

A cross-sectional study examining the equitability of invitation, uptake and coverage for NHS Health Check

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Title page

Title: A cross-sectional study examining the equitability of invitation, uptake and coverage for NHS Health Check

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Figure and Table legends

Figure 1: Flow showing eligible, invited and attended for NHS Health Check

Figure 2: Adjusted odds ratio by deprivation

Table 1: Characteristics of study population categorised by Eligible, Invited and Attended

Table 2: Regression analysis of invited amongst eligible, uptake amongst those invited and overall coverage amongst eligible population

Summary Box:

What is already known on this subject?

- *The evidence for attendance at NHS Health Check vary considerably across different regions in England however there is consistent evidence that support attendance being higher amongst older patients and female patients. The evidence is however mixed for ethnicity and deprivation. There is also limited studies examining impact of different invitation methods on uptake.*

What does this study add?"

- *This study found high level of uptake and coverage for NHS Health Check in Walsall however the study identified inequities in access to the service. Men had lower odds of invitation, uptake and coverage.*
- *Similarly, those in the most deprived part of the population and those from particular minority ethnic groups had lower odds of invitation, uptake and coverage.*
- *Opportunistic and telephone invitations were associated with higher odds of uptake.*

Abstract

Background: The evidence for access to NHS Health Check (NHS HC) vary considerably across the country. This study examined the equity in invitation, uptake and coverage of NHS HC and impact of different invitation methods.

Methods: This patient-level cross-sectional study from 52 general practices in Walsall used adjusted logistic regressions to examine the association between patient characteristics (age, sex, ethnicity and deprivation) and NHS HC access.

Results: Over 5-year study period, 61,464 people were eligible for NHS HC, 66% were invited, uptake was 74% and coverage was 55%. Males had lower odds of: invitation (AOR 0.78, 95%CI 0.75-0.81); uptake (0.73, 95%CI 0.70-0.77); and coverage (0.69, 95%CI 0.66-0.71). Compared with White, the “Other” ethnicity group (mixed backgrounds, other Asians that are not South Asians and other ethnic groups) had lower odds of: invitation (0.74, 95%CI 0.67-0.81), uptake (0.86, 95%CI 0.75-0.98) and coverage (0.74, 95%CI 0.68-0.81). The most deprived areas had lower odds of invitation, uptake and coverage. Opportunistic invitation had a 25-fold increase in odds of uptake.

Conclusion: The study has highlighted areas of inequities in access to NHS HC. The group most negatively affected were men, people from particular minority ethnic groups and people from deprived communities. Further actions are needed to reduce these inequities.

Background

NHS Health Check (NHSHC) is a national risk assessment and management programme for the prevention of cardiovascular disease (CVD) and other related diseases [1]. The NHSHC pathway consist of identifying and inviting eligible population once every five years, completing their risk assessment at attendance, referring those with high risk for clinical or lifestyle interventions [1].

Walsall is culturally diverse with higher proportion of Black, Asian and Minority Ethnic (BAME) compared with England. A quarter of Walsall's 167 Lower Layer Super Output Area (LSOA) are amongst the most deprived 10% in England with Walsall ranking 25th (out of 317) most deprived English local authorities [2]. NHSHC in Walsall is delivered primarily through General Practices (GP practices) however, additional provision is also made through the Health Workplace Programme [3] and more ad-hoc provision through various community events such as The Health Bus [4].

The NHSHC aims to address health inequalities by making the programme available to everyone aged between 40-74 years who meet the eligible criteria irrespective of their age, sex or ethnicity [1]. The potential challenge with this type of approach is that if there is bias in those who attends the NHSHC, this has the potential to inadvertently widen health inequity [5].

As part of the Public Health Outcomes Framework [6], there are three process measures used to evaluate the performance of NHSHC:

- Invited: percentage of the eligible population offered an NHSHC.
- Uptake: percentage of the eligible population offered an NHSHC who received an NHCHC.
- Coverage: percentage of the eligible population who received an NHSHC.

The evidence for NHSHC attendance vary considerably across different regions although there is consistent evidence that supports attendance being higher amongst older patients and female patients. The evidence is however mixed for ethnicity and deprivation. A national study by Chang et al [7], found significantly lower coverage in Black Africans and Chinese (compared with White ethnicity). This contrasts with most of the local peer-reviewed studies

that found higher level of attendance in Black [8, 9], South Asians [8, 10, 11] and minority ethnicity more generally [12].

The aim of the study was to assess the equity in the invitation, uptake and coverage of NHSHC in Walsall during the study period. The dimension of equity assessed were age, sex, ethnicity and deprivation. A second aim of the study was to examine the impact of the different invitation methods on uptake.

Methods

Cross-sectional data for NHSHC eligible patients in Walsall between 1st October 2014 and 30th September 2019 was obtained. By allowing for a complete 5-year cycle, this ensured that every eligible participant in the study should have attended at least one NHSHC during the study window.

In line with National rules of NHSHC [1], the study population for this study (Supplementary Figure 1) were patients currently registered with General Practice (GP) in Walsall who: were aged 40-74 years as of 1st October 2014, had not attended NHSHC in the previous 5 years before 1st October 2014, were not prescribed statin and did not have the following pre-existing diagnoses at the start of the study: coronary heart disease (CHD), chronic kidney disease (CKD) stages 3-5, diabetes, hypertension, atrial fibrillation (AF), transient ischaemic attack (TIA), hypercholesterolemia, heart failure, peripheral arterial disease and stroke.

All 52 General Practices (GP) in Walsall agreed for their patient records stored in the EMIS (Egton Medical Information Systems) [13] enterprise database to be interrogated for this study.

Outcomes

The primary outcomes for this study were invitation, uptake and coverage of NHS Health Check. Data on participants were extracted using universal Read codes as described in the NHSHC Business Rule [1].

Exposures and Co-variates

Data on patient demographics (age, sex, ethnicity, deprivation) and methods of invitation were extracted using Read codes described in the NHC Business Rule [1]. Age, sex, ethnicity and deprivation ~~are known confounders [14, 15] and~~ were adjusted for during analysis.

Data manipulation and cleansing

Anonymised individual level data was extracted from EMIS. Date of birth was converted to age at the start of the study, and these were grouped into 40-44, 45-54, 55-64, 65-74 years. Deprivation status was obtained by linking Lower Super Output Area (LSOA, derived from individual's postcode in EMIS) to Index of Multiple deprivation data [2019](#) (IMD).

Statistical Analysis

Associations between participant characteristics and each outcome measure were examined using unadjusted and adjusted multilevel logistic regression models (allowing for clustering of patients at general practice level as a random effect). Odds ratio (OR) and adjusted odds ratio (AOR) with 95% confidence intervals were reported. Intra-cluster correlation coefficients (ICC) were reported, using the null linear model.

All analyses were conducted using Stata v15. Data manipulations were performed using MS Access.

Research governance and ethical considerations

Ethical approval was not required for this service evaluation. However, approval to interrogate non-identifiable patient's data on EMIS database was granted by the assigned committees in Walsall Clinical Commissioning Group and Walsall Local Authority.

Results

Population profile

In the eligible population, there were more women compared to men (50.9% vs. 49.2%), more people aged 45-54 years (43.3%) compared to other age groups, more people who identified as white ethnicity (78.0%) and more people in the most deprived IMD quintiles (47.7%). The same patterns were observed in the invited and attended populations. Around 5% of patients had a high risk of CVD (QRISK>20) in all three groups (Table 1).

Invitation, uptake and coverage

Table 2 shows analyses of invitation, uptake and coverage by sex, age, ethnicity and deprivation. In total, 61,464 people were eligible for NHSHC during the study period, 40,591 (66.0% of eligible) were invited to participate with 74.4% uptake amongst those invited. Overall, 33,761 (54.9% of eligible) attended NHSHC (Figure 1). There was variation between general practices for invitation (8.6%-94.0%), uptake (33.5%-97.9%) and coverage (10.8%-93.7%). The ~~intra-cluster correlation coefficient (ICC)~~ for the null linear model (before adjustment) shows that invitation, uptake and coverage was slightly correlated within the general practice clusters with ICC of 25%, 21% and 18% respectively.

Equitability of access

Sex equity

There was a statistically significant 20% reduction in unadjusted odds of invitation for male participants, persisting after adjustment for confounders (AOR 0.78, 95%CI 0.75-0.81) (Table 2 & Supplementary Figure 2). Odds of uptake and coverage were also significantly lower for males compared with females in adjusted and unadjusted analyses (AOR 0.73, 95%CI 0.70-0.77 and AOR 0.69, 95%CI 0.66-0.71 respectively) (Table 2 & Supplementary Figure 2).

Age equity

The lowest invitation level (63%) was observed in the older population (65-74 years) however this group had the second highest attendance of all the age-groups (Table 2). After adjusting for confounders, the odds of invitation was 19% lower in oldest age group 65-74 compared with those aged 40-44 years, which is statistically significant at 5% level (AOR 0.81, 95%CI 0.75-0.86). However, when invited, participants in the older people age groups had a significantly increased odds (72% increased odds) of attending (e.g., AOR 1.72, 95%CI 1.57 - 1.89 for 65-74 compared with 40-44). ~~The odds of uptake increases as the age increases, in other words, there was a gradient increase in uptake that correlates with increasing age-group.~~ Similarly, participants in all the older age groups had a significantly higher odds of coverage compared with those aged 40-44 years (Table 2).

Ethnicity equity

Before adjustment, all non-white ethnicity groups had significantly lower odds of being invited compared to White ethnicity group however, after adjustment, only Black (AOR 0.85, 95%CI 0.75-0.96) and Other ethnic groups (AOR 0.74, 95%CI 0.67-0.81) remained significant.

Compared with White, South Asian had a significantly higher odds of uptake (AOR 1.32, 95%CI 1.19-1.45) and coverage (AOR 1.18, 95%CI 1.10-1.26). Black ethnicity group had significantly lower odds of invitation but significantly higher odds of uptake (AOR 1.23, 95%CI 1.04-1.45). The most consistent inequity was observed in the Other ethnicity category (consisting of mixed backgrounds, other Asians not from south Asians and other ethnic groups). After adjusting for confounders, the “Other” ethnicity group had significantly lower odds for invitation (AOR 0.74, 95%CI 0.67-0.81), uptake (AOR 0.86, 95%CI 0.75-0.98) and coverage (AOR 0.74, 95%CI 0.68-0.81) (Table 2 & Supplementary Figure 3 C). Sensitivity analyses showed that removing “unknown” ethnicity group had no impact on the overall result observed.

Socioeconomic (deprivation) equity

The odds of invitation, uptake and coverage was significantly lower for the most deprived group compared with least deprived and there was a gradient observed with reduction in odds in each group as the level of deprivation increases (Figure 2).

Invitation method

The most common method of invitation used was opportunistic (face-to-face), which was used in 63.8% of those invited (Supplementary Table 1). Both opportunistic and telephone invites were significantly associated with higher odds of uptake. Compared with invitation by letter, opportunistic had a 25-fold increase in odds of uptake (AOR 25.31, 95%CI 23.38-27.39) and telephone had over 3.5-fold increase (AOR 3.60, 95%CI 3.23-4.02).

After adjustment, odds of opportunistic invitation was significantly lower for male participants (AOR 0.79, 95%CI 0.75-0.83) but significantly higher for South Asian ethnicity (AOR 1.19, 95%CI 1.09-1.31) and oldest age group (e.g., AOR 1.36, 95%CI 1.25-1.49) (Supplementary Table 2). There was no significant difference in this method of invitation by deprivation-.

Discussion

Main finding of this study

Over the 5-year study period, 66% of Walsall's eligible population were offered (invited) NHSHC, uptake of those invitations was high at 74% and overall coverage was 55%. The study found that male participants and people from most deprived part of the communities had lower odds of invitation, uptake and coverage. [The odds of invitation was also significantly lower for people from Black ethnic group.](#) Compared with White, the "Other" ethnicity group (mixed backgrounds, other Asians that are not South Asians and other ethnic groups) also had lower odds of invitation, uptake, and coverage. [Participants from Black ethnicity group also had lower odds of invitation.](#)

This study found that younger age group 40-44 years, had significantly lower odds of taking up an NHSHC invite compared to all the other age groups (odds were up to 72% higher for those aged 65-74 years). Opportunistic invitation had a 25-fold increase in odds of uptake compared with invite by letter.

Proportion of eligible population invited for NHSHC in Walsall was lower than Public Health's England (PHE) 5-year national average of 71.8% for 2016/17 Q1 – 2020/21 Q4 [6]. The uptake and coverage in Walsall were considerably higher than PHE national average of 47% and 33% respectively although lower than the ambition of 75% set out at the start of the programme [16].

What is already known on this topic

Previous studies have reported variations in attendance across general practice [8, 7] and this study also found variations in general practices for invitation (8.6%-94.9%), uptake (33.5%-97.9%) and coverage (10.8%-93.7%) [of NHSHC. However, the analysis showed around 25% of variation in invitation, 21% in uptake and 18% in coverage were attributable to potentially unmeasured practice level factors.](#) The literature on NHSHC attendance by age is unequivocal; almost all studies have found that older participants are more likely to attend [17], which is consistent with the findings in this study. Similar to other studies [18, 17, 19, 20, 9, 21, 22], this study found that male participants had a significantly lower odds of

being invited and attending NHSHC. This is an area of concern especially as men are at greater risk of CVD [23].

What this study adds

The picture from literature on attendance by deprivation has been mixed with some reporting higher attendance in the most deprived population [19, 10], or higher attendance in the least deprived [24, 9] and others finding no difference [7, 21]. The findings from this study shows that the more deprived the area the lower the odds of invitation, uptake and coverage.

The literature is also mixed regarding impact of ethnicity on access to NHSHC. Several studies [20, 11, 10, 25] concur with the findings of this study that coverage was significantly higher amongst participants who identified as South Asians, however other studies reported that there were no significant difference by ethnicity [24] or that coverage was lower in South Asians [26]. This study also showed that participants from particular minority ethnic groups had a significantly lower odds of invitation, uptake and coverage (Supplementary Figure 3). The findings from this study adds to the existing evidence that screening-type programmes may not be reaching aspects of ethnic minority communities and those from more deprived areas [27, 28]. ~~Effectiveness of invitation methods for different segment of the population have been cited as possible reason lower level of attendance [29].~~

This study found opportunistic invitation was associated with higher odds of uptake, which is consistent with findings from an earlier study [17]. Younger people aged 40-44 had the lowest odds of being invited using this approach and this may partly explain the lower uptake in younger age group especially as this age-group are known to be less likely to visit GP practices [32]. ~~Conversely, people aged 65-74 who are more likely to visit the GP [32] had the lowest odds of being invited. Further research is needed to understand this decreased odds of invitation despite the increase odds of opportunistic method.~~ –Contrary to finding from previous studies where it was found that letter was the most common method of invitation used [17], the findings from this study indicate opportunistic invitation was the most used approach in Walsall. This may partly explain the higher than average uptake in Walsall as

findings from this study and other studies have shown non-written method of invitation such as face-to-face opportunistic invitations [9, 29] and telephone invitations [31] were more effective for increasing uptake. However, given that certain groups such as men are less likely to attend GP [32], it is possible that opportunistic invitation may also exacerbate inequality. In addition, this method of invitation can leave participants feeling forced and limits the opportunity for informed consent [33]. Furthermore, Cook et al showed that effectiveness of different invitation approach differs by patient demographics [9], which concurs with an RCT study that found telephone invitation to only be particularly effective for younger patients [31]. The key message for the programme team in Walsall given the dominance of opportunistic invitation, is to ensure there is adequate information and time to enable people to make an informed decision and also adopt broader recruitment approach that would tackle inequity of access to NHSHC.

One of the key objectives of NHSHC is the narrowing of health inequalities and there needs to be equitable uptake and coverage across all parts of the population for this ambition to be realised. This study has highlighted some areas of inequities in provision of NHSHC. In addition to ineffective invitation methods, previous studies into why uptake may be low in some groups have also identified lack of interest and awareness about the programme [22, 34]; lack of appreciation of the benefit [34]; and health-seeking barriers such as time constraint and wishing to avoid GP [29] as reasons for low attendance.

A further qualitative study in Walsall population would help identify local reasons for low attendance in males, younger people and those with mixed ethnicity. There is also potential to further utilise non-GP settings to increase access such as Walsall's existing workplace programme [35] and community outreach programme similar to the one in Greenwich [22], combined with drop-in sessions outside working hours [29]. However, it is worth noting that a local study found that 7% of those invited through community outreach declined because they would prefer appointment through GP practice [22] and another study found that concerns about competency of staff in non-GP settings may have hindered NHSHC attendance in those settings [34], which indicates a need for a clearer and more targeted messaging. Alternatively, two of the top tips from PHE is the use of financial incentives and behaviour insights messages to targets priority groups, however a double-blinded randomised study comparing behaviour insights leaflets to standard leaflets found no significant difference

in uptake [36]. In terms of financial incentives to patients and GPs, previous RCT study have found that offering financial incentives to patients did not increase uptake of NHSHC [29] and a study assessing views of GPs reported that some GPs have expressed uneasiness from too much emphasis on finance for GPs for what is supposed to be fundamental to public health [37].

This is the first study evaluating NHSHC in Walsall. A key strength of this study is direct access to EMIS database enabling the study to include all eligible participants during the evaluation window, resulting in study population of around 61,500 participants. This study is also one of few studies that have examined impact of different invitation methods on uptake of NHSHC. Findings from this study may be relevant to other areas with similar demographics.

Limitations of this study

~~This is the first study evaluating NHSHC in Walsall. A key strength of this study is direct access to EMIS database enabling the study to include all eligible participants during the evaluation window, resulting in study population of around 61,500 participants. The level of data available meant this analytical study has been able to quantify invite, uptake and coverage of NHSHC, and examined equity in the provision of NHSHC with logistic regression models that adjusted for key confounders. This study is also one of few studies that have examined impact of different invitation methods on uptake of NHSHC. Findings from this study may be relevant to other areas with similar demographics.~~

The level of data available meant this analytical study has been able to quantify invite, uptake and coverage of NHSHC, and examined equity in the provision of NHSHC with logistic regression models that adjusted for key confounders. However as this was an observational study, there will be residual confounders which have not been accounted for in the models.

Previous studies have reported poor data quality in relation to ethnicity, particularly amongst those who did not attend NHSHC. In this study, a key strength has been data completeness for ethnicity which was complete for 99.7% of attendees and 89.6% of non-attendees and as such has enabled analyses by ethnicity. However, small numbers in each ethnic category have restricted analyses to top-level categories.

Finally, initial plans for this study included analysing the data by broader characteristics such as carer status, serious mental illness and learning disability, however low data completeness level for these variables meant this was not possible.

Finally, the primary data source for this study is Walsall population registered with GP practice however the study was not able to access or estimate the number of eligible patients who may not have been registered with a GP practice. This may have introduced bias as there might have been a systematic difference between those who are registered and those not registered with GP practice in terms of equitability of access to NHS Health Check.

Conclusion

Over the 5-year study period, Walsall has achieved a high uptake of 74% amongst those invited compared with national average of 47% (2016/17 Q1 – 2020/21 Q4). The overall coverage of NHSHC in this study was 55% of Walsall's eligible population compared with 33% nationally. Despite the high level of uptake and coverage, the study has highlighted some areas of inequities in NHSHC provision. The study found that men had lower odds of invitation, uptake and coverage. Similarly, those in the most deprived part of the population and those from particular minority ethnic groups had lower odds of invitation, uptake and coverage. People from Black ethnic group also had lower odds of invitation. Opportunistic and telephone invitations were associated with higher odds of uptake of NHSHC invites. The group most negatively impacted were men, people from more deprived parts of the community and people from particular minority ethnicity groups. Further actions are needed to reduce these inequities in invitation, uptake and coverage of NHSHC.

Patient involvement statement

Patients or the public were not involved in the design or conduct of the research.

References

- [1] PHE, “NHS Health Check Best practice guidance: For commissioners and providers,” Public Health England, London, 2017.
- [2] Walsall Public Health, “Walsall Insight,” 2020. [Online]. Available: <https://www.walsallintelligence.org.uk/>. [Accessed 2 July 2021].
- [3] One You Walsall, “OneYouWalsall,” 2020. [Online]. Available: <https://www.oneyouwalsall.com/>. [Accessed 2 July 2021].
- [4] Walsall Clinical Commissioning Group, “The Health Bus - Walsall Town Centre,” 2019. [Online]. Available: <https://walsallccg.nhs.uk/the-health-bus/>. [Accessed 2 July 2021].
- [5] S. Capewell and H. Graham, “Will Cardiovascular Disease Prevention Widen Health Inequalities?,” *PLOS Medicine*, vol. 7, no. 8, pp. 1-5, 2010.
- [6] PHE, “Public Health Profiles,” 2020. [Online]. Available: <https://fingertips.phe.org.uk>. [Accessed 7 July 2021].
- [7] K. Chang, M. Soljak, J. Lee and M. Woringer, “Coverage of a national cardiovascular risk assessment and management programme (NHS Health Check): Retrospective database study,” *Preventive Medicine*, vol. 78, pp. 1-8, 2015.
- [8] M. Artac, A. Dalton, A. Majeed and J. Car, “Uptake of the NHS Health Check programme in an urban setting,” *Family Practice*, vol. 30, pp. 426-435, 2013.
- [9] E. Cook, C. Sharp, G. Randhawa and A. Guppy, “Who uses NHS health checks? Investigating the impact of ethnicity and gender and method of invitation on uptake of NHS health checks,” *International Journal for Equity in Health*, vol. 15, no. 13, pp. 1-11, 2016.
- [10] J. Robson, I. Dostal, V. Madurasinghe and A. Sheikh, “The NHS Health Check programme: implementation in east London 2009–2011,” *BMJ Open*, vol. 5, pp. 1-10, 2015.
- [11] A. Dalton, A. Bottle, C. Okoro, A. Majeed and C. Millett, “Uptake of the NHS Health Checks programme in a deprived, culturally diverse setting: cross-sectional study,” *J Public Health (Oxf)*, vol. 33, no. 3, pp. 422-429, 2011.

- [12] K. Chattopadhyay, M. Biswas and R. Moore, "NHS Health Check and healthy lifestyle in Leicester, England: analysis of a survey dataset," *Perspectives in Public Health*, vol. 140, no. 11, pp. 27-37, 2020.
- [13] EMIS, "EMIS Web," 2020. [Online]. Available: <https://www.emishealth.com/products/emis-web/>. [Accessed 7 July 2021].
- [14] A. Forster, H. Dodhia, H. Booth and A. Dregan, "Estimating the yield of NHS Health Checks in England: a population-based cohort study," *Journal of Public Health*, vol. 37, no. 2, pp. 234-240, 2014.
- [15] K. Chang, J. Lee, E. Vamos and M. Soljak, "Impact of the National Health Service Health Check on cardiovascular disease risk: a difference-in-differences matching analysis," *CMAJ*, vol. 188, no. 10, pp. E228-E238, 2016.
- [16] Department of Health, "Economic modelling for vascular checks," Department of Health, London, 2008.
- [17] A. Bunten, L. Porter, N. Gold and V. Bogle, "A systematic review of factors influencing NHS health check uptake: invitation methods, patient characteristics, and the impact of interventions," *BMC Public Health*, vol. 20, no. 93, pp. 1-16, 2020.
- [18] A. Martin, C. Saunders, E. Harte and S. Griffin, "Delivery and impact of the NHS Health Check in the first 8 years: a systematic review," *British Journal of General Practice*, vol. 68, no. 672, pp. e449-e459, 2018.
- [19] J. Robson, I. Dostal, A. Sheikh and S. Eldridge, "The NHS Health Check in England: an evaluation of the first 4 years," *BMJ Open*, vol. 6, pp. 1-10, 2016.
- [20] M. Artac, A. Dalton, H. Babu, S. Bates, C. Millett and A. Majeed, "Primary care and population factors associated with NHS Health Check coverage: a national cross-sectional study," *Journal of Public Health*, vol. 35, no. 3, pp. 431-439, 2013b.
- [21] N. Coghill, L. Garside and A. Montgomery, "NHS health checks: a cross-sectional observational study on equity of uptake and outcomes," *BMC Health Services Research*, vol. 18, no. 238, pp. 1-11, 2018.
- [22] S. Ramsay, J. Davidson and S. Taylor, "Evaluation of Nhs Health Check Plus Community Outreach Programme in Greenwich," London, 2011.

- [23] P. Bhatnagar, K. Wickramasinghe, E. Wilkins and N. Townsend, "Trends in the epidemiology of cardiovascular disease in the UK," *Heart*, vol. 102, pp. 1945-1952, 2016.
- [24] S. Attwood, K. Morton and S. Sutton, "Exploring equity in uptake of the NHS Health Check and a nested physical activity intervention trial," *Journal of Public Health*, vol. 38, no. 3, p. 560–568, 2015.
- [25] F. Qadri, "Health Equity Audit – Lewisham NHS Health Check Programme," London, 2013.
- [26] N. Richmond, L. Nurcombe, S. Thackray and S. Devine, "Health Equity Audit NHS Health Check Programme in Derbyshire County," Derbyshire County Council, Matlock, 2015.
- [27] S. Pruitt, M. Shim, P. Mullen, S. Vernon and B. 3. Amick, "Association of area socioeconomic status and breast, cervical, and colorectal cancer screening: a systematic review," *Cancer Epidemiol Biomarkers Prev*, vol. 18, no. 10, pp. 2579-2599, 2009.
- [28] D. Smith, K. Thomson, C. Bamba and A. Todd, "The breast cancer paradox: A systematic review of the association between area-level deprivation and breast cancer screening uptake in Europe," *Cancer Epidemiol*, vol. 60, pp. 77-85, 2019.
- [29] L. McDermott, A. Wright, V. B. Cornelius and A. Forster, "Enhanced invitation methods and uptake of health checks in primary care: randomised controlled trial and cohort study using electronic health records," *Health Technol Assess*, vol. 20, no. 84, pp. 1-92, 2016.
- [30] Y. Wang, K. Hunt, I. Nazareth, N. Freemantle and I. Petersen, "Do men consult less than women? An analysis of routinely collected UK general practice data," *BMJ Open*, vol. 3:e003320, pp. 1-7, 2013.
- [31] C. Gidlow, N. Ellis, V. Riley, T. Chadborn, A. Bunten and Z. Iqbal, "Randomised controlled trial comparing uptake of NHS Health Check in response to standard letters, risk-personalised letters and telephone invitations," *BMC Public Health*, vol. 19, pp. 1-11, 2019.
- [32] ESCAP, "Emerging evidence on the NHS Health Check: findings and recommendations," PHE, 2017.

- [33] E. Harte, C. MacLure, A. Martin, L. Saunders, C. Meads and F. Walter, "Reasons why people do not attend NHS Health Checks: a systematic review and qualitative synthesis," *Br J Gen Pract*, vol. 68, no. 666, pp. e28-e35, 2018.
- [34] N. Chauhan-Lall and P. Myers, "Locally Commissioned Service (LCS) Specification for NHS Health Checks in Primary Care," Walsall Public Health, Walsall, 2017.
- [35] N. Gold, C. Durlik, J. Sanders, K. Thompson and T. Chadborn, "Applying behavioural science to increase uptake of the NHS Health Check: a randomised controlled trial of gain- and loss-framed messaging in the national patient information leaflet," *BMC Public Health*, vol. 19, pp. 1-14, 2019.
- [36] R. Shaw, H. Lowe, C. Holland, H. Pattison and R. Cooke, "GPs' perspectives on managing the NHS Health Check in primary care: a qualitative evaluation of implementation in one area of England," *BMJ Open*, vol. 6, p. e010951, 2016.

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Statement On Ethical Approval

The study was a service evaluation and therefore ethical approval was not required. However, approval to interrogate non-identifiable patient's data on EMIS database was granted by the assigned committees in Walsall Clinical Commissioning Group and Walsall Local Authority.

Statement of contribution

FO was responsible for the research idea, study design, data extraction, data analysis and drafting of the manuscript. AS verified the statistical methods and provided critical feedback on the manuscript. NC, DH & PM provided critical input into the development of research idea, methods and manuscript.

Transparency statement

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Competing interests

None declared

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Data availability

No additional data available. Approval was granted to interrogate non-identifiable patient-level data and the data remain the property of the Walsall Clinical Commissioning Group and Walsall Local Authority.