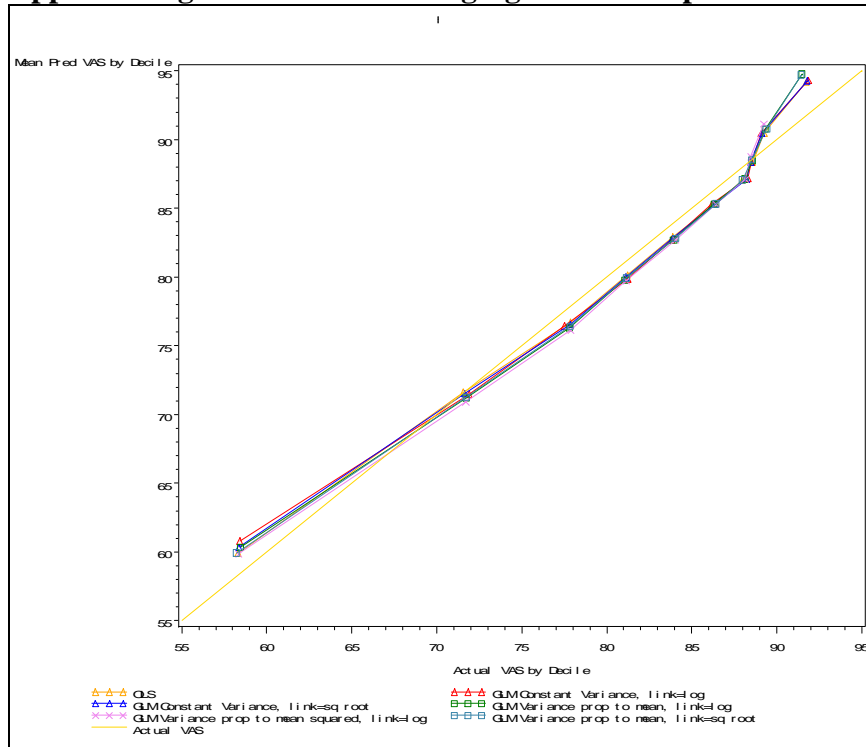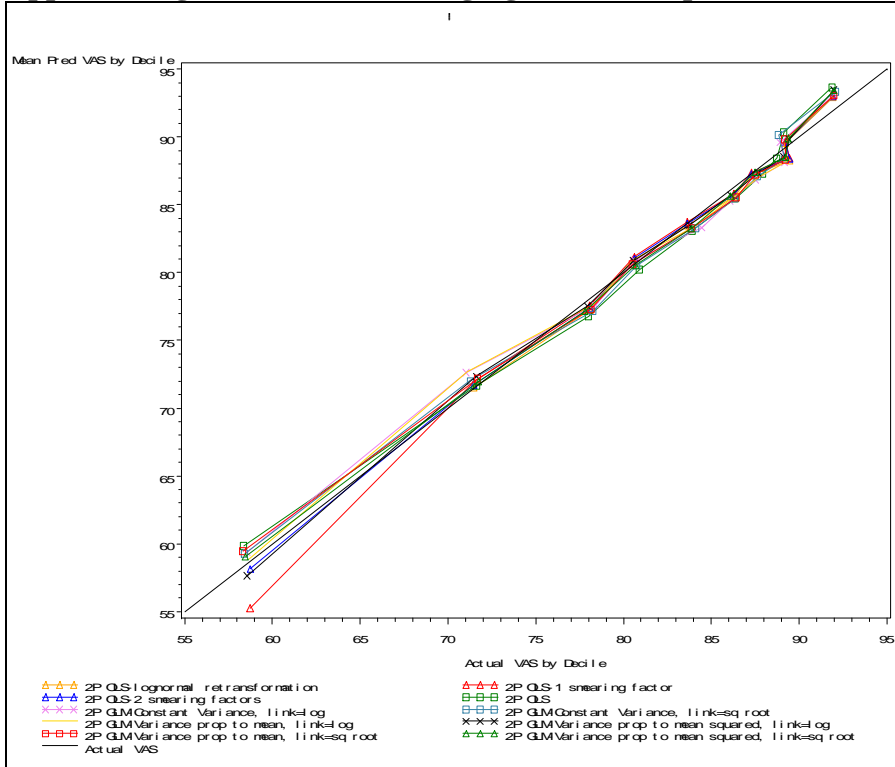## Appendix figures and tables

The analyses of the optimal functional form for the present paper were based on cross-national data in order to improve the stability of estimates (see Appendix Figure 1a, b, and Appendix Table 1). For a description of the sample, the reader is referred to

Alonso, J., Vilagut, G., Chatterji, S., Heeringa, S., Schoenbaum, M., Üstün, T.B., Rojas-Farreras, S., Angermeyer, M., Bromet, E., Bruffaerts, R., de Girolamo, G., Gureje, O., Haro, J.M., Karam, A.N., Kovess, V., Levinson, D., Liu, Z., Medina-Mora, M.E., Ormel, J., Posada-Villa, J., Uda, H., Kessler, R.C. (2010 epub). Including information about co-morbidity in estimates of disease burden: results from the World Health Organization World Mental Health Surveys. Psychological Medicine.

Appendix Figure 1a. Model-fitting figure for one-part models based on the WMH surveys

Appendix Figure 1b. Model-fitting figure for two-part models based on the WMH surveys

Legend:
- 2P OLS-lognormal retransformation
- 2P OLS-2 smearing factors
- 2P GLM Constant Variance, link=log
- 2P GLM Variance prop to mean, link=log
- 2P GLM Variance prop to mean, link=sq root
- Actual VAS
- 2P OLS-1 smearing factor
- 2P OLS
- 2P GLM Constant Variance, link=sq root
- 2P GLM Variance prop to mean squared, link=log
- 2P GLM Variance prop to mean squared, link=sq root

Appendix Table 1. Mean Square Error (MSE) and Mean Absolute Prediction Error (MAPE) of 17 one-part and two-part functional forms compared (based on the WMH surveys)

Model	MSE	MAPE
OLS	270.42279	11.809138
GLM Constant Variance, link=log	272.3286	11.856497
GLM Constant Variance, link=square root	271.313	11.832206
GLM Variance prop to mean, link=log	272.4885	11.872778
GLM Variance prop to mean squared, link=log	273.03428	11.896181
GLM Variance prop to mean, link=square root	271.46835	11.846401
GLM Variance prop to mean squared, link=square root*	983.79226	26.018077
2P OLS-lognormal retransformation	275.43747	11.833964
2P OLS-1 smearing factor	273.65284	11.753644
2P OLS-2 smearing factors	271.23583	11.72833
2P OLS	269.59903	11.770551
2P GLM-Constant Variance, link=log	268.49476	11.717132
2P GLM-Constant Variance, link=square root	268.22045	11.715089
2P GLM-Variance prop to mean, link=log	269.27739	11.711505
2P GLM-Variance prop to mean squared, link=log	270.88361	11.693274
2P GLM-Variance prop to mean, link=square root	268.90017	11.718927
2P GLM-Variance prop to mean squared, link=square root	269.90099	11.712024

* The negative of the Hessian is not positive definite. The convergence is questionable.
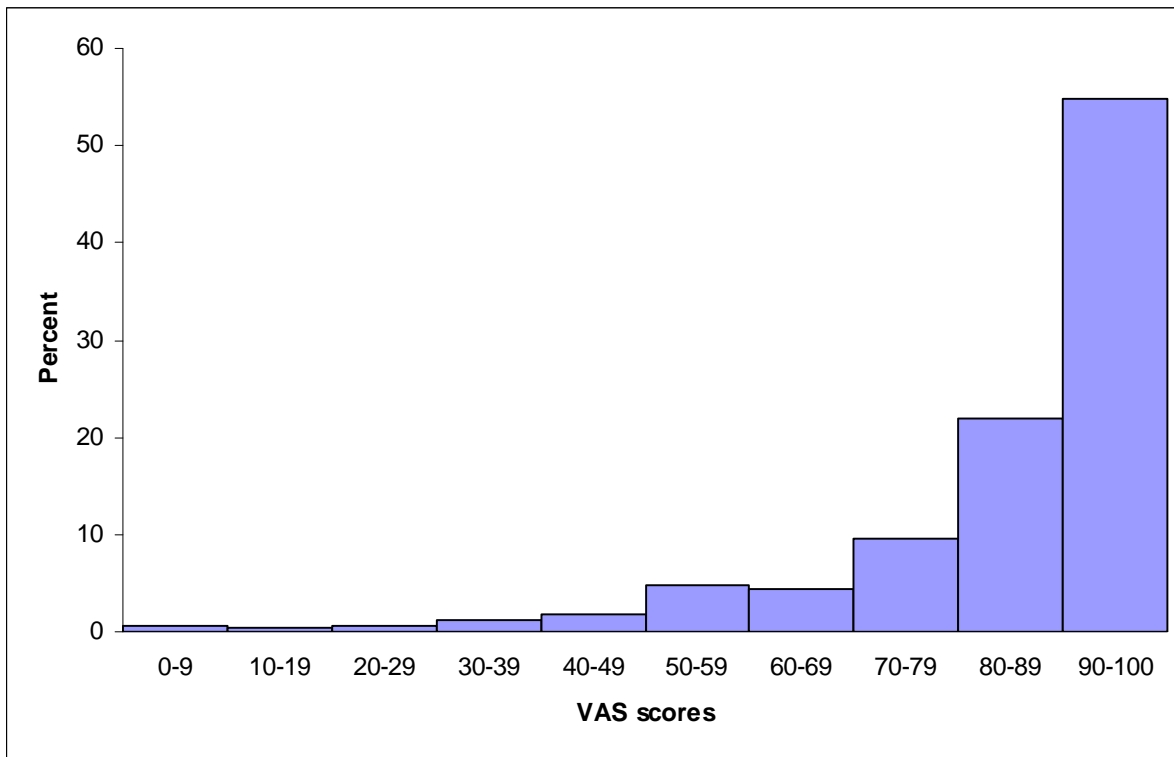
Appendix Table 2. Bivariate comorbidity among pairs of disorders: Unadjusted odds ratios and 95% CI

	Depression	BD	PD	SP	SoP	GAD	AA	DA	PTSD	Ins	Hea	Art	CPC	CD	RD	Dia	DD	ND
Bipolar disorder (BD)	15.5 (10.7, 22.3)**																	
Panic disorder (PD)	8.6 (6.4, 11.5)**	12.2 (8.4, 17.5)**																
Specific phobia (SP)	4.6 (3.6, 5.8)**	5.8 (4.1, 8.0)**	10.6 (8.0, 14.2)**															
Social phobia (SoP)	6.4 (5.2, 7.9)**	9.0 (6.5, 12.4)**	10.9 (8.2, 14.3)**	7.4 (5.8, 9.5)**														
Generalized anxiety disorder (GAD)	6.6 (4.7, 9.23)**	5.3 (3.2, 8.9)**	5.6 (3.8, 8.3)**	3.8 (2.8, 5.2)**	4.9 (3.3, 7.1)**													
Alcohol abuse (AA)	3.5 (2.6, 4.9)**	7.1 (3.9, 12.9)**	3.4 (2.0, 5.8)**	1.9 (1.3, 2.7)*	3.4 (2.3, 5.0)**	2.0 (1.1, 3.8)*												
Drug abuse (DA)	4.4 (2.8, 7.1)**	9.0 (5.3, 15.0)**	2.4 (1.0, 5.8)*	1.8 (0.9, 3.3)	4.0 (2.3, 6.9)**	3.0 (1.6, 5.8)*	33.0 (18.5, 58.8)**											
Post-traumatic stress disorder (PTSD)	8.2 (6.2, 10.7)**	8.4 (5.3, 13.2)**	9.4 (6.6, 13.4)**	6.2 (4.5, 8.4)**	6.3 (5.0, 7.8)**	0.8 (0.4, 1.7)	4.0 (2.7, 5.9)**	2.2 (1.2, 4.2)*										
Insomnia (Ins)	3.9 (3.2, 4.8)**	3.9 (2.8, 5.5)**	4.7 (3.7, 5.9)**	3.1 (2.5, 3.8)**	3.8 (3.2, 4.5)**	4.2 (3.1, 5.6)**	2.2 (1.5, 3.2)**	2.0 (1.2, 3.6)*	5.4 (4.1, 7.0)**									
Headaches or migraines (Hea)	3.8 (2.9, 4.9)**	3.9 (2.7, 5.6)**	4.0 (3.1, 5.1)**	2.8 (2.4, 3.3)**	2.2 (1.9, 3.4)**	2.7 (1.9, 3.6)**	1.5 (1.1, 2.2)*	1.7 (1.0, 3.1)	4.5 (3.6, 5.6)**	4.0 (3.2, 4.9)**								
Arthritis (Art)	1.2 (1.0, 1.4)	1.1 (0.9, 1.5)	1.6 (1.2, 2.2)**	1.6 (1.3, 1.9)**	1.2 (1.0, 1.5)	1.6 (1.2, 2.2)**	0.6 (0.4, 0.8)*	0.5 (0.3, 0.9)*	1.8 (1.4, 2.4)**	2.0 (1.7, 2.5)**	1.5 (1.3, 1.7)**							
Chronic pain conditions (CPC)	2.7 (2.2, 3.3)**	2.7 (1.8, 4.0)**	2.1 (1.7, 2.7)**	2.2 (1.9, 2.6)**	1.7 (1.4, 2.1)**	2.9 (2.1, 4.0)**	1.3 (0.9, 1.7)	1.1 (0.7, 1.8)	3.2 (2.5, 4.1)**	2.9 (2.5, 3.5)**	4.0 (3.3, 4.9)**	3.6 (3.0, 4.4)**						
Cardiovascular disorders (CD)	1.0 (0.8, 1.3)	1.0 (0.8, 1.4)	1.4 (1.0, 1.8)*	1.2 (1.0, 1.4)	1.0 (0.8, 1.3)	1.0 (0.8, 1.4)	0.5 (0.3, 0.7)**	0.7 (0.4, 1.3)	1.6 (1.2, 2.1)**	1.5 (1.1, 2.0)*	1.0 (0.8, 1.3)	3.9 (3.4, 4.6)**	1.9 (1.6, 2.2)**					
Respiratory disorders (RD)	1.6 (1.3, 1.9)**	1.6 (1.1, 2.2)*	1.7 (1.3, 2.2)**	1.6 (1.3, 1.9)**	1.4 (1.2, 1.8)**	2.0 (1.4, 2.9)**	1.1 (0.8, 1.6)	1.2 (0.8, 1.8)	1.8 (1.4, 2.3)**	1.7 (1.4, 2.0)**	2.2 (1.8, 2.6)**	1.5 (1.2, 1.8)**	2.0 (1.7, 2.4)**	1.1 (0.9, 1.3)				
Diabetes (Dia)	1.0 (0.6, 1.6)	1.1 (0.6, 2.1)	1.5 (0.9, 2.4)	1.2 (0.9, 1.7)	0.9 (0.6, 1.4)	1.2 (0.6, 2.2)	0.1 (0.0, 0.5)*	0.1 (0.0, 0.6)*	1.3 (0.9, 2.0)	2.0 (1.4, 2.8)**	0.6 (0.4, 0.9)*	3.2 (2.3, 4.4)**	1.9 (1.4, 2.5)**	8.0 (5.8, 11.0)**	0.9 (0.6, 1.4)			
Digestive disorders (DD)	3.3 (2.2, 5.0)**	4.3 (2.1, 8.6)**	2.8 (1.5, 5.2)*	2.4 (1.7, 3.4)**	2.4 (1.6, 3.6)**	2.6 (1.5, 4.7)*	1.9 (0.9, 4.0)	4.0 (1.9, 8.2)**	2.9 (1.6, 5.3)**	3.1 (2.0, 4.7)**	3.0 (2.2, 4.2)**	2.6 (2.0, 3.4)**	5.0 (3.4, 7.3)**	2.6 (1.7, 4.2)**	1.7 (1.2, 2.4)*	2.4 (1.4, 4.2)*		
Neurological disorders (ND)	1.9 (1.1, 3.3)*	0.8 (0.2, 2.4)	1.9 (0.9, 3.7)	2.0 (1.2, 3.5)*	1.7 (1.0, 2.9)	0.9 (0.3, 2.8)	1.7 (0.8, 3.8)	1.0 (0.1, 8.2)	3.0 (1.8, 5.0)**	1.3 (0.8, 2.0)	1.5 (0.8, 2.7)	1.5 (1.0, 2.3)	2.3 (1.5, 3.7)**	1.2 (0.7, 2.2)	1.8 (1.1, 2.9)*	1.7 (0.5, 5.5)	2.9 (0.8, 10.3)	
Cancer	0.8 (0.5, 1.3)	0.8 (0.4, 1.4)	0.9 (0.4, 1.6)	1.2 (0.9, 1.7)	0.9 (0.6, 1.4)	1.5 (0.9, 2.4)	0.5 (0.3, 0.9)*	0.5 (0.2, 1.7)	1.1 (0.7, 2.0)	1.6 (1.2, 2.2)*	1.1 (0.8, 1.5)	3.5 (2.6, 4.6)**	1.9 (1.4, 2.5)**	2.8 (2.2, 3.6)**	0.9 (0.7, 1.2)	1.6 (1.0, 2.6)*	1.6 (0.9, 2.6)	1.0 (0.4, 2.4)

* p<0.05
** p<0.001

Appendix Figure 2. Distribution of VAS scores

Appendix Table 2. Bivariate and multivariate associations between type and number of conditions and health valuations (regression coefficients and standard errors)[1]

	Bivariate [a] M0	Multivariate (types of conditions) [b] M1	Multivariate (# of conditions) [c] M2	Multivariate (types and # of conditions) [d] M3	Multivariate (M3 + interactions) [e] M4
Arthritis	-9.4 (0.8)*	-4.5 (0.7)*		-4.2 (0.9)*	-2.2 (1.1)*
Cancer	-1.4 (1.4)	1.0 (1.0)		1.3 (1.0)	1.0 (1.8)
Cardiovascular disorders	-9.2 (0.9)*	-5.4 (0.8)*		-5.2 (1.0)*	-4.8 (1.0)*
Chronic pain conditions	-12.1 (1.0)*	-6.7 (0.8)*		-6.2 (0.8)*	-4.8 (1.1)*
Diabetes	-10.3 (2.3)*	-5.9 (1.8)*		-5.5 (1.7)*	-2.3 (2.4)
Digestive disorders	-14.1 (2.6)*	-5.0 (2.6)		-4.3 (2.6)	-2.4 (3.2)
Headaches or migraines	-10.8 (0.8)*	-3.7 (0.7)*		-3.3 (0.7)*	-4.2 (1.4)*
Insomnia	-12.7 (1.3)*	-6.2 (1.2)*		-5.6 (1.1)*	-8.1 (1.7)*
Neurological disorders	-12.4 (3.4)*	-8.6 (2.5)*		-8.2 (2.6)*	-4.8 (3.1)
Respiratory disorders	-3.2 (0.8)*	-0.4 (0.7)		-0.2 (0.7)	-0.6 (0.6)
Alcohol abuse	-7.3 (1.1)*	-1.9 (1.2)		-1.6 (1.4)	-1.7 (2.4)
Bipolar disorder	-16.3 (1.5)*	-3.8 (1.6)*		-3.2 (1.6)*	-8.9 (3.0)*
Drug abuse	-9.7 (1.8)*	-3.1 (1.9)		-2.9 (1.9)	-3.6 (2.4)
Generalized anxiety disorder	-11.3 (0.9)*	-3.2 (1.3)*		-2.6 (1.5)	-6.2 (2.9)*
Major depressive episode	-14.0 (1.1)*	-5.9 (0.8)*		-5.5 (0.8)*	-4.4 (1.3)*
Panic disorder	-16.5 (1.4)*	-5.8 (1.3)*		-5.3 (1.4)*	0.3 (2.3)
Post-traumatic stress disorder	-15.0 (1.4)*	-3.6 (1.2)*		-3.0 (1.3)*	-1.2 (2.3)
Social phobia	-10.7 (1.1)*	-2.5 (1.2)*		-2.1 (1.4)	-4.1 (1.5)*
Specific phobia	-9.8 (0.8)*	-2.4 (0.8)*		-2.0 (1.0)*	-2.4 (1.4)
Exactly 1 condition			-2.4 (0.5)*		
Exactly 2 conditions			-5.3 (0.9)*	1.3 (1.1)	0.8 (1.2)
Exactly 3 conditions			-10.3 (0.7)*	0.3 (1.2)	-0.3 (1.7)
4+ conditions			-21.8 (1.3)*	-2.5 (2.3)	-3.2 (2.9)
Arthritis * #CD					-1.0 (0.4)*
Cancer * #CD					0.3 (0.6)
Chronic pain conditions * #CD					-0.5 (0.5)
Diabetes * #CD					-0.9 (0.6)
Digestive disorders * #CD					-0.4 (0.5)
Headaches or migraines * #CD					0.4 (0.4)
Insomnia * #CD					1.1 (0.5)*
Neurological disorders * #CD					-1.0 (1.0)
Respiratory disorders * #CD					0.6 (0.3)
Alcohol abuse * #CD					-0.0 (0.9)
Bipolar disorder * #CD					1.4 (0.7)
Drug abuse * #CD					0.2 (1.0)
Generalized anxiety disorder * #CD					1.0 (0.7)
Major depressive episode * #CD					-0.5 (0.5)
Panic disorder * #CD					-1.6 (0.6)*
Post-traumatic stress disorder * #CD					-0.4 (0.6)
Social phobia * #CD					0.7 (0.4)
Specific phobia * #CD					0.2 (0.4)

#CD, number of comorbid disorders
[1] All models use an OLS specification, adjusted by demographic controls.
* Significant at p-value<0.05 (two-sided test).
[a] Nineteen models were estimated with one condition at a time.
[b] A separate dummy variable predictor for each of the 19 conditions.

Appendix Table 3. Model comparisons for the multivariate associations of conditions on VAS scores

Model	AIC	BIC
M1. Types of disorders[a]	48789.9	48956.1
M2. Number of disorders[b]	49077.6	49144.1
M3. Types and number of disorders[c]	48777.9	48964.0
M4. M3 + interactions between types and number of disorders[d]	48752.3	49058.0

VAS, visual analog scale; AIC, Akaike's Information Criterion; BIC, Bayesian Information Criterion.

[a] A separate dummy variable predictor for each of the 19 conditions.

[b] A separate dummy variable predictor for having exactly one of the 19 disorders, exactly two of the 19 disorders, etc.

[c] The predictors in M1 and M2 with the exception that the dummy predictor for having exactly one disorder is omitted.

[d] The predictors in M3 plus interactions between each of the dummy predictors for type of disorders and a continuous variable for number of disorders.

Appendix Table 4. Tests of comparisons of groups of coefficients

Model	Contrast	Wald Chisq test	df	p-value
Model 1	Significance of all disorders as a set	1784.7	19	<0.001
Model 1	Significance of the differences among the 19 disorder coefficients	344.4	18	<0.001
Model 2	Significance of all number of disorders dummies as a set	399.2	4	<0.001
Model 3	Significance of all disorders as a set	539.7	19	<0.001
Model 3	Significance of the differences among the 19 disorder coefficients	324.8	18	<0.001
Model 3	Significance of all number of disorders dummies as a set	10.6	3	0.014
Model 4	Significance of all disorders as a set	172.4	19	<0.001
Model 4	Significance of the differences among the 19 disorder coefficients	122.1	18	<0.001
Model 4	Significance of all number of disorders dummies as a set	9.5	3	0.034
Model 4	Significance of all interactions as a set	112.5	18	<0.001
Model 4	Significance of the differences among the interactions	112.5	17	<0.001