Self-rated health, happiness, and global well-being: Evidence from the World Values Survey*

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Abstract

Using the World Values Survey, we analyze the relationship between happiness and self-rated physical health. We look at the joint distribution of health and happiness in a sample of over 200,000 individuals from 82 countries. Both in the case of happy predicting healthy, and vice versa, the relationship is highly statistically significant, and extremely robust to the inclusion of every available control variable. Coefficients in the health regressions can be fragile to the inclusion of happiness as a control, which has potentially important implications for happiness as an omitted variable in health research. If happiness should be included, then many existing models are misspecified. On the other hand, if happiness should not be included, then misspecification is not a problem, but justification for exclusion of such an important variable needs to be developed. This is applicable broadly to the epidemiology of self-rated health. We give a concrete example of model fragility with marital status and health, making it more than a theoretical concern.

Keywords: health, happiness, cross-national comparisons, marital status and health, model specification.

Word count, including tables and references: 7,508.

1 Introduction

In this paper, we bring the relationship between health and happiness — regardless of causal direction(s) — into sharp relief, by examining a large data set spanning many countries. We show that the association between health and happiness is highly statistically significant, and robust to every type of available control variable. Further, we show that inclusion of happiness can make regression models of self-rated health quite fragile. This raises a number of uncomfortable questions about self-rated health. One possibility is that happiness is a reflection of self-rated health, in which case happiness does not belong on the right hand side of the regression equation, and the model fragility is a moot point. On the other hand, if happiness should be included, we show it can make a major difference, and that its omission is a problem. One goal of this paper is to prompt researchers to think more seriously about these questions.

In and of itself, the association between happiness and health is neither a novel finding nor theoretically surprising. See, e.g., Dua (1994); Pettit et al. (2001); Clark and Oswald (2002); Easterlin (2003); Pressman and Cohen (2005); Deaton (2008); Yang (2008b) on the association of these two variables. Blanchflower and Oswald (2008) show that individuals in happier nations report lower blood pressure. Much cross-national research on happiness focuses on the associations between individual happiness and national wealth (Diener 1994) and political ideology (i.e., collectivist versus individualistic; Suh et al. 1998). Happiness could make people healthier through a variety of mechanisms, including success in various areas of life (which could influence health via still-different mechanisms). Equally, health could cause happiness — most obviously, poor health could reduce felicity. Moreover, healthy people are better able to participate in markets of employment and marriage, and so on. There may be many feedback loops in motion. This paper makes the case that whenever self-reported health is collected in survey data (and it is collected often), self-reported happiness should be included also.

2 Data

This study uses data from the World Values Survey (WVS) (cf. World Values Survey nd). The WVS is a set of national surveys designed to be integrable, by asking the same questions in each country. The WVS includes questions on both happiness and self-rated health. Happiness (4-point) and self-rated health (4- or 5-point) are measured on Likert scales. Since 1981, four waves of the WVS have been collected for nationally-representative samples in 86 countries. Respondents participated in a face-to-face interview outside the home. For this study, we analyze the integrated four-wave public release data file that includes observations for 211,312 individuals, spanning 82 countries where both health and happiness questions were asked in the same survey. The sample size for the country-waves ranges between 236 and 3,392 respondents (Montenegro, 1996; and Turkey, 2001, respectively).

The WVS measures self-rated health through the following question: "All in all, how would you describe your state of health these days? Would you say it is: Very good; Good; Fair; Poor"; some countries added "Very Poor" as a fifth category. We coded the health measure such that higher scores represent better health. Self-rated health is known to be a valid indicator of underlying physical health (Mossey and Shapiro 1982; Idler and Benyamini 1997; Idler et al. 2000; Goldman and Glei 2007). Recently, self-rated health has come under scrutiny, for its sensitivity to questionnaire wording after language translation (Bzostek et al., 2007), and for differential validity across social strata (Singh-Manoux et al., 2007; Dowd and Zajacova, 2007; Huisman et al., 2007). Nonetheless, self-rated health often remains the only available measure of health, physical measures being too expensive or impractical to collect in much survey research.

In this study, like others, happiness is measured as self-report of well-being. Diener (2000) identifies four main components that influence happiness: "life satisfaction (global judgements of one's life); satisfaction with important domains (e.g., work satisfaction); positive affect (experiencing many pleasant emotions and moods); and low levels of negative affect (experiencing few unpleasant emotions and moods)". Previous survey research has measured happiness as a single-item response as well as through multiple-item measures (Watson et al. 1988).

Accurate measurement of subjective well-being is a challenge (Campbell et al. 1976). Self-reported happiness can be affected by contextual factors and by item ordering on the survey instrument (Schwarz and Strack 1999). Moreover, responses can be contaminated by perceptions of what is normatively appropriate (Diener 2000). In cross-national research, cultural differences in the meaning of happiness can affect reporting (Kahneman and Riis

	happy			healthy	
healthy	mean	SD	*happy*	mean	SD
1	2.248	0.975	1	2.902	1.132
2	2.498	0.827	2	3.266	0.906
3	2.814	0.719	3	3.771	0.833
4	3.065	0.643	4	4.184	0.864
5	3.385	0.666			

Table 1: Descriptive statistics of happy, disaggregated by self-rated health status (left), and of self-rated health, disaggregated by happiness (right).

2005). However, intraindividual self-reported happiness has been shown to be stable enough to be considered a personality trait (Eid and Diener 1999).

In the WVS, happiness is measured through a single-item question shown to be an effective measure of well-being (Andrews and Withey 1976; Inglehart 1990). Respondents are asked the following question: “Taking all things together, would you say you are: Very happy; Rather happy; Not very happy; Not at all happy”. As with health, we coded the happiness responses in ascending order.

Table 1 gives the health-specific means and SDs for happiness, and the happiness-specific means and SDs for health. Table 2 (p. 5) gives other descriptive statistics. Table 3 (p. 7) gives the joint distribution of happiness and self-rated health for the whole data set and for five countries chosen to illustrate different national patterns.

Table 3 (p. 7) shows a strong diagonal association between happiness and health for whole sample (top left panel). As health increases, the modal happiness value increases monotonically. Following the italicized entries in table 3, as one climbs the health ladder, 1–5, one progresses along modal hap-

variable	N	mean	SD	p25	median	p75
key variables						
happy	211312	3.016	0.740	3	3	4
healthy	211312	3.760	0.926	3	4	4
demography						
age	209508	40.644	16.081	27	38	52
female [I]	211312	0.515				
has any children [I]	194299	0.760				
marital status						
married [I]	211312	0.605				
cohabiting [I]	211312	0.049				
divorced [I]	211312	0.046				
widowed [I]	211312	0.062				
socioeconomic status						
income	182642	4.690	2.452	3	4	6
social class	123419	2.665	0.985	2	3	3
education						
education: low [I]	135904	0.360				
education: medium [I]	135904	0.423				
education: high [I]	135904	0.217				
job market status						
employed full-time [I]	206113	0.389				
employed part-time [I]	206113	0.074				
self employed [I]	206113	0.094				
retired [I]	206113	0.124				
housewife [I]	206113	0.153				
student [I]	206113	0.070				
unemployed [I]	206113	0.080				
other employment [I]	206113	0.017				
religion						
freq. of attend religious services	199603	4.422	2.577	2	5	7

Table 2: Descriptive statistics of regression variables. [I] denotes indicator variable; these variables are naturally-coded (0/1), so means may be interpreted as the proportion of the sample with the characteristic. p25/p75 are the 25th/75th percentiles.

piness values of 2-3-3-3-4 . The aggregate masks some interesting country-level variation. In the USA (table 3, top right), even at the lowest value of healthy, the modal value of happy was tied between the two highest values. India (table 3, middle right) exhibits a more strongly diagonal pattern, while China, Hungary, and Nigeria all exhibit non-diagonal patterns. For example, in Nigeria (table 3, lower right), at all levels of self-rated health, the modal value of happiness was 4, the maximum. A similar pattern holds for China (middle left) and Hungary (lower left), except that the second-highest happiness level (3) is modal for all levels of health. All these tables amply reject the null hypothesis of no association in a Pearson χ^2 test, with the p-values all less than 0.0005.

More striking than the diagonality in table 3 is the sparseness of the off-diagonal. Happiness may only predict health in a fuzzy manner (or vice versa), but, apparently, healthiness predicts unhappiness almost perfectly — viz., those who self-report as most-healthy almost never report being unhappy. The strength of this is remarkable. For example, in the USA in 1999, out of 498 respondents self-rating as most-healthy, zero rated themselves as least-happy. Similarly, in Hungary in 1998, out of 304 people self-rating as 4 or 5 on health, there were no reports of the lowest happiness level. It is natural enough, looking at table 3, to infer that those who considers themselves to be fully healthy would not also self-rate as least-happy, precisely because of their hale state. Yang (2008a) shows that in the United States in the aggregate, happiness outlasts healthiness later in life, suggesting that, if happiness is driven by health, it is a lagging indicator. However, causality could run in the other direction, such that least-happy people do not regard themselves as healthy, because of their mental state.

	Entire sample, all years				
	healthy				
happy	1	2	3	4	5
1	686	1,660	1,974	1,289	570
2	*919*	5,678	16,824	10,870	3,323
3	707	*5,920*	*33,663*	*52,434*	21,515
4	316	1,561	9,310	18,904	*23,189*

	USA 1999			
	healthy			
happy	2	3	4	5
1	2	1	2	0
2	8	25	19	14
3	*11*	*102*	*302*	235
4	*11*	35	176	*249*

	China 2001			
	healthy			
happy	2	3	4	5
1	15	7	3	3
2	45	78	40	26
3	*56*	*155*	*241*	*210*
4	8	22	27	58

	India 2001			
	healthy			
happy	2	3	4	5
1	36	31	18	4
2	*79*	192	123	23
3	62	*230*	*541*	118
4	31	67	147	*261*

	Hungary 1998				
	healthy				
happy	1	2	3	4	5
1	7	9	9	0	0
2	5	27	59	21	3
3	*11*	*31*	*154*	*171*	*48*
4	0	7	20	35	26

	Nigeria 2000			
	healthy			
happy	2	3	4	5
1	1	3	8	6
2	5	56	46	40
3	4	51	279	172
4	*10*	*83*	*283*	*974*

Table 3: Joint distribution (counts) of happy and healthy, for the data set as a whole (top left), and for five indicative countries. Reading down each column of health, the modal value of happiness is italicized. The Pearson χ^2 test is significant ($p < 0.0005$) for all of the tables. Confer text for discussion.

Figure 1 presents scatterplots for happy *vs.* healthy, and healthy *vs.* happy, for all 211,312 observation (all countries, all years). This figure is the visual analogue of the top left tabulation of table 3. Because happy and healthy are both measured on Likert scales, an unmodified scatterplot would

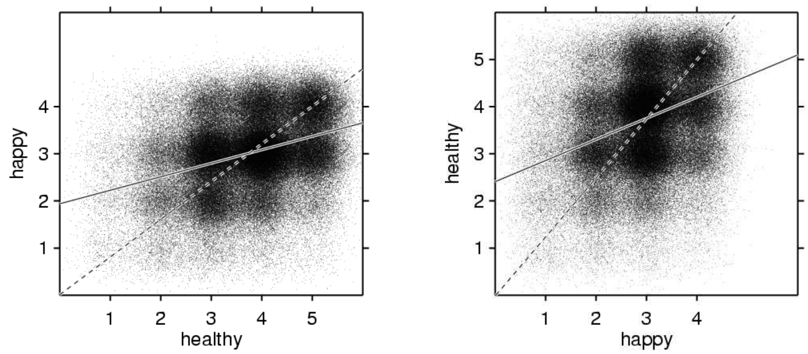

Figure 1: Jittered scatterplots, happy *vs.* healthy, and healthy *vs.* happy. Each panel depicts 211,312 points. These have been jittered by adding normally-distributed noise to each point, to avoid overlap at the 20 combinations of happy and healthy. The regression lines (solid) and SD lines (dashed) are also plotted. Please refer to text for more discussion.

show nothing but dots arranged in a grid; all the observations lie exactly on one of twenty combinations of happiness and health. To prevent this, we added normally-distributed random noise to each observation in figure 1, a technique known as jittering (Cleveland 1993). Through jittering, the overlapping points become a cloud, thus conveying density. The diagonal nature of these data, as discussed above, is seen in figure 1. Also apparent is the relative sparseness of the data at both the least-happy and least-healthy measures. Superimposed on the scatterplots are the regression lines (solid) and SD lines (dashed). The SD line (Freedman 2005), also called the reduced major axis (Sokal and Rohlf 1995), has slope equal to the ratio of the standard deviation of the y variable divided by the standard deviation of the x variable (and with the same sign as the correlation coefficient). The SD line and the regression line intersect at the point of averages (i.e. $(\bar{x}, \bar{y})$). The SD line, which is steeper, splits the scatterplot more symmetrically. It is also the line obtained by running an orthogonal regression, in other words when one minimizes the sum of squared right-angle distances between each point and the line, as opposed to the vertical distances as in the regression line. The advantage of this approach is that neither axis is privileged as plotting the "predictor" (x) or "outcome" (y) variables. A notable application of this logic to social science data is Preston (1976, chapter 6), who investigated male and female mortality using orthogonal regression.

3 Results

In this section we present a series of regression models of health on happiness, net of controls, and vice versa. Analyses were performed using Stata version 10.1 (Statacorp LP, College Station, TX). We estimate OLS models as follows:

$$E(\text{health}|X_{\text{happiness}}, \mathbf{X}) = \alpha + \gamma X_{\text{happiness}} + \boldsymbol{\beta}\mathbf{X} + \epsilon \quad (1)$$

$$E(\text{happiness}|X_{\text{health}}, \mathbf{X}) = \tilde{\alpha} + \delta X_{\text{health}} + \tilde{\boldsymbol{\beta}}\mathbf{X} + \varepsilon \quad (2)$$

where α and $\tilde{\alpha}$ are constants; γ, δ are the key coefficients of happiness (on health) and health (on happiness), respectively; $\mathbf{X}$ is a matrix of observed controls; $\boldsymbol{\beta}, \tilde{\boldsymbol{\beta}}$ are vectors of coefficients of the control variables; and ϵ, ε are error terms with presumed zero expectation.

Although for simplicity we refer to these models as OLS, we used Stata's survey estimation techniques throughout, so survey weights were used to calculate linearized (i.e., inflated) standard errors appropriately. We also performed ordered logistic regression (see, e.g., Agresti 1996), but this changed absolutely nothing of substance compared to the OLS (logistic tables not shown). Results for regressions like equation (1) are presented in table 4. Model 1a (referring to column numbers in table 4) is the most simple model, with a single coefficient (γ in equation (1)) and a constant. Staying in table 4, model 2a gives the exact same specification, when the sample is restricted to observations that are non-missing on all controls. In other words, model 2a has the same sample as model 12a, which we will discuss in due course. The coefficient of happy hardly changes in the restricted sample, which provides evidence that sample selectivity, from dropping observations when control variables are included, is modest.

In model 3a, country and year fixed effects are added. The degrees of freedom ("df" at the bottom of table 4), is for the model (i.e., it is the total number of estimated parameters, excluding the constant), and therefore jumps from 1 to 97. The coefficient on happy declines slightly in model 3a compared to model 2a, but is more sharply estimated ($t = 43.7$). This is not unexpected given that the fixed effects absorb a lot of country-to-country variation, and cross-national research using the WVS has found significant differences in reported happiness by country (Inglehart 1990).

Model 4a incorporates demographic characteristics, namely gender and age (quadratic). This causes a slight diminution in the coefficient for happy, but no change in statistical significance. Women report lower health, and, as expected, older age brings lower self-rated health. Previous studies have shown no gender difference in reports of happiness (Inglehart 1990; Michalos 1993). Model 5a includes marital status, with dummy variables for married, cohabiting, divorced, and widowed, with never-married as the omitted category. The married do not report better health in the overall WVS data set, which contradicts some single-country studies (Ross et al. 1990; Lillard and Panis 1996). This will be examined more below. In any case, including the dummies for marital status does not affect the coefficient for happy.

Model 6a adds income on an 11-point scale (as provided in the WVS dataset) and subjective social class (5-point Likert scale). The relationship between income and self-rated health is positive; this is not surprising given prior work (the literature here is vast; see Adler et al. 1994 or Case et al. 2002 for samples). Social class is also statistically significant; Townsend and Davidson (1992) discuss how social class may affect health independently of income per se. The coefficient of happy declines somewhat in the face of the income and class controls, but does not come close to losing statistical significance.

COEFFICIENT	(1a) healthy	(2a) healthy	(3a) healthy	(4a) healthy	(5a) healthy	(6a) healthy	(7a) healthy	(8a) healthy	(9a) healthy	(10a) healthy	(11a) healthy	(12a) healthy
happy	0.450***	0.449***	0.389***	0.360***	0.360***	0.348***	0.344***	0.346***	0.345***	0.346***	0.346***	0.349***
	(29.5)	(16.7)	(43.7)	(46.3)	(45.7)	(36.0)	(35.4)	(28.5)	(28.6)	(33.4)	(32.6)	(27.3)
female				-0.136***	-0.130***	-0.129***	-0.105***	-0.0926***	-0.0943***	-0.0976***	-0.0923***	-0.0856***
				(-18.6)	(-18.1)	(-10.8)	(-10.5)	(-8.28)	(-8.33)	(-8.15)	(-8.44)	(-6.63)
age÷100				-0.967***	-0.810***	-0.556***	-1.255***	-1.203***	-1.246***	-1.236***	-1.230***	-1.214***
				(-7.59)	(-6.30)	(-3.52)	(-7.35)	(-5.69)	(-5.90)	(-6.73)	(-6.66)	(-5.33)
$(\text{age}\div 100)^2$				-0.705***	-0.802***	-1.024***	0.0833	0.0581	0.0854	0.0389	0.0418	0.0378
				(-5.56)	(-5.96)	(-5.94)	(0.45)	(0.25)	(0.37)	(0.20)	(0.21)	(0.16)
married					-0.0368***	-0.0430**	-0.0273*	-0.0202	-0.0398*	-0.0535*	-0.0537*	-0.0490*
					(-3.87)	(-3.40)	(-2.14)	(-1.45)	(-2.30)	(-2.51)	(-2.48)	(-2.62)
cohab					-0.0793***	-0.0684***	-0.0523**	-0.0344	-0.0535*	-0.0712**	-0.0699**	-0.0518
					(-5.86)	(-4.06)	(-3.06)	(-1.66)	(-2.19)	(-2.95)	(-2.89)	(-1.95)
divorced					-0.0155	0.0147	0.0166	0.00920	-0.00820	-0.00707	-0.00919	-0.0143
					(-1.03)	(0.70)	(0.77)	(0.37)	(-0.31)	(-0.25)	(-0.32)	(-0.48)
widow					-0.0895***	-0.0568*	-0.0326	-0.0331	-0.0504	-0.0773*	-0.0832*	-0.0794**
					(-5.61)	(-2.55)	(-1.38)	(-1.34)	(-1.89)	(-2.36)	(-2.53)	(-2.72)
income						0.0226***	0.0163***	0.0188***	0.0187***	0.0168***	0.0175***	0.0176***
						(10.2)	(7.81)	(6.78)	(6.67)	(7.42)	(7.87)	(6.38)
social class						0.0709***	0.0609***	0.0588***	0.0594***	0.0555***	0.0557***	0.0580***
						(13.4)	(12.1)	(9.43)	(9.62)	(9.95)	(9.83)	(8.52)
middle-educ							0.0782***	0.0713***	0.0718***	0.0860***	0.0851***	0.0756***
							(7.67)	(5.85)	(5.85)	(8.55)	(8.32)	(6.63)
high-educ							0.124***	0.106***	0.108***	0.137***	0.139***	0.118***
							(8.89)	(6.83)	(6.88)	(9.27)	(9.30)	(7.25)
children									0.0318*	0.0303	0.0315	0.0366*
									(2.06)	(1.89)	(1.95)	(2.19)
rel. services											0.00442*	0.00262
											(2.21)	(1.20)
constant	2.391***	2.437***	2.964***	3.602***	3.586***	3.218***	2.757***	3.191***	2.992***	2.711***	3.275***	2.796***
	(44.1)	(26.6)	(50.7)	(61.8)	(62.0)	(76.7)	(54.9)	(43.7)	(16.0)	(44.8)	(59.2)	(17.5)
country FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
employment	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
ethnicity FE	No	No	No	No	No	No	No	Yes	Yes	No	No	Yes
relig denom FE	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
df	1	1	97	100	104	84	90	181	182	100	100	192
R^2	0.126	0.142	0.190	0.269	0.269	0.288	0.292	0.289	0.289	0.300	0.301	0.297
N	211312	55824	211312	209508	209508	108819	102209	69135	68388	80662	79594	55824

t statistics in parentheses; df is model degrees of freedom (number of estimated parameters, excluding constant)
*** p<0.001, ** p<0.01, * p<0.05

Table 4: OLS regression; dependent variable: self-rated health.

COEFFICIENT	(1b) happy	(2b) happy	(3b) happy	(4b) happy	(5b) happy	(6b) happy	(7b) happy	(8b) happy	(9b) happy	(10b) happy	(11b) happy	(12b) happy
healthy	0.279***	0.317***	0.233***	0.239***	0.234***	0.243***	0.246***	0.252***	0.251***	0.251***	0.251***	0.257***
	(33.4)	(20.1)	(42.8)	(41.9)	(41.0)	(35.2)	(34.7)	(28.8)	(28.6)	(32.1)	(31.5)	(26.7)
female				0.0474***	0.0614***	0.0610***	0.0509***	0.0431***	0.0434***	0.0442***	0.0431***	0.0330***
				(7.87)	(11.2)	(8.00)	(6.92)	(5.36)	(5.37)	(5.55)	(5.15)	(3.85)
age÷100				-0.170	-1.468***	-1.526***	-1.381***	-1.301***	-1.294***	-1.224***	-1.215***	-1.110***
				(-1.83)	(-15.8)	(-12.2)	(-10.0)	(-7.67)	(-7.52)	(-8.92)	(-8.86)	(-6.53)
$(\text{age}\div100)^2$				0.259**	1.601***	1.731***	1.544***	1.444***	1.439***	1.398***	1.367***	1.258***
				(2.66)	(17.0)	(13.5)	(10.4)	(7.82)	(7.72)	(9.52)	(9.44)	(6.93)
married					0.184***	0.176***	0.160***	0.138***	0.145***	0.158***	0.154***	0.142***
					(20.5)	(13.4)	(13.0)	(9.57)	(9.74)	(12.5)	(12.2)	(9.76)
cohab					0.0843***	0.0987***	0.0867***	0.0663**	0.0723**	0.0810***	0.0809***	0.0671**
					(6.33)	(5.67)	(4.91)	(3.21)	(3.45)	(4.47)	(4.48)	(2.95)
divorced					-0.126***	-0.0914***	-0.0990***	-0.107***	-0.0995***	-0.0905***	-0.0887***	-0.0970***
					(-12.4)	(-6.95)	(-7.15)	(-6.06)	(-5.29)	(-5.50)	(-5.45)	(-4.68)
widow					-0.0896***	-0.0524**	-0.0645***	-0.0754***	-0.0705***	-0.0624***	-0.0652***	-0.0639**
					(-7.96)	(-3.39)	(-4.17)	(-4.00)	(-3.51)	(-3.84)	(-4.00)	(-3.09)
income						0.0159***	0.0155***	0.0133***	0.0135***	0.0147***	0.0147***	0.0131***
						(7.91)	(7.48)	(5.20)	(5.18)	(6.66)	(6.60)	(4.81)
social class						0.0820***	0.0803***	0.0791***	0.0790***	0.0769***	0.0757***	0.0755***
						(12.8)	(12.6)	(9.86)	(9.76)	(11.4)	(11.0)	(8.87)
middle-educ							0.00658	0.0143	0.0149	0.0103	0.0103	0.0197
							(0.72)	(1.40)	(1.44)	(1.02)	(1.00)	(1.67)
high-educ							-0.0177	0.00104	0.000580	-0.0139	-0.0140	0.00464
							(-1.61)	(0.080)	(0.045)	(-1.18)	(-1.18)	(0.32)
children									-0.0118	-0.0130	-0.0127	-0.0198
									(-1.02)	(-1.26)	(-1.23)	(-1.67)
rel. services											0.0107***	0.0115***
											(4.72)	(4.13)
constant	1.962***	1.810***	1.396***	1.369***	1.517***	1.566***	2.142***	1.474***	1.862***	2.106***	1.450***	1.696***
	(49.1)	(26.3)	(17.8)	(16.6)	(18.8)	(36.4)	(45.7)	(12.4)	(7.87)	(37.7)	(27.1)	(17.6)
country FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
employment	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
ethnicity FE	No	No	No	No	No	No	No	Yes	Yes	No	No	Yes
relig denom FE	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
df	1	1	97	100	104	84	90	181	182	100	100	192
R^2	0.126	0.142	0.217	0.218	0.236	0.268	0.269	0.259	0.259	0.277	0.280	0.266
N	211312	55824	211312	209508	209508	108819	102209	69135	68388	80662	79594	55824

t statistics in parentheses; df is model degrees of freedom (number of estimated parameters, excluding constant)

*** p<0.001, ** p<0.01, * p<0.05

Table 5: OLS regression; dependent variable: happiness.

Model 7a adds dummies for employment status and for education. Employment status may be expected to affect health through selection effects (see, e.g., Arrighi and Hertz-Picciotto 1994). The estimates for the educational status dummies (high, medium, with low as the omitted category) are shown; these are context-specific rather than absolute. Not surprisingly, more education is associated with better self-reported health. This is also in-line with previous research (see, e.g., Schnittker 2004). The coefficient of happiness on health does not budge with the inclusion of employment status and education as controls.

In model 8a, we add fixed effects for ethnicities, and again the coefficient of happiness on health does not move except in the third decimal place. Ethnicities are country-specific and, for instance in the United States, overlap with what is typically called race. Previous research in the United States has found some differences in happiness along racial lines (Lawrence and Liang 1988). Having children (*vs.* not) is added in model 9a. The effect is small enough, at least net of other controls, that it may simply be due to the exclusion of very sick people from parenthood. Once again, the change in the coefficient of happy on self-rated health is negligible.

It is plausible that religion could affect one's outlook on life, and, therefore, happiness. Models 10a and 11a address this by including fixed effects for religious denomination. This is done in lieu of ethnicity fixed effects because of the colinearity of denomination and ethnicity in some WVS countries. Model 11a also includes frequency of attendance at religious services. Continuing a theme, the coefficient of happiness on health does not change. Net of the other variables in models 10a and 11a, including religion does not affect the relationship between happiness and health. Attendance at religious services has a small but statistically significant effect on health, and this may be because some people are too sick to attend services.

Model 12a is the so-called “kitchen sink” model, with everything. Specifically, ethnicity fixed effects are re-included. Again, the effect of happiness on self-rated health is hardly different from the other models. Recall that model 2a is the basic model, run with the restricted sample of model 12a.

Table 5 shows the same regressions as table 4, but our two key variables of interest have been swapped. Happiness is now the dependent variable, and self-rated health is a predictor. The models in table 5 are of the form of regression equation (2), and the key coefficient is now the estimate of δ. Model-by-model, the variables added are the same as in table 4, and we will not discuss each model individually. As with the prior family of models, the main coefficient of interest — in this case, representing the effect of health on happiness — is remarkably stable as other variables are added. Note that the other coefficients need not mirror across tables 4 and 5. For example, as discussed above, the education:health nexus is well established in the literature, and is reflected by significant coefficients in the expected direction in table 4. On the other hand, being more educated need not make one happier, and even with large sample size, the education coefficients for happiness (table 5) are not significant.

Note that model 2b, which differs from model 1b in sample only (i.e., it uses the restricted sample of model 12b) is a departure from the other models in table 5 (compare model 2a in table 4). Evidently, the sample attrition from adding covariates has more impact on the regressions when health is used to model happiness than vice versa. It is hard to see any basis to have predicted this, ex ante.

Goodness-of-fit statistics may seem like a logical place to look for guidance. Models 1a and 1b (and 2a and 2b) have the exact same R^2 (0.126 and 0.142, respectively) because, in the absence of control variables, the regression R^2 is simply the square of the Pearson correlation between happiness and health. In the presence of control variables, all bets are off. Specifically, the models are a better fit to the data when using happiness (plus controls) to fit self-rated health than vice versa. It seems to us that it would be jumping to conclusions to use the modest difference in R^2 (e.g., for model 11, 0.301 *vs.* 0.280) to infer that, generally, health is better predicted by happiness (net of controls) than the other way around. The difference in R^2 is not huge, and moreover these are nonexperimental data. As before, it is hard to see any clear reason (excluding ex-post rationalizations) why the goodness-of-fit statistics should favor happiness predicting health.

4 Discussion

Tables 4 and 5 establish that the association between happiness and health is undiminished in the presence of controls, regardless of which one is the dependent variable. How do we apply these findings to situations — quite common — where one does not have data on both dimensions? This approach, viz., running a set of regressions, then another set with interposed Y and X_1 variables (net of $X_2 \ldots X_N$ controls), is not an innovation, and we do not claim it as such. However, in the workaday practice of social research, coefficients that remain strong in the face of sequentially-added control variables are often implicitly (or explicitly) taken to be valuable predictors. Tables 4 and 5 are examples where the coefficients are remain strong in this manner. Yet, if we swap happy and healthy in these models, the strength does not diminish. Does being healthy cause one to be happy? Or does being happy improve one's self-rated health, and if so, is the mechanism perceptual or a real improvement in physical health? As with the goodness-of-fit statistics, the strength to inclusion of controls does not provide a basis for resolution. Accordingly, we are not trying to solve the causal directionality question, nor even to say whether the observed correlation is causal, at all (Freedman and Humphreys 1999 provide a critical appraisal of model-based approaches to causality).

One could use panel data, to establish temporal order. This has been done in Ballas and Dorling (2007), though observational longitudinal data do not escape the endogeneity problem (Oswald 2007). Happiness and health are hard or impossible to manipulate experimentally, ethically. Frey and Stutzer (2002) suggest instrumental variables, but happiness and health seem so intertwined that good instruments may be hard to find. There is a spirited debate about statistical inference of causality in the social sciences, and this is not the right place to wade deeply into those waters. Our posture here is like that of Aalen (2004): "at the end of the day, there are definite limits to how far one can get in understanding causal relationships from observational statistical studies". We acknowledge that there are differences of opinion on this point.

If we are not trying to infer causality, then what? Self-rated health is studied very often. Studies such as NHANES (the US National Health and Nutrition Examination Survey) collect objective physical health measures, but typically this is prohibitively expensive. This leaves self-rated health as the only measure of health in most survey research. Table 4 shows that subjective happiness has something to say about self-rated health. Ostensibly, happiness should be included in studies on health. On the other hand, health could cause happiness (or, at least, be a *sine qua non*), which would introduce concerns about tautology.

Our point is that, causality or no causality, there is a virtual cottage industry analyzing cross-sectional data on self-rated health. The present investigation illuminates the association between happiness and health and points to the important role of this association in survey research on health. This will also be relevant for those who are more sanguine than us about causal inference. So, for observational studies on health, what should be the role of happiness data? Happiness potentially makes a huge difference in real data and typical analyses.

Consider the study of health and marriage (Verbrugge 1979; Gove et al. 1983; Hahn 1993; Joutsenniemi et al. 2006; Liu and Umberson 2008). Table 6 shows two regression models that might be used to study this problem. For both models, health is the dependent variable, and the data are the same as before. Model 1c finds no significant health effect for the married or cohabitors compared to single people, net of controls for age, income, and so on. In many survey data sets, this would be a typical regression model. Model 2c introduces happiness — a variable available to us, but not always

COEFFICIENT	(1c) healthy	(2c) healthy
happy		0.345***
		(36.1)
married	0.0130	-0.0472**
	(0.74)	(-2.92)
cohab	-0.0366	-0.0662**
	(-1.61)	(-3.28)
divorced	-0.0313	0.00408
	(-1.21)	(0.17)
widow	-0.0874**	-0.0599*
	(-3.14)	(-2.34)
female	-0.117***	-0.128***
	(-9.01)	(-10.7)
age÷100	-1.300***	-0.664***
	(-7.87)	(-4.31)
$(\text{age}\div100)^2$	-0.279	-0.853***
	(-1.60)	(-5.15)
income	0.0271***	0.0191***
	(10.8)	(8.90)
social class	0.0964***	0.0598***
	(15.8)	(11.8)
middle-educ	0.0879***	0.0788***
	(7.91)	(7.57)
high-educ	0.132***	0.127***
	(8.33)	(8.75)
children	0.0233	0.0217
	(1.81)	(1.81)
constant	4.118***	3.231***
	(108)	(77.7)
country FE	yes	yes
year FE	yes	yes
df	85	86
R^2	0.226	0.291
N	104729	104729

t statistics in parentheses
*** p<0.001, ** p<0.01, * p<0.05

Table 6: OLS regression, the effect of including happiness.

included in this type of research — and is otherwise the same model, on the same sample. As is now familiar from table 4, the coefficient on happiness is highly statistically significant. More importantly, with the inclusion of happiness, both the married and cohabiting groups become statistically significant, and negative (as does, for that matter, the quadratic term for age). The overall picture is much different with happiness included. Happier people are healthier, all things being equal. But net of this happiness gradient in model 2c, the married do not enjoy better health. As we have noted, including happiness (or not) may only muddy the causal waters, but it clearly affects, in this example, the regression coefficients for marital status on health.

If the data are available, is it wise to include happiness in the regression when the dependent variable is health, as in table 6? Or is the correct specification to exclude happiness? If happiness belongs on the right hand side of the regression equation, that is fine, but it means that models that exclude it are misspecified — and as we see in table 6, the differences are not small. Many surveys collect data on health but not happiness, so carrying the logic forward, only misspecified models may be estimated from such data. On the other hand, if happiness is simply a mirror of health, it does not belong on the right hand side of the equation in the first place. However, table 3 and figure 1 show that health and happiness are not purely mechanical duplicates.

The result is a somewhat unhappy state of affairs. The unfortunate temptation is to include happiness when one wants a statistically significant coefficient (e.g. on married), and to exclude it otherwise. As Leamer (1983,

p. 38) puts it, "Sometimes I control for variable z, sometimes I don't". If one is agnostic about the sign of the marriage coefficient, the 6.5% absolute difference in R^2 between model 1c and model 2c may be an enticement to include happiness.

The model fragility is a case of omitted variables bias, a problem that has been studied for 50 years (Griliches 1957; Theil 1957) or longer (Hotelling 1940). However, this is a particularly pernicious case of omitted variables bias, as self-rated health is heavily used in social science research, and simultaneous happiness data are not usually available. This presents a quandary, heretofore inadequately considered, as to the meaning of self-rated health. Health and happiness seem to be two ways of looking at the same thing, namely overall well-being. Indeed, Covinsky et al. (1999) suggest that health and well-being are indistinguishable at older ages (Schnittker 2005 makes the subtler point that self-rated health at older ages is largely self-rated mental, not physical, health). In this sense, one should choose to examine happiness or health, but not both simultaneously. If one is a dependent variable, then including the other on the right hand side of a regression model would be tautological at best, and biasing at worse. As Greenland et al. (1999) point out, sometimes "adjustment for [a variable] is not only unnecessary but irremediably harmful (biasing)" (p. 43); Hernán et al. (2002) and Jewell (2004) (pp. 102-112) make similar points.

Herein lies the problem: as already discussed, happiness and health are concepts that are at least partly separable. If this were not so, then, for instance, the idea of poor health causing unhappiness would not make any sense. More reflection is needed on the roles of happiness and health in each other and in overall well-being, and these relationships may not be static in time, place, or age. Co-measurement of self-reported well-being should be a required adjunct to microdata collection where physical health is already measured.

5 Conclusion

1. Happiness matters for health, and vice versa. Causality can run either way, and this study does not address directionality. No available controls meaningfully diminish the magnitude nor statistical significance of the healthy-happy association, and this is true whether the dependent variable is happiness or, *mutatis mutandis*, health.

2. Regression models with self-rated health as the dependent variable are fragile to the inclusion of happiness. This is a potentially serious shortcoming of self-rated health research. Many things putatively related to health, such as marriage, are also intertwined with happiness. We show in an example how coefficients can change dramatically when happiness is added as a control.

3. Point 2 implies that a lot of thinking needs to be done on model specification for the study of self-rated health. Measuring happiness in studies of objective health will help to clarify this relationship, and should be pursued.

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