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Complete List of Authors:	Emond, Alan; University of Bristol, School of Social and Community Medicine Ridd, Matthew; University of Bristol, Sutherland, Hilary; Deaf Studies Trust, Allsop, Lorna; Deaf Studies Trust, Alexander, Andrew; SignHealth, Kyle, Jim; University of Bristol, Deaf Studies
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Manuscripts

The health of Deaf people in the UK

Alan Emond, Matthew Ridd, Hilary Sutherland, Lorna Allsop, Andrew Alexander, Jim Kyle

Alan Emond School of Social and Community Medicine, University of Bristol, Oakfield House, Oakfield Grove, Bristol BS8 2BN; professor

Matthew Ridd School of Social and Community Medicine, University of Bristol, Canynge Hall, Whatley Road, Bristol BS8 2PS; clinical lecturer

Hilary Sutherland Deaf Studies Trust, The Vassall Centre, Gill Ave, Bristol BS16 2QQ; research associate

Lorna Allsop Deaf Studies Trust, The Vassall Centre, Gill Ave, Bristol BS16 2QQ; research associate

Andrew Alexander SignHealth, 5 Baring Road, Beaconsfield, Buckinghamshire, HP9 2NB; medical director

Jim Kyle Deaf Studies, University of Bristol, 8-10 Berkeley Square, Bristol BS8 1HH; Emeritus professor

Corresponding author: Prof Alan Emond alan.emond@bristol.ac.uk
0117 331 4099

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Abstract

Objectives: To assess the current health of the Deaf community in the UK and compare with the general population.

Design: A quota sample of adult Deaf British Sign Language (BSL) users underwent a health assessment and interview in 2012-13. Comparative data were obtained from the Health Survey of England 2011 (HSE) and the Quality Outcomes Framework 2012 (QOF).

Setting: Participants completed a structured interview and health assessment at 7 Bupa centres across the UK, supported in BSL by Deaf advisers and interpreters.

Participants: 298 Deaf people, 20 to 82 years old, 47% male, with 11% from ethnic minorities.

Main outcome measures: self-reported health conditions, medication usage and tobacco and alcohol consumption; measured blood pressure (BP), BMI, fasting blood sugar and lipid profile.

Results: Rates of obesity in the Deaf sample were high, especially in those over 65, and 48% were in a high risk group for serious illness. High BP readings were obtained in 37% of Deaf people (21% in HSE): 29% were unaware of this (6% in HSE). Only 42% of Deaf people being treated for hypertension had adequate control, compared with 62% of the general population. Deaf people self-reported cardiovascular disease (CVD) significantly less than the general population. One third of Deaf participants had total cholesterol >5mmol but although control rates were high (for self-reported CVD), treatment rates were half the general population rate. 11% of Deaf participants had a blood sugar at pre-diabetic or diabetic levels, and 77% of those at pre-diabetic levels were unaware of it. Deaf respondents self-reported more depression (31% of women, 14% of men), but less smoking (8%) and alcohol intake (2-8 units/week).

Conclusions: Deaf people's health is poorer than that of the general population, with probable under-diagnosis and under-treatment of chronic conditions putting them at risk of preventable ill-health.

Article summary

Strengths and limitations of this study

- This is the first comprehensive survey of the health of Deaf adults in UK, utilizing British Sign Language throughout.
- Mixed methods were used to obtain a standardised health assessment on all participants, including questionnaire and interview data and a structured medical assessment undertaken by an independent provider (Bupa Healthcare).
- Data were usually self-reported for the medical history and medication usage, without access to individuals' health records
- The 'well person' medical assessment offered by Bupa, was a single check on one day and did not include any information from the individual's existing medical record.
- The datasets used to provide comparisons with the hearing population (the Health Survey of England and the Quality Outcome Framework) were derived only from England and have their own limitations.

INTRODUCTION

Deaf adults in the UK occupy poorer socio-economic positions, have poorer literacy and have limited access to communication through speech. Yet they have their own fully functioning language (British Sign Language - BSL), their own community network and a rich and vibrant culture¹. We use Deaf (with a capital D as in English, French) to indicate membership of the sign language using community.

The UK Census 2011² for England and Wales recorded use of BSL as the main language for 15,487 people. Given the difficulties of Deaf people completing the form and the fact that the Census obtained only 94% returns, we estimate that potentially 20,000 people are Deaf community members and using BSL. There may be other users of BSL who are bilingual. Although these represent very small numbers of Deaf patients in any one GP practice, they are important because of the enormous difficulties experienced by Deaf people in accessing healthcare.

Although there is evidence^{3,4,5} that Deaf people have poor access to healthcare, there are few data in the UK or worldwide concerning their health status⁶. The claimed prevalence of mental health problems, such as anxiety and depression, in Deaf people is greater than that of the general population⁷. The extent of physical health problems and chronic disease in the Deaf community in the UK is not known.

The aim of the Deaf Health study was to assess the current health of a representative sample of the Deaf community in the UK, and to compare with that of the general population.

METHODS

Sample:

As no register of Deaf people exists, it is not possible to recruit a random sample of the UK Deaf community. Instead, a quota sample of adults was planned, stratified by age and gender and ethnicity to match the UK population, and to represent the main populated areas. Recruitment of BSL-using Deaf adults to this quota sample was undertaken (a) by approaching respondents who had given consent to be contacted, in a previous online survey of Deaf people carried out by Ipsos MORI for SignHealth⁸ (n=80) and (b) by direct contact with the Deaf community via Deaf clubs and networks (n=223).

Information in BSL about the study was made available in video online, and informed consent to participate was obtained in BSL and English. A total of 298 participants aged from 20 to 82 years old, made up of 139 men and 159 women, with 11% from ethnic minorities, attended for free health assessments during 2012 and 2013 at Bupa centres in Bristol, London, Brighton, Solihull, Cardiff, Manchester and Glasgow. In each session, they were supported in BSL by Deaf advisers and interpreters.

Measures:

The one hour structured health assessment consisted of the standard health check provided by Bupa Healthcare, augmented by a set of health questions based on the Health Survey for England (HSE). The assessment started with a fasting blood test, following an overnight fast for a morning appointment and a 6 hour fast for an afternoon appointment. After a light snack and a drink, participants were weighed with light clothing and no shoes, and their height measured using a standing stadiometer. BMI (wt/ht^2) was then calculated. Body fat percentage was measured using bio-electrical impedance (Bodystat 1500). Blood pressure was measured in the resting state, sitting, using an electronic sphygmomanometer (Omron). At least 2

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3 blood pressure measurements were taken, with the lowest reading recorded, and
4 checked using an aneroid sphygmomanometer if necessary.
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8 A structured interview in two parts: (a) with a Bupa health adviser supported by a
9 BSL interpreter, and (b) directly with a Deaf adviser, using BSL, then explored the
10 participant's medical history, their awareness of any current health conditions, their
11 current medication usage and consumption of cigarettes and alcohol. Following the
12 assessment, the results were provided in a written report to the Deaf participant, with
13 an explanation given by the Bupa adviser and interpreted in BSL, together with
14 guidance on what action to take about the results, including showing the results to
15 their GP.
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24 Resting blood pressure of the participants was classified using the BHS guidelines
25 2004 as: low-normal (systolic<120: diastolic<80); high normal (120-139; 80-89), mild
26 hypertension (140-159; 90-99) and moderate-severe hypertension (160+; 100+).
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30 Consistent with the definition used in the HSE 2011 for doctor-diagnosed
31 cardiovascular disease (CVD), we defined the presence of CVD as the self-report of
32 any one or more of the following: angina, heart failure, heart attack, stroke and atrial
33 fibrillation. For fasting blood sugar, we used the accepted classification of less than
34 6.1 mmol/l as normal, 6.1 to 7.0 mmol/L as pre-diabetic and 7.1 or more as diabetic.
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42 **Analysis:**

43 Comparative data for the hearing population were derived from the Health Survey of
44 England 2009, 2010 & 2011 (HSE)⁹, and the Quality and Outcomes Framework
45 2012 (QOF)¹⁰ for all GP surgeries in England. Initial analysis was descriptive, and
46 where appropriate comparisons could be made between the Deaf sample and the
47 general population simple statistical comparisons were carried out using Chi² tests.
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55 Ethical approval for the study was given by the NHS Local Research Committee
56 (NRES Committee South West – Frenchay. ref no: 11/sw/0151).
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RESULTS

Sample

The final recruited sample (Table 1) was close to the designed sampling frame, although young adults 18-24 years were under-represented. There is a slight imbalance of females among the Deaf participants and this is most marked proportionately in the middle-aged group (too many) and in the elderly group (too few). These variations are similarly found in the other major comparator data sets.

Table 1. The Deaf Health sample, by age, gender and ethnicity

		Study sample number (%)	Target number by UK census (%)
Age	18-24 yrs	8 (3)	36 (12)
	25-44 yrs	113 (38)	105 (35)
	45-64 yrs	122 (41)	96 (32)
	65-82 yrs	55 (18)	63 (21)
Gender	Male	139 (47)	150 (50)
	Female	159 (53)	150 (50)
Ethnicity	White	261 (88)	264 (88)
	Black and Minority Ethnic Groups	35 (12)	36 (12)

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3 The UK regions and countries of residence of the participants were London & South
4 England (34%), West of England & Wales (21%), Midlands (19%), North England
5 (14%), Scotland (12%).
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11 12 13 **Obesity**

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16 Overall, 41% of the Deaf participants were overweight (BMI 25-30), and 30% were
17 clinically obese (BMI>30). The gender difference seen in the general population was
18 not observed in the Deaf sample. In the HSE dataset, 65% of men and 58% of
19 women were overweight or obese while the corresponding figures for Deaf
20 participants were 72% and 71%. ($X^2=23.5$, $df=2$, $p<.001$). In the Deaf sample, 90%
21 of those over 65 years were classed as overweight or obese.
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30 Mean waist circumference for Deaf males was 97.9 cm (SE 1.1) and for Deaf
31 females was 92.6 cm (SE 1.1). This compares to 97.1 (SE 0.38) and 88.5cm (SE
32 0.38) for the general population (HSE 2011). The frequency of raised waist
33 circumference for Deaf males and females was 57% and 76% respectively as
34 compared to 34% and 47% from the HSE. (comparison for males: $X^2=9.7$, $df=1$,
35 $P<.01$; for females: $X^2=47.6$, $df=1$, $p<.001$)
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43 The waist circumference and BMI data were combined to give a categorisation of risk
44 of serious illness, (coronary heart disease, Type 2 diabetes, osteoarthritis and some
45 cancers) using NICE 2006 predictions.¹¹ At least 48% of Deaf people would be
46 placed in the “high to very high risk” category as a result of their BMI and waist
47 circumference measurements (Table 2).
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Table 2: Risk estimates from BMI and Waist Circumference (risk adapted from the NICE, 2006 predictions)
- % of the Deaf sample in each risk category (n=288)

<i>BMI</i>	<i>Normal Waist Circumference</i>	<i>High Waist circumference</i>	<i>Very High Waist Circumference</i>
Desirable 20-25	23 No increased risk	6 No increased risk	1 increased risk
Overweight 26-30	9 No increased risk	13 increased risk	18 high risk
Moderate obesity 31-40	1 increased to very high risk	2 high to very high risk	26 very high risk
Severe obesity 41+			2 very high risk

Blood pressure

The frequency of raised BP was higher in the Deaf participants (37%) than that reported in the HSE (21%) ($\chi^2=6.9$, $df=1$, $p<0.01$). (Table 3) Moderate-severely high BP was significantly more common in Deaf men (15.9%) than in Deaf women (7.7%) ($\chi^2= 18.1$, $df=3$, $p<.001$).

Table 3: Comparison (%) of Raised Blood Pressure, by gender
(Deaf n=287; HSE n=4,753)

	Measured BP >140/90	
	Deaf	HSE 2011
Males	41.7	20.0
Females	32.2	17.0
Overall	36.6	21.1

The *awareness* of their raised blood pressure was poor in the Deaf sample, with 68 (23%) self-reporting they had hypertension. Of those who self-reported they did *not*

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3 have a problem of high blood pressure, 29% had raised clinic BP readings. Only half
4 of those with moderate-severely raised BP levels were aware they had a problem.
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8 In the general population, HSE 2009 reported that 6% were not aware of their raised
9 blood pressure (29% had survey diagnosed raised BP and 23% self-reported
10 hypertension). The comparative figures in this study for Deaf people are 14%
11 unaware (37% had measured raised BP and 23% self-reported hypertension).
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15 The *detection* rates of hypertension in the general population aged 18-80 calculated
16 from data reported in HSE 2011 were 58% (male) and 59% (female). The
17 corresponding figures for Deaf people were 44% (male) and 54% (female). There
18 was evidence of a difference between Deaf males and men in the general population
19 ($\chi^2=5.16$, $df=1$, $p<0.05$).
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23 Of the 68 Deaf people who reported they did have hypertension, only 51% were
24 receiving antihypertensive medication (beta blockers, ace inhibitors, calcium channel
25 blockers, Angiotensin II Receptor Blockers or diuretics). Among those Deaf people
26 apparently receiving treatment for hypertension, only 42% had measurements of
27 140/90 or less. This contrasts with the HSE 2011 (<140/90) report of 62%, and
28 QOF 2012 figures (<=150/90) of 80% adequate control.
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45 **Cardiovascular Disease (CVD)**

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47 Self-report of CVD was significantly less among Deaf people than in the general
48 population ($\chi^2=7.8$, $df=1$, $p<0.01$) but with higher rates of self-report among Deaf
49 women. The association of increasing prevalence with age was not as strong as in
50 the general population (Table 4).
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Table 4: Self-reported cardiovascular disease (CVD) by Age (%)

(Deaf n=288, HSE 2011 n=8,380)

	<i>Deaf Self report CVD</i>	<i>HSE self-report ('doctor diagnosed')CVD</i>
25-44 yrs	1.7	5.3
45-64 yrs	11.5	14.1
65-82 yrs	11.1	26.2

Of those who said they did have CVD, only 45% were taking aspirin or clopidogrel. A comparison with HSE 2011 is limited, as younger people are excluded and the data for females are treated as unreliable. For men aged 55-84 years in HSE, the treatment rate for ischaemic heart disease and stroke was between 61% and 70%; in comparison, for Deaf men aged 45-84 years, the treatment rate for all CVD was 45%.

Cholesterol

The mean level of cholesterol in both male and female Deaf participants (4.6 mmol/L and 4.5 mmol/L respectively) was lower than reported in the HSE (5.1mmol/L and 5.2 mmol/L respectively) (Table 5).

Table 5: Distribution (%) of total cholesterol levels, by gender (n=274)

	<i>desirable cholesterol (≤5mmol/L)</i>	<i>elevated cholesterol (>5mmol/l)</i>	<i>HSE 2011 elevated cholesterol</i>
Men	77.5	22.4	56
Women	58.6	41.3	57
Overall	67.5	32.4	57

Women seem to have a greater problem with high cholesterol, although overall levels are considerably lower than in the HSE 2011. 15% of Deaf men and 11% of Deaf women had a total cholesterol to high density lipoprotein ratio (TC/HDL) above 4.5.

The use of HMG CoA reductase inhibitors (statins) among the Deaf participants was associated with lower cholesterol levels (mean 3.80mmol/l compared to mean 4.69 with no treatment). However, only 31% of those who had elevated cholesterol said they had been provided with this treatment. Treatment rates for the general population reported in HSE 2011 seem higher at 79% for men and 71% for women.

Diabetes

The self-reported prevalence of diabetes among Deaf participants was 7% (7% males, 6% for females) This is similar to the HSE 2011 figures for people with doctor-diagnosed diabetes (recalculated having removed the oldest age group who do not match the Deaf sample) of 7% (9% males, 5% females). We considered the relationship of self-report of diabetes and the measurement of fasting glucose levels. Overall, 8% of the Deaf sample had glucose measurements in the pre-diabetic range, and 3% were diabetic (Table 6).

Table 6: Self-reported diabetes and measured fasting blood glucose (row %)

Self-Report	Normal (<6.1 mmol/l)	Pre-diabetic (6.1-7.0 mmol/l)	Diabetic (>7.0mmol/l)	n=
no diabetes	92.4	6.8	0.8	249
diabetes	44.4	27.8	27.8	18
Overall	89.1	8.2	2.6	267

(column %)

Self-Report	Normal (<6.1 mmol/l)	Pre-diabetic (6.1-7.0 mmol/l)	Diabetic (>7.0mmol/l)
No diabetes	96.6	77.3	28.6
Diabetes	3.4	22.7	71.4
n=	238	22	7

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3 Of those who believed they did not have diabetes, 8% had elevated blood sugar
4 levels. Of those with raised levels of blood sugar at pre-diabetic levels, more than
5 three quarters (77%) were unaware of it. Of those who reported diabetes, 44% had
6 normal levels of blood sugar so nearly 56% had diabetes which was not under
7 control – although we note that the actual numbers are small in this sub-group.
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14 Overall, Deaf participants had similar rates of diabetes to the general population, but
15 were less likely to be aware of the problem, and more likely to have inadequate
16 control when they have been diagnosed with diabetes.
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20 21 **Respiratory conditions**

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24 The Health Survey of England (2010) reported that 16% of adult men and 17% of
25 adult women had been diagnosed with asthma at some time in their life. Asthma
26 was self-reported at a similar level among the Deaf participants: 15% and 17% for
27 men and women respectively.
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33 Chronic obstructive pulmonary disease (COPD) appeared to be uncommon in the
34 Deaf population. The self-reported rate from Deaf participants was less than 1% – ie
35 only one person mentioned this. In comparison, in the HSE (2010) 4% of men and
36 5% of women had at some time been diagnosed with COPD. This may be a result of
37 low rates of smoking by Deaf adults, but it may also reflect undiagnosed illness,
38 misdiagnosis (e.g “asthma”) or failure to communicate effectively a diagnosis of
39 COPD.
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49 **Depression**

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51 The rates of ‘depression’ self-reported by Deaf participants were 24% overall, 32%
52 women and 14% men. Only 15% of those who reported that they had depression
53 were using antidepressant drugs. In comparison, the QOF figure for treated clinical
54 depression (mixed depression and anxiety) was 12% in 2011-12.
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Smoking

The same percentage (8%) of men and women reported smoking. This compares to the reported UK rate (2010) of 21% for men and 20% for women¹³. More Deaf women have never smoked (72%) compared to men (61%).

Alcohol consumption

Participants were asked to define their average weekly consumption of alcohol in units. Average alcohol consumption was self-reported as 5.4 units for men and 3.4 units for women. These figures are very low in comparison to the self-reported mean alcohol consumption for the general UK population of 15.6 units for men and 9.5 units for women¹⁴.

Our study showed that 33% of Deaf males, and 40% of Deaf females do not drink at all. If we remove these from the calculation, the weekly consumption among those who do drink is 8.0 units (males) and 5.7 units (females), which is still well below the figures reported for the general population.

DISCUSSION

Summary of findings

This study of BSL-using Deaf adults has shown high levels of risk factors for common conditions such as cardiovascular disease, hypertension and diabetes, and high levels of self-reported depression, but low levels of reported smoking and alcohol consumption. Deaf people had high rates of raised BP at assessment, which could reflect undetected hypertension and poorly controlled hypertension. Half of Deaf people reporting CVD appeared to not be on appropriate treatment. One third of Deaf participants had total cholesterol >5mmol but treatment rates were half that of the general population rate. Overall, Deaf adults had similar rates of diabetes to the general population, but were less likely to be aware of problems with glucose tolerance, and more likely to have inadequate control when they have been diagnosed with diabetes. The prevalence of overweight and obesity was high in Deaf people, especially those over 65.

Strengths and limitations of this study

The strengths of the methods used in this study are that BSL was utilised throughout, and that as well as collecting questionnaire and interview data, a structured medical assessment was undertaken. By using an independent provider (Bupa Healthcare) we were able to obtain a standardised health assessment on all participants, whether resident in England Scotland or Wales. The disadvantage of not having access to the participants' own medical records was offset by the advantage of having an independent structured health report on each participant.

There are several caveats which should be considered when interpreting the results.

Firstly, we were usually reliant on self-report for the medical history and the

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3 medication usage, and did not have access to individuals' health records although
4 some participants did bring their list of prescribed medication. This is also an issue in
5 most health surveys including HSE. Self-report of medical problems can be
6 associated with bias in both directions – an exaggeration of medical diagnoses (eg
7 any wheeze is categorised as asthma), or an under-reporting of chronic conditions
8 (eg hypertension, high cholesterol) through lack of awareness, denial, or poor
9 communication by the medical practitioner. Secondly, the medical assessment
10 offered by Bupa, whilst broadly the same as their routine 'well person' check, was a
11 single check on one day and did not include any information from the individual's
12 existing medical record. For example, no serial BP or ambulatory BP measurements
13 were available on participants, and no measurements were made of lung function.
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26 Thirdly, the datasets used to provide comparisons with the hearing population have
27 their own limitations. The Quality Outcome Framework (QOF) data are derived only
28 from English general practices. The data are aggregated by practice rather than
29 patient level and cannot be treated as prevalence data. When using the QOF in
30 making any comparison between Deaf and hearing populations, we are effectively
31 treating our sample of Deaf adults as if they all belonged to the same general
32 practice, and comparing them as a group to other general practices in England.
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Although HSE is a large scale study, it has all the usual problems in response rates
and participation. The sample for 2011 was over-represented by women (56%) and
varies in response (better in the North of England than in London). The overall
response rate was 59% of all those adults eligible to take part, but 39% proceeded to
the nurse interview and only 29% gave a blood sample.

Reference to existing literature

Although hypertension cannot be diagnosed on the basis of two BP readings on one
day, the BP results are of concern as they indicate that Deaf adults are not only at
risk of hypertension but also show an apparent lack of awareness of the problem.

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3 This lack of awareness of raised BP occurs, but is less prominent, in the general
4 population¹⁵. Because of difficulties in accessing routine health checks and poor
5 communication in primary care, it is probable that Deaf people have their BP
6 measured less frequently, and action is less likely to be taken over one-off elevated
7 readings, than among hearing people. Our data also show that even if prescribed
8 anti-hypertensives, the Deaf patient may not be taking enough tablets, or may not be
9 taking the medication regularly, to control the BP- again suggesting that
10 communication with doctors and nurses has not been clear.
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15 Studies from the USA¹⁶ have shown that Deaf people are at a double disadvantage in
16 accessing health information about cardiovascular disease. Pollard and Barnett¹⁷
17 showed that even highly educated Deaf adults scored only at the level of
18 schoolchildren aged 14–15 years for health literacy. The combination of the levels of
19 BP and the raised risk of serious illness calculated from BMI and waist circumference
20 will potentially reduce life expectancy in Deaf compared to hearing populations.
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25 The finding that more than half of the Deaf participants diagnosed with diabetes
26 were not adequately controlled is also of concern, as Deaf people are put at risk of
27 preventable complications including blindness, but in the general population in the
28 UK the prevalence of inadequate glycaemic control has been generally high (>60%)
29 in patients with type 2 diabetes.¹⁸ Similar to the hearing population, 8 % of Deaf
30 adults had fasting blood sugars in the pre-diabetic or intermediate hyperglycaemia
31 range¹⁹. However, although people with pre-diabetes are at high risk for
32 diabetes, and evidence points to high potential benefit from lifestyle interventions²⁰,
33 diabetes prevention requires societal change and a concerted global public health
34 approach²¹.
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55 There was a high prevalence of obesity in the Deaf sample, particularly in women,
56 and in those over 65 years. We had no reliable data on activity levels in our sample,
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3 nor details of diet, but it is probable that the overweight and obesity seen in Deaf
4 people is due to the same factors as the general population- ie a mixture of intake of
5 calories in excess of metabolic requirements and a lack of physical activity. Health
6 promotion messages on healthy eating and regular exercise designed for the hearing
7 population are not reaching the Deaf community, especially the older members of the
8 community (in whom the obesity problem is greatest). The problem of access of the
9 Deaf community to health promotion messages is illustrated by the finding that
10 understanding and knowledge of AIDS and risk behaviours were found to be lower in
11 deaf and hard of hearing people than in hearing people²². In addition to living in the
12 same obesogenic environment as hearing people, Deaf adults also face barriers due
13 to communication difficulties, and stigma, in participating in sporting activities and
14 joining gyms, clubs and slimming groups. In contrast, the Deaf community seems to
15 have taken note of the health promotion messages about smoking, maybe because
16 of visual warnings on cigarette packaging.
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32 *Conclusion*

33 Deaf adults in the UK have high rates of known risk factors for chronic disease such
34 as cardiovascular disease, hypertension and diabetes, and high rates of self-
35 reported depression. Lack of awareness, under-diagnosis and under-treatment of
36 chronic conditions may be putting them at risk of preventable ill-health and potentially
37 reduced life expectancy .
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Transparency statement

Alan Emond will act as the manuscript's guarantor, and affirms that the 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.

Data sharing statement

Alan Emond can be contacted regarding access to the Deaf Health Dataset.

Authors' contributions

Alan Emond contributed to study design, was a member of the study management committee, supervised training, data collection and analysis and contributed to data interpretation. He wrote the first draft of the paper and approved the final version of the manuscript.

Matthew Ridd contributed to study design, was a member of the study management committee, and contributed to data interpretation. He contributed to earlier drafts and approved the final version of the manuscript.

Hilary Sutherland was one of the study researchers and a member of the study management committee. She enrolled participants, collected outcome data, prepared data files for analysis and contributed to data interpretation. She approved the final version of the manuscript.

Lorna Allsop was one of the study researchers and a member of the study management committee. She enrolled participants, collected outcome data, prepared data files for analysis and contributed to data interpretation. She approved the final version of the manuscript.

Andrew Alexander was an expert member of the study management committee. He contributed to trial design, data interpretation, earlier drafts of the manuscript, and approved the final version of the manuscript.

Jim Kyle was the PI on the study. He contributed to study design, chaired the study management committee, supervised data collection, undertook most of the analysis and contributed to data interpretation. He wrote the report to funders, contributed to earlier drafts of the manuscript and approved the final version of the manuscript.

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Competing interest statement.

The authors have no conflicts of interest to declare

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STROBE Statement— **The health of Deaf people in the UK**

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found Abstract
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Introduction p4
Objectives	3	State specific objectives, including any prespecified hypotheses Introduction p4
Methods		
Study design	4	Present key elements of study design early in the paper Methods : Sample p5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Methods : Sample p5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants Methods : Sample p5 (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Methods: Measures p5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Methods: Measures p5
Bias	9	Describe any efforts to address potential sources of bias Methods : Sample p5 and Results: Sample p7
Study size	10	Explain how the study size was arrived at Methods : Sample p5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Methods: Analysis p6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions

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(c) Explain how missing data were addressed

Methods: Analysis p6

(d) *Cohort study*—If applicable, explain how loss to follow-up was addressed

Case-control study—If applicable, explain how matching of cases and controls was addressed

Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy

(e) Describe any sensitivity analyses

Continued on next page

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Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Results: Sample p7 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Results: Sample p7 (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures Results: Findings by condition p7-13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion

Key results	18	Summarise key results with reference to study objectives Discussion: main findings p15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Discussion: Strengths and limitations p15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discussion: Reference to existing literature p16
Generalisability	21	Discuss the generalisability (external validity) of the study results Discussion: Reference to existing literature p16

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at

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2 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
3 available at www.strobe-statement.org.
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BMJ Open

The current health of the signing Deaf community in the UK compared with the general population: a cross-sectional study

Journal:	<i>BMJ Open</i>
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Primary Subject Heading:	Public health
Secondary Subject Heading:	Health services research
Keywords:	Hypertension < CARDIOLOGY, Diabetes & endocrinology < INTERNAL MEDICINE, MENTAL HEALTH, Deaf

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Manuscripts

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4 **The current health of the signing Deaf community in the UK compared with the**
5 **general population: a cross-sectional study**
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9 Alan Emond, Matthew Ridd, Hilary Sutherland, Lorna Allsop, Andrew Alexander, Jim
10 Kyle
11

12
13
14 Alan Emond School of Social and Community Medicine, University of Bristol,
15 Oakfield House, Oakfield Grove, Bristol BS8 2BN; professor
16

17
18
19 Matthew Ridd School of Social and Community Medicine, University of Bristol,
20 Canynge Hall, Whatley Road, Bristol BS8 2PS; clinical lecturer
21

22
23
24 Hilary Sutherland Deaf Studies Trust, The Vassall Centre, Gill Ave, Bristol BS16
25 2QQ; research associate
26

27
28
29 Lorna Allsop Deaf Studies Trust, The Vassall Centre, Gill Ave, Bristol BS16 2QQ;
30 research associate
31

32
33
34 Andrew Alexander SignHealth, 5 Baring Road, Beaconsfield, Buckinghamshire,
35 HP9 2NB; medical director
36

37
38
39 Jim Kyle Deaf Studies, University of Bristol, 8-10 Berkeley Square, Bristol BS8 1HH;
40 Emeritus professor
41

42
43
44 Corresponding author: Prof Alan Emond alan.emond@bristol.ac.uk
45
46 0117 331 4099
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Abstract

Objectives: To assess the current health of the Deaf community in the UK and compare with the general population.

Design: A quota sample of adult Deaf British Sign Language (BSL) users underwent a health assessment and interview in 2012-13. Comparative data were obtained from the Health Survey of England 2011 (HSE) and the Quality Outcomes Framework 2012 (QOF).

Setting: Participants completed a structured interview and health assessment at 7 Bupa centres across the UK, supported in BSL by Deaf advisers and interpreters.

Participants: 298 Deaf people, 20 to 82 years old, 47% male, with 12% from ethnic minorities.

Main outcome measures: self-reported health conditions, medication usage, tobacco and alcohol consumption; measured blood pressure (BP), BMI, fasting blood sugar and lipid profile.

Results: Rates of obesity in the Deaf sample were high, especially in those over 65, and 48% were in a high risk group for serious illness. High BP readings were obtained in 37% of Deaf people (21% in HSE): 29% were unaware of this (6% in HSE). Only 42% of Deaf people being treated for hypertension had adequate control, compared with 62% of the general population. Deaf people self-reported cardiovascular disease (CVD) significantly less than the general population. One third of Deaf participants had total cholesterol >5mmol- but although control rates were high compare to HSE, treatment rates for self-reported CVD were half the general population rate. 11% of Deaf participants had a blood sugar at pre-diabetic or diabetic levels, and 77% of those at pre-diabetic levels were unaware of it. Deaf respondents self-reported more depression (31% of women, 14% of men), but less smoking (8%) and alcohol intake (2-8 units/week).

Conclusions: Deaf people's health is poorer than that of the general population, with probable under-diagnosis and under-treatment of chronic conditions putting them at risk of preventable ill-health.

Article summary

Strengths and limitations of this study

- This is the first comprehensive survey of the health of Deaf adults in UK, utilizing British Sign Language throughout.
- Mixed methods were used to obtain a standardised health assessment on all participants, including questionnaire and interview data and a structured medical assessment undertaken by an independent provider (Bupa Healthcare).
- Data were usually self-reported for the medical history and medication usage, without access to individuals' health records
- The 'well person' medical assessment offered by Bupa was a single check on one day and did not include any information from the individual's existing medical record.
- The datasets used to provide comparisons with the hearing population (the Health Survey of England and the Quality Outcome Framework) were derived only from England and have their own limitations.

INTRODUCTION

Deaf adults in the UK occupy poorer socio-economic positions, have poorer literacy and have limited access to communication through speech. Yet they have their own fully functioning language (British Sign Language - BSL), their own community network and a rich and vibrant culture¹. We use Deaf (with a capital D as in English, French) to indicate membership of the sign language using community.

The UK Census 2011² for England and Wales recorded use of BSL as the main language for 15,487 people. Given the difficulties of Deaf people completing the form and the fact that the Census obtained only 94% returns, we estimate that potentially 20,000 people are Deaf community members and using BSL. There may be other users of BSL who are bilingual. Although these represent very small numbers of Deaf patients in any one GP practice, they are important because of the enormous difficulties experienced by Deaf people in accessing healthcare, and in communicating with clinicians in consultations.

Although there is evidence^{3,4,5} that Deaf people have poor access to healthcare, there are few data in the UK or worldwide concerning their health status⁶. The claimed prevalence of mental health problems, such as anxiety and depression, in Deaf people is greater than that of the general population⁷. The extent of physical health problems and chronic disease in the Deaf community in the UK is not known.

The aim of the Deaf Health study was to assess the current health of a representative sample of the Deaf community in the UK, and to compare with that of the general population.

METHODS

Sample:

As no register of Deaf people exists, it was not possible to recruit a random sample of the UK Deaf community. Instead, a quota sample of adults was planned, stratified by age and gender and ethnicity to match the UK population, and to represent the main populated areas. Recruitment of BSL-using Deaf adults to this quota sample was undertaken (a) by approaching respondents who had given consent to be contacted, in a previous online survey of Deaf people carried out by Ipsos MORI for SignHealth⁸ (n=80) and (b) by direct contact with the Deaf community via Deaf clubs and networks (n=223).

Information in BSL about the study was made available in video online, and informed consent to participate was obtained in BSL and English. A total of 298 participants aged from 20 to 82 years old, made up of 139 men and 159 women, with 11% from ethnic minorities, attended for free health assessments during 2012 and 2013 at Bupa centres in Bristol, London, Brighton, Solihull, Cardiff, Manchester and Glasgow. In each session, they were supported in BSL by Deaf advisers and interpreters.

Measures:

The one hour structured health assessment consisted of the standard health check provided by Bupa Healthcare, augmented by a set of health questions based on the Health Survey for England (HSE). The assessment started with a fasting blood test, following an overnight fast for a morning appointment and a 6 hour fast for an afternoon appointment. After a light snack and a drink, participants were weighed with light clothing and no shoes, and their height measured using a standing stadiometer. BMI (wt/ht^2) was then calculated. Body fat percentage was measured using bio-electrical impedance (Bodystat 1500). Blood pressure was measured in the resting state, sitting, using an electronic sphygmomanometer (Omron). At least 2

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3 blood pressure measurements were taken, with the lowest reading recorded, and
4 checked using an aneroid sphygmomanometer if necessary.
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8 A structured interview in two parts: (a) with a Bupa health adviser supported by a
9 BSL interpreter, and (b) directly with a Deaf adviser, using BSL, then explored the
10 participant's medical history, their awareness of any current health conditions, their
11 current medication usage and consumption of cigarettes and alcohol. Following the
12 assessment, the results were provided in a written report to the Deaf participant, with
13 an explanation given by the Bupa adviser and interpreted in BSL, together with
14 guidance on what action to take about the results, including showing the results to
15 their GP.
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24 Resting blood pressure of the participants was classified using the BHS guidelines
25 2004 as: low-normal (systolic<120; diastolic<80); high normal (120-139; 80-89), mild
26 hypertension (140-159; 90-99) and moderate-severe hypertension (160+; 100+).
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30 Consistent with the definition used in the HSE 2011 for doctor-diagnosed
31 cardiovascular disease (CVD), we defined the presence of CVD as the self-report of
32 any one or more of the following: angina, heart failure, heart attack, stroke and atrial
33 fibrillation. For fasting blood sugar, we used the accepted classification of less than
34 6.1 mmol/l as normal, 6.1 to 7.0 mmol/L as pre-diabetic and 7.1 or more as diabetic.
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42 **Analysis:**

43 Comparative data for the hearing population were derived from the Health Survey of
44 England 2009, 2010 & 2011 (HSE)⁹, and the Quality and Outcomes Framework
45 2012 (QOF)¹⁰ for all GP surgeries in England. Initial analysis was descriptive, and
46 where appropriate comparisons could be made between the Deaf sample and the
47 general population simple statistical comparisons were carried out using Chi² tests.
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55 Ethical approval for the study was given by the NHS Local Research Committee
56 (NRES Committee South West – Frenchay. ref no: 11/sw/0151).
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RESULTS

Sample

The final recruited sample (Table 1) was close to the designed sampling frame, although young adults 18-24 years were under-represented. There is a slight imbalance of females among the Deaf participants and this is most marked proportionately in the middle-aged group (too many) and in the elderly group (too few). These variations are similarly found in the other major comparator data sets.

Table 1. The Deaf Health sample, by age, gender and ethnicity

		Study sample number (%)	Target number by UK census (%)
Age	18-24 yrs	8 (3)	36 (12)
	25-44 yrs	113 (38)	105 (35)
	45-64 yrs	122 (41)	96 (32)
	65-82 yrs	55 (18)	63 (21)
Gender	Male	139 (47)	150 (50)
	Female	159 (53)	150 (50)
Ethnicity	White	261 (88)	264 (88)
	Black and Minority Ethnic Groups	35 (12)	36 (12)

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3 The UK regions and countries of residence of the participants were London & South
4 England (34%), West of England & Wales (21%), Midlands (19%), North England
5 (14%), Scotland (12%).
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10 11 12 13 **Obesity**

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15 Overall, 41% of the Deaf participants were overweight (BMI 25-30), and 30% were
16 clinically obese (BMI>30). The gender difference seen in the general population was
17 not observed in the Deaf sample. In the HSE dataset, 65% of men and 58% of
18 women were overweight or obese while the corresponding figures for Deaf
19 participants were 72% and 71%. ($X^2=23.5$, $df=2$, $p<.001$). In the Deaf sample, 90%
20 of those over 65 years were classed as overweight or obese.
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29 Mean waist circumference for Deaf males was 97.9 cm (SE 1.1) and for Deaf
30 females was 92.6 cm (SE 1.1). This compares to 97.1 (SE 0.38) and 88.5cm (SE
31 0.38) for the general population (HSE 2011). The frequency of raised waist
32 circumference for Deaf males and females was 57% and 76% respectively as
33 compared to 34% and 47% from the HSE. (comparison for males: $X^2=9.7$, $df=1$,
34 $P<.01$; for females: $X^2=47.6$, $df=1$, $p<.001$)
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43 The waist circumference and BMI data were combined to give a categorisation of risk
44 of serious illness, (coronary heart disease, Type 2 diabetes, osteoarthritis and some
45 cancers) using NICE 2006 predictions.¹¹ At least 48% of Deaf people would be
46 placed in the “high to very high risk” category as a result of their BMI and waist
47 circumference measurements (Table 2).
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Table 2: Risk of illness estimates from BMI and Waist Circumference (risk adapted from the NICE, 2006¹¹ predictions)
- % of the Deaf sample in each risk category (n=288)

<i>BMI</i>	<i>Normal Waist Circumference</i>	<i>High Waist circumference</i>	<i>Very High Waist Circumference</i>
Desirable 20-25	23 No increased risk	6 No increased risk	1 increased risk
Overweight 26-30	9 No increased risk	13 increased risk	18 high risk
Moderate obesity 31-40	1 increased to very high risk	2 high to very high risk	26 very high risk
Severe obesity 41+			2 very high risk

Blood pressure

The frequency of raised BP was higher in the Deaf participants (37%) than that reported in the HSE (21%) ($\chi^2=6.9$, $df=1$, $p<0.01$). (Table 3) Moderate-severely high BP was significantly more common in Deaf men (15.9%) than in Deaf women (7.7%) ($\chi^2= 18.1$, $df=3$, $p<.001$).

Table 3: Comparison (%) of Raised Blood Pressure, by gender
(Deaf n=287; HSE n=4,753)

	Measured BP >140/90	
	Deaf	HSE 2011
Males	41.7	20.0
Females	32.2	17.0
Overall	36.6	21.1

The *awareness* of their raised blood pressure was poor in the Deaf sample, with 68 (23%) self-reporting they had hypertension. Of those who self-reported they did *not*

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3 have a problem of high blood pressure, 29% had raised clinic BP readings. Only half
4 of those with moderate-severely raised BP levels were aware they had a problem.
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8 In the general population, HSE 2009 reported that 6% were not aware of their raised
9 blood pressure (29% had survey diagnosed raised BP and 23% self-reported
10 hypertension). The comparative figures in this study for Deaf people are 14%
11 unaware (37% had measured raised BP and 23% self-reported hypertension).
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17 The *detection* rates of hypertension in the general population aged 18-80 calculated
18 from data reported in HSE 2011 were 58% (male) and 59% (female). The
19 corresponding figures for Deaf people were 44% (male) and 54% (female). There
20 was evidence of a difference between Deaf males and men in the general population
21 ($\chi^2=5.16$, $df=1$, $p<0.05$).
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28 Of the 68 Deaf people who reported they did have hypertension, only 51% were
29 receiving antihypertensive medication (beta blockers, ace inhibitors, calcium channel
30 blockers, Angiotensin II Receptor Blockers or diuretics). Among those Deaf people
31 apparently receiving treatment for hypertension, only 42% had measurements of
32 140/90 or less. This contrasts with the HSE 2011 (<140/90) report of 62%, and
33 QOF 2012 figures (<=150/90) of 80% adequate control.
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45 **Cardiovascular Disease (CVD)**

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47 Self-report of CVD was significantly less among Deaf people than in the general
48 population ($\chi^2=7.8$, $df=1$, $p<0.01$) but with higher rates of self-report among Deaf
49 women. The association of increasing prevalence with age was not as strong as in
50 the general population (Table 4).
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Table 4: Self-reported cardiovascular disease (CVD) by Age (%)

(Deaf n=288, HSE 2011 n=8,380)

	<i>Deaf Self report CVD</i>	<i>HSE self-report ('doctor diagnosed')CVD</i>
25-44 yrs	1.7	5.3
45-64 yrs	11.5	14.1
65-82 yrs	11.1	26.2

Of those who said they did have CVD, only 45% were taking aspirin or clopidogrel. A comparison with HSE 2011 is limited, as younger people are excluded and the data for females are treated as unreliable. For men aged 55-84 years in HSE, the treatment rate for ischaemic heart disease and stroke was between 61% and 70%; in comparison, for Deaf men aged 45-84 years, the treatment rate for all CVD was 45%.

Cholesterol

The mean level of cholesterol in both male and female Deaf participants (4.6 mmol/L and 4.5 mmol/L respectively) was lower than reported in the HSE (5.1mmol/L and 5.2 mmol/L respectively) (Table 5).

Table 5: Distribution (%) of total cholesterol levels, by gender (n=274)

	<i>desirable cholesterol (≤5mmol/L)</i>	<i>elevated cholesterol (>5mmol/l)</i>	<i>HSE 2011 elevated cholesterol</i>
Men	77.5	22.4	56
Women	58.6	41.3	57
Overall	67.5	32.4	57

Women seem to have a greater problem with high cholesterol, although overall levels are considerably lower than in the HSE 2011. 15% of Deaf men and 11% of Deaf women had a total cholesterol to high density lipoprotein ratio (TC/HDL) above 4.5.

The use of HMG CoA reductase inhibitors (statins) among the Deaf participants was associated with lower cholesterol levels (mean 3.80mmol/l compared to mean 4.69 with no treatment). However, only 31% of those who had elevated cholesterol said they had been provided with this treatment. Treatment rates for the general population reported in HSE 2011 seem higher at 79% for men and 71% for women.

Diabetes

The self-reported prevalence of diabetes among Deaf participants was 7% (7% males, 6% for females) This is similar to the HSE 2011 figures for people with doctor-diagnosed diabetes (recalculated having removed the oldest age group who do not match the Deaf sample) of 7% (9% males, 5% females). We considered the relationship of self-report of diabetes and the measurement of fasting glucose levels. Overall, 8% of the Deaf sample had glucose measurements in the pre-diabetic range, and 3% were diabetic (Table 6).

Table 6: Self-reported diabetes and measured fasting blood glucose (row %)

Self-Report	Normal (<6.1 mmol/l)	Pre-diabetic (6.1-7.0 mmol/l)	Diabetic (>7.0mmol/l)	n=
no diabetes	92.4	6.8	0.8	249
diabetes	44.4	27.8	27.8	18
Overall	89.1	8.2	2.6	267

(column %)

Self-Report	Normal (<6.1 mmol/l)	Pre-diabetic (6.1-7.0 mmol/l)	Diabetic (>7.0mmol/l)
No diabetes	96.6	77.3	28.6
Diabetes	3.4	22.7	71.4
n=	238	22	7

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3 Of those who believed they did not have diabetes, 8% had elevated blood sugar
4 levels. Of those with raised levels of blood sugar at pre-diabetic levels, more than
5 three quarters (77%) were unaware of it. Of those who reported diabetes, 44% had
6 normal levels of blood sugar so nearly 56% had diabetes which was not under
7 control – although we note that the actual numbers are small in this sub-group.
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14 Overall, Deaf participants had similar rates of diabetes to the general population, but
15 were less likely to be aware of the problem, and more likely to have inadequate
16 control when they have been diagnosed with diabetes.
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20 21 **Respiratory conditions**

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24 The HSE (2010) reported that 16% of adult men and 17% of adult women had been
25 diagnosed with asthma at some time in their life. Asthma was self-reported at a
26 similar level among the Deaf participants: 15% and 17% for men and women
27 respectively.
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33 Chronic obstructive pulmonary disease (COPD) appeared to be uncommon in the
34 Deaf population. The self-reported rate from Deaf participants was less than 1% – ie
35 only one person mentioned this. In comparison, in the HSE (2010) 4% of men and
36 5% of women had at some time been diagnosed with COPD. This may be a result of
37 low rates of smoking by Deaf adults, but it may also reflect undiagnosed illness,
38 misdiagnosis (e.g “asthma”) or failure to communicate effectively a diagnosis of
39 COPD.
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49 **Depression**

50 Participants were asked if they suffered from ‘depression’, with no definition supplied.
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52 The rates of depression self-reported by Deaf participants were 24% overall; 32%
53 women and 14% men- similar rates to those from other studies of Deaf adults.¹²
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3 Only 15% of those who reported that they had depression were using
4 antidepressant drugs. In comparison, the QOF figure for treated clinical depression
5 (mixed depression and anxiety) was 12% in 2011-12.
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10 **Smoking**

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12 The same percentage (8%) of men and women reported smoking. This compares to
13 the reported UK rate (2010) of 21% for men and 20% for women¹³. More Deaf
14 women have never smoked (72%) compared to men (61%).
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23 **Alcohol consumption**

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25 Participants were asked to define their average weekly consumption of alcohol in
26 units. Average alcohol consumption was self-reported as 5.4 units for men and 3.4
27 units for women. These figures are very low in comparison to the self-reported mean
28 alcohol consumption for the general UK population of 15.6 units for men and 9.5
29 units for women¹⁴.
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37 Our study showed that 33% of Deaf males, and 40% of Deaf females do not drink at
38 all. If we remove these from the calculation, the weekly consumption among those
39 who do drink is 8.0 units (males) and 5.7 units (females), which is still well below the
40 figures reported for the general population.
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DISCUSSION

Summary of findings

This study of BSL-using Deaf adults has shown high levels of risk factors for common conditions such as cardiovascular disease, hypertension and diabetes, and high levels of self-reported depression, but low levels of reported smoking and alcohol consumption. Deaf people had high rates of raised BP at assessment, which could reflect undetected hypertension and poorly controlled hypertension. Half of Deaf people reporting CVD appeared to not be on appropriate treatment. One third of Deaf participants had total cholesterol >5mmol but treatment rates were half that of the general population rate. Overall, Deaf adults had similar rates of diabetes to the general population, but were less likely to be aware of problems with glucose tolerance, and more likely to have inadequate control when they have been diagnosed with diabetes. The prevalence of overweight and obesity was high in Deaf people, especially those over 65.

Strengths and limitations of this study

The strengths of the methods used in this study are that BSL was utilised throughout, and that as well as collecting questionnaire and interview data, a structured medical assessment was undertaken. By using an independent provider (Bupa Healthcare) we were able to obtain a standardised health assessment on all participants, whether resident in England Scotland or Wales. The disadvantage of not having access to the participants' own medical records was offset by the advantage of having an independent structured health report on each participant.

There are several caveats which should be considered when interpreting the results.

Firstly, we were usually reliant on self-report for the medical history and the

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3 medication usage, and did not have access to individuals' health records although
4 some participants did bring their list of prescribed medication. This is also an issue in
5 most health surveys including HSE. Self-report of medical problems can be
6 associated with bias in both directions – an exaggeration of medical diagnoses (eg
7 any wheeze is categorised as asthma), or an under-reporting of chronic conditions
8 (eg hypertension, high cholesterol) through lack of awareness, denial, or poor
9 communication by the medical practitioner. Secondly, the medical assessment
10 offered by Bupa, whilst broadly the same as their routine 'well person' check, was a
11 single check on one day and did not include any information from the individual's
12 existing medical record. For example, no serial BP or ambulatory BP measurements
13 were available on participants, and no measurements were made of lung function.
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26 Thirdly, the datasets used to provide comparisons with the hearing population have
27 their own limitations. The Quality Outcome Framework (QOF) data are derived only
28 from English general practices. The data are aggregated by practice rather than
29 patient level and cannot be treated as prevalence data. When using the QOF in
30 making any comparison between Deaf and hearing populations, we are effectively
31 treating our sample of Deaf adults as if they all belonged to the same general
32 practice, and comparing them as a group to other general practices in England.
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Although HSE is a large scale study, it has all the usual problems in response rates
and participation. The sample for 2011 was over-represented by women (56%) and
varies in response (better in the North of England than in London). The overall
response rate was 59% of all those adults eligible to take part, but 39% proceeded to
the nurse interview and only 29% gave a blood sample.

Reference to existing literature

Although hypertension cannot be diagnosed on the basis of two BP readings on one
day, the BP results are of concern as they indicate that Deaf adults are not only at
risk of hypertension but also show an apparent lack of awareness of the problem.

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3 This lack of awareness of raised also BP occurs, but is less prominent, in the general
4 population¹⁵. Because of difficulties in accessing routine health checks and poor
5 communication in primary care, it is probable that Deaf people have their BP
6 measured less frequently, and action is less likely to be taken over one-off elevated
7 readings, than among hearing people. Our data also show that even if prescribed
8 anti-hypertensives, the Deaf patient may not be taking enough tablets, or may not be
9 taking the medication regularly, to control the BP- again suggesting that
10 communication with doctors and nurses has not been clear.
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15 Our results indicated lower rates of self-reported CHD than the general population,
16 but also lower rates of treatment with anti-platelet medication. This could be due to
17 genuine lower rates (associated with less smoking) but could also reflect under-
18 diagnosis. Studies from the USA¹⁶ have shown that Deaf people are at a double
19 disadvantage in accessing health information about cardiovascular disease. Pollard
20 and Barnett¹⁷ showed that even highly educated Deaf adults scored only at the level
21 of schoolchildren aged 14–15 years for health literacy. The combination of the levels
22 of BP and the raised risk of serious illness calculated from BMI and waist
23 circumference will potentially reduce life expectancy in Deaf compared to hearing
24 populations.
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29 The finding that more than half of the Deaf participants diagnosed with diabetes
30 were not adequately controlled is also of concern, as Deaf people are put at risk of
31 preventable complications including blindness, but in the general population in the
32 UK the prevalence of inadequate glycaemic control has been generally high (>60%)
33 in patients with type 2 diabetes.¹⁸ Similar to the hearing population, 8 % of Deaf
34 adults had fasting blood sugars in the pre-diabetic or intermediate hyperglycaemia
35 range¹⁹. However, although people with pre-diabetes are at high risk for
36 diabetes, and evidence points to high potential benefit from lifestyle interventions²⁰,
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3 diabetes prevention requires societal change and a concerted global public health
4 approach²¹.
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8 There was a high prevalence of obesity in the Deaf sample, particularly in women,
9 and in those over 65 years. We had no reliable data on activity levels in our sample,
10 nor details of diet, but it is probable that the overweight and obesity seen in Deaf
11 people is due to the same factors as the general population- ie a mixture of intake of
12 calories in excess of metabolic requirements and a lack of physical activity. Health
13 promotion messages on healthy eating and regular exercise designed for the hearing
14 population are not reaching the Deaf community, especially the older members of the
15 community (in whom the obesity problem is greatest). The problem of access of the
16 Deaf community to health promotion messages is illustrated by the finding that
17 understanding and knowledge of AIDS and risk behaviours were found to be lower in
18 deaf and hard of hearing people than in hearing people²². In addition to living in the
19 same obesogenic environment as hearing people, Deaf adults also face barriers due
20 to communication difficulties, and stigma, in participating in sporting activities and
21 joining gyms, clubs and slimming groups.
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37 In contrast, the Deaf community seems to have taken note of the health promotion
38 messages about smoking, maybe because of prominent visual warnings on cigarette
39 packaging, and this was associated with lower rates of self-reported chronic
40 respiratory disease and CVD. The self-reported alcohol consumption was also lower
41 than the general population, which may partially be due to communication issues in
42 BSL, but also probably reflects different social patterns of drinking and a relatively
43 high rate of abstinence in the Deaf community.
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52 *Conclusion*

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54 Deaf adults in the UK have high rates of known risk factors for chronic disease such
55 as cardiovascular disease, hypertension and diabetes, and high rates of self-
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3 reported depression. Lack of awareness, under-diagnosis and under-treatment of
4 chronic conditions may be putting them at risk of preventable ill-health and potentially
5 reduced life expectancy.
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25 and Bupa healthcare for their collaboration.
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27
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29 funders.
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32 **Transparency statement**

33 Alan Emond will act as the manuscript's guarantor, and affirms that the manuscript is
34 an honest, accurate, and transparent account of the study being reported; that no
35 important aspects of the study have been omitted; and that any discrepancies from
36 the study as planned have been explained.
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40 **Data sharing statement**

41 Alan Emond can be contacted regarding access to the Deaf Health Dataset.
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45 **Authors' contributions**

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48 **Alan Emond** contributed to study design, was a member of the study management
49 committee, supervised training, data collection and analysis and contributed to data
50 interpretation. He wrote the first draft of the paper and approved the final version of
51 the manuscript.
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53

54 **Matthew Ridd** contributed to study design, was a member of the study management
55 committee, and contributed to data interpretation. He contributed to earlier drafts and
56 approved the final version of the manuscript.
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3 **Hilary Sutherland** was one of the study researchers and a member of the study
4 management committee. She enrolled participants, collected outcome data, prepared
5 data files for analysis and contributed to data interpretation. She approved the final
6 version of the manuscript.
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9 **Lorna Allsop** was one of the study researchers and a member of the study
10 management committee. She enrolled participants, collected outcome data, prepared
11 data files for analysis and contributed to data interpretation. She approved the final
12 version of the manuscript.
13

14 **Andrew Alexander** was an expert member of the study management committee. He
15 contributed to trial design, data interpretation, earlier drafts of the manuscript, and
16 approved the final version of the manuscript.
17

18 **Jim Kyle** was the PI on the study. He contributed to study design, chaired the study
19 management committee, supervised data collection, undertook most of the analysis
20 and contributed to data interpretation. He wrote the report to funders, contributed to
21 earlier drafts of the manuscript and approved the final version of the manuscript.
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23

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29 30 31 **Competing interest statement.**

32 The authors have no conflicts of interest to declare
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STROBE Statement—

The health of Deaf people in the UK

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found Abstract
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Introduction p4
Objectives	3	State specific objectives, including any prespecified hypotheses Introduction p4
Methods		
Study design	4	Present key elements of study design early in the paper Methods : Sample p5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Methods : Sample p5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants Methods : Sample p5 (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Methods: Measures p5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Methods: Measures p5
Bias	9	Describe any efforts to address potential sources of bias Methods : Sample p5 and Results: Sample p7
Study size	10	Explain how the study size was arrived at Methods : Sample p5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Methods: Analysis p6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions

(c) Explain how missing data were addressed

Methods: Analysis p6

(d) *Cohort study*—If applicable, explain how loss to follow-up was addressed

Case-control study—If applicable, explain how matching of cases and controls was addressed

Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy

(e) Describe any sensitivity analyses

Continued on next page

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Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Results: Sample p7 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Results: Sample p7 (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures Results: Findings by condition p7-13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion

Key results	18	Summarise key results with reference to study objectives Discussion: main findings p15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Discussion: Strengths and limitations p15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discussion: Reference to existing literature p16
Generalisability	21	Discuss the generalisability (external validity) of the study results Discussion: Reference to existing literature p16

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at

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2 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is
3 available at www.strobe-statement.org.
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