened articles for inclusion, extracted and synthesised the data, interpreted the findings and wrote the first draft of the manuscript.

**Competing Interests**

None declared.

**FIGURE LEGENDS**

Figure 1: PRISMA diagram

Figure 2:Change in the percentage of people being prescribed statins before and after attending an NHS Health Check

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**Table 1: Overall Coverage**

|  |  |  |
| --- | --- | --- |
| **Author**  **/ Year** | **Setting**  **and time period** | **Coverage per one fifth of the total eligible population** |
| **NATIONAL LEVEL** | |  |
| Public Health England[22] | England  2013-4 to Q2 2016-7 | **45.6%** |
| Artac 2013[24] | England  2011-12 | **8.1%** |
| Chang 2015[18] | England  2009-13 | **26.7%** |
| Robson 2016[21] | England  2009-12 | **12.8%** |
| **REGIONAL LEVEL** | |  |
| Artac 2013[23] | 27 (of 31) PCTs in Hammersmith and Fulham 2008-09  2010-11 | **2008-09:32.7%**  **2010-11:20.0%** |
| Baker  2015[25] | 83 (of 85) practices in Gloucestershire  2011-12 | **49.8%** |
| Coffey 2014[13] | 40 (of 47) practices in Salford  2013-14 | **34%** |
| Cook 2016[26] | Not reported  2013-14 | **56.5%** |
| Krska  2015[27] | 13 (of 55) GP practices in Sefton, North West England  2011-12 | **47.2%** |
| Robson 2015[29] | 3 PCTs in East London  2009-10  2010-11  2011-12 | **2009-10: 33.9%**  **2010-11: 60.6%**  **2011-12: 73.4%** |

**Table 2: Associations between coverage and area-level or individual-level characteristics from multivariable adjusted studies**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author**  **/ Year** | **Description of analysis** | **Age** | **Gender** | **Ethnicity** | **Deprivation** | **Smoker** | **Family history of CHD** | **Other** |
| Artac  2013[24] | Multivariable linear regression comparing PCT-level characteristics | Highest proportion of PCT population in 40-74 age range compared to lowest Coefficient -0.03  (-0.87-0.36) *p*=0.668 | Not reported | Highest proportion of PCT population of minority ethnicity compared to lowest Coefficient 0.08  (-0.17-0.95) *p*=0.424 | **Least deprived tertile compared to most deprived:**  **Coefficient -0.51**  **(-1.88-0.0) *p*=0.035\*** | --- | --- | Population size, QOF points, patient experience, FTE GPs, estimated proportion at high-risk and estimated CVD prevalence: ns |
| Chang 2015[18] | Multilevel logistic regression of individual-level patient characteristics | **Compared to 40-49 years:**  **Aged 50-59:**  **1.60 (1.54-1.67)\***  **Aged 60-69:**  **2.47 (2.36-2.58)\***  **Aged 70-74:**  **2.88 (2.49-3.31)\*** | Female:  1.01 (0.98-1.05) | **Compared to White:**  **Black African:**  **0.75 (0.61-0.92)\***  **Chinese:**  **0.68 (0.47-0.96)\***  **Other White:**  **0.35 (0.33-0.37)\***  **Other Black:**  **0.58 (0.46-0.74)\***  **Not recorded:**  **0.18 (0.17-0.19)\***  **Prefer not to state:**  **0.47 (0.41-0.53)\***  Irish: ns  Indian: ns  Pakistani/Bangladeshi: ns  Other Asian: ns  Caribbean: ns | Most deprived quintile compared to least deprived:  0.91 (0.63-1.31) | --- | **Positive family history compared to no family history:**  **2.37 (2.22-2.53)\*** | --- |
| Artac  2013[23] | Multilevel logistic regression of individual-level patient characteristics using data on 27 (of 31) PCTs in London | **Compared to 40-54 years:**  **Aged 55-64**  **Y1: 1.34 (1.11-1.61)\***  **Y2: 1.79 (1.67-1.93)\***  **Aged 65-74**  **Y1: 2.05 (1.67-2.52)\***  **Y2: 2.79 (2.49-3.12)\*** | **Female:**  **Y1:**  **0.80 (0.67-0.94)\***  **Y2:**  **1.27 (1.20-1.35)\*** | **Compared to White:**  **Black**  Y1:1.05 (0.78-1.41)  **Y2: 1.58 (1.43-1.75)\***  **South Asian**  **Y1:1.27 (0.88-1.87) \***  **Y2: 1.50 (1.25-1.78)\***  **Not recorded:**  **Y1: 0.11 (0.07-0.17)\***  **Y2: 0.08 \*0.07-0.10)\*** | **Least deprived tertile compared to most deprived:**  Y1:  0.84 (0.69-1.01)  **Y2:**  **0.80 (0.73-0.87)\*** | **Current smokers compared to non-smokers:**  **Y1:**  **0.71 (0.61-0.83)\***  **Y2:**  **0.83 (0.77-0.90)\*** | **Positive family history compared to no family history:**  **Y1:**  **2.49 (2.15-2.90)\***  **Y2:**  **2.01 (1.87-2.16)\*** | **Presence of non-CVD co-morbidities:**  **Y1: 1.53 (1.13-1.80)\***  **Y2: 1.75 (1.64-1.87)\***  **Practice list size:**  **>10,000 compared to <6000**  Y1: 1.16 (0.51-2.65)  **Y2: 6.05 (0.85-43.4)\*** |

\* p<0.05 ns: not significant. Results presented as adjusted odds ratios unless stated otherwise. PCT – Primary Care Trust; QOF – Quality Outcomes Framework; FTE – full time equivalent; CVD – cardiovascular disease;

**Table 3: Uptake and variation in uptake of NHS Health Checks**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study characteristics** | | | **Uptake** | **Multi-variable logistic regression analysis of individual-level factor affecting uptake of NHS Health Checks** | | | | |
| **Author**  **/ Year** | **Study design/setting** | **Sample characteristics where reported** |  | **Age** | **Gender** | **Ethnicity** | **Deprivation (area-level)** | **Other** |
| Public Health England  [22] | Published data, whole of England | Whole population data | 48.2% | Not reported |  |  |  |  |
| Attwood  2015[34] | Triala set in 4 GP practices in the East of England | 1,380 patients  Mean age: 52.4  Male: 49.7%  White: 72.9% | 27.0% | **For each increasing year:**  **1.05 (1.04-1.07)\*** | Female:  1.29 (0.95-1.76) | Compared to white:  Other:  0.85 (0.29-2.52) | **Most deprived quintile compared to least deprived:**  **0.42 (0.20-0.88)\*** | ---c |
| Cochrane  2013[33] | Observational study using electronic practice records from 37 (of 57) GP practices in Stoke on Trent | 10.483 high risk patients  Aged >55: 79.6%  Aged >65: 36.4%  Male: 81.3% | 43.7% | **Change in odds moving to next category higher for age ≥30-<55, ≥55-<65 and ≥65:**  **1.64 (1.51-1.77)\*** | **Female:**  **0.70 (0.58-0.84)\*** | --- | Change in odds moving to next deprivation tertile from **l**east deprived:  1.12 (0.96-1.30) | Change in odds moving to next:  **Higher risk category**  **≥15-<25%, ≥25-<35% and ≥35% estimated 10 year risk:**  **0.90 (0.80-1.02)**  Larger practice size  <3500, ≥3500-<7000 and ≥7000  1.03 (0.88-1.20) |
| Coffee  2015 d [12] | Observational study using data from 2 community medical centres in Birmingham | 188 patients already using secondary mental health services | 71.8% | Not reported | | | | |
| Coghill  2016 d [14] | Quasi-experimental study/Electronic practice records of 17 GP practices in Bristol | 5,678 patients | 34.1% | **Compared to age 40-69:**  **Age 70-74: 2.09\*** | **Male: 0.82\*** | --- | Least deprived quintile most likely to attend | --- |
| Cook  2016[26] | Observational study using electronic practice records from 30 (all) GP practices in Luton | 50.485 patients  Aged>55: 30.5%  Aged>65: 7.6%  Male: 53.3%  White British: 32.5% | 43.7% | Not reported / Unadjusted differences reported in Appendix Table A3 | | | | |
| Dalton  2011[32] | Observational study using electronic practice records from 29 (of 86) GP practices in Ealing, London | 5,294 high risk patients  Aged>55: 80.8%  Aged >65: 40.8%  Male: 80.9%  White British: 21.7% | 44.8% | **Compared to age 35-54:**  **Age 55-64:**  **1.74 (1.34-2.25)\***  **Age 65-74:**  **2.27 (1.47-3.50)\*** | **Age 35-54b:**  **Female**  **1.71 (1.03-2.85)\***  Aged 55-64:  Female  1.22 (0.89-1.67)  Aged 65-74:  Female  0.96 (0.76-1.22) | Compared to white:  **South Asian**:  **1.71 (1.29-2.27)\***  **Mixed race:**  **2.42 (1.50-3.89)\***  Black:  1.34 (0.91-1.98)  Other:  1.15 (0.76-1.74)  **Missing:**  **0.51 (0.30-0.88)\*** | --- | **Practice size:**  **Compared to 3000-5999**  **<3000: 2.53 (1.09-5.84)\***  ≥6000: 0.79 (0.33-1.88)  **Hypertension:**  **1.31 (1.15-1.51)\***  Smoker:  0.88 (0.75-1.02) |
| Hooper  2014[31] | Observational study using data from 40 GP practices in Warwickshire | 37,236 patients | 44.8% | Not reported | | | | |
| Krska  2015[27] | Observational study using electronic practice records in 13 (of 55) GP practices in Sefton, North West England | 2,892 high risk patients  Aged >65: 69.4%  Male: 78.3%  White: 99.1% | 52.9% | Not reported / Univariate analyses in Appendix Table A3 | | | | |
| Kumar  2011[30] | Observational study using data from 2 (of approx. 57) GP practices in Stoke on Trent | 1,606 patients (of whom 661 were high risk patients)  Aged >60: 31.5%  Male: 56.7% | 30.9% | Not reported | | | | |
| NHS Greenwich [16] | Observational study using data from 5 community based venues in South East London | 1,400 patients  Aged >65: 27.5%  Male: 45.1% | 45.9% | Not reported | | | | |
| Sallis 2016[35] | Pragmatic quasi-randomised controlled trial in 4 GP practices in Medway | 3511 patients  Mean Age: 53.1  Male: 49.1% | 31.4% | **For each increase in 10 years:**  **1.62 (1.50-1.75) \*** | **Female:**  **1.50 (1.29-1.74) \*** | --- | **Least deprived quintile compared to most deprived**  **1.61 (1.14-2.26)\*** | --- |

Results presented as adjusted odds ratios

\* p<0.05 ns: not significant

a data from control arm of trial who attended NHS health checks; b reported with age interaction; c the model also controlled for GP practice (n=4).

**Table 4. Studies with a comparison group reporting the health-related impact of the NHS Health Check**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Study characteristics** | | | **RESULTS** | | | |
| **Author**  **/ Year** | **Study design/Setting**  **Study time period** | **Comparison and**  **Statistical Method** | **Disease detection** | **Health-related behaviours** | **Individual-risk factors / CVD risk reduction** | **Prescribing** |
| Chang  2016[20] | Individual-level matched cohort study using CPRD data  Baseline:  April 2009 - March 2013  Follow-up:  Median of 2 years | Difference in difference analysis comparing attendees with non-attendees with propensity score matching on age, gender, ethnicity, deprivation and region | AF: 0.02 (-0.02 to 0.06)  **CKD: 0.17 (0.11 to 0.23)\***  CAD: 0.02 (-0.04 to 0.08)  **FH: 0.09 (0.07 to 0.11)\***  Heart failure: 0.01 (-0.01 to 0.03)  **Hypertension: 2.99 (2.77 to 3.21)\***  **PVD: 0.03 (0.01 to 0.05)\***  **Stroke: -0.03 (-0.05 to -0.01)\***  TIA: 0.008 (-0.01 to 0.03)  **T2DM: 1.31 (1.17 to 1.45)\*** | Smoking prevalence:  -0.11  (-0.35 to 0.13) | **CVD risk:-0.21% (-0.24 to -0.19)\***  **SBP: -2.51mmHg (-2.77 to -2.25)\***  **DBP: -1.46mmHg (-1.62 to -1.29)\***  **BMI: -0.27 (-0.34 to -0.20)\***  **Cholesterol: -0.15mmol/L**  **(-0.18 to -0.13)\*** | I**ncrease in statin prescribing:**  **3.83 (3.52 to 4.14)\***  **Increase in anti-hypertensive prescribing:**  **1.37 (1.08 to 1.66)\*** |
| Forster  2015[19] | Individual-level matched cohort study using CPRD data  April 2009 - March 2013 | Cohort study comparing attendees with non-attendees matched on age, gender and general practice | Hypertension:  Men: +5%\*; Women: ns  **Hypercholesterolemia:**  **Men: +33%\* ; Women +32%\*** | --- | --- | **New statin prescribing: HR 1.58 (1.53 to 1.63)\***  **New antihypertensive drug prescribing:**  **HR 1.06 (1.03 to 1.10)\*** |
| Caley  2014[36] | Observational study using electronic medical records in 79 GP practices in Warwickshire  June 2010 – March 2013 (39 months) | Multivariable regression analysis reporting association between % eligible completing an NHS Health Check at practice level and change in prevalence of five conditions | Observed change in prevalence of T2DM, hypertension, CHD, CKD, AF was not statistically significant | --- | --- | --- |
| Jamet 2014[15] | Observational study using prescription data in  145 PCTs in England  2012 (1 year) | Multivariable regression analysis reporting association between number of NHS Health Checks completed and statin prescribing at PCT level | --- | --- | **---** | **Prescriptions of high dose statins: regression coefficient 0.094\***  Prescriptions of low dose statins: Not significant |
| Lambert  2016[37] | Observational study using local data returned from GP practices to commissioners in 3 health districts (101 practices) in North East England  Unclear year 30 months | Univariate regression models reporting association between number of NHS Health Checks provided in the health district and incident cases of disease | The number of health checks performed explained almost none (1% or less) of the growth in hypertension or diabetes registers and 6-60% of incident cases of hypertension | --- | **77–92% of variance between practices in numbers of incident high risk of cardiovascular disease was explained by the number of health checks performed.** | **---** |

\* p<0.05; CPRD – Clinical Practice Research Datalink; AF- atrial fibrillation; CKD – chronic kidney disease; CAD – coronary artery disease; FH – familial hypercholesterolaemia; PVD – peripheral vascular disease; TIA – transient ischaemic attack; T2DM – type 2 diabetes; DBP – diastolic blood pressure; SBP – systolic blood pressure; BMI – body mass index; HR – hazard ratio; CHD – coronary heart disease