

Supplementary Information

Title:

Associations of mental health with subsequent weight development during a 4-year follow-up in adolescence

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Supplementary Table S1. Comparison of baseline characteristics between participants who completed the follow-up (64%) and those who were lost to follow-up (36%).

Characteristic	Follow-up mean (SD) or % n = 814	Missing n	Drop out mean (SD) or % n = 466	Missing n	p-value ^a
Sex		0		0	0.84
Girl	52%		51%		
Boy	48%		49%		
Age, years	11.23 (0.11)	0	11.24 (0.11)	0	0.036
Body mass index z-score	0.28 (0.95)	7	0.38 (1.02)	2	0.09
Waist-to-height ratio	0.45 (0.05)	7	0.45 (0.05)	4	0.25
Physical activity (h/week)	6.6 (2.7)	6	6.8 (2.6)	3	0.13
Caregiver's BMI (kg/m ²)	24.74 (4.27)	50	25.27 (4.61)	42	0.049
Dietary pattern		57		47	0.59
Unhealthy	14%		16%		
Vegetable avoider	45%		45%		
Healthy	41%		39%		
Caregiver's education level ^b		70		43	0.010
Lower	22%		30%		
Middle	45%		42%		
Higher	33%		29%		
Puberty status		65		68	0.99
Pre	50%		50%		
Pubertal	50%		49%		
Post	0%		1%		
Depressive symptoms score ^c	8.9 (7.1)	8	9.6 (8.1)	15	0.19
Anxiety symptoms score ^d	11.2 (7.2)	6	11.4 (7.7)	7	0.69
Self-esteem score ^e	56.4 (6.2)	1	55.9 (6.4)	3	0.15
Psychological resilience ^f		52		60	0.013
Resilient	26%		25%		
Non-resilient	49%		58%		
Complete MH	11%		7%		
Suboptimal MH	14%		10%		
Number of stressful life events		51		57	<0.001
0	25%		17%		
1–2	55%		56%		
over 2	20%		28%		

^a Results from Welch's t-tests (continuous variables) or Pearson's chi-square test (categorical variables).

^b Lower = comprehensive school, Middle = vocational school or equivalent, Higher = university degree or equivalent.

^c Depressive symptoms were assessed using the Centre for Epidemiological Studies Depression Scale for Children (CES-DC).

^d Anxiety symptoms were assessed using the Screen for Children Anxiety-Related Emotional Disorders (SCARED).

^e Self-esteem was assessed using the Self-Perception Profile for Children (SPPC).

^f Psychological resilience phenotypes: Resilient = complete mental health after exposure to stressful life events; Non-resilient = suboptimal mental health after exposure to stressful life events; Complete MH = complete mental health without exposure to stressful life events; Suboptimal MH = suboptimal mental health without exposure to stressful life events.

Supplementary Table S2. Prevalence of stressful life events among participants (n = 1,280).

Life event	Has not happened (%)	Has happened (%)	Missing (n)
Family moved to another municipality	70%	30%	41
Sibling was born	55%	45%	61
Family member was seriously ill/injured	80%	20%	52
Parental separation or divorce	80%	20%	41
Parents argued with each other more than previously	80%	20%	50
Mother/father became unemployed	89%	11%	46
Family member died	92%	8%	51
Parent was accused, arrested or convicted of a crime	99%	1%	48
Family had financial difficulties	89%	11%	59

Supplementary Table S3. Cross-sectional linear associations of mental health indicators with waist-to-height ratio (WtHr) at age 11 (baseline), indicated with unstandardized b coefficients with 95% confidence intervals (CI).

Mental health indicator	Model 1: b [95% CI]	<i>P</i> -value	df	Model 2: b [95% CI]	<i>P</i> -value	df
Depressive symptoms	0.001 [3.3e-04, 0.001]	<0.001	1242	0.001 [2.2e-04, 0.001]	0.002	955
Anxiety symptoms	0.001 [3.5e-04, 0.001]	<0.001	1252	0.001 [1.9e-04, 0.001]	0.004	953
Self-esteem	-0.002 [-0.002, -0.001]	<0.001	1261	-0.001 [-0.002, -0.001]	<0.001	953
Psychological resilience ^{a,b}			1155			927
Non-resilient	0.014 [0.008, 0.021]	<0.001		0.010 [0.003, 0.017]	0.006	
Complete MH	-0.008 [-0.018, 0.003]	0.15		-0.009 [-0.020, 0.002]	0.10	
Suboptimal MH	0.016 [0.007, 0.026]	<0.001		0.011 [0.001, 0.021]	0.036	

Model 1 adjusted for sex and age. Model 2 adjusted for sex, age, puberty status, physical activity, dietary pattern, caregivers' education level, and caregiver's BMI.

^a Reference = Resilient group. Coefficients for other groups represent the differences relative to this group.

^b Psychological resilience phenotypes: Resilient = complete mental health after exposure to stressful life events; Non-resilient = suboptimal mental health after exposure to stressful life events; Complete MH = complete mental health without exposure to stressful life events; Suboptimal MH = suboptimal mental health without exposure to stressful life events.

Supplementary Table S4. Associations between mental health indicators at age 11 and changes in waist-to-height ratio (WtHr) over a 4.3-year follow-up period, indicated with unstandardized fixed effect regression coefficients (b) with standard errors and 95% confidence intervals (CI) from linear mixed models.

Mental health indicator ^a	Model 1: b [95% CI]	<i>p</i> -value	df ^b	Model 2: b [95% CI]	<i>p</i> -value	df ^b
<u>Depressive symptoms</u>	0.0004 [0.0001, 0.0008]	0.011	1248	0.0003 [-3.6-05, 0.0007]	0.08	954
Age	-0.0024 [-0.0030, -0.0018]	<0.001	870	-0.0027 [-0.0034, -0.0021]	<0.001	714
Depression*Age	-0.0001 [-0.0002, -0.0001]	0.002	891	-0.0002 [-0.0002, -0.0001]	0.002	701
<u>Anxiety symptoms</u>	0.0005 [0.0002, 0.0008]	0.004	1236	0.0004 [1.8-05, 0.0008]	0.041	939
Age	-0.0024 [-0.0030, -0.0018]	<0.001	872	-0.0027 [-0.0034, -0.0020]	<0.001	712
Anxiety*Age	-0.0001 [-0.0002, -2.1e-05]	0.015	881	-0.0001 [-0.0002, -5.9-06]	0.038	691
<u>Self-esteem</u>	-0.0014 [-0.0018, -0.0010]	<0.001	1245	-0.0012 [-0.0016, -0.0007]	<0.001	960
Age	-0.0024 [-0.0030, -0.0018]	<0.001	884	-0.0027 [-0.0034, -0.0020]	<0.001	716
Self-esteem*Age	0.0001 [2.9e-05, 0.0002]	0.011	890	0.0001 [9.6e-06, 0.0002]	0.034	690
<u>Psychological resilience^{c,d}</u>						
Non-resilient	0.0116 [0.0055, 0.0177]	<0.001	1123	0.0078 [0.0013, 0.0143]	0.019	911
Complete MH	-0.0050 [-0.0145, 0.0045]	0.30	1096	-0.0074 [-0.0174, 0.0026]	0.15	877
Suboptimal MH	0.0147 [0.0061, 0.0234]	<0.001	1101	0.0102 [0.0008, 0.0196]	0.035	892
Age	-0.0020 [-0.0032, -0.0008]	0.012	812	-0.0023 [-0.0036, -0.0010]	<0.001	676
Non-resilient*Age	-0.0013 [-0.0028, 0.0001]	0.07	817	-0.0011 [-0.0027, 0.0005]	0.19	674
Complete MH*Age	0.0015 [-0.0007, 0.0037]	0.18	799	0.0015 [-0.0009, 0.0040]	0.22	655
Suboptimal MH*Age	-0.0005 [-0.0026, 0.0015]	0.62	800	-0.0003 [-0.0025, 0.0020]	0.81	658

Model 1 adjusted for sex and age. Model 2 adjusted for sex, age, puberty status, physical activity, dietary pattern, caregivers' education level, and caregiver's BMI.

*Indicates interaction term.

^a Depressive symptoms, anxiety symptoms, self-esteem and age were centered around their respective sample means before running the linear mixed models.

^b Degrees of freedom vary across models due to differences in the number of observations included in each analysis, reflecting missing data in the respective variables.

^c Reference = Resilient group. Coefficients for other groups represent the differences relative to this group.

^d Psychological resilience phenotypes: Resilient = complete mental health after exposure to stressful life events; Non-resilient = suboptimal mental health after exposure to stressful life events; Complete MH = complete mental health without exposure to stressful life events; Suboptimal MH = suboptimal mental health without exposure to stressful life events.

Supplementary Table S5. Results from pairwise comparisons of groups according to levels of depression and anxiety symptoms, self-esteem and psychological resilience on change between baseline and follow-up in WtHr (Δ WtHr).

Mental health indicator	Comparison	Model 1: Δ WtHr	<i>p</i> -value	<i>p</i> _{cor} ^a	Model 2: Δ WtHr	<i>p</i> -value	<i>p</i> _{cor} ^a
Depressive symptoms	Low vs. Average	0.0012	0.24	0.24	0.0017	0.13	0.13
	High vs. Average	-0.0029	0.001	0.002	-0.0028	0.004	0.007
	High vs. Low	-0.0041	0.001	0.002	-0.0045	0.001	0.003
Anxiety symptoms	Low vs. Average	0.0002	0.87	0.87	0.0002	0.84	0.84
	High vs. Average	-0.0011	0.19	0.41	-0.0017	0.08	0.22
	High vs. Low	-0.0013	0.27	0.41	-0.0019	0.15	0.22
Self-esteem	Low vs. Average	-0.0016	0.08	0.11	-0.0027	0.010	0.015
	High vs. Average	0.0012	0.16	0.16	0.0008	0.36	0.36
	High vs. Low	0.0027	0.012	0.037	0.0035	0.005	0.015
Psychological resilience ^b	Resilient vs. Non-resilient	0.0014	0.07	0.22	0.0011	0.19	0.33
	Resilient vs. Complete MH	-0.0015	0.18	0.27	-0.0015	0.22	0.33
	Resilient vs. Suboptimal MH	0.0005	0.62	0.62	0.0003	0.81	0.81
	Non-resilient vs. Complete MH	-0.0029	0.007	0.041	-0.0026	0.026	0.15
	Non-resilient vs. Suboptimal MH	-0.0008	0.38	0.46	-0.0008	0.46	0.55
	Complete MH vs. Suboptimal MH	0.0020	0.11	0.22	0.0018	0.20	0.33

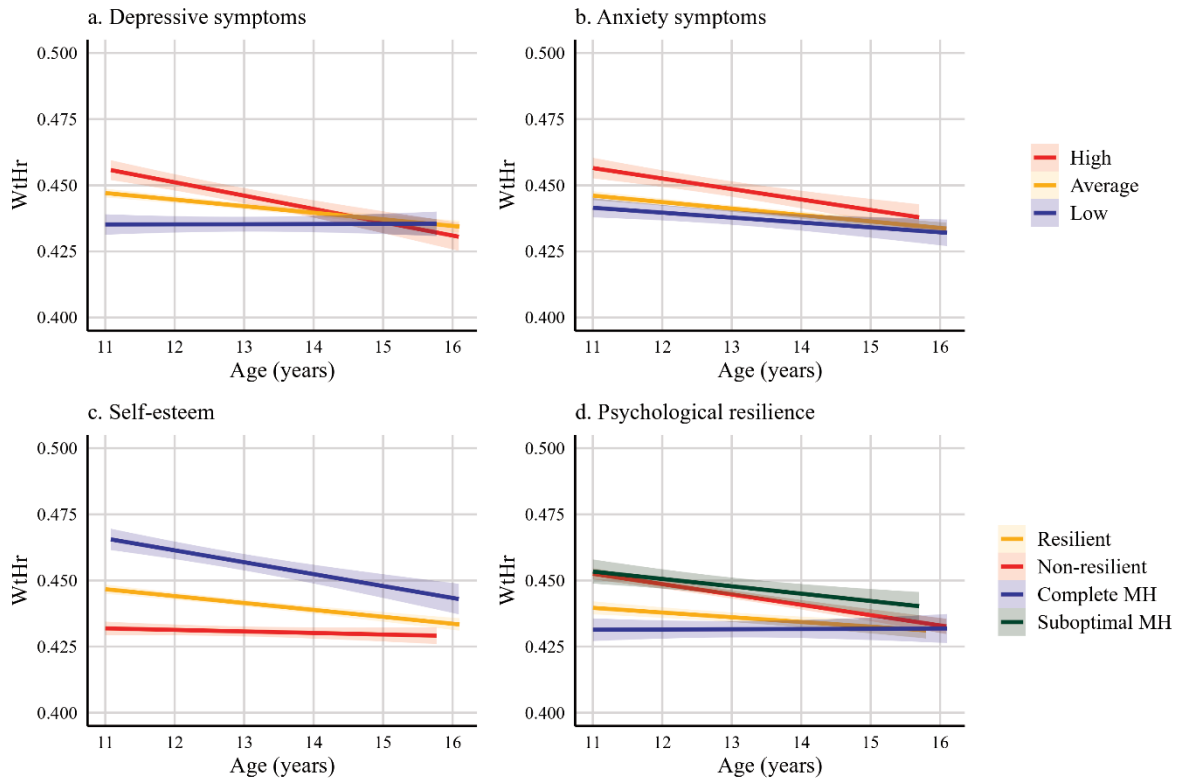
Δ = Difference in b coefficient.

Model 1 adjusted for sex and age. Model 2 adjusted for sex, age, puberty status, physical activity, dietary pattern, caregivers' education level, and caregiver's BMI.

Low group = mean - 1 SD, High group = mean + 1 SD.

^a FDR-corrected p-values.

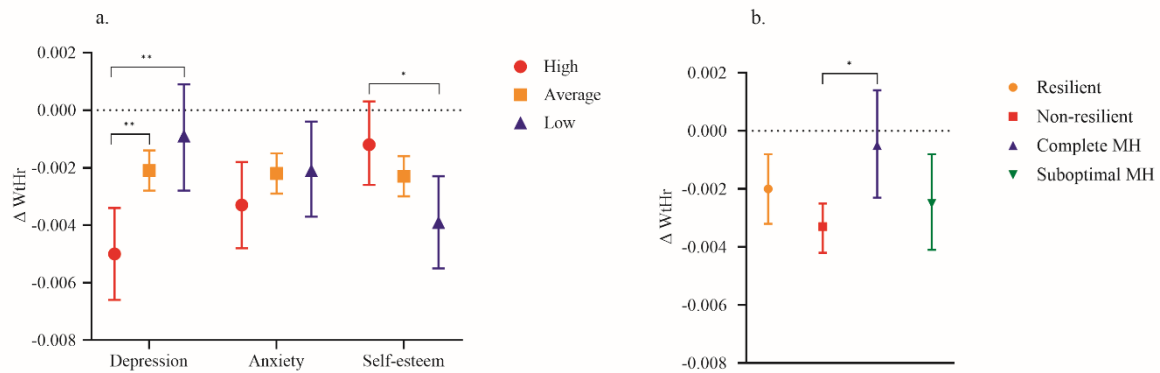
^b Psychological resilience phenotypes: Resilient = complete mental health after exposure to stressful life events; Non-resilient = suboptimal mental health after exposure to stressful life events; Complete MH = complete mental health without exposure to stressful life events; Suboptimal MH = suboptimal mental health without exposure to stressful life events.



Supplementary Figure S1. Panels a–d illustrates the interaction between age x (a) depressive symptoms, (b) anxiety symptoms, (c) self-esteem, or (d) psychological resilience predicting changes in WtHr, corresponding to the terms reported in Supplementary Table S4. Shaded areas indicate confidence intervals corresponding to ± 1 standard error of the mean.

Note. These results are from the Model 1. In Model 2, the depression x age ($p = 0.002$), anxiety x age ($p = 0.038$) and self-esteem x age ($p = 0.034$) interactions remained significant. For depressive symptoms, anxiety symptoms, and self-esteem, participants were grouped into low (mean - 1 SD), average, and high (mean +1 SD).

The y-axis range is restricted to 0.40-0.50.



Supplementary Figure S2. Panels a-b present yearly changes in WtHr with 95% confidence intervals, alongside pairwise group comparisons: low, average and high levels of depressive and anxiety symptoms, self-esteem (a) and different resilience phenotypes (b).

For depressive symptoms, anxiety symptoms, and self-esteem, participants were grouped into low (mean - 1 SD), average, and high (mean +1 SD). Pairwise comparisons between the low, average, and high groups were conducted using the emmeans package in R (see Supplementary Table S5). These results are from the Model 1.

* $p < 0.05$, ** $p < 0.01$; FDR-corrected p-values.

The y-axis range is restricted to -0.008-0.002.