Derived and adjusted variables

BRHS 20 year follow-up (Q20)

1998-2000

A number of key variables were derived by BRHS researchers working with the BRHS data collected at the 20 year follow-up in 1998-2000 (Q20). These are variables that were created by calculating or categorising new variable using existing BRHS data. These variables have been shared and widely used by other researchers working with the BRHS data

Some of the physiological measurements were adjusted for observer error. The derived and adjusted variables that are available are listed below. A description/reference of the method used to derive/adjust each variable, is given in the sections that follow.

	Derived variables:	**section**
Behavioural	Smoking status categories Physical activity categories Alcohol intake categories	1 2 3
Diet	Elderly Dietary Index Healthy Diet Indicator (HDI) Macronutrient and micronutrient estimates Dietary patterns	4 5 6 7
Physiological	Body composition Fev1(height adjusted)	8 9
Medications	Blood pressure medication Lipid lowering medication Diabetic	10
Fasting duration	Fasting duration	11
ECG	Left Ventricular Hypertrophy (LVH) Right Ventricular Hypertrophy (LVH) Conduction defects (CD) MI or Ischaemia grade (MISH) Atrial Fibrillation	12

	Adjusted variables:	**section**
Anthropometric (adjustment for observer error)	Subscapular skinfold Triceps skinfold Waist Circumference Hip Circumference	13
Physiological (adjustment for observer error + systematic over-reading of SBP	Mean sitting and standing Systolic blood pressure Mean sitting and standing Diastolic blood pressure	14

Adjustment methods are described in Appendix 1:

BRHS reference documents:

Appendix 1: ***BRHS Q20 Physical Measurement adjustments by JEmberson.pdf***

DERIVED VARIABLES

1. Smoking status

The participant responses to smoking related questions 10.0 -10.4 in the main 20 year follow-up survey questionnaire (*BRHS 1998-2000 20 year follow-up survey Main Qr Q20.pdf*) as well as the participant's previous smoking history (i.e. responses to smoking related questions from previous waves of questionnaires) were used to assign the smoking status category of BRHS participants at the 20 year follow-up study time point as shown in the table below.

Derived variables Smoking	**Value labels/categories**	**BRHS Variable name**	**Data access**
Q20 Smoking status 7 categories	1=Never 2= Long term Ex-smoker (since Q1baseline) > 20 years 3= Gave up at Q5 (15-20 years before Q20) 4= Gave up 10-15 years ago 5= Gave up 5-10 years ago 6= Gave up within las 5 years 8= Current smoker	q20smok7	Yes
Q20 Smoking status 4 categories	1=never 2=long term Ex (Ex at Q1 or Q5) 3=recent Ex (gave up between Q5 and Q20) 4=current smoker	q20smok4	Yes
Q20 Smoking Pipe status	1=yes 0=no	q20pipe	Yes

2. Physical activity

"A physical activity (exercise) score was derived for each man based on the frequency and type (intensity) of the physical activity. Scores were assigned for each type of activity and duration based on the intensity and energy demands of the activities reported. This was based on the recommendations of a National Heart, Lung and Blood Institute (NHLBI) workshop and the Minnesota intensity codes. Scores were heavily weighted on vigorous exercise. Physical activity at work was excluded from the score partly because few middle-aged men do physically demanding work and partly because such activity is not readily amenable to modification. Though the gradings were arbitrary we tried to ensure that any given score implied approximately equal intensity and energy demands for the various types of activity. The total score for each man was not a measure of total time spent in physical activity but was a relative measure of how much physical activity has been carried out or energy expended. Regular walking and cycling related to weekday journeys, including those to and from work. Recreational activity includes gardening, pleasure walking, and do-it-yourself jobs. Sporting (vigorous) activity includes running, golf, swimming, tennis, sailing, digging, etc. It was not possible to identify the type of vigorous activity for each man (copies of the questionnaire are available on request) but it was regarded as being vigorous."

1. *Shaper AG, Wannamethee G, Weatherall R. Physical activity and ischaemic heart disease in middle-aged British men. Br Heart J1991;66:384–94.*

Derived variables Physical activity	**Value labels/categories**	**BRHS Variable name**	**Data access available**
Q20 Physical Activity status	0= Inactive 1= Occasional 2= Light 3= Moderate 4= Moderate vigorous 5= Vigorous	q20pa	Yes

3. Alcohol intake

Alcohol consumption was recorded using questions on frequency and quantity consumed on the 20 year follow-up survey questionnaire (questions 11.0 to 11.2 in **BRHS 1998-2000 20 year follow-up survey Main Qr Q20.pdf**. Using the responses to these questions the participants were classified into five main categories listed in the table below. An additional category (10) includes self-reported drinkers who had not provided any information on the amount they drank during an average week. One UK unit of alcohol (one drink) is defined as half a pint of beer, a single measure of spirits, or a glass of wine (approximately 8–10 g alcohol).

Derived variables Alcohol intake variables	**Value labels/categories**	**BRHS Variable name**	**Data access**
Q20 Alcohol intake	1= None 2= Occasional(<1 **drink**/week) 3= Light(1-15/week) 4= Moderate(16-42/weeks) 5= Heavy(>42/week) 10= Drinkers(unclassified) - no information on the amount they drank/week	q20alc	Yes

4. Elderly Dietary Index

The EDI was developed by Kourlaba et al, specifically to address adherence to nutritional recommendations for older adults, based on the frequency of consumption of specific foods/food groups in the Modified MyPyramid for Older Adults.1, 2 The EDI consisted of nine components (meat; fish and seafood; vegetables; cereals; fruit; legumes; olive oil; dairy; bread), each assigned a four-point scoring system based on frequency of consumption, resulting in a total score range from 9-36. The frequency of olive oil consumption was not available so the scoring of this component was modified from the original score used (1 = <1 day/week; 2 = 1-2 days/week; 3 = 3-6 days/week; 4 = daily) to the quantity of weekly consumption (never/rarely consumed and tertiles of weekly consumption). The derived EDI components and total score are based on responses to the dietary questions of the 20 year follow-up Physical Activity and Diet questionnaire (*BRHS 1998-2000 20 year follow-up survey Physical activity and Diet Qr Q20.pdf*)

References:

1. Atkins JL, Whincup PH, Morris RW, Lennon LT, Papacosta O, Wannamethee SG. High diet quality is associated with a lower risk of cardiovascular disease and all-cause mortality in older men. J Nutr. 2014 May;144(5):673-80. doi: 10.3945/jn.113.186486. Epub 2014 Feb 26.
2. Kourlaba G, Polychronopoulos E, Zampelas A, Lionis C, Panagiotakos DB. Development of a diet index for older adults and its relation to cardiovascular disease risk factors: the Elderly Dietary Index. Journal of the American Dietetic Association. 2009;109:1022-30.
3. Lichtenstein AH, Rasmussen H, Yu WW, Epstein SR, Russell RM. Modified MyPyramid for Older Adults. The Journal of nutrition. 2008;138:5-11.

Elderly Dietary Index components and scoring criteria:

Elderly Dietary Index Scoring (EDI)				
Component	**Score = 1**	**Score = 2**	**Score = 3**	**Score = 4**
Meat	≥3 days/week	Never/rarely	<1 day/week	1-2 days/week
Fish/Seafood	Never/rarely	<1 day/week	≥3 days/week	1-2 days/week
Legumes	Never/rarely	<1 day/week	≥3 days/week	1-2 days/week
Fruit	<1 day/week	1-2 days/week	3-6 days/week	Daily
Vegetables	<1 day/week	1-2 days/week	3-6 days/week	Daily
Cereals	<1 day/week	1-2 days/week	3-6 days/week	Daily
Bread	None	White	White and whole grain	Whole grain
Olive oil	Never/Rarely	Tertile 1 of intake	Tertile 2 of intake	Tertile 3 of intake
Dairy	Full-fat milk and full-fat cheese	Semi-skimmed milk and full-fat cheese / full-fat milk and low-fat cheese	Skimmed milk and full-fat cheese	Skimmed/Semi-skimmed milk and low-fat cheese

Derived variables EDI component score	Value labels/categories	BRHS Variable name	Data access
Bread	1-4 as above	Q20EDI_bread	yes
Vegetables	1-4 as above	Q20EDI_veg	Yes
Fruit	1-4 as above	Q20EDI_fru	Yes
Legumes	1-4 as above	Q20EDI_legume	Yes
Meat	1-4 as above	Q20EDI_meat2	Yes
Cereals	1-4 as above	Q20EDI_cereal2	Yes
Olive oil	1-4 as above	Q20EDI_olive_oil2	Yes
Fish/Seafood	1-4 as above	Q20EDI_fish2	Yes
Dairy	1-4 as above	Q20EDI_dairy	Yes
EDI Total score (sum of all components)	12-35	Q20EDI_total_9_FINAL	Yes

5. Healthy Diet Indicator (HDI)

The HDI was constructed using WHO dietary guidelines for the intake of nutrients and food components, as initially used by Huijbregts et al.1, 2 The HDI consisted of eight components (SFA; PUFA; protein; carbohydrates; sugar; fibre; fruit and vegetables; cholesterol), each scoring one if the dietary guideline was met and zero otherwise, resulting in a total score range from 0-8. Dietary data for pulses, nuts and seed were unavailable so this component could not be included in the HDI. The cut-off points for PUFA and fibre intake were modified for use in a British population as performed previously.3, 4 The weight of fruit and vegetables consumed was not available, so this component was modified from the original scoring used (1 = ≥400g/day; 0 = < 400g/day) to the consumption of both fruit and vegetables daily. The derived HDI components and total score are based on responses to the dietary questions of the 20 year follow-up Physical Activity and Diet questionnaire (*BRHS 1998-2000 20 year follow-up survey Physical activity and Diet Qr Q20.pdf*)

References:

1. Atkins JL, Whincup PH, Morris RW, Lennon LT, Papacosta O, Wannamethee SG. High diet quality is associated with a lower risk of cardiovascular disease and all-cause mortality in older men. J Nutr. 2014 May;144(5):673-80. doi: 10.3945/jn.113.186486. Epub 2014 Feb 26.
2. World Health Organization. Diet, nutrition and the prevention of chronic disease. Joint WHO/FAO expert consultation. WHO Technical Report Series, No 916. Geneva: WHO; 2003.
3. Huijbregts P, Feskens E, Rasanen L, Fidanza F, Nissinen A, Menotti A, Kromhout D. Dietary pattern and 20 year mortality in elderly men in Finland, Italy, and The Netherlands: longitudinal cohort study. BMJ. 1997;315:13-7.
4. Maynard M, Ness AR, Abraham L, Blane D, Bates C, Gunnell DJ. Selecting a healthy diet score: lessons from a study of diet and health in early old age (the Boyd Orr cohort). Public health nutrition. 2005;8:321-6.
5. McNaughton SA, Bates CJ, Mishra GD. Diet quality is associated with all-cause mortality in adults aged 65 years and older. The Journal of nutrition. 2012;142:320-5.

Healthy Diet Indicator (HDI) components and scoring criteria:

Healthy Diet Indicator Scoring (HDI)		
Component	**Score = 0**	**Score = 1**
SFA (% energy)	>10	0-10
PUFA (% energy)	<6 and >10	6 - 10
Protein (% energy)	<10 and >15	10 - 15
Total carbohydrates (% energy)	<50 and >70	50-70
Sugar (% energy)	>10	0-10
Dietary Fibre (g/day)	<18 and >32	18-32
Cholesterol (mg/d)	>300	0-300
Fruits and Vegetables	Less frequent than daily consumption of both	Daily consumption of both

Derived variables Healthy Diet Indicator (HDI)	Value labels/categories	BRHS variable name	Data access
Healthy Diet Indicator (HDI) Total score (sum of HDI components)	0-7	Q20HDI_total	Yes

6. Macronutrient and micronutrient estimates

A validated computer programme was used to calculate the total macronutrient and micronutrient intakes of all foods reported as consumed by the BRHS participants in the FFQ of the 20 yearfollow-up Physical Activity and Diet questionnaire (*BRHS 1998-2000 20 year follow-up survey Physical activity and Diet Qr Q20.pdf*)) and hence the total energy intake (Ref 1). This computer programme multiplied food frequency by standard portion sizes for each food and by the nutrient composition of the food obtained from the UK food composition tables (Ref 2). The distribution of total energy intakes was checked for any extreme values. A list of the macronutrient and micronutrient with estimated intakes are shown in the table below.

1: Wannamethee, SG, Lowe, GD, Rumley, A, et al. (2006) Associations of vitamin C status, fruit and vegetable intakes, and markers of inflammation and hemostasis. *Am J Clin Nutr* 83, 567–574.
2: Holland, B, Welch, AA, Unwin, ID, et al. (1991) McCance and Widdowson's the Composition of Foods, 5th ed. London: Royal Society of Chemistry and Ministry of Agriculture, Fisheries and Food.

Derived variables Macronutrients and micronutrients	Units	BRHS Variable name	Data access
Fat	mg/d	Q20_FAT	yes
Saturated fat	mg/d	Q20_SAT	yes
Polyunsaturated fat	mg/d	Q20_POLY	yes
Protein	mg/d	Q20_PROT	yes
Carbohydrate	mg/d	Q20_CHO	yes
Starch	mg/d	Q20_STCH	yes
Sugar	mg/d	Q20_SUG	yes
Alcohol	mg/d	Q20_ALC	yes
Cereal fibre	mg/d	Q20_CF	yes
Vegetable fibre	mg/d	Q20_VF	yes
Vitamin C	mg/d	Q20_VITC	yes
Total daily k calories	kcal	Q20_KCAL	yes
Cholesterol	mg/d	Q20_CHOLEST	yes
Retinol (ie dietary vitamin A)	mg/d	Q20_RETINEL	yes
Beta carotene	mg/d	Q20_B_CAROT	yes
Alpha tocopherol (i.e. dietary vitamin E)	mg/d	Q20_A_TOCOP	yes
Dietary intake linoleic acid	mg/d	Q20_LINOLEIC	yes
Iron	mg/d	Q20_IRON	yes

7. Dietary patterns

The FFQ items on the 20 year follow-up Physical Activity and Diet questionnaire (BRHS 1998-2000 20 year follow-up survey Physical activity and Diet Qr Q20.pdf) were used to generate 34 food groups. Principal component analysis identified dietary patterns that were categorised into quartiles, with higher quartiles representing higher adherence to the dietary pattern. Three interpretable dietary patterns were identified: **'high fat/low fibre'** (high in red meat, meat products, white bread, fried potato, eggs), **'prudent'** (high in poultry, fish, fruits, vegetables, legumes, pasta, rice, wholemeal bread, eggs, olive oil) and **'high sugar'** (high in biscuits, puddings, chocolates, sweets, sweet spreads, breakfast cereals)[1]

Derived Dietary patterns		BRHS VARIABLE NAME	Data access
High fat/low fibre diet	PCA factor scores	q20pc1_highfat_lowfibre	yes
High fat/low fibre diet quartiles	PCA factor score quartiles	q20pc1_quart_highfat_lowfibre	yes
Prudent diet	PCA factor scores	q20pc2_prudent	yes
Prudent diet quartiles	PCA factor score quartiles	q20pc2_quart_prudent	yes
High sugar	PCA factor scores	q20pc3_high_sugar	yes
High sugar quintiles	PCA factor score quartiles	q20pc3_quart_high_sugar	yes

1. Janice L. Atkins et al. Dietary patterns and the risk of CVD and all-cause mortality in older British men. British Journal of Nutrition (2016), 116, 1246–1255

8. MEASURES OF BODY COMPOSITION

Commonly used measures of body composition such as Fat Free Weight, Fam mass and Body Fat were calculated, using the formulae shown below, for general use by researchers using the BRHS data.

The impedance coefficient(value) was obtained from Bioelectrical impedance analysis (BIA) during the 20 year follow-up physical examination (see section 4.2.5 of the *BRHS 1998-2000 (Q20) 20yr follow-up Physical examination protocol.pdf*). BIA is a method for measuring body composition based on the rate at which an electrical current travels through the body and is measured in Ohms (Ω). Body fat (adipose tissue) causes greater resistance (impedance) than fat-free mass and slows the rate at which the current travels. Fat-free mass was determined using the impedance coefficient/value from the BIA using a Bodystat 500 (Bodystat Ltd, Douglas, uk) and the Deurenberg et al equation **https://link.springer.com/content/pdf/10.1007/s12603-013-0336-9.pdf**

Derived Variables:

1. Fat free weight (ffw) = 6710*((height(*in metres*)^2 /impedance coefficient))+7
2. Fat mass (fatmass) = Weight(in kg) - Fat free weight (ffw)
3. Body fat(bodyfat) = Fat mass(fatmass)/Weight(kg)

*Note: q20actweigh = actual weight(kg)
q20height = height in cm
q20impedanc= coefficient reading from bodystat machine

SAS code

```
q20height=q20height/100;
q20bmi=(q20actweigh)/(q20height*q20height);

*Fat free weight;
q20imp=(q20height*q20height)/q20impedanc;
q20ffw=6710*q20imp+7;

*Fat mass;
q20fatmass=q20actweigh-q20ffw;
if q20fatmass lt 0 then q20fatmass= .;

*Body fat;
q20bodyfat=q20fatmass/q20actweigh;
q20bodyfat=round(q20bodyfat,0.01);
```

Derived variables Body composition measures	units	BRHS Variable name	Data access
Fat free weight(mass)	kg	q20ffw	yes
Fat mass	kg	q20fatmass	yes
Body fat	kg	q20bodyfat	yes
Height^2 square/ BIA (Bodystat) impedance coefficient		q20imp	yes

9. FEV1

Derived variable of height adjusted FEV1.

FEV1 is adjusted for the mean height of the population at Q20 (mean height=1.73 cm) using the equation: *q20afev1=q20fev1*((**1.73**/q20ht)****2**)* where q20fev1 and q20ht are the participant's Fev1 and height as measured at Q20. FEV1 was measured at the physical examination (see section 3.2.8 of the *BRHS 1998-2000 (Q20) 20yr follow-up Physical examination protocol.pdf*)

Derived variables	units	BRHS Variable name	Data access
adjusted FEV1	L	q20afev1	yes

10.Medications – derived variables

BRHS participants were asked to list the names of regular medications taken, the dose, frequency and reason they were taken in question 18.2 of the 20 year follow-up survey questionnaire (*BRHS 1998-2000 20 year follow-up survey Main Qr Q20.pdf*). Using this information, the medications were coded according to the British National Formulary (BNF) classification codes.

Variables indicating whether BRHS participants were taking certain types of medications were derived based on defined BNF codes or responses to questions 18.3-18.5 of main 20 year follow-up survey questionnaire.
Some of the medication derived variables are listed below.

Derived variables Medications	Value, labels/categories	BRHS Variable name	Data access
Lipid lowering medications			
Statins (BNF 2.12 – statins only)	1=yes 0=no	q20statins	Yes
Fibrates	1=yes 0=no	q20fibrates	Yes
Anion exchange resins	1=yes 0=no	q20anion_ex	Yes
Nicotinic Acid	1=yes 0=no	q20nic_acid	Yes
Fish Oil	1=yes 0=no	q20fish_oil	Yes
Ispaghula	1=yes 0=no	q20ispaghul	Yes
on ANY Lipid lowering drug (categorical) BNF=2.12 - all	0= none 1= on Statins 2= other lipid lowering drugs (not statins) 3= on both (Statins and other) 8= on lipid lowering drug – type unknown	q20lipid_drugs	Yes
On ANY lipid lowering drug (binary) BNF=2.12 - all	1=yes, 0=no (1 includes Statins, fibrates, anion exchange, nicotinic acids, fish oil, ispaghula)	q20onlipid_drugs	Yes

Aspirin use† (question 18.3,18.4)	1=yes 2=no	q20asp	Yes
Antiplatelet - Aspirin +BNF 2.9	1=yes 2=no	q20aplat	Yes
Warfarin BNF 2.8.2.0	1=yes 0=no	q20warf	Yes

†based on Q20 main questionnaire responses to questions 18.3,18.4

Blood Pressure lowering medication BNF codes: [2.2.1, 2.2.8, 2.4, 2.5, 2.6.2]	0= not on BP lowering medication 1= taking BP lowering drugs (reason: ICD codes 401 429 459) 2= taking BP lowering drugs (reason: not for hypertension (ICD other than those above)) 9= taking BP lowering drugs (reason: not specified)[usually grouped with code 1 – assume taken for BP] .= missing data on drug taking	q20bpmed_icd	Yes
Diabetic medication Insulin BNF codes 6.1.1 Antidiabetic drugs BNF codes 6.1.2	 0=no, 1=yes 0=no, 1=yes	 q20DiabDrugBNF611 q20DiabDrugBNF612	Yes

11. Fasting duration

Fasting duration(hours) was calculated from the participant's response to question 20.0(time last ate or drunk) on the 20 year follow-up questionnaire (*BRHS 1998-2000 20 year follow-up survey Main Qr Q20.pdf*) and the recorded time the blood sample was taken on the physical examination datasheet (*BRHS Q20 1998-2000 datasheet.pdf*).

Fasting duration	**Value labels/categories**	BRHS Variable name	**Data access**
Fasting duration	hours	q20fastingtime	Yes

12. Derived variables using ECG Minnesota codes

Minnesota codes were used in algorithms to obtain Left Ventricular Hypertrophy (LVH), Right Ventricular Hypertrophy (LVH), Conduction defects (CD), MI or Ischaemia grade (MISH) and Atrial fibrillation (AF)

Derived variables **Description**	**Value label**	**BRHS Variable name**	**Reference algorithm:**	**Data access**
MI or Ischaemia grade Classified using Minnesota codes from ECG	1='definite MI - acute' 2='definite MI' 3='probable MI' 4='definite ischaemia' 5='probable ischaemia' 6='possible ischaemia'	q20ecg_mish	SAS code[1]	yes
Left Ventricular Hypertrophy Classified using Minnesota codes from ECG	1 = definite LVH 2 = probable LVH 3 = possible LVH	q20ecg_lvh	SAS code[1]	yes
Right Ventricular Hypertrophy Classified using Minnesota codes from ECG	1 = definite RVH 2 = probable RVH 3 = possible RVH	q20ecg_rvh	SAS code[1]	yes
Conduction defects based in Minnesota codes LBBB = Left Bundle Branch Block RBBB = Right Bundle Branch Block CHB = Complete Heart Block WPW= Wolff Parkinson White syndrome	1 = LBBB 2 = RBBB 3 = CHB 4 = WPW 5 = LBBB and WPW 6 = RBBB and CHB	q20ecg_cd	SAS code[1]	yes
Atrial Fibrillation Classified using Minnesota codes from ECG	1=yes, 2=no	q20AtriFib	SAS code[2]	yes

SAS code[1] deriving:-

Left Ventricular Hypertrophy (LVH)
Right Ventricular Hypertrophy (LVH)
Conduction defects (CD)
MI or Ischaemia grade (MISH)

```
ecg=1;
if p_axis lt -327 then p_axis = .;
if qrs_axis lt -327 then qrs_axis= .;
if t_axis lt -327 then t_axis= .;
/*   to remove certain LBBBs        */
if ((mg1_l ge 110 and mg1_l le 119) or  (mg1_p ge 110 and mg1_p le 119)  or  (mg1_a ge 110 and mg1_a le 119)) or
((mg1_l ge 121 and mg1_l le 126)  or  (mg1_p ge 121 and mg1_p le 126)  or  (mg1_a ge 121 and mg1_a le 126))
and  mg7_1=711 then mg7_1=740;
```

*** CREATE Left Ventricular Hypertrophy using Minnesota codes * (LVH) ;**

```
if ecg=1 then lvh=0;
if (mg3 = 310 or mg3 = 330) and (mg4_l = 412 or mg4_l = 420 or mg4_p = 412   or mg4_p = 420 or mg4_a = 412
or mg4_a = 420 or mg4_a=411   or mg5_l = 510 or mg5_l = 520 or mg5_p = 510   or mg5_p = 520 or mg5_a = 510
or mg5_a = 520) then lvh=1;
if mg3 = 310 and lvh ne 1 then lvh = 2;
if mg3 = 330 and lvh ne 1 then lvh = 3;
```

*** CREATE Conduction defects using Minnesota codes * (CD);**

```
cd=.;
if mg7_1 = 711 then cd=1;
if mg7_1 = 721 then cd=2;
if mg6 = 610 then cd=3;
if mg6 = 641 then cd=4;
if mg7_1 = 711 and mg6 = 641 then cd=5;
if mg7_1 = 721 and mg6 = 610 then cd=6;
```

*** CREATE MI or Ischaemia grade using Minnsesota codes * (MISH);**

```
if ecg = 1 then mish=0;
if (mg4_l ge 430 and mg4_l le 439) or  (mg4_p ge 430 and mg4_p le 439) or  (mg4_a ge 430 and mg4_a le 439)
or (mg5_l ge 530 and mg5_l le 549) or  (mg5_p ge 530 and mg5_p le 549) or  (mg5_a ge 530 and mg5_a le 549)
then mish=6;
if (mg4_l ge 420 and mg4_l le 429) or  (mg4_p ge 420 and mg4_p le 429) or  (mg4_a ge 420 and mg4_a le 429)
or (mg5_l ge 520 and mg5_l le 529) or  (mg5_p ge 520 and mg5_p le 529) or  (mg5_a ge 520 and mg5_a le 529)
then mish=5;
if (mg4_l ge 410 and mg4_l le 419) or  (mg4_p ge 410 and mg4_p le 419) or  (mg4_a ge 410 and mg4_a le 419)
or (mg5_l ge 510 and mg5_l le 519) or  (mg5_p ge 510 and mg5_p le 519) or  (mg5_a ge 510 and mg5_a le 519)
then mish=4;
if (mg1_l ge 121 and mg1_l le 127) or  (mg1_p ge 121 and mg1_p le 127) or  (mg1_a ge 121 and mg1_a le 127)
then mish=3;
if ((mg1_l ge 110 and mg1_l le 119) or  (mg1_p ge 110 and mg1_p le 119)  or  (mg1_a ge 110 and mg1_a le 119))
or ((mg1_l ge 121 and mg1_l le 127)  or (mg1_p ge 121 and mg1_p le 127)   or (mg1_a ge 121 and mg1_a le 127))
and ((mg5_l ge 510 and mg5_l le 539) or (mg5_p ge 510 and mg5_p le 539)  or (mg5_a ge 510 and mg5_a le 539))
then mish=2;
if ((mg1_l ge 110 and mg1_l le 119) or  (mg1_p ge 110 and mg1_p le 119)  or  (mg1_a ge 110 and mg1_a le 119))
or ((mg1_l ge 121 and mg1_l le 127)  or (mg1_p ge 121 and mg1_p le 127)   or (mg1_a ge 121 and mg1_a le 127))
and ((mg9_l ge 920 and mg9_l le 929) or (mg9_p ge 920 and mg9_p le 929)  or (mg9_a ge 920 and mg9_a le 929))
then mish=2;
if ((mg9_l ge 920 and mg9_l le 929) or (mg9_p ge 920 and mg9_p le 929)  or (mg9_a ge 920 and mg9_a le 929))
and mish=2 then mish=1;
if ecg ne 1 then mish = .;
```

```
* CREATE Right Ventricular Hypertrophy using Minnesota codes * (RVH);
if ecg=1 then rvh=0;
if mg3=320 then rvh=3;
if mg3=320 and (mg4_l = 420 or mg4_p = 420 or mg4_a = 420  or mg5_l = 520 or mg5_p = 520 or mg5_a = 520) then rvh = 2;
if mg3=320 and (mg4_l = 412 or mg4_p = 412 or mg4_a = 412 or mg4_a = 411 or mg5_l = 510 or mg5_p = 510 or mg5_a = 510) then rvh = 1;

* DERIVED ECG VARIABLES FOR Q20: *;
q20ecg_mish=mish;
q20ecg_lvh=lvh;
q20ecg_rvh=rvh;
q20ecg_cd=cd;
*END*;
```

SAS code[2]: deriving Atrial fibrillation(AF)

```
*AF was defined according to Minnesota codes:;

if (mg8_1=831 or mg8_1=832 or mg8_2=831) then a q20AtriFib=1;else q20AtriFib =2;
```

q20AtriFib:
1= with atrial fibrillation
2= with no atrial fibrillation

Adjusted measurements

13. Adjusted anthropometric measurements

Differences between observers were detected for skinfold, waist and hip measurements, and blood pressure measurements. Adjustment for observer error was carried out for these variables.

Method of adjustment is described in *BRHS Q20 Physical Measurement adjustments by JEmberson.pdf*

Adjusted variables Anthropometric measures	units	BRHS Variable name	Data access
Hip Circumference (mean)	cm	q20dhipc	yes
Subscapular skinfold	cm	q20dsubskin	yes
Triceps skinfold	cm	q20dtriskin	yes
Waist Circumference (mean)	cm	q20dwaistc	yes

14. Adjusted physiological measurements

Differences between observers were detected for blood pressure measurements. Adjustment for observer error was carried out for these variables. An adjustment was also made for systematic over-reading of systolic blood pressure.

Method of adjustment is described in *BRHS Q20 Physical Measurement adjustments by JEmberson.pdf*

Adjusted variables Blood Pressure	units	BRHS Variablename	Data access
Sitting SBP (mean)	mmHG	q20sbp20	yes
Sitting DBP (mean)	mmHG	q20dbp20	yes
Standing SBP (mean)	mmHG	q20d_stand_SBP	yes
Standing DBP (mean)	mmHG	q20d_stand_DBP	yes

APPENDIX 1

Adjustment of Physical Measurements for Observer Error.

Jon Emberson – 8/3/2001

SUMMARY

Differences between observers were detected for skinfold measurements, waist and hip measurements, and blood pressure measurements, and were not explained by age or town of residence.

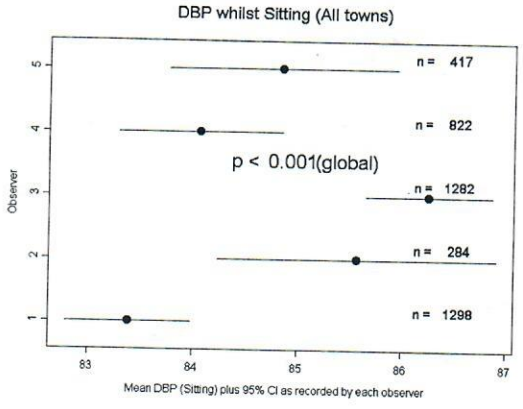
Adjustment for observer error was carried out for these variables, and was based on the difference between the observer mean and the overall mean on a within town basis [1].

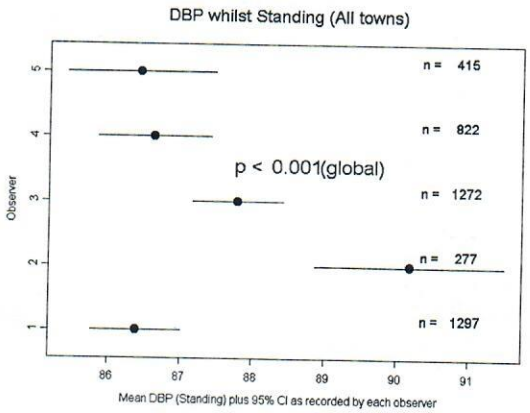
VARIABLES

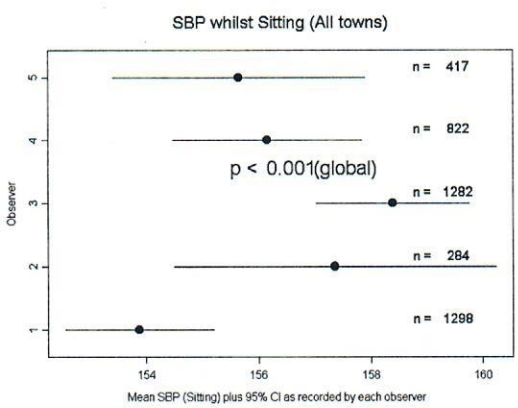
Investigation was carried out to see whether physical measurements differed systematically between observers. The variables that were considered were height, weight, subscapular skinfold, triceps skinfold, waist circumference, hip circumference, and both systolic and diastolic blood pressure (sitting and standing).

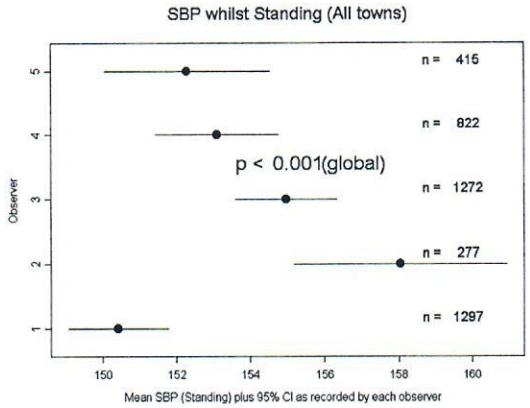
In theory, subjects were assigned to observers randomly, and so any differences should be due to observer error and not any other difference between the subjects. However it was noticed that town of residence did confound an association between observer and height measurements. Even after adjusting for age and town of residence differences between observers were detected for the skinfold measurements, waist and hip measurements, and blood pressure measurements.

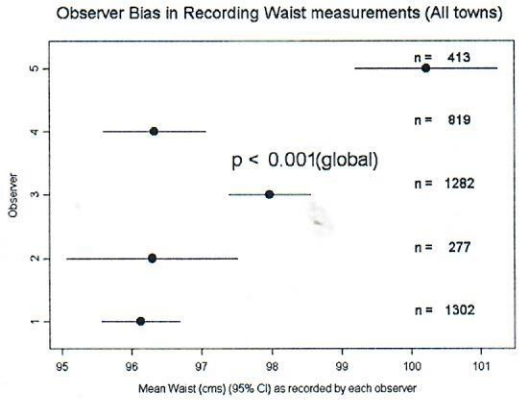
These differences are shown below, where mean measurements are shown for each observer, with 95% confidence intervals. P values are from a global test in an ANOVA.

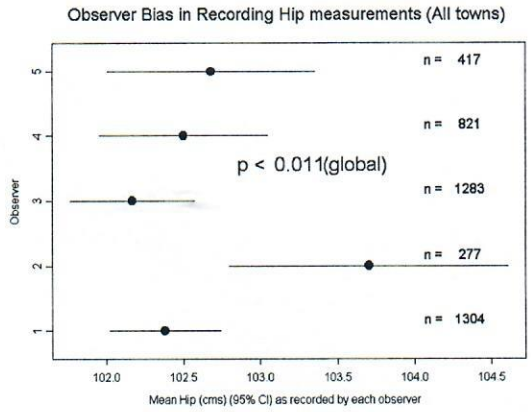












ADJUSTMENT

There was no evidence of heteroscedasticity for any of these measurements, but the blood pressure and skinfold measurements were observed to be lognormally distributed within towns. For these measurements we adjust using the arithmetic mean applied to observations on the log scale (equivalent to using a geometric mean [1] (see below)), and for the waist and hip measurements we adjust using the standard arithmetic mean to adjust each observer's town mean based on the overall town mean.

$$\log\left(\tilde{y}_{ijk}\right) = \log\left\{ y_{ijk} \frac{\left(\prod_{i,k} y_{ijk}\right)^{1/n_j}}{\left(\prod_{k} y_{ijk}\right)^{1/n_{ij}}} \right\}$$

$$= \log\left(y_{ijk}\right) + \frac{1}{n_j}\sum_{i,k} \log y_{ijk} - \frac{1}{n_{ij}}\sum_{k} \log y_{ijk}$$

$$= y^{*}_{ijk} + \left(\bar{y}^{*}_{.j.} - \bar{y}^{*}_{ij.}\right)$$

REFERENCES

[1] Bruce, Shaper, Walker, Wannamethee (1988), Observer Bias in Blood Pressure Studies, *J.Hypertension, **6**:375-380*