

Online Supplements 1-5 for *Life satisfaction and mental health problems (18-35 years)*.

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Supplement 1: *Confirmatory factor analysis of life satisfaction items*

As described in the text of the paper, confirmatory factor analysis was conducted to examine the dimensionality of the life satisfaction items at each assessment (18, 21, 25, 30 and 35 years). The approach taken was to fit a single factor model of the item set at each age, while allowing for sources of correlated specificity between items tapping similar domains.

Model fitting was conducted using Mplus 7 (Muthén and Muthén, 1998-2012) and methods of maximum likelihood estimation robust to data non-normality. Model goodness of fit was assessed using a number of indices including: the log likelihood ratio chi square fit statistic; the comparative fit index (CFI); the root mean square error of approximation (RMSEA); and the standardized root mean square residual (SRMR). In well-fitting models the values of CFI should be approaching one, RMSEA should be less than 0.05, and SRMR should be close to zero (Schermelel-Engel *et al.*, 2003).

In the first instance a single factor model with uncorrelated residuals was fitted to the item set separately for each assessment. In all cases the fit of the model to the observed data was relatively poor. However, in all cases inspection of model modification indices showed that the fit of the model could be improved by allowing correlated residuals for some item pairs. These correlations appeared to reflect sources of specificity common to items that reflected similar domain, for example, between items 5 and 6 (relationships with people of the same sex, opposite sex), and between items 2 and 8 (the work you do, the money you get). Further, the patterning of correlated residuals appeared remarkably consistent across assessments.

A further model was fitted to the data at each age incorporating a series of correlated residuals for each item set. To avoid capitalizing on chance variations in the data, correlated residuals were included in the fitted model only if they were observed on two or more of the five assessments.

Supplement Table S1.1 below shows the factor loadings for the 11 life satisfaction items from the models incorporating correlated residuals and the corresponding goodness of fit indices at each age. All models appeared to provide an adequate fit to the observed data. In addition, the fitted models showed remarkable consistency of factor loadings across all assessments. These findings suggest that, with some allowance for correlated specificities, the data were consistent with an underlying latent dimension reflecting overall life satisfaction at each age, and further that the 11 items behaved in a very consistent manner over time. In all cases, the CFI was greater than 0.98, the RMSEA was less than 0.05 and the SRMR was less than 0.025.

Table S1.1. Factor loadings and goodness of fit indices for single factor models fitted to the life satisfaction data at ages 18, 21, 25, 30 and 35 years

Item	18 years	21 years	25 years	30 years	35 years
1. Your life as a whole	.59	.69	.69	.65	.66
2. The work you do (on the job, in your education, at home)	.44	.50	.50	.55	.56
3. What you do in your spare time (sport, hobbies, etc.)	.58	.64	.63	.68	.64
4. Your partner relationships	.38	.47	.52	.45	.47
5. Your relationships with people of the same sex	.62	.63	.67	.71	.69
6. Your relationships with people of the opposite sex	.62	.63	.69	.69	.69
7. Your social life	.70	.58	.62	.71	.68
8. The money you get each week	.39	.41	.46	.49	.54
9. Your independence - being able to do what you want	.59	.62	.66	.64	.60
10. The people you interact with on a day to day basis, e.g., workmates, friends, etc.	.63	.57	.58	.52	.66
11. Your future	.59	.67	.64	.65	.71
Goodness of fit indices					
$\chi^2(df)$	51.7 (31)	83.6 (31)	79.5 (31)	69.2 (29)	74.1 (29)
RMSEA	.026	.041	.040	.038	.040
SRMR	.020	.024	.023	.021	.020
CFI	.992	.982	.985	.987	.986

RMSEA = root mean square error of approximation; SRMR = standardised root mean square residual; CFI = comparative fit index

For analysis purposes, scale score estimates of overall life satisfaction were constructed from an unweighted sum of the 11 items at each age. Table S1.2 shows the matrix of correlations, means, standard deviations and reliabilities (Cronbach's α) for the five scale scores. All scales were of moderate to high internal consistency with α 's ranging from $\alpha = 0.84$ to $\alpha = 0.89$. The life satisfaction scores show continuity with across time correlations ranging from $r = 0.30$ to $r = 0.53$.

Table S1.2. Matrix of correlations, means, standard deviations, and reliabilities for life satisfaction scores at ages 18, 21, 25, 30 and 35 years

Assessment age	18 Years	21 Years	25 Years	30 Years	35 Years
18 Years	1.00				
21 Years	0.42	1.00			
25 Years	0.36	0.48	1.00		
30 Years	0.32	0.43	0.52	1.00	
35 Years	0.30	0.36	0.48	0.53	1.00
Mean	34.97	35.18	36.07	36.18	36.19
Standard Deviation	3.78	4.11	4.31	4.39	4.36
Reliability (α)	0.84	0.86	0.87	0.88	0.89

It could be suggested that the inclusion of correlated residuals in the fitted models potentially impugns the structural validity of the life satisfaction scale. To examine this issue, the single factor models at each age were fitted eliminating items with correlated residuals and re-estimating the factor score using only the remaining items. The reduced scale included 5 items (items: 3, 6, 8, 9, 11). In each case, a single factor model fitted to the 5-item scale showed an excellent fit to the observed data. Further, comparison of the correlations between the original (11 item) scale including correlated residuals and mental health problems with the same correlations for the reduced 5-item scale, showed that the correlations were virtually identical. This suggests that the properties of the life satisfaction scale were robust to the manner in which this scale was constructed.

Supplement 2: Source data for GEE models of the associations between specific mental health problems and life satisfaction (18-35 years)

Table S2.1. Life satisfaction scores (mean, S.D. (n)) by presence of mental health problems (past 12 months) observed at 18, 21, 25, 30 and 35 years, and pooled over all observations; and fitted regression model coefficients testing for mental health by age and mental health by gender interactions

Predictor	Mean, S.D. (n) life satisfaction score by presence/absence of mental health problem		Tests of significance
	Problem present	Problem absent	
<u>Major depression</u>			
17-18 years	94.5, 9.6 (186)	99.1, 8.6 (838)	Major depression B=-4.380, S.E.=0.388, $p<0.001$ Age: B=0.150, S.E.=0.020, $p<0.001$ Gender: B=1.566, S.E.=0.437, $p<0.001$ Major depression x age: B=-0.104, S.E.=0.064, $p=0.105$ Major depression x gender: B=0.531, S.E.=0.830, $p=0.523$
20-21 years	94.8, 10.3 (184)	99.6, 9.4 (827)	
24-25 years	95.9, 10.2 (146)	101.7, 10.0 (852)	
29-30 years	95.1, 10.5 (134)	102.1, 10.1 (852)	
34-35 years	93.2, 12.5 (100)	102.1, 9.6 (861)	
Pooled	94.8, 10.5 (750)	100.9, 9.6 (4230)	
<u>Anxiety disorder</u>			
17-18 years	95.5, 8.9 (174)	98.8, 8.9 (850)	Anxiety disorder B=-2.767, S.E.=0.378, $p<0.001$ Age: B=0.154, S.E.=0.021, $p<0.001$ Gender: B=1.334, S.E.=0.556, $p=0.003$ Anxiety disorder x age: B=-0.012, S.E.=0.059, $p=0.842$ Anxiety disorder x gender: B=0.842, S.E.=0.794, $p=0.289$
20-21 years	94.7, 10.2 (130)	99.4, 9.5 (881)	
24-25 years	97.3, 10.9 (132)	101.4, 10.0 (866)	
29-30 years	97.7, 11.4 (145)	101.7, 10.1 (841)	
34-35 years	96.9, 10.4 (128)	101.8 10.1 (833)	
Pooled	96.4, 10.4 (709)	100.6, 9.8 (4271)	
<u>Suicidal ideation/attempt</u>			
17-18 years	94.2, 8.7, (117)	98.8, 8.8 (907)	Suicidal ideation/attempt B=-4.521, S.E.=0.587, $p<0.001$ Age: B=0.142, S.E.=0.020, $p<0.001$ Gender: B=1.267, S.E.=0.438, $p=0.004$ Suicidal ideation/attempt x age: -0.243, S.E.=0.126, $p=0.054$ Suicidal ideation/attempt x gender: B=0.056, S.E.=1.157, $p=0.961$
20-21 years	92.6, 10.9 (86)	99.3, 9.4 (925)	
24-25 years	93.6, 10.2 (57)	101.3, 10.0 (941)	
29-30 years	93.8, 10.7 (41)	101.4, 10.3 (945)	
34-35 years	85.4, 14.3 (20)	101.5, 10.0 (941)	
Pooled	93.0, 10.4 (321)	100.5, 9.8 (4659)	

Alcohol dependence

17-18 years	95.0, 11.0 (57)	98.4, 8.8 (967)	Alcohol dependence: alcohol dependence B=-2.168, S.E.=0.717, $p=0.003$
20-21 years	94.7, 9.4 (43)	98.9, 9.7 (968)	Age: B=0.149, S.E.=0.021, $p<0.001$
24-25 years	95.6, 9.4 (37)	101.1, 10.2 (961)	Gender: B=1.257, S.E.=0.442, $p=0.005$
29-30 years	96.6, 9.4 (22)	101.2, 10.4 (964)	Alcohol dependence x age: B=0.042, S.E.=0.105, $p=0.691$
34-35 years	96.1, 9.3 (18)	101.2, 10.3 (943)	Alcohol dependence x gender: B=-2.911, S.E.=1.442, $p=0.044$
Pooled	95.4, 9.8 (177)	100.2, 10.0 (4803)	

Illicit substance dependence

17-18 years	96.0, 12.2 (49)	98.4, 8.7 (975)	Illicit substance dependence: B=-2.915, S.E.=0.817, $p<0.001$
20-21 years	94.6, 10.2 (54)	99.0, 9.7 (957)	Age: B=0.153, S.E.=0.021, $p<0.001$
24-25 years	94.5, 9.7 (46)	101.2, 10.1 (952)	Gender: B=1.111, S.E.=0.439, $p=0.011$
29-30 years	94.7, 12.0 (30)	101.3, 10.3 (956)	Illicit substance dependence x age: B=-0.100, S.E.=0.157, $p=0.525$
34-35 years	93.9, 14.1 (21)	101.3, 10.2 (940)	Illicit substance dependence x gender: B=-0.607, S.E.=1.787, $p=0.734$
Pooled	94.9, 11.2 (200)	100.2, 9.9 (4780)	

Any mental health problem

17-18 years	96.2, 9.3 (363)	99.4, 8.5 (661)	Any mental health problem: any mental health problem: B=-3.730, S.E.=0.293, $p<0.001$
20-21 years	95.5, 9.9 (311)	100.2, 9.3 (700)	Age: B=0.157, S.E.=0.022, $p<0.001$
24-25 years	96.7, 10.2 (278)	102.5, 9.7 (720)	Gender: B=1.520, S.E.=0.452, $p<0.001$
29-30 years	96.9, 10.7 (253)	102.6, 9.9 (733)	Any mental health problem x age: B=-0.100, S.E.=0.047, $p=0.035$
34-35 years	96.0, 10.9 (210)	102.6, 9.7 (751)	Any mental health problem x gender: B=0.271, S.E.=0.593, $p=0.647$
Pooled	96.2, 10.1 (1415)	101.5, 9.6 (3565)	

Supplement 3: Adjustment for fixed effects and time dynamic covariates

Table 2 of the paper reports the results of fixed effects regression analyses controlling the associations between mental health and life satisfaction for confounding by non-observed fixed factors. These analyses were extended to take into account a series of observed time-dynamic covariates assessed on the cohort over the period from 18-35 years. The time dynamic factors were selected from a wider array of social, family and contextual factors on the basis that they were associated with mental health problems and predictive of life satisfaction in the cohort. The selected factors included the following measures assessed at ages 18, 21, 25, 30 and 35 years:

Cohabiting partner relationship. At each assessment participants were asked if they were currently involved in a cohabiting partnership. Overall, 5.0% of participants had a cohabiting partner at age 18; 22.4% at age 21; 47.6% at age 25; 66.0% at age 30; and 74.7% at age 35.

Interpersonal problems. Participants were asked whether or not they had experienced any serious interpersonal problems between themselves and their partner, parents, siblings or friends in the 12 months preceding the interview. These measures were summed and dichotomized to represent those respondents who had experienced relationship problems and those who had not. Overall, 46.8% of respondents reported a relationship problem in the previous 12 months at age 18; 37.3% at age 21; 21.2% at age 25; 13.0% at age 30; and 12.5% at age 35.

Financial problems. Participants were asked if they had experienced any serious financial problems in the 12 months preceding the interview. Overall, 5.7% had experienced serious financial problems in the previous 12 months at age 18; 15.3% at age 21; 10.7% at age 25; 8.1% at age 30; and 3.4% at age 35.

Weekly income (\$NZ). At each assessment participants were asked to report their usual weekly income from paid employment, after tax and other deductions. Income reported in currencies other than New Zealand dollars were converted into New Zealand dollars using Purchasing Power Parities (Organisation for Economic Co-operation and Development (OECD), 2007), scaled to 2012 New Zealand dollar equivalents at age 35. Weekly income had a mean (standard deviation) of \$134 (\$170) at age 18; \$276 (\$264) at age 21; \$565 (\$416) at age 25; \$740 (\$573) at age 30; and \$777 (\$616) at age 35.

Findings

Table S3.1 below shows the estimated effects of mental health problems on life satisfaction from fixed effects regression models including time-dynamic covariates. The pattern of findings is very similar to those presented

in Table 2 of the paper. After additional adjustment for time dynamic factors all of the associations between life satisfaction and the presence of mental health problems remained statistically significant, with the exception of alcohol dependence which was reduced to statistical non-significance. This result suggests that the associations between life satisfaction and mental health were generally robust to control for both non-observed fixed sources of confounding and the correlated effects of time-dynamic covariates.

Table S3.1. *Fitted regression coefficients (B (S.E.), p) showing the estimated effects of presence of mental health problems on life satisfaction scores after adjustment for confounding by non-observed fixed factors and time-dynamic covariates¹*

Predictor	B (S.E.)	p
Major depression	-3.417 (0.378)	<0.001
Anxiety disorder	-1.791 (0.385)	<0.001
Suicidal ideation/attempt	-2.756 (0.542)	<0.001
Alcohol dependence	-0.977 (0.701)	0.163
Illicit substance dependence	-1.412 (0.693)	0.042
Any mental health problem	-2.550 (0.314)	<0.001

¹Time dynamic covariates included: being in a cohabiting partnership; interpersonal problems in the past 12 months; financial problems in the past 12 months; and weekly income from paid employment (\$NZ)

Supplement 4: The association between number of mental health problems and life satisfaction

Table S4.1 Mean, S.D., (n) life satisfaction by number of mental health problems at ages 18, 21, 25, 30 and 35, and pooled over all observations

Mean, S.D. (n) life satisfaction score	Number of mental health problems			
	0	1	2	3+
Age 18	101.2, 9.5, (661)	99.9, 10.0 (214)	95.3, 8.9, (99)	93.1, 12.3, (50)
Age 21	101.5, 9.6, (700)	98.5, 9.3 (180)	94.8, 10.0, (84)	92.7, 11.9, (47)
Age 25	101.6, 9.5, (720)	96.7, 10.0, (179)	95.6, 9.6, (65)	92.3, 10.4, (34)
Age 30	101.4, 9.5, (733)	97.2, 9.8, (167)	93.3, 10.4, (57)	93.7, 11.6, (29)
Age 35	101.4, 9.4, (751)	96.5, 9.3, (150)	94.5, 10.4, (43)	83.6, 14.7, (17)
Pooled	101.5, 9.6, (3565)	97.8, 9.6, (890)	94.6, 9.6, (348)	91.8, 11.0, (177)

Table S4.2. Regression coefficients (B, (S.E.), p) showing the effect of number of mental health problems on life satisfaction scores (18-35 years): (a) unadjusted association estimated using population averaged GEE model; (b) association adjusted for confounding by fixed effects

	B (S.E.)	p
Unadjusted association	-2.477 (0.171)	< 0.001
Association adjusted for fixed effects	-1.974 (0.188)	< 0.001

Supplement 5: Test of causal direction using structural equation modelling

The findings in the text of the paper suggest a possible causal association between the number of mental health problems and life satisfaction. Specifically, it can be suggested that the presence of mental health problems decreases life satisfaction. However, it may also be the case that life satisfaction may influence the development of mental health problems.

To examine these alternative causal interpretations, the structural equation modelling (SEM) approach described in Boden, Fergusson and Horwood (2010) and Fergusson, Boden and Horwood (2009) was applied to the data. Briefly, this approach makes it possible to develop tests of the likely direction of causal association between mental health problems and life satisfaction, taking into account the correlated effects of fixed factors that influence mental health and life satisfaction over time, as well as across time continuities in mental health and life satisfaction.

The general approach is illustrated by the model shown in Figure 1 of the paper. This model assumes that:

a) Mental health problems were assessed on five occasions concurrently with the assessment of life satisfaction. The assessment of mental health problems at the t -th period of observation is denoted MH_t and the assessment of life satisfaction at the t -th period LSt ($t = 18, 21, 25, 30$ and 35 year assessments).

b) The repeated measures of mental health are influenced by a common fixed effect factor MH and the repeated measures of life satisfaction are influenced by a common fixed effect factor LS . In this model MH and LS are permitted to be correlated. This component of the model takes into account fixed common and correlated factors that exert constant effects on the assessments of mental health (MH_t) and life satisfaction (LSt) over time.

c) The terms UMH_t , $ULSt$ ($t = 18, 21, 25, 30$ and 35 year assessments) represent the components of mental health and life satisfaction at time t that are not explained by the common fixed factors MH and LS . The correlations between these terms both within and across time are accounted for by: i) an auto-regressive model linking measures of the same construct across time; and ii) a reciprocal path model in which UMH_t is permitted to influence $ULSt$ and $ULSt$ is permitted to influence UMH_t . The bidirectional influences between UMH_t and $ULSt$ are represented by parameters $B1$ (life satisfaction to mental health) and $B2$ (mental health to life satisfaction). These reciprocal effects are assumed to be constant over time.

The importance of this model is that, subject to the availability of repeated measures data, it becomes possible to test for reciprocal relationships between mental health problems and life satisfaction after adjustment for common and correlated fixed confounding factors. The equations defining this model were as follows:

Model equations:

$$\begin{aligned}
 LS_t &= LS + ULSt \quad (t = 18, 21, 25, 30, 35 \text{ years}) & MH_t &= MH + UMHt \quad (t = 18, 21, 25, 30, 35 \text{ years}) \\
 ULS_{35} &= B2 \text{ } UM_{H35} + B3 \text{ } ULS_{30} + v_{35} & UM_{H35} &= B1 \text{ } ULS_{35} + B7 \text{ } UM_{H30} + \tau_{35} \\
 ULS_{30} &= B2 \text{ } UM_{H30} + B4 \text{ } ULS_{25} + v_{30} & UM_{H30} &= B1 \text{ } ULS_{30} + B8 \text{ } UM_{H25} + \tau_{30} \\
 ULS_{25} &= B2 \text{ } UM_{H25} + B5 \text{ } ULS_{21} + v_{25} & UM_{H25} &= B1 \text{ } ULS_{25} + B9 \text{ } UM_{H21} + \tau_{25} \\
 ULS_{21} &= B2 \text{ } UM_{H21} + B6 \text{ } ULS_{18} + v_{21} & UM_{H21} &= B1 \text{ } ULS_{21} + B10 \text{ } UM_{H18} + \tau_{21}
 \end{aligned}$$

Model assumptions:

$$\begin{aligned}
 \text{Cov}(LS, ULSt) &= \text{Cov}(LS, UMHt) = \text{Cov}(MH, ULSt) = \text{Cov}(MH, UMHt) = 0 \quad (t = 18, 21, 25, 30, 35 \text{ years}) \\
 \text{Cov}(LS, vt) &= \text{Cov}(LS, \tau t) = \text{Cov}(MH, vt) = \text{Cov}(MH, \tau t) = 0 \quad (t = 21, 25, 30, 35 \text{ years}) \\
 \text{Cov}(vt, \tau s) &= \text{Cov}(vt, vs) = \text{Cov}(\tau t, \tau s) = 0 \text{ for } t \neq s \quad (t, s = 21, 25, 30, 35 \text{ years}) \\
 \text{Cov}(LS_t, vs) &= \text{Cov}(LS_t, \tau s) = \text{Cov}(MH_t, vs) = \text{Cov}(MH_t, \tau s) = 0 \text{ for } t < s \\
 \text{Cov}(ULSt, vs) &= \text{Cov}(ULSt, \tau s) = \text{Cov}(UMH_t, vs) = \text{Cov}(UMH_t, \tau s) = 0 \text{ for } t < s
 \end{aligned}$$

In these equations the terms v_t and τ_t ($t = 21, 25, 30, 35$ years) represent disturbance terms reflecting unexplained sources of variation in the time-dynamic components of life satisfaction ($ULSt$) and mental health problems ($UMHt$) respectively. The coefficients $B1, B2$ represent the reciprocal effects of life satisfaction on mental health and vice versa respectively within each period. The coefficients $B3, B4, B5$ and $B6$ represent the across-time stabilities in the time-dynamic components of life satisfaction, and the coefficients $B7, B8, B9$ and $B10$ represent the across-time stabilities in the time-dynamic components of mental health.

Model fitting

The model in Figure 1 was fitted to a data set comprising observations on 1056 respondents who were assessed on measures of mental health and life satisfaction on at least one occasion at ages 18, 21, 25, 30 or 35 years. In each case, the model was fitted to the variance-covariance matrix of the repeated measures of mental health problems and life satisfaction using methods of full-information maximum likelihood estimation. Model fitting was conducted using Mplus 7 (Muthén and Muthén, 1998-2012). Model goodness-of-fit was assessed on the basis of the following fit indices: the model chi-square goodness-of-fit test statistic; the comparative fit

index (CFI); and the root mean squared error of approximation (RMSEA). The values of CFI range between 0 and 1 with values closer to one indicating good fit. In well-fitting models, values of RMSEA should be less than .05 (Schermelel-Engel *et al.*, 2003). To examine the relative fit of alternative models these indices were supplemented by the Akaike Information Criterion (AIC) and model chi square difference testing for comparison of nested models. The model with the smallest AIC is assumed to be the best fitting from a series of competing models (Schermelel-Engel *et al.*, 2003).

Findings

In the first instance the model in Figure 1 was fitted using the overall measure of number of mental health problems. Three versions of this model were fitted to the observed data:

Model 1. A model assuming reciprocal paths between life satisfaction and mental health (i.e., $B1 \neq 0$; $B2 \neq 0$).

Model 2. A unidirectional model assuming life satisfaction influenced mental health but there was no effect of mental health on life satisfaction (i.e., $B1 \neq 0$; $B2 = 0$).

Model 3. A unidirectional model assuming that mental health influenced life satisfaction but life satisfaction did not influence mental health (i.e., $B1 = 0$; $B2 \neq 0$).

Initial examination of the model goodness-of-fit indices for Model 1 showed that the fit of the model to the observed data was not optimal ($\chi^2(df) = 69.691(31)$, $p < 0.001$; CFI=0.983; RMSEA=0.034). Closer examination of model residuals and modification indices suggested that the fit of the model could be improved by allowing for a more complex autoregressive structure on the across time continuities in time-dynamic components of life satisfaction (ULSt). Reanalysis allowing for a second order autoregressive structure on these components produced a substantial improvement in model fit, and the revised model showed an excellent fit to the observed data ($\chi^2(df) = 31.777(28)$, $p = 0.284$; CFI=0.998; RMSEA=0.011). For this reason all three models were fit with this more complex autoregressive structure.

Estimates of the key model parameters (B1, B2) and model goodness of fit for the three models are summarised in Table 3 of the main paper. Examination of the fit indices shows that for all indices Model 1 provided the best fitting model. Further, comparison of the chi square goodness fit statistics for Model 1 vs Models 2, 3 showed that in both cases the fit of Model 1 represented a significant improvement over the fit of the other two models (Model 1 vs Model 2: $\Delta\chi^2(1) = 4.82$, $p < 0.05$; Model 1 vs Model 3: $\Delta\chi^2(1) = 6.09$, $p < 0.05$).

These results suggest that the best fitting and most parsimonious model was the reciprocal model (Model 1). Examination of the parameter estimates (B1, B2) for this model showed the presence of statistically significant effects of: a) life satisfaction on number of mental health problems $B1 = -0.018$, S.E. = 0.007, $p = 0.011$; and b) mental health problems on life satisfaction $B2 = -0.496$, S.E. = 0.222, $p = 0.025$. The standardised regression coefficients for B1 ranged from -0.088 to -0.137 over the five times and for B2 ranged from -0.066 to -0.103. Jointly these findings suggest the presence of modest reciprocal associations between mental health and life satisfaction over time such that increasing mental health problems were associated with small decreases in life satisfaction, and similarly increasing life satisfaction was associated with small decreases in number of mental health problems.

To examine the robustness of these findings for specific mental health problems the reciprocal model (Model 1) was re-fitted using data on the individual mental health problems (depression, anxiety disorder, suicidal ideation/attempt, alcohol dependence, illicit drug dependence). In all cases the model showed an adequate fit to the observed data. However, examination of the key model parameters (B1, B2) produced somewhat inconsistent evidence regarding the direction of causation (see supplement Table S5.1). For the measures of depression and illicit drug dependence there was a statistically significant effect of life satisfaction on mental health, but no effect of mental health on life satisfaction; for anxiety disorder there was a significant effect of mental health on life satisfaction but no significant effect of life satisfaction on mental health. For suicidal ideation/attempt there was a significant effect of life satisfaction on mental health and a marginally significant effect of mental health on life satisfaction. For alcohol dependence neither parameter was significant.

Table S5.1. Fitted model parameter estimates for the effect of life satisfaction on mental health (B1) and mental health on life satisfaction (B2) for specific mental health problems

Measure of mental health	Effect of life satisfaction on mental health		Effect of mental health on life satisfaction	
	B1 (S.E.)	<i>p</i>	B2 (S.E.)	<i>p</i>
Major depression	-0.130 (0.039)	0.001	-0.010 (0.070)	0.886
Anxiety disorder	0.005 (0.006)	0.482	-0.976 (0.337)	0.004
Suicidal ideation/attempt	-0.005 (0.002)	0.008	-0.734 (0.396)	0.064
Alcohol dependence	-0.001 (0.007)	0.913	-0.250 (0.185)	0.175
Illicit drug dependence	-0.023 (0.010)	0.017	0.084 (0.122)	0.492
Number of mental health problems	-0.018 (0.007)	0.011	-0.496 (0.222)	0.025

The analyses presented above show that there were modest reciprocal associations between the number of mental health problems and life satisfaction. Specifically, an increasing number of mental health problems was associated with decreasing life satisfaction, while increasing life satisfaction was associated with a decreasing number of mental health problems. However, the individual mental health problems and life satisfaction analyses showed inconsistent results, suggesting unidirectional associations of life satisfaction on mental health (major depression, suicidal ideation/attempt and illicit drug dependence), while the analysis of anxiety disorder suggested unidirectional associations of mental health on life satisfaction. The implications of these findings are unclear but could suggest that there are complex relationships between mental health and life satisfaction that vary with the extent and nature of mental health difficulties. It is suggested that further investigation of the associations between mental health and life satisfaction should be undertaken.

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