SUPPLEMENTARY MATERIAL

Baldwin, Ayorech, Rijsdijk, Schoeler, & Pingault. Cyber-victimisation and mental health in young people: A co-twin control study.

Supplementary Table 1. Sample characteristics.

Sample	N families	% White	% Mothers with A-levels or higher	% Fathers with A-levels or higher	% Mother employed	% Father employed	% Female	% MZ twins
National equivalent		93.0	35.0	47.0	50.0	91.0		33.0
TEDS first contact (age 1 year)	13759	91.7	35.5	44.8	43.1	91.6	50	33.3
TEDS study sample (age 22 years)	3853	93.4	47.0	55.0	47.1	94.3	62	39.3

Note: Data for national equivalents refers to cohorts of parents with small children born in late 1990s to early 2000s: full references for these data can be found in Rimfeld et al. (2019). A-levels are national qualifications in the UK taken at ages 17-18 years prior to university.

Supplementary Table 2. Descriptive statistics for mental health measures at age 22.

Measure (scale-informant)	N	Mean/Percentage	SD/N
Total difficulties			
Total difficulties (SDQ-parent)	6926	5.26	4.01
Total difficulties (SDQ-self)	7478	8.39	4.77
Internalising problems			
Anxiety (SDQ-parent)	6924	2.39	2.3
Anxiety (SDQ-self)	7478	3.57	2.69
General anxiety (SMGAD-self)	6080	7.24	7.26
Depression (MFQ-self)	7480	4.38	4.09
Suicidal ideation (CASE-self)	6026	27.02	1643
Self-harm (CASE-self)	6044	10.15	619
Eating disorder symptoms (EDI2-self)	7708	16.83	9.98
Externalising problems			
Inattention-hyperactivity (SDQ-parent)	6928	1.77	1.9
Inattention-hyperactivity (SDQ-self)	7476	3.29	2.17
Hyperactivity-impulsivity (Conners-parent)	6920	2.35	3.48
Hyperactivity-impulsivity (Conners-self)	6146	5.37	4.48
Inattention (Conners-parent)	6912	3.60	4.11
Inattention (Conners-self)	6148	7.97	5.59
Total (Conners-parent)	6916	5.94	6.51
Total (Conners-self)	6148	13.34	8.67
Conduct problems (SDQ-parent)	6938	1.11	1.19
Conduct problems (SDQ-self)	7478	1.53	1.28
Antisocial behaviour (ESYPQ-self)	5910	0.52	1.45
Alcohol use (AUDIT-self)	5170	8.04	4.89
Cannabis use (CAST-self)	3860	0.54	2.08
Psychotic-like experiences			
Paranoid thoughts (SPEQ-self)	6146	9.84	11.22
Hallucinations (SPEQ-self)	6144	1.63	3.87
Total psychotic experiences (SPEQ-self)	6146	11.47	13.27
Negative symptoms (SPEQ-parent)	6916	3.06	4.03

Abbreviations: SD=standard deviation. N=Sample size with complete data for mental health measures at age 22 and cyber-victimisation for both twins in a pair. SDQ=Strengths and Difficulties Questionnaire; SMGAD= Severity Measure for Generalized Anxiety Disorder; MFQ=Mood and Feelings Questionnaire; CASE=Child and Adolescent Self-harm in Europe Study measure; EDI2= Eating Disorder Inventory-2; Conners=Conners Rating Scale; ESYPQ=The Edinburgh Study of Young People Questionnaire; AUDIT=The Alcohol Use Disorders Identification Test; CAST=Cannabis Abuse Screening Test; SPEQ=Specific Psychotic Experiences Questionnaire.
Results are presented as means and standard deviations (SD) for continuous variables and percentages and numbers for binary variables (i.e., self-harm and suicidal ideation).

Supplementary Table 3. Descriptive statistics for covariates.

Covariate	N	Mean	SD
Mental health measure at age 16 (scale-informant)			
Total difficulties (SDQ-self)	5922	7.75	4.40
Anxiety (ARBQ-parent)	5960	3.60	4.14
Anxiety (SDQ-self)	5922	2.84	2.26
Depression (MFQ-self)	5928	3.72	4.47
Hyperactivity (SDQ-parent)	5954	2.02	1.83
Hyperactivity (SDQ-self)	5922	3.42	2.28
Inattention (Conners-parent)	5952	3.62	4.41
Hyperactivity (Conners-parent)	5952	2.26	3.11
Total (Conners-parent)	5954	5.88	6.63
Conduct problems (SDQ-parent)	5964	1.07	1.28
Conduct problems (SDQ-self)	5922	1.49	1.39
Paranoid thoughts (SPEQ-self)	5922	12.11	10.51
Hallucinations (SPEQ-self)	5928	4.66	5.98
Total psychotic experiences (SPEQ-self)	5932	16.75	14.28
Negative symptoms (SPEQ-parent)	5952	2.66	3.74
Face-to-face peer victimisation at age 22			
Peer victimisation	5904	2.93	3.95

Abbreviations: SD=standard deviation. N=Sample size with complete data for each covariate and cyber-victimisation for both twins in a pair. SDQ=Strengths and Difficulties Questionnaire; SMGAD= Severity Measure for Generalized Anxiety Disorder; MFQ=Mood and Feelings Questionnaire; CASE=Child and Adolescent Self-harm in Europe Study measure; EDI2= Eating Inventory Conners=Conners Rating Scale; ESYPQ=The Edinburgh Study of Young People Questionnaire; AUDIT=The Alcohol Use Disorders Identification Test; CAST=Cannabis Abuse Screening Test; SPEQ=Specific Psychotic Experiences Questionnaire.

Supplementary Table 4. Moderation of the associations between cyber-victimisation and mental health problems by sex.

Mental health problem (scale-informant)	β (95% CI)*		
	Female	Male	Sex difference
Total difficulties			
Total difficulties (SDQ-parent)	0.15 (0.11 to 0.18)	0.15 (0.10 to 0.20)	0.00 (-0.06 to 0.06)
Total difficulties (SDQ-self)	0.28 (0.25 to 0.32)	0.26 (0.22 to 0.31)	-0.02 (-0.08 to 0.04)
Internalising problems			
Anxiety (SDQ-parent)	0.10 (0.06 to 0.14)	0.08 (0.04 to 0.12)	-0.03 (-0.08 to 0.03)
Anxiety (SDQ-self)	0.22 (0.18 to 0.25)	0.19 (0.15 to 0.24)	-0.02 (-0.08 to 0.03)
General anxiety (SMGAD-self)	0.22 (0.17 to 0.27)	0.15 (0.10 to 0.20)	-0.07 (-0.15 to 0.00)
Depression (MFQ-self)	0.26 (0.22 to 0.30)	0.22 (0.17 to 0.26)	-0.04 (-0.10 to 0.02)
Suicidal ideation (CASE-self)	0.21 (0.16 to 0.26)	0.17 (0.10 to 0.23)	-0.04 (-0.12 to 0.04)
Self-harm (CASE-self)	0.21 (0.16 to 0.26)	0.14 (0.06 to 0.22)	-0.07 (-0.16 to 0.03)
Eating disorder symptoms (EDI2-self)	0.18 (0.15 to 0.22)	0.14 (0.10 to 0.19)	-0.04 (-0.10 to 0.02)
Externalising problems			
Inattention-hyperactivity (SDQ-parent)	0.14 (0.10 to 0.17)	0.16 (0.10 to 0.22)	0.02 (-0.05 to 0.09)
Inattention-hyperactivity (SDQ-self)	0.23 (0.19 to 0.26)	0.17 (0.12 to 0.22)	-0.06 (-0.12 to 0.00)
Hyperactivity-impulsivity (Conners-parent)	0.13 (0.09 to 0.17)	0.15 (0.10 to 0.21)	0.02 (-0.05 to 0.09)
Hyperactivity-impulsivity (Conners-self)	0.17 (0.13 to 0.21)	0.17 (0.11 to 0.23)	0.00 (-0.07 to 0.07)
Inattention (Conners-parent)	0.11 (0.07 to 0.14)	0.12 (0.06 to 0.17)	0.01 (-0.06 to 0.08)
Inattention (Conners-self)	0.17 (0.12 to 0.21)	0.10 (0.04 to 0.16)	-0.07 (-0.14 to 0.00)
Total (Conners-parent)	0.14 (0.10 to 0.17)	0.15 (0.10 to 0.21)	0.02 (-0.05 to 0.08)
Total (Conners-self)	0.20 (0.16 to 0.24)	0.15 (0.09 to 0.21)	-0.04 (-0.11 to 0.03)
Conduct problems (SDQ-parent)	0.13 (0.09 to 0.18)	0.14 (0.09 to 0.19)	0.00 (-0.06 to 0.07)
Conduct problems (SDQ-self)	0.24 (0.19 to 0.28)	0.31 (0.24 to 0.38)	0.08 (-0.01 to 0.16)
Antisocial behaviour (ESYPQ-self)	**0.12 (0.08 to 0.17)**	**0.27 (0.16 to 0.39)**	**0.15 (0.02 to 0.27)**
Alcohol use (AUDIT-self)	0.10 (0.06 to 0.15)	0.15 (0.08 to 0.21)	0.04 (-0.03 to 0.12)
Cannabis use (CAST-self)	0.11 (0.04 to 0.17)	0.11 (0.00 to 0.21)	0.00 (-0.12 to 0.12)
Psychotic-like experiences			
Paranoid thoughts (SPEQ-self)	0.31 (0.26 to 0.36)	0.28 (0.22 to 0.34)	-0.03 (-0.11 to 0.05)
Hallucinations (SPEQ-self)	0.23 (0.17 to 0.29)	0.14 (0.08 to 0.21)	-0.09 (-0.18 to 0.00)
Total psychotic experiences (SPEQ-self)	0.32 (0.28 to 0.38)	0.28 (0.22 to 0.34)	-0.05 (-0.13 to 0.03)
Negative symptoms (SPEQ-parent)	0.06 (0.03 to 0.10)	0.00 (-0.04 to 0.05)	-0.06 (-0.12 to 0.00)

Abbreviations: SDQ=Strengths and Difficulties Questionnaire; SMGAD= Severity Measure for Generalized Anxiety Disorder; MFQ=Mood and Feelings Questionnaire; CASE=Child and Adolescent Self-harm in Europe Study measure; EDI2= Eating Disorder Inventory-2; Conners=Conners Rating Scale; ESYPQ=The Edinburgh Study of Young People Questionnaire; AUDIT=The Alcohol Use Disorders Identification Test; CAST=Cannabis Abuse Screening Test; SPEQ=Specific Psychotic Experiences Questionnaire. *Significant sex differences are shown in bold text. Coefficients for suicidal ideation and self-harm are from probit regressions.

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Supplementary Table 5. Associations between individual-level covariates (mental health problems at age 16 and face-to-face peer victimisation at age 22) with cyber-victimisation at age 22.

Individual-level predictor	No. twin pairs	β (95% CI)*
Mental health measure at age 16		
Total difficulties (SDQ-self)	2961	**0.16 (0.13 to 0.19)**
Anxiety (ARBQ-parent)	2980	**0.08 (0.05 to 0.11)**
Anxiety (SDQ-self)	2961	**0.10 (0.08 to 0.13)**
Depression (MFQ-self)	2964	**0.14 (0.10 to 0.17)**
Hyperactivity (SDQ-parent)	2977	**0.10 (0.07 to 0.13)**
Hyperactivity (SDQ-self)	2961	**0.11 (0.09 to 0.14)**
Inattention (Conners-parent)	2976	**0.10 (0.07 to 0.13)**
Hyperactivity (Conners-parent)	2976	**0.11 (0.08 to 0.14)**
Total (Conners-parent)	2977	**0.12 (0.08 to 0.15)**
Conduct problems (SDQ-parent)	2982	**0.12 (0.09 to 0.15)**
Conduct problems (SDQ-self)	2961	**0.14 (0.11 to 0.17)**
Paranoid thoughts (SPEQ-self)	2961	**0.20 (0.16 to 0.23)**
Hallucinations (SPEQ-self)	2964	**0.13 (0.10 to 0.17)**
Total psychotic experiences (SPEQ-self)	2966	**0.20 (0.17 to 0.24)**
Negative symptoms (SPEQ-parent)	2976	**0.06 (0.03 to 0.09)**
Face-to-face peer victimisation at age 22		
Peer victimisation	2952	**0.38 (0.34 to 0.42)**

Abbreviations: SDQ=Strengths and Difficulties Questionnaire; ARBQ=Anxiety-Related Behaviours Questionnaire; MFQ=Mood and Feelings Questionnaire; Conners=Conners Rating Scale; SPEQ=Specific Psychotic Experiences Questionnaire.
*Significant associations are shown in bold text.

Supplementary Table 6. Associations between face-to-face peer victimisation and prior mental health with mental health problems in emerging adulthood.

Outcome at age 22 (scale-informant)	Predictor: Peer victimisation (age 22)		Predictor: Mental health (age 16)		
	No. twin pairs	β (95% CI)*	Predictor measure (scale-informant)	No. twin pairs	β (95% CI)*
Total difficulties					
Total difficulties (SDQ-parent)	2928	**0.12 (0.09 to 0.14)**	Total difficulties (SDQ-self)	3842	**0.32 (0.30 to 0.35)**
Total difficulties (SDQ-self)	2946	**0.28 (0.26 to 0.31)**	Total difficulties (SDQ-self)	2961	**0.43 (0.40 to 0.45)**
Internalising problems					
Anxiety (SDQ-parent)	2925	**0.07 (0.04 to 0.10)**	Anxiety (ARBQ-parent)	3893	**0.47 (0.44 to 0.49)**
Anxiety (SDQ-self)	2946	**0.19 (0.16 to 0.22)**	Anxiety (SDQ-self)	2961	**0.42 (0.40 to 0.44)**
General anxiety (SMGAD-self)	3214	**0.34 (0.31 to 0.37)**	Anxiety (SDQ-self)	2622	**0.35 (0.32 to 0.38)**
Depression (MFQ-self)	2946	**0.27 (0.24 to 0.30)**	Depression (MFQ-self)	2964	**0.34 (0.32 to 0.37)**
Suicidal ideation (CASE-self)	3190	**0.36 (0.32 to 0.39)**	Total difficulties (SDQ-self)	2604	**0.24 (0.20 to 0.28)**
Self-harm (CASE-self)	3195	**0.31 (0.27 to 0.35)**	Total difficulties (SDQ-self)	2608	**0.26 (0.21 to 0.31)**
Eating disorder symptoms (EDI2-self)	3010	**0.15 (0.12 to 0.17)**	Total difficulties (SDQ-self)	3005	**0.26 (0.24 to 0.29)**
Externalising problems					
Inattention-hyperactivity (SDQ-parent)	2928	**0.11 (0.08 to 0.14)**	Inattention-hyperactivity (SDQ-parent)	3892	**0.54 (0.52 to 0.57)**
Inattention-hyperactivity (SDQ-self)	2945	**0.25 (0.23 to 0.28)**	Inattention-hyperactivity (SDQ-self)	2959	**0.37 (0.35 to 0.40)**
Hyperactivity-impulsivity (Conners-parent)	2924	**0.10 (0.07 to 0.13)**	Hyperactivity-impulsivity (Conners-parent)	3886	**0.57 (0.54 to 0.61)**
Hyperactivity-impulsivity (Conners-self)	3235	**0.30 (0.27 to 0.32)**	Hyperactivity-impulsivity (Conners-parent)	2670	**0.27 (0.24 to 0.31)**
Inattention (Conners-parent)	2917	**0.10 (0.07 to 0.13)**	Inattention (Conners-parent)	3884	**0.56 (0.53 to 0.59)**
Inattention (Conners-self)	3235	**0.28 (0.25 to 0.30)**	Inattention (Conners-parent)	2672	**0.30 (0.27 to 0.33)**
Total (Conners-parent)	2920	**0.11 (0.09 to 0.14)**	Total (Conners-parent)	3889	**0.59 (0.56 to 0.62)**
Total (Conners-self)	3235	**0.33 (0.30 to 0.36)**	Total (Conners-parent)	2672	**0.31 (0.27 to 0.34)**
Conduct problems (SDQ-parent)	2933	**0.11 (0.09 to 0.14)**	Conduct problems (SDQ-parent)	3903	**0.45 (0.42 to 0.48)**
Conduct problems (SDQ-self)	2946	**0.24 (0.21 to 0.28)**	Conduct problems (SDQ-self)	2961	**0.30 (0.28 to 0.33)**
Antisocial behaviour (ESYPQ-self)	3265	**0.34 (0.30 to 0.39)**	Conduct problems (SDQ-self)	2540	**0.23 (0.19 to 0.27)**
Alcohol use (AUDIT-self)	2742	**0.28 (0.25 to 0.32)**	Total difficulties (SDQ-self)	2263	**0.09 (0.06 to 0.12)**
Cannabis use (CAST-self)	2026	**0.19 (0.14 to 0.23)**	Total difficulties (SDQ-self)	1682	**0.13 (0.08 to 0.17)**
Psychotic-like experiences					
Paranoid thoughts (SPEQ-self)	3236	**0.49 (0.46 to 0.52)**	Paranoid thoughts (SPEQ-self)	2657	**0.40 (0.36 to 0.43)**
Hallucinations (SPEQ-self)	3236	**0.28 (0.24 to 0.32)**	Hallucinations (SPEQ-self)	2660	**0.32 (0.27 to 0.37)**
Total psychotic experiences (SPEQ-self)	3236	**0.50 (0.46 to 0.53)**	Total psychotic experiences (SPEQ-self)	2662	**0.42 (0.39 to 0.46)**
Negative symptoms (SPEQ-parent)	2922	**0.04 (0.02 to 0.07)**	Negative symptoms (SPEQ-parent)	3882	**0.54 (0.50 to 0.57)**

Abbreviations: SDQ=Strengths and Difficulties Questionnaire; SMGAD= Severity Measure for Generalized Anxiety Disorder; MFQ=Mood and Feelings Questionnaire; CASE= Child and Adolescent Self-harm in Europe Study measure; EDI2= Eating Disorder Inventory-2; Conners=Conners Rating Scale; ESYPQ=The Edinburgh Study of Young People Questionnaire; AUDIT=The Alcohol Use Disorders Identification Test; CAST=Cannabis Abuse Screening Test; SPEQ=Specific Psychotic Experiences Questionnaire; ARBQ=Anxiety-Related Behaviours Questionnaire. *Significant associations are shown in bold text

Supplementary Table 7. Subgroup analyses of the pooled association between cyber-victimisation and mental health problems by informant.

Analysis type	Pooled β (95% CI) across mental health outcomes*	
	Self-reported outcomes (k=18)	Parent-reported outcomes (k=8)
Individual-level	0.19 (0.17 to 0.21)	0.12 (0.11 to 0.14)
DZ co-twin control	0.13 (0.10 to 0.17)	0.11 (0.08 to 0.15)
MZ co-twin control	0.12 (0.09 to 0.16)	0.04 (0.01 to 0.06)
MZ co-twin control adjusted	0.07 (0.04 to 0.11)	0.04 (0.01 to 0.06)

Abbreviations: DZ=dizygotic (same-sex) twins; MZ=monozygotic twins. *Estimates were obtained from aggregate single-study meta-analysis models which account for correlations between the outcomes.

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