Hypertension and Happiness across Regions

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Abstract

Human well-being is important but hard to measure. Using data on approximately 100,000 individuals, this paper extends in two ways the Blanchflower and Oswald (2008) approach that proposes blood pressure as a biomarker of national happiness. First, we use objective rather than subjective measures of hypertension. Our analysis draws upon nurse-collected systolic and diastolic readings. Second, we document an apparently strong relationship – other factors held constant – between the measured blood pressure in an area and the level of GHQ mental strain in that area. We conclude, cautiously, that blood pressure may be a defensible biomarker for psychological well-being.

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1. Introduction

Some elementary measures of human well-being -- rates of early mortality, real Gross Domestic Product, malnutrition, cancers -- are easy to count. Governments in most developed nations currently do so. However, in the industrialized world, where starvation is largely a thing of the past, the quantification of subjective well-being in a broader sense is more complex than a century ago.

In a recent paper, Blanchflower and Oswald (2008) make an attempt to develop a form of 'biomarker' or physiological approach for use in the assessment of human happiness in rich nations. The authors study the cross-country correlation, within Europe, between a measure of psychological well-being and a measure of high blood-pressure. Their work -- building on the known clinical association at the micro level discussed in sources such as Jonas and Lando 2000 and Steptoe and Wardle 2005 -- uncovers what appears to be a systematic inverse relationship: 'happier' countries seem to report less hypertension. Their paper argues that this may help to validate the kinds of subjective well-being data now being routinely considered in comparisons of different nations. The authors also suggest that blood-pressure readings might form an element in a national well-being index. Complementary analysis has been done by Mojon-Azzi and Sousa-Poza (2007). Hudson (2006) studies other correlates with these same inter-country happiness patterns.

At its simplest, the intuitive idea behind biomarker work of this kind is that humans' fight-or-flight response means that when placed under strain the heart responds in ways that can be detected. If so, objective cardiovascular data can then potentially signal mental well-being or ill-being.

Blanchflower and Oswald are not the only writers recently to have made a case for taking subjective well-being data seriously in the evaluation of human welfare.[1] This form of research may presage -- as proposed in Diener et al 2008 and Dolan and Peasgood 2008 -- a move away from simple GDP targets of the sort that have been favoured in post-war economic policy. Nicholas Sarkozy of France has recently set up the Stiglitz Commission on the Measurement of Social and Economic Progress, on which a large number of economists and specialists sit, specifically to consider the issue of the right maximand for the future.

However, the Blanchflower and Oswald (2008) method is open to a justifiable criticism. It is that their international data provide only subjective hypertension measures. To make progress on the construction of a well-being proxy or index, a clear empirical justification for the use of life-satisfaction and happiness statistics is needed. Using only subjective blood-pressure assessments thus risks a circularity in which one set of subjective numbers are being employed to justify another set. It is known, for example, as discussed in Johnston et al (2009), that high blood pressure is often asymptomatic, so that subjective assessments inherently cannot be expected to provide error-free data.

This is the general problem we attempt to address.

2. Analysis

The data source we use is the Health Survey for England (HSE). The HSE is an annual survey and is designed to monitor trends in the nation's health. The unit of survey in the HSE is the household. Information is collected through a combination of a face-to-face interview, a self-completion questionnaire, and a medical examination (including various measurements such as height and weight, and the taking of a blood and saliva sample for clinical tests) conducted by a trained nurse. Three blood pressure measurements are available

[1] See for example Easterlin (1974, 2003), Ng (1997), Diener et al (1995), Frey and Stutzer (2002), Di Tella and MacCulloch (2006), Kahneman et al (2004), Offer (2006), and Van Praag and Ferrer-I-Carbonell (2004).

in approximately 99% of cases, so we take the average for both systolic and diastolic. In this paper, we pool data from the 1998 to 2007 HSEs.

We begin with the determinants of blood-pressure. Table 1 sets out a number of regression equations in which the dependent variable is either an objective or subjective measure of blood-pressure problems. These use Ordinary Least Squares, Dprobit and Ordered Logit methods. They are to be read vertically, and can be thought of as hypertension regression equations. Here the sample size in column 1 is 82,179 people. We control for the age of each person and its square, gender, ethnic origin, year dummies, and also for the level of education -- with seven schooling dummies that are not reported explicitly -- of each individual in the data set.

The main finding in Table 1 is the distinct pattern found in the regional dummy variables – running from high values of regression-corrected blood pressure in the North West to low values in the South West. The North East is the omitted base category. As can be seen, the systolic readings are approximately 4 points lower on average in London than in the North East. The South East and the South West are approximately 2 points lower than the North East. Yorkshire and Humberside also has a relatively high blood-pressure reading. Equivalent patterns are found in the next three columns – for objective diastolic blood pressure and then for two measures of subjective hypertension ('ever had high blood pressure', and 'above-normal blood pressure last time it was taken'). As explained above, wherever possible we average across three readings of systolic and diastolic blood pressure.

Table 2, which now includes nearly 109,000 observations, moves to regression equations in which the dependent variable is a standard measure of strain (or psychological ill-being), namely, GHQ. See, for example, its construction and use in sources such as Goldberg et al (1997) and Theodossiou (1998). Table 2 excludes 2007 because a GHQ score is unavailable that year.

A GHQ score, defined to lie between zero and 36, is a widely used mental well-being and psychiatric screening instrument that is an amalgamation of 0-3 integer answers to the questions:

Have you recently

1. *Been able to concentrate on whatever you are doing?*
2. *Lost much sleep over worry?*
3. *Felt that you are playing a useful part in things?*
4. *Felt capable of making decisions about things?*
5. *Felt constantly under strain?*
6. *Felt you could not overcome your difficulties?*
7. *Been able to enjoy your normal day-to-day activities?*
8. *Been able to face up to your problems?*
9. *Been feeling unhappy and depressed?*
10. *Been losing confidence in yourself?*
11. *Been thinking of yourself as a worthless person?*
12. *Been feeling reasonably happy all things considered?*

The control variables in the statistical analysis of Table 2 are, by design, exactly those in the Table 1 regressions for blood pressure. Column 1 uses an overall GHQ score which is the sum of twelve individual sub-components each scored as integer numbers from zero to three. Hence, by construction, the dependent variable has values that can range between zero and thirty six (mean=10.37 in these data). By contrast, in columns 2 and 3, we model separately two of its twelve components. These are #12 (denoted 'Happy') and #9 (denoted 'Unhappy') above.

In column 2 of Table 2, the dependent variable relates to whether over recent weeks the individual recently has *been feeling reasonably happy - more so than usual; about same as usual; less so than usual; much less than usual?* In column 3 of Table 2, the dependent variable is whether the individual had been feeling unhappy and depressed - *not at all: no more than usual; rather more than usual; much more than usual?* The structure of the

answers is similar across these columns, although it should be noted that the coefficients in the second column relate to happiness whereas in columns 1 and 3 to unhappiness, and hence they have opposite signs. For simplicity of reading and interpretation, Table 2 relies on an elementary cardinal estimator. The substantive results are almost identical with ordered estimators.

This paper's principal conclusion follows from a combination of Table 1 and Table 2. As is visible from the raw numbers, the regional pattern is approximately the same in the blood-pressure equations and the mental-strain equations. But with this analysis, unlike the equivalent correlation uncovered internationally in the Blanchflower and Oswald (2008) work, it is possible to show a relationship between an objective heart indicator and a measure of mental well-being. In this way, a potential circularity that might arise from the use of two subjective measures -- one on each axis – can be avoided.

Figures 1 to 4 illustrate the central point in a different way. Each graphical dot here is a separate English region. Each figure plots an indicator of blood pressure or hypertension for each area against an indicator of the level of happiness -- or more strictly the level of psychological stress -- in the area. More literally, the graphs display the region dummies from Table 1 against the region dummies from Table 2. Hence both are conditioned on people's characteristics. We also report R-squared coefficients for blood-pressure area dummies correlated with the GHQ area dummies.

For a two-tailed test, significance at 5% requires a Pearson correlation coefficient of approximately 0.6 and thus an R-squared of 0.36. So it can be seen that for objectively measured blood-pressure it is possible to reject the null hypothesis of no correlation. In this case, in fact, because the intention is to check and extend the known Blanchflower-Oswald pattern, a less restrictive one-tailed test might arguably be appropriate as the correct significance check.

Diastolic blood pressure works more strongly, in Figure 2, than systolic does in the figure before it. The subjective measures also give the same broad pattern, in both Figures 3 and 4, but, as perhaps might have been anticipated, the scatter is less tight and the null of zero cannot then be rejected.

We do not, in this paper, go through the regional correlations for a set of regression equations with huge numbers of different personal and demographic controls. We have checked, for example, for the influence of diet, exercise, income, social-class, and much else in regression equations of the general form of Table 1 and Table 2. The inter-region correlation in the region dummies is only marginally affected by altering the list of personal controls beyond those in the tables reported in the paper. It is also debatable whether it is desirable to introduce large numbers of endogenous variables. Currently, years of education might be seen as the only one, although regions' age and ethnic mix are themselves alterable over long periods.

We omit these checks with the varying sets of controls in the regression equations. Further details are available upon request.

3. Conclusions

This paper studies the connection across regions between the level of blood-pressure and the level of mental well-being. It builds on the intuition that, when under stress, human beings exhibit signs of strain on their cardiovascular system. We conclude, cautiously, that blood pressure provides a biomarker for psychological well-being. [2]

The paper is designed as an extension of, and a complement to, the international analysis of Blanchflower and Oswald (2008). Instead of using subjective high-blood pressure assessments on randomly sampled individuals in different countries, we draw on a

[2] It should perhaps be emphasized that we are not arguing that one causes the other, but rather that they offer complementary ways of detecting the underlying human well-being condition. The objective blood-pressure readings suggest a further reason to take seriously, and thus go some way to help validate, the regional pattern found in mental well-being data.

large sample of randomly selected English citizens who have their systolic and diastolic blood pressure levels taken by nurses.

The paper's main statistical result is a simple but, we believe, important one. It is that the pattern of region dummies in tables like Table 1 is similar to the pattern of the dummy variables for regions in a table like Table 2. In other words, after correcting for other influences such as the ethnic and educational structure of different populations, areas with high levels of GHQ mental strain are also areas of high blood pressure. This is consistent with the idea that a biological marker, that of objectively recorded blood pressure, may give us reliable information about a variable as subtle as the psychological health of a region. To a degree, human beings' happiness may be objectively measurable.

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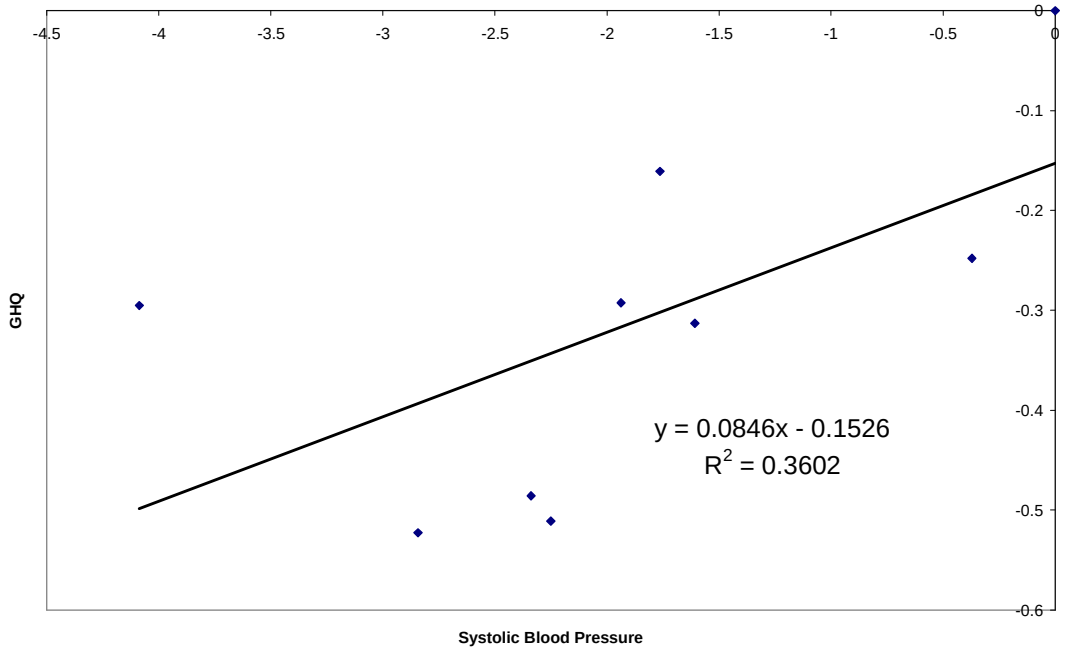
Figure 1. GHQ and Systolic Blood Pressure



Note to this and later figures: These points plot region-dummy coefficients from the appropriate columns of Table 1 against Table 2. The North-East area is [0,0].

Figure 2. GHQ and Diastolic Blood Pressure

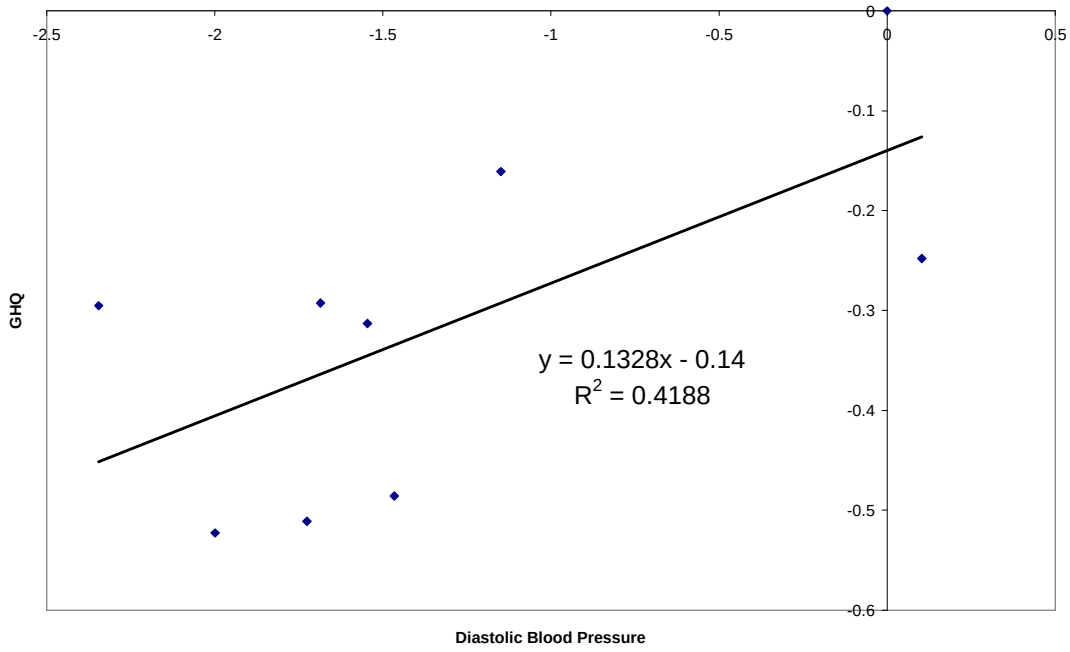


Figure 3. GHQ and Ever Had High Blood Pressure

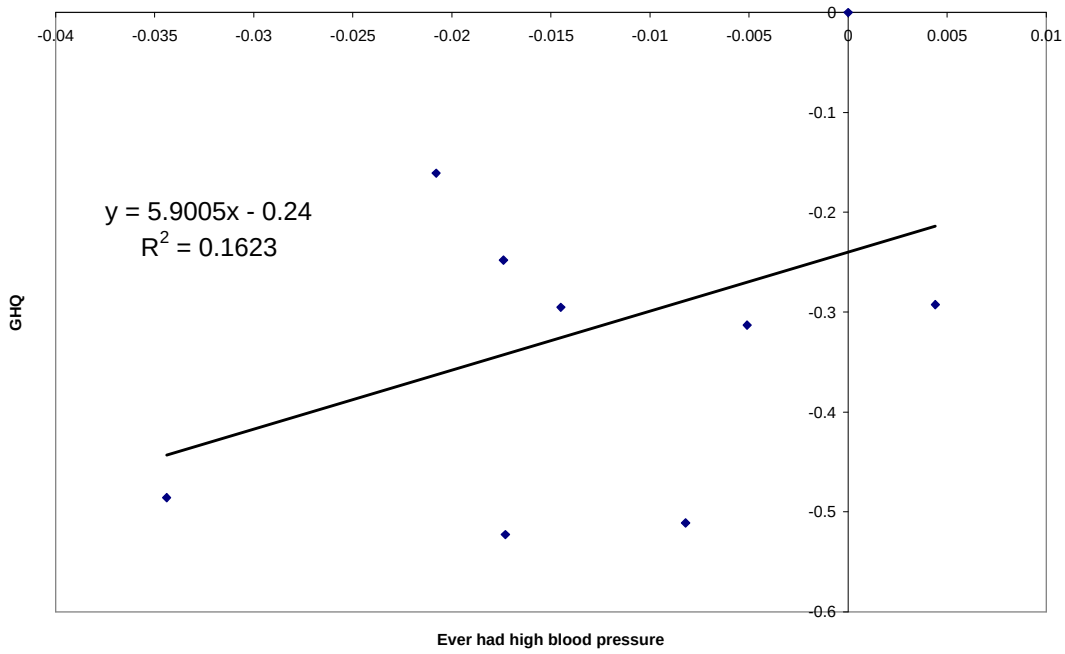


Figure 4. GHQ and Last Time Blood Pressure Measured

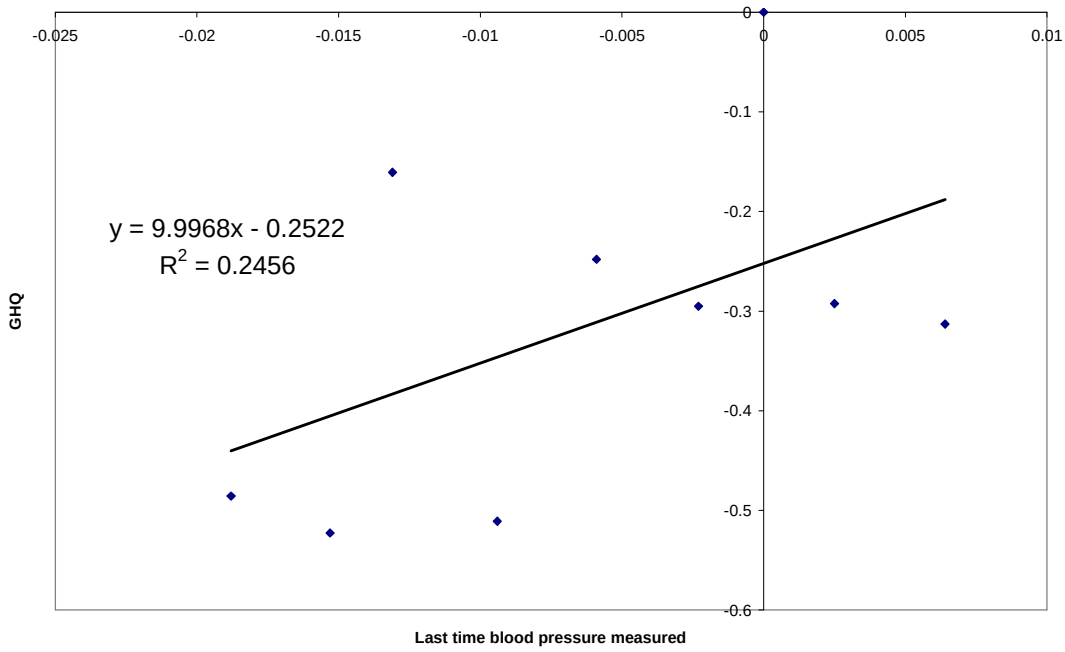


Table 1. Objective and Subjective Blood-Pressure Equations, 1998-2007

	(1)	(2)	(3)	(4)
	Systolic BP	Diastolic BP	Ever high	Last time above
	OLS	*OLS*	*Dprobit*	*OLS*
Age	.1362 (7.16)	.9693 (69.31)	.0169 (27.31)	.0044 (7.17)
Age squared	.0033 (17.66)	-.0082 (58.79)	-.00009 (15.91)	-.00001(2.20)
Male	5.4360 (45.99)	2.7058 (31.15)	-.0580 (16.03)	.0386 (10.26)
Asian	-1.6481 (5.99)	1.0329 (5.11)	-.0226 (3.08)	.0167 (2.31)
Black	2.1251 (6.16)	2.0596 (8.13)	.0539 (5.98)	.0577 (6.71)
Other race	-1.4211 (2.17)	-.2234 (0.46)	.0404 (1.91)	.0199 (1.02)
North West	-1.7633 (6.10)	-1.1489 (5.41)	-.0208 (2.28)	-.0131 (1.35)
Yorks & Humber	-.3721 (1.22)	.1031 (0.46)	-.0174 (1.79)	-.0059 (0.57)
East Midlands	-1.6083 (5.27)	-1.5462 (6.89)	-.0051 (0.53)	.0064 (0.64)
West Midlands	-1.9377 (6.32)	-1.6856 (7.48)	.0044 (0.45)	.0025 (0.25)
East Anglia	-2.8433 (9.46)	-1.9991 (9.05)	-.0173 (1.82)	-.0153 (1.52)
London	-4.0869 (13.48)	-2.3457 (10.53)	-.0145 (1.57)	-.0023 (0.24)
South East	-2.2508 (7.76)	-1.7260 (8.10)	-.0082 (0.89)	-.0094 (0.96)
South West	-2.3390 (7.78)	-1.4658 (6.63)	-.0344 (3.64)	-.0188 (1.84)
Year dummies	9	9	5	4
Constant	120.6277	50.1796		.8626
N	82,179	82,179	61,390	49,149
Adjusted R^2	.2541	.1157	.1119	.0292

Source: National Health Surveys of England, 1998-2007.

Notes: excluded categories: North East. The equations also include seven schooling dummies. The first two columns are for objective systolic and diastolic b.p. readings. The two final columns are subjective measures using respectively the following two questions. *Have you ever had high blood pressure? Was your blood pressure normal last time it was measured - below normal; normal; above normal?*

Columns 1 and 2 are for 1998-2007; column 3 1998-2000 and 2003-2006; column 4 1998-2000, 2003, 2004 and 2006

Table 2. GHQ Mental Strain Equations, 1998-2006 (OLS Estimates)

	(1) GHQ	(2) Happy	(3) Unhappy
Age	.0755 (15.91)	-.0065 (13.36)	.0060 (8.06)
Age squared	-.0008 (16.97)	.00006 (13.07)	-.00009 (12.69)
Male	-.9125 (30.48)	.0370 (11.95)	-.1093 (23.07)
Asian	.1158 (1.87)	.0054 (0.85)	.0215 (2.21)
Black	-.2773 (3.42)	.0221 (2.65)	.0257 (2.01)
Other race	.1857 (1.07)	-.0142 (0.79)	.0597 (2.18)
North West	-.1608 (2.15)	.0105 (1.36)	-.0304 (2.57)
Yorks & Humber	-.2479 (3.17)	.0130 (1.60)	-.0309 (2.50)
East Midlands	-.3131(4.00)	.0223 (2.76)	-.0317 (2.56)
West Midlands	-.2925 (3.74)	.0268 (3.30)	-.0401 (3.23)
East Anglia	-.5227 (6.80)	.0355 (4.45)	-.0810 (6.65)
London	-.2952 (3.86)	.0187 (2.36)	-.0185 (1.53)
South East	-.5110 (6.86)	.0323 (4.19)	-.0705 (5.98)
South West	-.4857 (6.23)	.0368 (4.56)	-.0641 (5.18)
Constant	10.0993	3.0922	1.8789
N	107,822	108,648	108,577
Adjusted R^2	.0179	.0055	.0159

Source: National Health Surveys of England, 1998-2006.

Notes: excluded categories: North East. The dependent variable runs from 0 to 36. The equations also include seven schooling dummies and 8 year dummies.

The final two columns are for two sub-questions within the GHQ scoring. *We should like to know… Have you recently a) been feeling reasonably happy - more so than usual; about same as usual; less so than usual; much less than usual? b) been feeling unhappy and depressed - not at all - no more than usual; rather more than usual; much more than usual?*