Dissertation Title: Changes in the number of close friendships during adolescence: longitudinal associations with adolescent depression.

Programme: MRes Health and Wellbeing

Module: SHSM025

Title: *Dissertation (Journal Article)*

Journal style: *Journal of Adolescent Health*

Deadline: 26/08/2021

Word Count: 3,499

Student number: 660052997

UNIVERSITY OF
EXETER

Changes in the number of close friendships during Adolescence: associations with adolescent depression

Abstract

Purpose

Adolescent friendships are associated with depression. Levels of social support may influence risk of depressive disorder. However, much of the evidence is cross-sectional. This study investigates associations between changes in quantity of friendships and GHQ-12 scores during adolescence.

Methods

Using Understanding Society (USoc) data, this study explored associations between changes in friendships and symptoms of depression measured by the GHQ-12 amongst 16-21 year olds. Using multiple regressions, this research estimated associations between friend change groups and GHQ-12 scores over a 3 year period.

Results

1,073 participants fulfilled criteria for inclusion in the final model. The majority (86%) had between 1 and 9 close friends at wave 6. Of these, 20% (351) had no change in number of close friends, 41% (715) gained friends, and 39% (682) lost them. Losing friends was associated with higher GHQ-12 scores at wave 9 compared with gaining friends ($ß = 1.11$, 95% CI 0.3, 1.93, p=0.008), with borderline evidence suggesting that losing friends increased GHQ-12 score versus no change in friendships ($ß = 0.95$, 95% CI 0.00, 1.90, p = 0.050).

Conclusions

Changes in the quantity of close friendships during adolescence influences symptoms of depression. Losing friends may increase symptoms compared with no change or gaining close friends.

Introduction

Depression is consistently recognised as a critical[1] public health issue in the UK. This highly prevalent illness may affect 20% of the population[2], placing a significant burden on society[3]. Wide ranging symptoms from fatigue and sadness, to aches and pains, amongst others, can impact day-to-day life for individuals[4]. The consequences may be long-lasting. Multiple studies demonstrate long-term risks to health resulting from depression[5]. Considering this, and against a backdrop where depression is a major cause of loss of healthy life in the UK[6], the provision of care is clearly essential. However, as is argued[7], treatment alone does not tackle the complex array of factors which influence the risk of depression throughout the lifecourse.

Research by Kendler et al.,[8,9] demonstrated that risk-factors for depression exist before birth, shaping mental health throughout childhood, into adolescence and adulthood. This emphasises the importance of the lifecourse. At every stage in life, the risk of depression is shaped by exposures and experiences in the past[10], ranging from childhood trauma, to levels of social support and stressful life events, amongst many others[9,10]. Taking a lifecourse-based approach can reveal critical time-periods and factors in the development of depression[11].

Adolescence, broadly defined as a 'transition from childhood to adulthood' from 10-24 years of age'[12], has emerged from the evidence base as a key period in the development of mental health[13]. This may be highly relevant for depression. A recent review[14] suggests a strong link between adolescent depression and an increased risk of depression in adulthood. The early-onset of depression is therefore thought to be a significant risk-factor in depression throughout the lifecourse[18], with an increasing risk of recurrence with lower age of first-onset[16]. Findings suggesting first-onset is likely to be during adolescence[20], and that adolescent women in the UK may be the highest risk group[17], there is a strong case to develop our understanding of risk factors for adolescent depression.

Social support as a key risk factor

Compelling evidence suggests that late adolescence is a period of particular risk for depression amongst females. In the UK, more than 1 in 4 women between the ages of 16-24 show moderate symptoms for common mental disorders[17]. This proportion decreases into middle age for women, and increases for men. As a vulnerable time for young women, or an important developmental phase for young men, harmful and beneficial factors shape mental health during adolescence[19]. Many are well known, relating to mental health throughout life. Socioeconomic position, alcohol use, smoking habits, childhood trauma, familial depression, stressful events, amongst others, are all associated with risk of depression[7]. Social support may play an additional role in the complex aetiology of depression[20]. Evidence suggests social relationships may influence the development of mental health during adolescence[21].

Differences in adolescent relationships may be a key predictor of mental ill health. There is a well-established link between parent-child relationships and adolescent mental health[22]. However, a developing evidence base sheds light on the possible influence of friendships. Research demonstrates that associations between the number and quality of friendships and depression observed during adulthood may also apply to adolescents[23,24]. Concepts around the role of friendships and their influence on depression have since been refined. A recent review[25] describes the theoretical background on the subject, distinguishing between quality, quantity and source of social support – identifying parents, teachers, friends, family and spouses as unique, time-dependent predictors of mental health. Alongside more recent studies[25,26], it is recognised that the importance of friendships may increase throughout adolescence, as individuals become less dependent on parental support.

The distinction between parental relationships and friendships underpins previous research on the subject. Beginning in childhood, the need for companionship[23] and the development of relationships with greater equality may form a sense of belonging and identity[24]. This may take on a specific importance during adolescence[27]. Ultimately, friendships may provide individuals with a support network, 'buffering' the effects of stresses which increase the risk of mental ill health[28]. This theory is supported by longitudinal analysis on adolescent resilience[29], and amongst general populations[30]. Crucially, recent work provides evidence that friendships during adolescence may protect individuals from the development of depression over time[21].

Reviews on social support and depression[25,31] show a potential gender-difference in the relationship between friendships and mental health. Evidence generally suggests that, whilst friendships are beneficial to both men and women, there is a stronger protective effect amongst females[32]. Research also indicates that social media may have become an influential factor in adolescent mental health. Growth in its use has influenced the way adolescents interact with friends, with potential implications for mental health[33]. Findings like these demonstrate that an interplay of behaviours and characteristics may shape how friendships influence mental health.

Aims and Objectives

This study aims to address a handful of issues from the literature. The majority of studies investigating the topic are cross-sectional, and show mixed support for the importance of friendships for mental health during adolescence[25]. The potentially harmful[33] influence of social media arguably needs to be considered in research on this subject. Finally, there is strong evidence that having no close friends increases the risk of mental ill health[34]. By a) investigating the influence of close friendships over time, b) controlling for the influence of social media use, and, c) using *change* in number of friends as an exposure, this study aims to present findings on the association between friendships and depression during adolescence. It is hypothesised that: losing friends would be associated with a decrease in mental health compared with gaining friends and neither gaining/losing them.

Research question: Do changes in the number of close friendships during adolescence influence symptoms of depression?

Methods

Sample

Understanding Society (USoc) is a UK-based longitudinal study, including 100,000 individuals[35]. Information is collected on all household members: parents provide data on children under 10 years old, 10-15 year olds complete a youth survey, and 16+ year olds complete the main survey. This work utilises youth and main survey data from waves 1-9 of the USoc data (2009-2019). A full guide and searchable variable dictionary is available through the USoc website[36].

The study sample included adolescents aged 16-21 at wave 6 of USoc with the relevant data to address the research question. 1,748 individuals had data available on the exposure (change in number of friendships wave 6 to wave 9) and outcome (GHQ-12 score, wave 9).

USoc has gained ethical approval for data collection, with all approvals granted by the University of Essex Ethics Board. Approvals for this study were granted by the University of Exeter Sports and Health Sciences Ethics Committee (26/7/2021, ID: 21-07-14-B-03).

Measures

Outcome

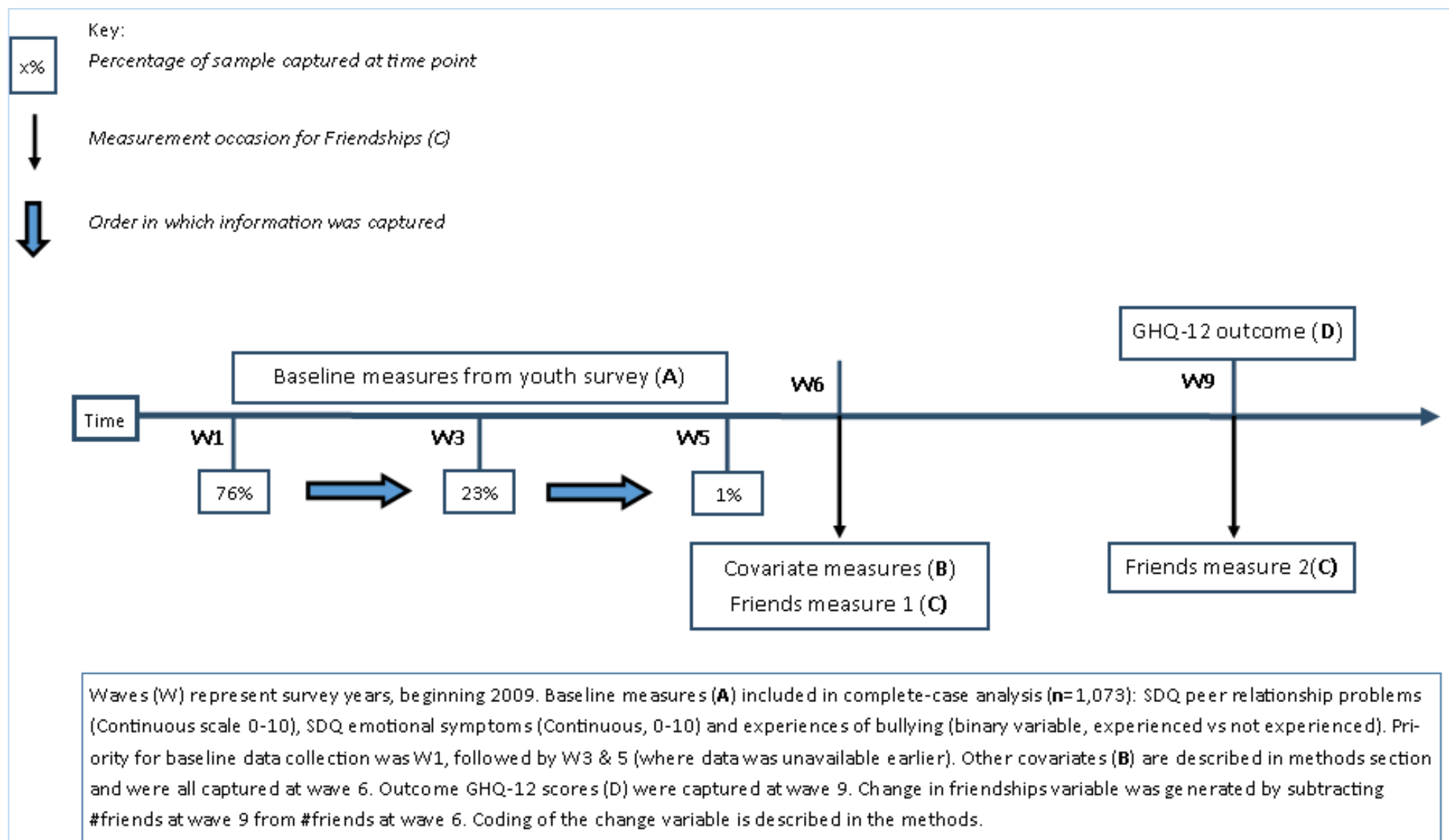The GHQ-12 (GHQ) is a validated questionnaire capturing mental health symptoms amongst general populations[37]. It has been chosen for its strength in detecting mental ill health in longitudinal analyses[38], and its applicability to depression[37]. The GHQ consists of 12 statements relating to recent experiences, each with 4 possible responses. These items were assigned a score (0-1-2-3), and were combined to

form a total score ranging from 0-36 – a standard method used elsewhere[39]. Higher scores indicate a greater degree of psychological distress. This score was used as a baseline measure of mental health (GHQ at wave 6; GHQ-w6), and as an outcome (GHQ-w9). Measurement occasions are included in figure 1.

Exposure

Participants reported number of close friends at waves 6 and 9. They answered the following question: *"How many close friends would you say you have?",* and could respond with any number. Responses are reported in table 1. Change in friendships was calculated by creating a categorical variable from two measurement occasions (figure 1). The range in number of friends gained and lost was large (ranging from -35 to +50 friends). Categorical groups were coded as follows: no change (0), gained friends (1), and lost friends (2).

Figure 1. Measurement occasions

Key:

x% — Percentage of sample captured at time point

↓ — Measurement occasion for Friendships (C)

⇓ — Order in which information was captured

GHQ-12 outcome (**D**)

Baseline measures from youth survey (**A**)

W6

W9

Time

W1

W3

W5

76%

23%

1%

Covariate measures (**B**)

Friends measure 1 (**C**)

Friends measure 2(**C**)

Waves (W) represent survey years, beginning 2009. Baseline measures (**A**) included in complete-case analysis (**n**=1,073): SDQ peer relationship problems (Continuous scale 0-10), SDQ emotional symptoms (Continuous, 0-10) and experiences of bullying (binary variable, experienced vs not experienced). Priority for baseline data collection was W1, followed by W3 & 5 (where data was unavailable earlier). Other covariates (**B**) are described in methods section and were all captured at wave 6. Outcome GHQ-12 scores (D) were captured at wave 9. Change in friendships variable was generated by subtracting #friends at wave 9 from #friends at wave 6. Coding of the change variable is described in the methods.

Potential Confounders

A range of variables were initially added to the complete-case (CC) analysis. These included information on childhood peer relationship problems and emotional symptoms (using the Strengths and Difficulties Questionnaire; *SDQ*). Both are continuous measures ranging from 0-10, where a higher score indicates greater difficulty. Previous experiences of bullying were also included (0 - never experienced, 1 - experienced). As figure 1 shows, data on SDQ scores and bullying was captured at the earliest possible time-point. Further variables were included for potential confounding such as: long standing illness/disability (0 – No, 1 – Yes), social media use (categorical, see table 1) and sex (0 – Male, 1 – Female). A housing tenure variable (see table 1) provided a measure of socioeconomic status.

Analysis

Multiple linear regression models were used to test whether changes in number of close friendships were associated with GHQ-w9 scores. These were carried out using STATA 17 SE, using the "regress" command. This followed a three-stage model strategy:

1. Bivariate association between change in friends and GHQ-w9 score.

2. Adjustment for covariates at wave 6

3. Complete-case analysis adjusting for baseline youth covariates

These models were developed and tested for validity along the following steps:

1. Covariate inclusion: a regression model was run including *all* potential covariates. These were excluded if non-significant, unless specifically related to the research aims.

2. Multi-collinearity and model fit were investigated using the "vif" and "rvfplot" commands in STATA (appendix, 1 and 2).

Table 1. Descriptive Results

Max Sample

variable	Obs	Mean	Std. Dev.	Min	Max
GHQ-w9*	1,748	11.75	6.02	0	36
GHQ-w6	1,708	10.96	5.86	0	36
Age (wave 6)	1,748	18.45	1.75	16	21
Age (wave 9)	1,748	21.49	1.77	18	25
#Friends (wave 6)	1,748	4.99	3.60	0	50
#Friends (wave 9)	1,748	5.05	3.89	0	100

Complete Case

variable	Obs	Mean	Std. Dev.	Min	Max
GHQ-w9*	1,073	11.58	5.95	0	35
GHQ-w6	1,073	10.86	5.64	0	36
Age (wave 6)	1,073	17.70	1.39	16	21
Age (wave 9)	1,073	20.72	1.39	18	24
#Friends (wave 6)	1,073	5.08	3.51	0	40
#Friends (wave 9)	1,073	5.17	3.27	0	25
SDQ Peer relations (0-10)	1,073	1.71	1.62	0	9
SDQ Emotional Symptoms (0-10)	1,073	2.89	2.16	0	10

* (bold) text = exposure and outcome variables

Underlined text = reference category used in regression models

Note: n varies by variable due to missing data

variable	Max Sample Freq.	Max Sample Percent	Complete Case Freq.	Complete Case Percent
friends change*				
no change	351	20.08	209	19.48
Gained Friends	715	40.9	442	41.19
Lost Friends	682	39.02	422	39.33
Sex				
Male	771	44.11	456	42.5
Female	977	55.89	617	57.5
Social media use				
None	160	9.16	97	9.04
<1 hour	532	30.45	285	26.56
1-3 hours	730	41.79	475	44.27
4-6 hours	219	12.54	150	13.98
7+ hours	106	6.07	66	6.15
Friends Categories (wave 6)				
None	21	1.2	12	1.12
1-2	301	17.22	161	15
3-5	924	52.86	585	54.52
6-9	310	17.73	197	18.36
10-15	165	9.44	103	9.6
16+	27	1.54	15	1.4
Long standing illness				
No	1479	85.74	939	87.51
Yes	249	14.26	134	12.49
Housing Tenure				
Local Auth/Housing Assoc.	312	18.17	186	17.33
Private Let	223	12.99	108	10.07
Mortgage	870	50.67	591	55.08
Owned Outright	312	18.17	188	17.52

Results

Model Development

Certain covariates were included in the model regardless of significance, due to their relevance to the literature and research question. These were: sex, social media use, baseline number of friends, and baseline GHQ-w6 score. Remaining covariates were excluded if individual and global p-values were non-significant in the CC analysis (α=0.05). These were individually added to the model to test for individual or global significance, with likelihood ratio tests (appendix, 4) to determine model fit. No remaining covariates were significant or improved model fit and were excluded from the final model. These included: age at wave 6, housing tenure, long-standing health issues and experiences of bullying. A sensitivity analysis investigated whether categorising age at wave 6 by school (<18) or non-school (19+) age influenced the model. This was non-significant and was not included in the final analysis. Results of model development are included in the appendix.

Descriptive Analysis

Table 1 shows results of descriptive analysis. Distributions of the data were similar between maximum (Max) and CC samples. The CC analysis sample (n=1,073) by its nature included fewer individuals than the Max sample (n=1,748). The majority of individuals excluded from CC analysis had no data on baseline measures from the youth survey (see figure 1). Mean GHQ scores had increased from wave 6 (M = 10.58, SD = 5.64) *to* wave 9 (M = 11.58, SD = 5.95). Mean number of close friends

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remained similar between waves 6 ($M = 5.08$, $SD = 3.51$) and 9 ($M = 5.17$, $SD = 3.27$), although the overall range narrowed from 0-40 to 0-25.

Model Results

1. Bivariate associations

There was a significant association between change in number of friends and GHQ-w9 score in both the Max and CC analyses (see Table 2). The Max sample showed those in the lost friends group had significantly higher GHQ-w9 scores compared with gaining friends ($ß = 0.77$, 95% CI 0.14, 1.40, p=0.016), and the no change group had higher GHQ-w9 scores compared to gaining friends ($ß = 0.95$, 95% CI 0.18, 1.71. p=0.016). The CC analysis showed that losing friends was significantly associated with higher GHQ-w9 scores compared to those who gained friends ($ß = 0.94$, 95% CI 0.16, 1.75, p=0.02).

2. Adjusted for wave 6 covariates

When adjusting for: social media use, GHQ-w6 score, sex, and number of friends at wave 6, CC and Max sample analyses showed significant associations between change in number of friends and GHQ-w9 score (table 2). The Max sample model showed that those who lost friends had higher GHQ-w9 scores compared with those who gained friends ($ß = 0.81$, 95% CI 0.15, 1.46, p=0.016), however differences in GHQ-w9 score of the no change versus gained friends group was attenuated beyond the significance level ($ß = 0.63$, 95% CI -0.10, 1.36, p = 0.091). CC analysis also

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showed that losing friends led to higher GHQ-w9 scores compared with gaining friends ($ß$ = 1.15, 95% CI 0.33, 1.98, p =0.006).

3. Fully-adjusted model

Change in friendships

Table 3 shows results of the final regression model on the CC sample. The fully adjusted model showed a significant association between changes in number of friends and GHQ-w9 scores. Change in friendships were significantly associated with GHQ-w9 score at wave 9 (F = 3.91, global p-value = 0.020). Losing friends was associated with higher GHQ-12 score at wave 9 compared to those who gained friends ($ß$ = 1.11, 95% CI 0.3, 1.93, p=0.008). When using no change in friendships as a reference category, losing friends was at the significance threshold for higher GHQ-w9 scores ($ß$ = 0.95, CI 0.00, 1.9, p=0.050) compared to the no change group.

Covariates

There was no statistically significant association between time spent on social media, number of friends at wave 6, or sex and GHQ-12 scores. GHQ-w6 score was significantly associated with increased GHQ-w9 score ($ß$ =0.34, CI 0.28, 0.40, p<0.001). Higher SDQ peer relationship problems ($ß$ = 0.28, CI 0.05, 0.51, p =0.016) and SDQ emotional symptoms ($ß$ = 0.29, CI 0.12, 0.46, p=0.001) scores were significantly associated with an increase in GHQ-w9 score.

Table 2. Model strategy results

	change in #friends	Bivariate			Adjusted for t1			Fully-Adjusted		
		Co-efficient (95% CIs)	p	n	Co-efficient (95% CIs)	p	n	Co-efficient (95% CIs)	p	n
Complete- Case	No change	0.54 [-0.44, 1.52]	0.28	1,073	0.14 [-0.79, 1.07]	0.77	1,073	0.16 [-0.76, 1.08]	0.727	1,073
	Lost	**0.94 [0.16, 1.75]**	**0.02***		**1.15 [0.33, 1.98]**	**0.006****		**1.11 [0.30, 1.93]**	**0.008****	
Max Sample	No change	**0.95 [0.18, 1.71]**	**0.016***	1,748	0.63 [-0.10, 1.36]	0.091	1,707	N/A		
	Lost	**0.77 [0.14, 1.40]**	**0.016***		**0.81 [0.15, 1.46]**	**0.016***				

Notes: reference category for friends change variable is gained friends. Sample size varies due to missing data on the included variables. R^2 values for complete-case models were: bivariate $R^2 = 0.0052$, t1-adjusted $R^2 = 0.1433$, fully-adjusted $R^2 = 0.1643$. Max Sample models: bivariate $R^2 = 0.0047$, t1-adjusted $R^2 = 0.1417$.

Table 3. Final regression model output (Complete-case analysis, n=1,073).

Variables	Coefficient	p	95% CIs		Global p-value
Change in # friends (vs gained)					
no change	0.16	0.727	-0.76	1.08	
Lost Friends	**1.11**	**0.008****	**0.30**	**1.93**	
Change in # friends (vs no change)					
Gained Friends	-0.16	0.727	-1.08	0.76	
Lost Friends	0.95	0.05	0.00	1.90	**0.0203***
Social Media use (hours)					
None	-0.42	0.503	-1.63	0.80	
<1 hour	0.48	0.245	-0.33	1.29	
4-6 hours	-0.14	0.782	-1.16	0.87	
7+ hours	0.35	0.625	-1.07	1.77	0.5969
Friends categories at (wave 6)					
None	-1.90	0.240	-0.51	1.28	
1-2	-0.61	0.233	-0.16	0.39	
6-9	-0.69	0.140	-1.61	0.23	
10-15	-0.95	0.119	-2.14	0.24	
16+	2.45	0.09	-0.40	5.31	0.0798
GHQ-12 score (wave 6)	**0.34**	**<0.001**	**0.28**	**0.40**	N/A
Sex (Female)	0.19	0.596	-0.51	0.89	
SDQ Peer Relations	**0.28**	**0.016***	**0.05**	**0.51**	
SDQ Emotional Symptoms	**0.29**	**0.001****	**0.12**	**0.46**	N/A
_cons	6.17	<0.001	5.11	7.22	

Notes: * denotes significance level: * = $p<0.05$, ** = $p<0.01$, *** = $p<0.001$. P-values are reported, unless below the $p<0.001$ threshold. $R^2 = 0.1643$.

The second (lower) set of change in #friends variable are inserted from a secondary multiple regression model (see appendix, 3) using no change in friendships as a reference category.

All other reference categories are reported in table 1.

Discussion

Model Results

The results in table 2 suggest that the CC sample is unlikely to be a substantially biased sub-set of the Max sample. Whilst possible effects of sampling selection cannot be conclusively ruled out, this discussion focuses on the results of the CC analysis. After adjustment for covariates at wave 6, this provided strong evidence that changes in friendships influenced GHQ score. The models consistently suggested that losing friends was associated with higher GHQ-12 score than gaining friends. Baseline measures from earlier childhood and adolescence (Table 3) were highly significant predictors of GHQ-12 score. There was no difference in GHQ-12 score between social media use groups, or by sex. Combined with results from model fit analyses (see appendix) and the large, representative sample of USoc, this work provides evidence that losing friends may harm adolescent mental health.

Key findings

The final model provided strong evidence that losing friends has a negative impact on mental health over time compared with those who gain friends, with a difference of around one point on the GHQ scale. This effect size equated to scoring three points higher on baseline GHQ score, or three points higher on childhood SDQ measures. These findings broadly support work suggesting that greater quantity and quality of support from friends may benefit adolescent mental health[28, 29], influencing the development of depression[23,24]. As hypothesised, losing friends was associated

with higher GHQ score compared with gaining friends and - albeit weakly - versus no change.

The effect of losing close friends (compared with an increase or no change) was roughly a 10% increase from mean GHQ score. An increase which has the potentially to be clinically significant. Research on the validity of the GHQ-12[37] suggests a threshold of ≥12 points for detecting the presence of depressive disorder. Given that average GHQ scores here (Table 1) are around 10-11 points, a small increase may represent a 'tipping point' into minor depression. However, a more cautious interpretation places the loss of close friendships within a complex[20], time-dependent[10] and varied[11] set of influences which combine to create mental ill health.

The categorisation of depression is dependent on multiple factors, where a range of symptoms in different combinations may lead to a diagnosis[4,8]. With this in mind, it is important to understand the implications of small changes in symptomology. An increase of one point on the GHQ-12 represents a change in how frequently a person has experienced a symptom. For example, 'feeling unhappy' from more than usual, to much more than usual. Changes like these are not likely to be single causal factors in the development of depression. These results support this more comprehensive view. Childhood mental health, and adolescent mental health were strongly and independently predictive of GHQ outcome scores, as were childhood social relations – supporting previous work on the onset[18,19] and risk of depression[11,14]. Alongside other influential factors not discussed here[7], the risk of developing a depressive disorder is known to be shaped by influences at different

points in the lifecourse. This study adds changes in quantity of close friends during adolescence to this evidence base, developing the view[13] that tackling exposures during adolescence may provide benefits into adulthood.

Despite being generally supportive of a relationship between number of close friends and mental health among adolescents, this study diverges from previous work in a number of ways. Where other work has focused on the mediating influence of friendships[21], or vulnerable adolescents specifically[29], this work demonstrates the potential harm of losing close friends amongst the general population. It also contrasts with the combined results of previous reviews[25] which tend to rely on cross-sectional findings using odds ratios to compare high/low risk groups. Given the small effect size seen here, it is arguably not surprising that binary measures of mental health outcomes have produced somewhat inconclusive findings[25]. This is particularly relevant, given evidence that the method of scoring the GHQ-12 used here has been shown to perform excellently in detecting depression in general populations[37].

Alongside research which suggests that perceptions[24], quantity[29], quality[21] and setting[23] of friendships can influence adolescent mental health, this study introduces changes in number of close friends as an important risk-factor.

Strengths and Limitations

There are limitations within this study. Potential confounders such as weight, and smoking and drinking habits[7] could not be included due to missing data. Reverse-

causality remains a possibility, as those who become depressed may avoid social activities[40]. The influence of people with no friends[34] is also difficult to judge, although a t-test of mean GHQ scores (see appendix, 5) showed no significant difference. These findings could also be interpreted as evidence for the increasing importance of friendships throughout adolescence[26]. Additionally, by studying a smaller sub-set of the sample, this work may have introduced forms of selection bias which were undetected, and it is unclear whether attrition or reporting biases have influenced the results. USoc has a weighting system which can be used to address such biases in the sample[36], which were not utilised here due to time limitations. Methods such as propensity score matching and inverse-probability weighting may provide a method to account for the influence of missing data between the study samples.

Despite limitations, this study provides promising evidence on friendships and depression amongst adolescents. The use of continuous GHQ-12 scores enabled detection of small changes in mental health. These results suggest the effect of losing or gaining friends is small – demonstrating the importance of a sensitive outcome measure. Using number of close friendships also provided interesting insight. 86% of participants reported having 1-9 close friends (Table 1), suggesting most people consider a handful of friends to be 'close'. Losing or gaining these friendships may significantly influence the risk of depression. However, definitions of close friendships may change with age, as the narrowing range (Table 1) suggests. By adjusting for influential covariates, including social media use, this study presents longitudinal evidence that suggests changes in the number of close friendships amongst UK adolescents may influence the risk of depression.

Conclusions

This study provides evidence that changes in quantity of 'close' friendships is associated with GHQ-12 score amongst adolescents in the UK. Losing friends may increase symptoms of depression, especially compared against those who gain close friends. These findings add to the literature linking the quantity and quality of social relationships to adolescent mental health.

Impact statement

The findings of this study may be useful to public health practitioners aiming to improve mental health outcomes during adolescence and beyond. They also underscore the need for research to consider multiple influences, including friendships, when aiming to understand and improve depressive disorders in the UK.

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Appendix

1. Variance Inflation Factor – variables included CC analysis final model. All variables below the threshold of 5 for high correlation.

Variable	VIF
friends change	
no change	1.90
lost friends	2.00
social media use	
None	1.13
<1 hour	1.19
4-6 hours	1.15
7+ hours	1.08
sex	1.12
Friends categories (wave 6)	
None	1.04
1-2	1.18
6-9	1.18
10-15	1.15
16+	1.04
SDQ Peer Relations	1.26
SDQ Emotional Symptoms	1.31

2. Residuals vs. Fitted Plot (CC analysis final model)
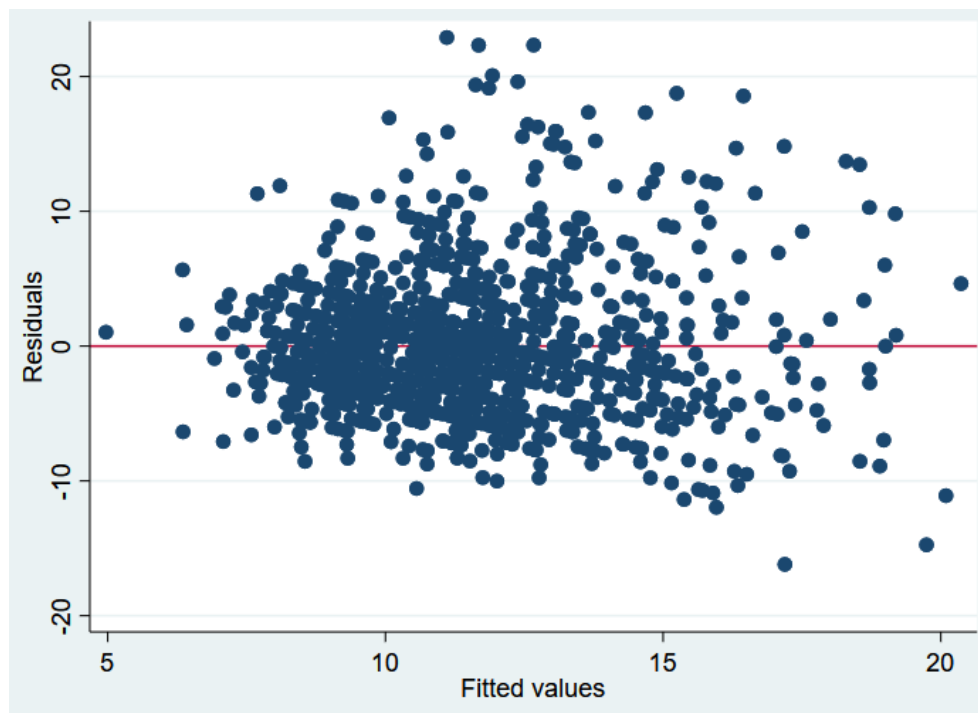
3. Regression results - model using no change in friendships as reference category. **R²** = 0.1643

Variables	Coefficient	p	95% CIs	
Change in # friends (vs no change)				
Gained Friends	-0.16	0.727	-1.08	0.755
Lost Friends	0.95	0.05	-0	1.896
Social Media use (hours)				
None	-0.42	0.503	-1.63	0.801
<1 hour	0.48	0.245	-0.33	1.29
4-6 hours	-0.14	0.782	-1.16	0.871
7+ hours	0.35	0.625	-1.07	1.775
GHQ-12 score (wave 6)	0.34	<0.001	0.282	0.403
Sex (Female)	0.19	0.596	-0.51	0.89
Friends categories at (wave 6)				
None	-1.90	0.240	-5.08	1.276
1-2	-0.61	0.233	-1.6	0.391
6-9	-0.69	0.140	-1.61	0.227
10-15	-0.95	0.119	-2.14	0.244
16+	2.45	0.092	-0.4	5.307
SDQ Peer Relations	0.28	0.016	0.053	0.507
SDQ Emotional Symptoms	0.29	0.001	0.116	0.464
_cons	6.33	<0.001	5.135	7.527

4. Likelihood ratio tests (CC analysis fully-adjusted model vs. the inclusion of individual, non-significant covariates). LR = likelihood ratio p-value. Global p-value = significance of variable within regression model.

Variable Added	LR p-value ($\alpha=0.05$)	Improved model fit?	global p-value
Bullied	0.9717	No	N/A
Age at Wave 6	0.6913	No	N/A
Long-standing health issue	0.5856	No	N/A
Tenure	0.4896	No	0.4974

5. T-Test comparing mean GHQ-12 scores between those with no/more than 1 close friend

# Friends	Observations	Mean GHQ-12 score	95% CI
0 friends	12	9.75	7.01, 12.49
1+ friends	1,061	11.6	11.24, 11.93

T-test results

Difference < 0	Difference = 0	Difference > 0
p = 0.1427	p = 0.2853	p = 0.8573