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Cardiovascular risk profiles and the uptake of the NHS Healthcheck programme in male prisoners in six UK prisons: an observational cross-sectional survey

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ABSTRACT

Introduction Half of all deaths in custody are due to natural causes, the most common being cardiovascular disease (CVD). National Health Service Healthchecks should be available to all eligible prisoners; it is not clear who receives them. Mental health issues are common in prisoners and may affect how healthcare interventions should be delivered. Current policy is to offer Healthchecks to those serving over 2 years in prison.

Objectives, methods, setting and design An observational cross-sectional survey in six male prisons in England between September 2017 and January 2019 in prisoners aged 35–74 to identify who was eligible for a Healthcheck and compare CVD risk data with those that were not, and factors associated with uptake.

Outcome measures Characteristics of those accepting a Healthcheck were compared with those declining. Assessments of anxiety and depression were compared with CVD risk factors.

Results 1207 prisoners completed a Healthcheck. 21.8% of prisoners were ineligible due to existing comorbidities. 76.4% of those invited took up a Healthcheck, and of those, 12.1% were found to have new significant CVD comorbidity. CVD risk was similar to community levels but this population was 10 years younger. Definite case-level depression or anxiety was present in 20.7% and 18.0%, respectively, of participants. An association was found between ethnicity and those invited (p=0.023, ϕ=0.1) and accepting (p=0.008, ϕ=0.1) a Healthcheck. 9.7% of prisoners serving less than 2 years had CVD risk scores of 10% or more, and had similar CVD risk profiles but much higher levels of anxiety (p<0.001, ϕ=0.2) or depression (p=0.009, ϕ=0.2) than those serving 2 years or more.

Conclusion Cardiovascular risk was comparable with community rates and in some prisons, much higher. Rates of anxiety and depression were high. The national policy for selecting prisoners for Healthchecks may leave many high-risk prisoners without appropriate cardiovascular preventative assessments.

Strengths and limitations of this study

- This study is the largest study of its kind to report cardiovascular risk in male prisoners, and allowed measurement of cardiovascular disease (CVD) risk across the whole eligible prison population.
- We compared estimated QRISK2 scores assuming missing lipid values with scores based on actual results and showed that QRISK2 scores were statistically worse (greater CVD risk) when using actual scores suggesting that any bias introduced as a result of missing blood values may have been to underestimate CVD risks in this population.
- The self-rating measures used to assess anxiety and depression are not the same as clinical diagnosis although scores recorded implied high levels of definite or probable depression and anxiety cases in this population.
- Smoking, alcohol use and activity status were subject to error as both prisoners and healthcare staff interpreted current status differently.
- Due to logistical problems, the dataset contained missing values so the study may be underpowered to detect differences for these, and for information only available for those who underwent a Healthcheck.

INTRODUCTION

The National Health Service (NHS) Healthchecks programme[1] is designed to identify individuals between the ages of 40 and 75 with a high risk of future cardiovascular disease (CVD) and then offer interventions to help reduce that risk. Although its effectiveness has attracted controversy,[2–5] it remains government policy and appears to be an important public health intervention with benefits especially for higher risk patients in more disadvantaged communities.[4 6 7]

The prison population is ageing with a rise in the proportion over 50 from 7% in 2002 to 16% in 2018,[8] so the burden of CVD is likely to rise. In prison, 54% of deaths are currently due to natural causes[9] and of those, 35% have

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been estimated to be due to CVD.[10] The chief medical officer for England identifies prisoner health as a priority and there is growing awareness of the need to improve services and offer parity of care with community settings.[11]

Studies of cardiovascular risk factor profiles in prisoners within the last 15–20 years are rare in the UK[12] but commoner in the USA and Australia.[13–16] Reports describing the results of Healthchecks in prisoners generally summarise only those prisoners who undertake a Healthcheck. There are good data comparing the characteristics of those that do or don't take up Healthchecks in community settings,[6] but such data have not been published for prisoners.

There is an established relationship between cardiovascular risk and mental health with depression and anxiety both arising from, and a possible causative agent for, CVD.[17–19] There is a high prevalence of mental disorder in prisoner populations,[4] but patterns of anxiety or depression in those taking up a Healthcheck in this setting are unknown. Designing interventions to reduce cardiovascular risk requires an understanding of the pattern of risk factors present in target populations.

Recent national advice from Public Health England[20] has restated the need for a high uptake of Healthchecks in prisoners. It has lowered the age of first invitation (from 40 to 35) because prisoners are perceived to be at higher risk of cardiovascular ill health than the general population. The advice also specifies targeting prisoners with expected incarceration of 2 years or more.[20] This study was designed to describe the burden of cardiovascular risk of male prisoners whatever their length of incarceration, and measure indicators of mental illness in study participants.

METHODS

All participating prisoners in the research study provided written informed consent.

Study design

An observational cross-sectional survey was conducted in prison healthcare services in the East Midlands. In the period of data collection from September 2017 to January 2019, there were 13 male prisons in the region. Healthcare services at six prisons were approached and all agreed to contribute. The prisons were chosen to cover a broad spectrum of remand through to longer stay. They held NHS (n=4) or private (n=2) contracts for healthcare. The total number of potential eligible participants from these prisons was calculated by using turnover of the eligible prison population and the actual recorded population. This identified an annual turnover of prisoners between 5% and 35%, depending on the prison site, with a month by month turnover of between 15 and 100 eligible new prisoners by prison. The outcomes variables were the physical measures from the NHS Healthcheck and mental health measures of depression and anxiety.

Sampling procedure

All prisoners (regardless of sentence length or time served) who were deemed eligible for the NHS Healthcheck Programme in prison settings[20] were scheduled to be invited to participate (aged between 35 and 74 years old with no exclusion diagnosis as per NHS Healthcheck criteria). Eligibility was sought using clinic reports from SystmOne, an NHS clinical record system, where those ineligible were subsequently filtered. As per NHS Healthceck guidance, those excluded were prisoners with established CVD, and those on statins.

Each prison ran a new report every 3 weeks to identify the eligible population and allow for new prisoner receptions and to discount released or transferred prisoners from being invited. From the total eligible, those actually invited were determined by individual prison capacity and conditions, with no predetermined selection criteria.

Variables collected and outcomes measured

Physical measures

All variables as per NHS Healthcheck guidance were collected; age, ethnicity (census categories), height, weight, body mass index (BMI), blood pressure, smoking status (current smoker, ex-smoker and never smoked), family history of CVD, and alcohol intake using the Alcohol Use Disorders Identification Test (AUDIT). AUDIT-Concise (AUDIT-C) is a shortened version of the 10 question AUDIT tool which identifies individuals who may have hazardous drinking or alcohol drinking disorders.[21] The full 10 question AUDIT was undertaken if prisoners scored 5 or above on AUDIT-C. Physical activity was recorded using the General Practice Physical Activity Questionnaire, a validated screening tool,[22] categorising patients as active, moderately active, moderately inactive or inactive.

Blood tests for creatinine, plasma glucose, lipids and HbA1c were requested. If participants had blood tests within 15 months, such results were used. Last known postcodes were recorded and Index of Multiple Deprivation (IMD) codes applied[23]; IMD 1 being the most deprived area. 35.1% of prisoners were of no fixed abode (NFA) prior to incarceration which does not have an IMD code so NFA was handled as a discreet categorical value.

As stated in the programme guidance, the physical healthcheck in prison risk assessment required the use of a risk engine to calculate the individual's risk of developing CVD in the next 10 years. As advised by national guidance,[1] this study used QRISK2.[24]

Mental health measures

Two mental health screens were used: the Patient Health Questionnaire (PHQ-9)[25 26] and the Generalised Anxiety Disorder Assessment (GAD-7).[27] The PHQ-9 is a self-rated tool consisting of nine items with a good sensitivity (88%) and specificity (88%) to detect major depressive disorder.[25 26] The GAD-7 is a 7-item self-reported anxiety scale with a sensitivity of 89% and specificity of 82% for GAD.[27] Both screens require the individuals to rate their

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symptoms and feelings related to the previous 2 weeks period, with items measuring the frequency of symptoms on a scale of 0 (not at all), to 3 (nearly every day). The screens have cut-off scores>10. The thresholds mild=0–5, moderate=6–10, moderate/severe=11–14 and severe ≥15 were used in this study. The PHQ-9 and GAD-7 are used nationally in the Improving Access to Psychological Therapies services, allowing the potential to benchmark against community scoring patterns.

SystmOne was also used to collect monthly anonymised denominator reports at each prison site to compare the whole population characteristics with those eligible to have an NHS Healthcheck and those eligible but declining active participation, so differences in the CVD risk profiles between eligible, ineligible, responders and non-responders could be described.

The descriptive analysis compared: those invited for an NHS Healthcheck with those who were invited but did not attend; the eligible population invited with the eligible population uninvited and the whole prison population (age 35–74) with the eligible prison population.

Statistical analysis

Summary measures were described using mean (SD) or median (IQR) for continuous variables, categorical data were given as a count (percentage). Means were compared using a two-sample t-test and medians with a two-sample Wilcoxon test. Count data were compared using a X^2 test, or in the case of small counts, Fisher's exact test. Cohens d statistic (d) was calculated using a pooled estimate of SD to estimate effect size[28] for normally distributed continuous variables, Phi coefficient (ϕ) and Cramér's V (V) for categorical variables with two or more than two levels, respectively, and the formula:

$$r = \frac{z}{\sqrt{N}}$$

The assumptions of normality, independence, sample size and homogeneity of variance were checked as appropriate.

A multiple logistic regression was fitted on the population offered a healthcheck with declined healthcheck as the outcome variable, fitted with age, BMI, smoking status, prison, IMD, ethnicity and sentence length.

Baseline characteristics were taken from the first month a prisoner was recorded in the denominator data for all analyses except those using only prisoners who received a Healthcheck, who were not included in any analyses requiring denominator data.

Sample size was estimated by assuming a range of prevalances for QRISK 2 of 10% and a precision of ±2% requiring 2185 individuals or for a precision of ±3%, 971 individals if prevalence was assumed to be 35%. For a lower prevalence at 18%, then a sample of 908 participants would enable a precision of ±2.5% around this estimate. All analyses were performed using R V.3.5.3.

Patient and public involvement

Prisoner involvement was used to development the consent form, qualitative aspects of the research and to check easy-read versions of material; prisoners did not take part in recruitment. Results were disseminated via participation groups in each establishment and on the East Midlands-Collaborations for Leadership in Applied Health Research and Care (EM-CLAHRC) website.

RESULTS

Eligible and ineligible populations

Table 1 describes the characteristics of a point prevalence sample of the whole population of prisoners aged 35–74 collected at August 2018 (n=2107) comparing the eligible (n=1648) and ineligible populations (n=459) across all prisons at that point in time. Overall 21.8% of the prison population were ineligible for a Healthcheck due to existing comorbidity. The ineligible prisoners were older (mean age 53.5 (10.2) vs 43.8 (7.6) years, p<0.001, d=1.6), had a higher BMI (30.5 (6.7) vs 26.9 (5.2), p<0.001, d=0.9), had a higher QRISK2 score (median 13.4 (7.5–22.1) vs 3.2 (1.8–6.2), p<0.001, r=0.5) and sentence length (3.45 years (1.5–7.0) vs 2.5 (1.0–6.0) p<0.001, r=0.1). Ethnicity was significantly different (p=0.008, ϕ=0.1) with the eligible group containing more white prisoners (85.0% vs 79.6%) and fewer from Asian backgrounds (2.8% vs 5.4%). The predominant reasons for ineligibility were established history of hypertension (12.9%) and diabetes (8.5%) (table 2). The proportion ineligible due to comorbidities varied considerably by prison (between 14% and 37%), largely reflecting age structure differences between prisons. Among all participants aged 35–74, smokers totalled 1748 (82.9%).

Recruitment of eligible prisoners

Overall 1207 subjects completed Healthchecks from an invited eligible population of 1579, a response rate of 76.4%. In all the total eligible population during the course of the study was 3620 individuals, so 43.6% of the available eligible population were invited and 33.3% took part. The mean age (SD) of the whole eligible population was 43.8 (7.6) years. Not all eligible prisoners were invited because of the capacity of the researchers and the volume of prisoner churn.

Characteristics of the eligible study population

Ethnicity, smoking status, sentence length (p<0.001, ϕ<0.1) and prison attended (p<0.001, ϕ=0.3) were all significantly different between those eligible prisoners who were invited to receive a Healthcheck and those eligible but who were not invited. Of those who were invited, there were significant differences in ethnicity (p=0.023, ϕ=0.1) and length of sentence (p<0.001, ϕ<0.1), with the invited group containing more white prisoners (82.4% vs 79.2%) and prisoners serving a 2-year or longer sentence (29.8% vs 26.1%). Invited prisoners were also less likely to be smokers (83.6% vs 86.3% p=0.024, ϕ<0.1).

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Table 1 Baseline characteristics of those prisoners eligible and not eligible for Healthchecks .

	Non-eligible (n=459)	N missing	Eligible (n=1648)	N missing	P value	Effect size
Ethnicity N (%)		32		62	0.008	ϕ=0.1
White	363 (85.0 95% CI 82.0 to 88.2)		1262 (79.6, 95% CI 77.7 to 81.5)			
Black	27 (6.3, 95% CI 3.3 to 9.5)		86 (5.4, 95% CI 3.6 to 7.4)			
Asian (S & E)	12 (2.8, 95% C: 0.0 to 6.0)		86 (5.4, 95% CI 3.6 to 7.4)			
Mixed/ other	25 (5.9, 95% CI 2.8 to 9.0)		152 (9.6, 95% CI 7.8 to 11.5)			
Age (years)	53.5 (10.2) CI: 33.9 to 73.2	0	43.8 (7.6) 95% CI 28.9 to 58.7	0	<0.001	d=1.6
Weight (kg)	93.5 (20.7) 95% CI 52.9 to 134.1	1	83.9 (16.9) 95% CI 50.7 to 117.0	15	<0.001	d=0.8
BMI	30.5 (6.7) 95% CI 17.3 to 43.6	2	26.9 (5.2) 95% CI 16.7 to 37.1	20	<0.001	d=0.9
Smoking status N (%)		2		13	<0.001	ϕ=0.07
Non-smoker	98 (21.4, 95% CI 17.9 to 25.4)		246 (15.1, 95% CI 13.4 to 16.8)			
Smoker	359 (78.6, 95% CI 75.1 to 82.5)		1389 (85.0, 95% CI 83.3 to 86.7)			
Sentence length (years) median (IQR)	3.45 (1.50–6.99)	177	2.5 (1.0–6.00)	580	<0.001	r=0.1
QRISK2 score Median (IQR)	13.4 (7.5–22.1)	0	3.2 (1.8–6.2)	0	<0.001	r=0.5
Prevalent disease	454 (99.1, 95% CI 98.5 to 99.9)		–			
On a statin	4 (0.9, 95% CI 0.2 to 1.6)		–			

All values are mean (SD) unless otherwise stated.
These 2107 prisoners were a subset of the whole prison population aged 35–74 available at August 2018.

Other baseline characteristics were not significantly different between the two groups (online supplementary table s1).

Characteristics of those who took up compared with those who declined a Healthcheck

From those invited (n=1579), those who took up a Healthcheck in this study (n=1191 plus 16 who took part but for whom baseline data was not available) differed from those who declined (n=388) in terms of ethnicity (p=0.008, ϕ=0.1), with a smaller percentage of black prisoners receiving a Healthcheck than declining (3.7% vs 7.0%). There was also significant variability by prison (online supplementary table s2). The level of deprivation of the participants was estimated; 35% of participants were identified as of NFA and a further 29% were in the lowest IMD quintile. (online supplementary table s3)

The multiple logistic regression showed a significantly higher odds of declining a health check for prison C (OR 6.4, 95% CI 3.4 to 13.4) and prison B (OR 5.3, 95% CI 2.8 to 11.0) when compared with the reference prison A, while prison E showed no significant difference. Prisons D and F were missing from the analysis due to these prisoners having missing data on other variables. BMI (p=0.17) and smoking status (p=0.80) were not significant. Having a length of sentence of 4 years or more significantly decreased the odds of declining the heathcheck (OR 0.5, 95% CI 0.2 to 0.9), but the other categories of sentence length were not significant. For ethnicity black prisoners had significantly higher odds of declining a health check (OR 2.7, 95% CI 1.3 to 5.9) compared with the reference category of white prisoners, Asian and mixed/other ethnicity were not significant (online supplementary table s4).

Table 2 Prevalance of existing cardiovascular comorbidity in the whole prisoner population studied aged 35–74 as at August 2018 (n=2107)

Comorbidity	N (%)
Hypertension	272 (12.9, 95% CI 11.5 to 14.4)
Diabetes	180 (8.5, 95% CI 7.4 to 9.8)
Cardiovascular disease	117 (5.6, 95% CI 4.6 to 6.6)
High cholesterol/statin	17 (0.8, 95% CI 0.5 to 1.3)
Chronic kidney disease	12 (0.6, 95% CI 0.3 to 1.0)
All comorbidities	459 (21.8, 95% CI 20.0 to 23.6)

QRISK2 profiles of eligible prisoners

The QRISK2 profile for all 3620 eligible individuals identified that the proportion of male prisoners above a 10% threshold of QRISK2 varied between 5.6% and 19.8% of the population in the age range 35–74 years in each prison; 10.2% (370) across all six prisons during the study period (online supplementary table s5).

High QRISK2 (≥10) prisoner characteristics

Those prisoners who received a Healthcheck and were in the high QRISK2 group (n=125, 10.3% of participants) were compared for variables not used in the QRISK2 scoring. The high-risk group had greater numbers with a positive family history (69.2% vs 53.7%, p=0.002, ϕ=0.1). There was a significant association between QRISK2 score and anxiety with the high-risk group containing fewer prisoners with high anxiety scores (8.0% vs 19.2%,) than the lower risk prisoners, linked to length of sentence

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Table 3 Characteristics of prisoners who received a Healthcheck (n=1207) with high versus low QRISK2 scores

Variable	QRISK2 <10 (n=1082)	No missing	Qrisk2 ≥10 (n=125)	No missing	P value	Effect size
Depression: PHQ-9 N (%)		2		0	0.058	ϕ=0.1
None or mild	668 (61.7, 95% CI 58.9 to 64.8)		84 (67.2, 95% CI 59.2 to 75.2)			
Moderate	177 (16.4, 95% CI 13.4 to 19.4)		27 (21.6, 95% CI 13.6 to 29.6)			
Moderate/severe or severe	235 (21.7, 95% CI 18.8)		14 (11.2, 95% CI 3.2 to 19.2)			
Anxiety: GAD-7 N (%)		2		0	0.016	ϕ=0.1
None or mild	730 (67.6, 95% CI 64.8 to 70.4)		97 (77.6, 95% CI 71.2 to 85.0)			
Moderate	143 (13.2, 95% CI 10.5 to 16.1)		18 (14.4, 95% CI 8.0 to 21.8)			
Severe	207 (19.2, 95%CI 16.4 to 22.0)		10 (8.0, 1.6–15.4)			
First degree family history[1]	82			5	0.002	ϕ=0.1
Yes	537 (53.7, 95% CI 50.5 to 56.9)		83 (69.2, 95% CI 61.7 to 78.0)			
No	463 (46.3, 95% CI 43.1 to 49.5)		37 (30.8, 95% CI 23.3 to 39.7)			
Ethnicity		4		0	0.057	ϕ=0.1
White	876 (81.3, 95% CI 79.1 to 83.5)		113 (90.4, 95% CI 86.4 to 95.4)			
Black	44 (4.1, 95% CI 1.9 to 6.3)		2 (1.6, 95% CI 0.0 to 6.6)			
Asian	62 (5.8, 95% CI 3.6 to 8.0)		6 (4.8, 95% CI 0.8 to 9.8)			
Mixed/other	96 (8.9, 95% CI 6.8 to 11.2)		4 (3.2, 95% CI 0.0 to 8.2)			

Family history of at least one of the following: hypercholesterolaemia, ischaemic heart disease, angina, myocardial infarction, cardiovascular disease or diabetes.
GAD-7, Generalised Anxiety Disorder-7; PHQ-9, Patient Health Questionnaire-9.

(online supplementary table s6). There was no significant difference in measured levels of depression (PHQ-9) or ethnicity between these groups (table 3).

Cardiovascular comorbidites in the participants

Among the 1207 prisoners who received a Healthcheck, 146 (12.1%) were found to have at least one of high CVD risk (on QRISK2), renal impairment or diabetes / pre-diabetes, with seven having two, and one all three, risk factors. There were substantial missing values for the comorbidities defined by blood-based testing (online supplementary table s7). Prisoners with blood test results were younger (mean age 42.7, SD 7.0; p<0.001) than those without (mean age 45.5, SD 8.2, d=0.4); completeness of blood results also varied by prison. Of the 1207 participants, 56.5% (n=682) of participants described themselves as active or moderately active, and 43.5% (n=525) inactive or moderately inactive.

Mental health of participants

Overall, (as measured by PHQ-9 and GAD-7) 20.7% (n=249) of participants were classed as moderately severe to severely depressed and 18.0% (n=217) were suffering from severe anxiety (definite cases). These values rose to 37.6% (n=453) for moderate depression or worse and 31.5% (n=378) for moderate anxiety of worse (definite and probable cases) (table 3).

Length of sentence

Those prisoners who received a Healthcheck and were sentenced to less than 2 years, compared with longer sentences, did not show significant differences for diabetes or QRISK2 score but had significantly higher rates of possible cases of anxiety (34.9% vs 23.8% p<0.001, ϕ=0.2) and depression (41.1% vs 31.4% p=0.009, ϕ=0.2). (online supplementary table s7).

DISCUSSION

Main findings

When offered a Healthcheck, uptake was high at 76.4% of those invited. Clinically important cardiovascular risk, as measured by a QRISK2 score ≥10%, diabetes or pre-diabetes, or renal impairment, was present in 12.1% of those participating in the study. This study also identified that the prevalence of existing CVD limiting eligibility for the NHS Healthchecks programme was 21.8% (range 13.8%–37.3%) of the prison populations studied (as at August 2018), and appeared to be influenced strongly by the age profile of the prisons. 82.9% of all prisoners aged 35–74 were recorded as smokers. Observed levels of clinically important anxiety (18.0%) and depression (20.7%) were more than double the rates found in a similar aged general male population.[29]

What is known about CVD risk already and what the study adds

In community populations eligible for an NHS Healthcheck, uptake between 2009 and 2012 has been reported between 18.7%[6] and 21.4%.[30] The uptake of a

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Healthcheck in our prison populations who were invited was 76.4 %, much higher than attendance rates found in community samples. This represented an opportunity to intervene positively; that 24.6% did not take up that offer from this at-risk population is a matter of concern especially as a higher proportion of BME prisoners did not access a Healthcheck. In community studies, 30% of those in the age group 40–74 were already ineligible because of existing comorbidity.[6] In our study, 21.8% of those aged 35–74 were ineligible but from a substantially younger mean age population (mean age=43.8 years compared with a mean age of 53.3 for the England population distribution for males between the ages of 35 and 74).[31]

Among the study population who received a Healthcheck we found important levels of comorbidity in 12.1%. The proportion of Healthcheck participants who are found to have new significant comorbidity (hypertension, type 2 diabetes or chronic kidney disease) nationally was 5%, rising to 37.3% if QRISK2>=10% was also included.[6] Comorbidity rates vary substantially and in one large multiethnic population studied which including those with a high diabetes risk (4.6%) and QRISK2>=10%, 53.4% of males had one of these comorbidities newly identified in the Healthcheck.[32] In this study, with its much younger study participants, 12.1% of participants had at least one of these comorbidities newly identified.

In community studies, 19% of males aged 35–74 have a QRISK2 score of 10 or above.[24] Overall, 10.2% of the eligible prison population studied here had a QRISK2 score of 10 or more but the prison population was almost 10 years younger on average. The age-specific QRISK2 bands described here (online supplementary tables s8) suggest the level of risk is at least comparable; for the age bands 60–74, 26.9% of our participants, and 29.7% of all eligible prisoners in this study had a QRISK2 score of 20 or more, compared with 30.7% nationally[6] and 39.0% in a high risk multiethnic population.[32] The respective values for QRISK2 of 10 or more were 98.1% of participants and 92.0% of all eligible prisoners in our study, and 86.6% in the high-risk population.[32] In our study population, only six prisoners were over 70 (0.5%) compared with 8.7% in the general population of males aged 35–74.[31]

A larger percentage of prisoners from a non-white heritage were ineligible for a Healthcheck because of existing comorbidity compared with prisoners from a white heritage, and of those eligible, a smaller proportion were both invited to a healthcheck, and received a Healthcheck, with black prisoners having 2.74 times the odds of declining a Healthcheck compared with white prisoners. It may be important to monitor Heathcheck uptake by ethnicity to assess potential inequity in provision of care.

Multiple logistic regression showed evidence of an association between prison, black ethnicity and a sentence length of 4years or more to be associated with prisoners declining a health check. Due to missing data and small numbers in certain categories, the analysis is likely to be underpowered to detect differences for the smaller categories of variables and only four prisons were included in the analysis due to missing data on other variables There may have been other significant differences that we were underpowered to detect.

We compared estimated QRISK2 scores assuming missing lipid values with scores based on actual results and showed that QRISK2 scores were statistically worse (greater CVD risk) when using actual scores (online supplementary table s9) suggesting that any bias introduced as a result of missing blood values may have been to under-estimate CVD risks in this population.

This study is the first in the UK to describe whole eligible denominator populations, rather than just those who actually undertook a Healthcheck, and so allows an estimate of cardiovascular risk across the eligible population by institution. Differences in those eligible, invited and participants were a reflection of a variety of practical barriers to healthcare operating in this study but are likely to be relevant nationally.

High cardiovascular risk is commoner in deprived communities with a 20% higher crude incident rate of CVD in the most deprived quintile compared with the least deprived.[24] If we assume that those with NFA in our study were likely to have characteristics similar to the highest deprivation quintile, 65% of participants could be considered to come from the most disadvantaged fifth of society, with associated overall disease risks and healthcare access challenges.

With 83% of all prisoners aged 35–74 being recorded as smokers, there appears to be a large unmet need for preventative interventions, although further work is required on standardising how lifestyle data is collected in prison settings.

Public Health England adjusted the eligibility criteria for NHS Healthchecks in 2017 to those aged 35–74 and incarcerated for 2 years or more.[33] We identified one prisoner among the 3620 eligible (0.02%) under the age of 40 who had a QRISK2 score of 10 or above, suggesting that the reduction in eligibility to age 35 may not be an efficient use of scare primary care resources. Similarly, prisoners with a sentence length of 2 years or more had similar proportions with QRISK2 score of 10 or above (12.8% vs 9.7%, p=0.238) suggesting this eligibility change did not itself identify those with higher risk. For those serving less than 2 years, there remained a substantial number with adverse cardiovascular risk profiles; higher levels of anxiety and depression (online supplementary table s7) were possibly associated with more rapid transit through the system rather than any association with CVD risk, but suggest unmet physical and mental healthcare need. Extending Healthchecks irrespective of length of sentence would seem a positive policy step but may require additional resources to tackle unmet mental and physical health need. Good primary care follow-up may also be more challenging after discharge if prisoners are returning to primary care services in areas of highest need.

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CONCLUSION

This study identified that 21.8% of the prison population aged 35–74 already had comorbities that precluded them from taking part in a Healthcheck. Across the whole prison population aged 35–74, 82.9% were recorded as smokers. Of those that were eligible for an NHS Healthcheck and took part, a further 12.1% were found to have a significant clinical risk for future CVD (QRISK2 ≥10) and 20.7% and 18.0%, respecively, had clinically significant depression or anxiety, further strengthening the case of need for good mental health services in prison. Ethnicity was associated with invitation to attend (p=0.023, ϕ=0.1) and accept a health check, with higher odds of black prisoners declining (OR 2.7 95% CI : 1.3 to 5.9) compared with white prisoners. Prisoners serving less than 2 years, who would not normally receive NHS Healthcheck through prison healthcare services, had much higher levels of anxiety or depression and high CVD risk (9.7%). With two-thirds of this group likely to come from the most deprived fifth of society, ensuring good prison mental health services and access to primary care services on discharge is vital to achieving equity of care in this patient group.

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Contributors CP designed the study, wrote the proposal and led the research. MW initiated the data collection, trained healthcare staff, liaisied with the Ethics committee, and led the qualitative research. EB led the research teams collecting the data, completed the project management required by CLARHC, and developed the methods section. JM undertook the statistical analysis and commented on presentation. RM developed the PHQ-9 and GAD-7 analysis. KK helped wih refinements to the study design based on past community research. RM and KK commented extensively on the manuscript. All authors contributed individually to the report content.

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Patient consent for publication Not required.

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Data availability statement All data relevant to the study are included in the article or uploaded as online supplementary information. Anonymised data are currently held securely in the host NHS Trust and Leicester University as per the research protocol.

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