Research Article

A CONTROLLED TRIAL OF A SCHOOL-BASED INTERNET PROGRAM FOR REDUCING DEPRESSIVE SYMPTOMS IN ADOLESCENT GIRLS

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Background: *This study evaluates the benefits of a self-directed Internet intervention for depression (MoodGYM) delivered as a part of the high school curriculum.* **Method:** *One hundred and fifty-seven girls, aged 15 and 16 years, were allocated to undertake either MoodGYM or their usual curriculum. MoodGYM's impact on depressive symptoms, risk of depression, attributional style, depression literacy and attitudes toward depression was examined using random effect regression.* **Results:** *MoodGYM produced a significantly faster rate of decline in depressive symptoms over the trial period than the control condition. The effect size for MoodGYM was not significant immediately after the intervention (Cohen's $d = .19$, 95% CI −.18–.56) but was moderate and significant 20 weeks after the intervention ($d = .46$, 95% CI .10–.82). Girls with high depression scores before intervention showed the strongest benefits on self-reported depression at follow-up ($d = .92$, 95% CI .10–1.38). There were no significant intervention effects on depression status, attributional style, depression literacy, and attitudes. Approximately 70% of girls in the MoodGYM group completed less than three of its modules and completion of fewer modules was related to high depression score before intervention.* **Conclusions:** *The findings suggest that there are benefits from MoodGYM on self-reported depressive symptoms but has low rates of completion highlight problems in ensuring adherence to Internet programs for depression. Depression and anxiety 26:65–72, 2009.*

Key words: *depression; adolescent; intervention; Internet; girls*

INTRODUCTION

Depression remains the major mental health problem in adolescence. It has a very high prevalence,[1] is associated with significant morbidity even at subthreshold levels,[2] and treatment utilization by adolescents is low.[3] One approach for preventing and reducing depression in adolescents is school-based delivery of cognitive behavioral therapy and psycho-education. These programs show benefits particularly for youth with current symptoms or for those with a risk for depression.[4] Their benefits when applied universally are less certain.[4–8] For the most part, they are face-to-face group programs delivered by mental health workers, or by the school's teachers specifically trained in the particular program. The need for staff training

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and support means the programs are often resource intense, costly, and difficult to sustain.[9] If they are to be effective in reducing adolescent depression broadly, such programs must address the problems associated with going to that scale in their delivery.[9]

There is evidence that Internet delivery of self-directed CBT programs can increase treatment access and be effective for a range of problems in adults including depression.[10–12] Although adolescents report more positive engagement with computers and the Internet than other age groups,[13] it is not known whether adolescents will also benefit from Internet CBT interventions for depression.

The aim of the present research is to evaluate the benefits of a self-directed Internet intervention for depression (MoodGYM) delivered as a part of the high school curriculum. MoodGYM has been shown to reduce the symptoms of depression and improve dysfunctional thinking in adults.[14] The one study examining its benefits for adolescents[15] found no between-group differences for depressive symptoms. There was a reduction in the risk of being classified depressed in the MoodGYM group of 9% at post treatment compared to an increased risk for the control group. This was not sustained at 6-month follow-up. That study highlighted two important issues that warrant clarification and continued investigation in adolescents. First, as a self-directed program the question of the amount of MoodGYM needed to produce an effect is critical. The findings in O'Kearney[15] showed benefits for the adolescent boys who completed more modules. Versions of MoodGYM with three or more modules are significantly more effective than briefer versions for adults.[16] Second, it is important to examine whether the effects of MoodGYM as a curriculum-based intervention works for all students or for those adolescents with or at risk of depressive symptoms.

This study examines MoodGYM's effectiveness in reducing depression and depressive symptoms, and for enhancing attributional style. We examine attributional style because it is important that studies of universal interventions assess their impact on vulnerabilities for depression as well as depressive symptoms.[17,18] Cognitive variables, particularly attributional style, continue to be considered good candidates for understanding psychological vulnerability to depression.[19,20] The study also examines, as secondary outcomes, knowledge about depression and its treatment and attitudes toward depression. The study focuses on the use of MoodGYM as a part of the year 10 school curriculum for girls. It was directed at females only because of the higher risk of depressive symptoms in adolescent girls and in view of the evidence of better effects for interventions that had a greater percentage of females. [17] We test the relative benefits of MoodGYM by examining between group differences in trajectories of change across time (pre-assessment, post-assessment and follow-up). In addition, we explore results for two subgroups; the first defined by their level of depression before intervention, the second by the amount of MoodGYM completed.

METHOD

PARTICIPANTS

Eligible participants were year 10 girls attending a single sex school in Canberra, Australia. The primary demographic of the school is moderate to high-income families in Canberra. The total number of students in year 10 was 157 and all 157 girls agreed to participate and obtained written consent from their parents.

INTERVENTION

MoodGYM is designed to help people identify problems with depression, overcome these problems, and develop good coping skills. It contains information, demonstrations, questionnaires, and skills exercises (relaxation, problem solving, cognitive restructuring, assertiveness, self-esteem training, and coping with relationships). Users are able to proceed through the program at their own pace.

MoodGYM was delivered as the personal development curriculum for 6 weeks with each module open for 2 weeks. Participants in the control group undertook the school's normal personal development activities about nutrition during the trial. At the completion of the trial, participants in both groups resumed the usual personal development activities. Participants completed the assessment questionnaires at pre-intervention, at the completion of the trial 6 weeks later, and at follow-up 20 weeks after the post-assessment.

OBJECTIVES

The primary outcomes were depression severity and status, and attributional style. Secondary outcomes were depression literacy and attitudes to depression. The independent variables were treatment group (MoodGYM, Control), and time (pre-assessment, post-intervention, follow-up). The hypotheses were that individuals using MoodGYM when compared to controls would show faster rates of improvement in depressive symptoms over the trial period and greater rates of change from high to low depression status. In addition, it was predicted that MoodGYM would facilitate greater change in attributional style toward less depressogenic attributions, strengthen knowledge of depression and its treatments, and improve attitudes to depression.

OUTCOMES

Outcomes were measured at the individual level by self-report instruments.

Depression. Depression was measured using the 20 item Centre for Epidemiological Studies Depression Scale (CESD[21]). The CESD has good construct validity and reliability ($\alpha = .87$)[22], and is sensitive to individual differences in depressive severity in student populations.[19,20] Radloff (1991) suggested a cut-off of 16 for older adolescents whereas others[25] have found cut-offs of 22 for boys and 24 for girls optimize specificities and sensitivity for detecting adolescent with clinical levels of depressive symptoms. We use a cut-off of 24 for binary outcomes (Depression Status; Low (< 24), High ($> = 24$) level of depressive symptoms) and also to divide the participants into those with a high and low level of initial depressive symptoms.

Attributional Style. Attributional style was assessed using the 24 item Revised Children's Attributional Style Questionnaire (CASQ-R). [26] The CASQ-R consists of hypothetical situations followed by alternative statements explaining why that situation

happened. All three dimensions of attributions (internal–external, stable–unstable and global–specific) are assessed. Scores are calculated for positive events and for negative events. An overall CASQ-R score is calculated by subtracting the negative score from the positive score. The higher the CASQ-R score the less depressive is the attributional style. The CASQ-R has been shown to be an adequate measure of attributional style ($\alpha = .45$–$.60$).[26]

Depression Literacy. Knowledge about depression was assessed using a 15-item depression literacy scale (DLC).[27] The scale assesses three domains of depression literacy: medical literacy, psychological literacy, and lifestyle literacy. An overall depression literacy score (0–8) is calculated by summing the domain scores. In this study, the DLC had a low internal consistency reliability at pre-test ($\alpha = .31$) but it was acceptable at post-test ($\alpha = .64$) and follow-up ($\alpha = .64$).

Attitudes to Depression. Attitudes to depression were assessed using the scale constructed by Griffiths.[14] Nine 4-point Likert-type items assessed the following attitudinal themes: depression as an illness, whether depression is under personal control, whether depression is a character flaw, the dangerousness and unpredictability of someone with depression, and social distance associated with depression. A total score is obtained by summing all the items with higher scores indicating more positive attitudes. Griffiths[14] reported good internal reliability in an adult sample ($\alpha = .64$). In this study, the scale had internal consistency reliability of between .72 and .79.

SAMPLE SIZE DETERMINATION

For sample size determination, it was assumed that the control group would show improvements of 50% of that of the MoodGYM group. This corresponds to effect sizes of .3 for changes on the CESD and of .03 for changes in identifying depression status (a 5-point difference in CESD scores for the MoodGYM group).[27, 28] Sample size estimates indicated that 140 participants (70 per group) were sufficient to detect differences with power of .8 in one-tailed tests at $\alpha = .05$.

ALLOCATION: IMPLEMENTATION AND CONCEALMENT

Students were allocated to the MoodGYM intervention or control group according to personal development class membership. Students' assignment to a particular personal development class was determined by the school before the commencement of the school year with no streaming of students based on academic achievement. Because the maximum number of students who could access a personal computer was equivalent to three classes, the deputy principal determined that the first three classes finishing their personal development activities would be allocated to MoodGYM. The remaining four classes were allocated to the control group. This decision was made before the commencement of the school year. Personal development class teachers and participants were not informed about allocation until after pre-intervention assessment and the researchers who administered the self-report instruments were blind to assignment. Blinding of participants, teachers, or researchers was not possible at subsequent assessments.

ETHICS

The Australian National University's Human Research Ethics Committee approved the study design in accordance with National Health and Medical Research Council ethical guidelines.

ANALYSIS PLAN

MoodGYM effectiveness on all outcomes was assessed with random effects regression. This method estimates individuals' trajectories of change across pre-assessment, post-intervention, and follow-up and considers between-group differences in regression estimates. It utilizes all existing data, at the individual and group level, rather than requiring imputation for missing values. As regression considers time as a continuous variable it accommodates varying intervals between measurement points. Analyses for the total sample and for initial depression level subgroups (Low, High) are presented. For any significant effect of MoodGYM, a comparison between MoodGYM subgroups based on the number of MoodGYM modules completed (Low, High completion; High $>=$ 3 modules) was undertaken. All of these analyses were conducted with MLWin using $\alpha = .05$. To assess the clinical significance of any benefits of MoodGYM, we report effect sizes at post and follow-up as standardized mean differences (Cohen's *d*).

RESULTS

PRELIMINARY ANALYSES

Descriptive data for the two groups are presented in Table 1. The groups did not differ before intervention on the CESD, Depression status, CASQ-R, or Attitudes to depression. The control group reported significantly higher depression literacy than the MoodGYM group at pre-intervention. Before intervention, 25% of participants reported the levels of depression considered above the cut-off for high depression status.

PARTICIPANT FLOW

Figure 1 describes the flow of participants during the trial. All eligible students were included in the study with 67 allocated to MoodGYM and 90 to the control. Whereas equivalent proportions of participants were missing from each group at post assessment (χ^2 (1, $N = 156$) = 2.82, $P = .09$) a higher proportion of the MoodGYM group were missing at the follow-up assessment (χ^2 (1, $N = 156$) = 6.48, $P = .01$).

OUTCOME ANALYSIS

Table 2 presents the estimates from the regression model for time (pre, post, follow-up) and time by group (MoodGYM, Control) interactions for all outcomes for the total sample and the initial depression level subgroups. There was a significant effect for time and a significant time by group interaction suggesting that the rate of decline in depression scores across the time course of the study was significantly greater for the MoodGYM participants in general. This group by time effect was also significant for the subgroup of participants with high initial CESD scores but not for those with initially low scores. Figure 2 graphs the trajectories of estimated means from the multilevel models for CESD scores over the three time points for control and MoodGYM participants. Cohen's *d* indicated that immediately following the intervention

TABLE 1. Means (*SD*) for each continuous outcome measure and proportion (*N*) for binary outcome by group for each assessment and significance of difference between groups before intervention

	MoodGYM	Control	Comparison
CESD			
Baseline	17.93 (11.71)	18.53 (11.50)	t (155) = .33; P = .75
Post Tx (6 weeks)	15.25 (11.47)	17.22 (10.52)	
20 weeks follow-up	12.99 (11.53)	16.22 (11.10)	
High level of CESD (%; N)			
Baseline	23.9% (16)	26.7% (24)	χ^2 (1, N = 154) = .16; P = .69
Post Tx (6 weeks)	9.5% (5)	20.3% (12)	
20 weeks follow-up	10.4% (5)	21.3% (17)	
CASQ-R			
Baseline	3.81 (4.38)	2.93 (4.55)	t (155) = −1.28; P = .23
Post Tx (6 weeks)	3.98 (4.44)	3.73 (4.37)	
20 weeks follow-up	5.14 (4.10)	3.94 (3.84)	
Depression literacy			
Baseline	2.00 (1.34)	2.52 (1.42)	t (154) = 2.33; P = .02
Post Tx (6 weeks)	2.21 (1.77)	2.56 (1.49)	
20 weeks follow-up	2.29 (1.43)	2.54 (2.09)	
Attitudes to depression			
Baseline	26.65 (3.27)	26.66 (3.91)	t (153) = .02, P = .99
Post Tx (6 weeks)	27.38 (3.93)	26.68 (3.37)	
20 weeks follow-up	27.23 (3.17)	26.56 (4.47)	

there were small, nonsignificant effects favoring MoodGYM for the total sample (d = .19, 95% CI −.18–.56) and for those with high initial CESD (d = .12, 95% CI −.69 to .81). At follow-up there was a moderate and significant effect favouring MoodGYM for the total sample (d = .46, 95% CI .10–.82) and a moderate to large, significant effect for the initially high CESD participants (d = .92, 95% CI .10–1.38).

In terms of trajectories of depression status and CASQ-R there were no overall effects of time or time by group effects for the total sample or the initial depression level subgroups. There were also no significant effects for time or significant time by group interactions for the secondary outcomes.

ADHERENCE

About 30% (20 of 67) of MoodGYM students completed three or more modules. A random effects regression model with time and MoodGYM completion group (High, Low) as levels was used to investigate the effect of MoodGYM according to the amount of MoodGYM completed. The rates of decline of self-reported depression over the post-intervention period were equivalent for the two MoodGYM subgroups (β = −.15, SE = 17, Z = .88, P = .386). However, students who completed fewer than three modules (M = 20.13, SD = 12.48) reported significantly higher initial depression scores than those who completed three or more modules (M = 12.25, SD = 7.11), t (65) = 2.71, P = .009).

MISSING DATA ANALYSIS

We examined the relationship between having missing data at post and follow-up and initial depression scores using Group (MoodGym, Control) by Missingness (Missing, Nonmissing) Analysis Of Variances. Those with missing data at post (M = 20.42, SD = 11.80) were not significantly more depressed at initial assessment than those with post data (M = 17.41, SD = 11.39) F (1,153) = 25.07, P = .125, and there was no significant interaction between Group and Missingness, F (1, 153) = .09, P = .77. Those with missing data at follow-up (M = 23.44, SD = 13.36) were not significantly more depressed initially than those with follow-up data (M = 17.10, SD = 10.82), F (1, 153) = 2.75, P = .345. There was, however, a significant interaction between Group and Missingness at follow-up, F (1, 153) = 3.81, P = .05. Those in the control group with missing data at follow-up (M = 29.70, SD = 11.99) were significantly more depressed initially than those in the control with data at follow-up (M = 17.13, SD = 10.71), t (88) = 3.45, P = .001) whereas there was no difference for the MoodGYM groups (M = 20.16, SD = 13.13; M = 17.04, SD = 11.11; t (65) = .98, P = .33).

DISCUSSION

This is the first controlled study investigating the benefits of a curriculum-based Internet intervention for adolescent depression in girls. The results demonstrate that MoodGYM produced a significantly faster rate of decline in self-reported depressive symptoms than the usual curriculum. This benefit was most evident for those girls with initial levels of depression above the cut-off for a clinically relevant level of symptoms. The size of the MoodGYM effect was significant at 20 weeks follow-up for the total sample (d = .46) and for those with a high level of depression before the

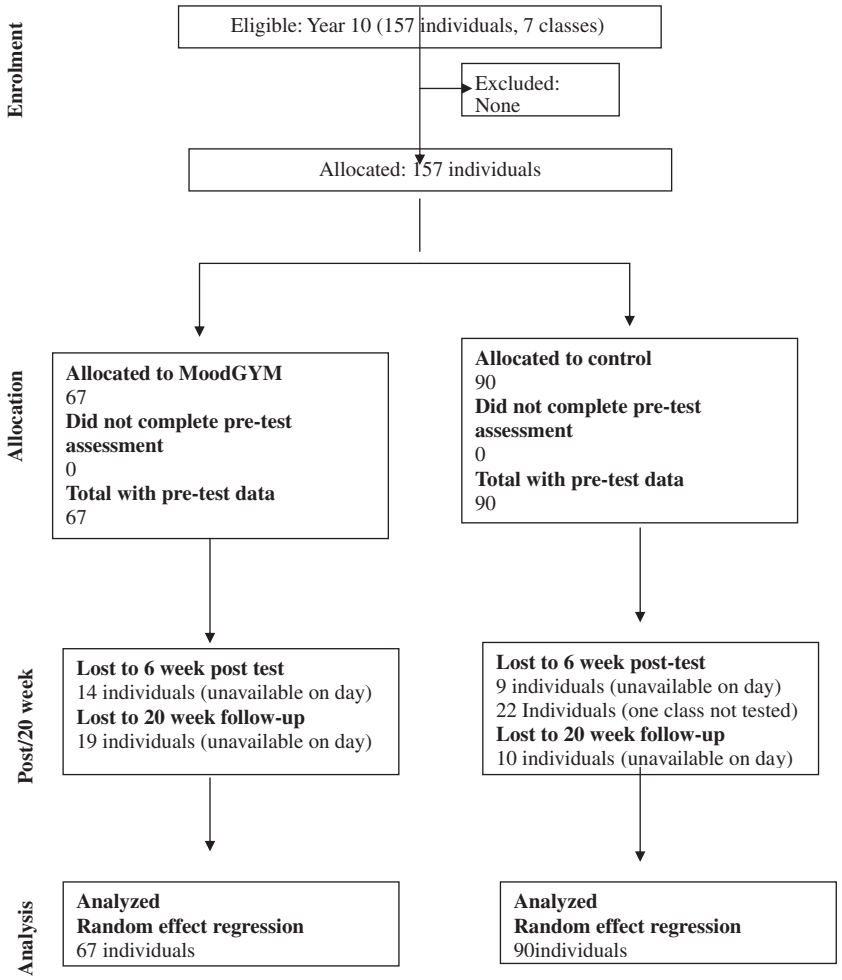

Figure 1. Participant flow through the study.

intervention ($d = .92$) but was not significant for any group immediately post-intervention. The rates of change from above the high depression cut-off to below the cut-off and from nondepressed to depressed status did not differ significantly between the groups. There were no significant effects of MoodGYM on attributional style, knowledge about, and attitudes toward depression.

The differential reduction of self-reported depressive symptoms in the MoodGYM group is encouraging because of the link between subthreshold levels of depressive symptoms and negative behavioral, emotional, and social outcomes.[2] It also compares positively to the effect sizes for other school-based interventions.[4, 29] This is an important finding as it indicates that a self-directed intervention delivered via the Internet may be as effective at reducing depressive symptoms as more resource intense face-to-face interventions. As Internet delivery offers flexibility and sustainability, the findings suggest that MoodGYM could be a valuable resource for reducing distress and depressive symptoms in adolescents. The lack of an effect on attributional style is disappointing as MoodGYM's cognitive module contributes most to the outcomes it obtains with adults.[16] This failure to find intervention effects on vulnerability is consistent with other school-based strategies[6,30,31] and represents a challenge for school-based prevention strategies for depression.

The association between lower completion rates for MoodGYM and higher levels of depressive symptoms mitigates conclusions about the effectiveness of MoodGYM as a depression intervention strategy. There may be obstacles to effective engagement with the program for many of those who are most likely to benefit. Depression impacts on individuals' school attendance and on their motivation and their ability to concentrate in a self-directed format. In addition, there is a risk that information about levels of depressive symptoms could be identify-confirming for vulnerable or depressed adolescents and reduce engagement with the program. The findings suggest that MoodGYM may need to be

modified into a simpler, possibly shorter, format so that depressed adolescents find it easier to engage in the exercises.

The overall low rate of completion of MoodGYM modules is also problematic for the use of MoodGYM as a curriculum-based program. It suggests difficulties with the amount of material, the age appropriateness of the program's themes and examples, and problems with its use in a group format. All these issues are relevant not only to MoodGYM but also to other computer delivery self-directed interventions. Nevertheless, such programs offer opportunities to overcome many of these difficulties. The options that can be provided through a menu of modules available to specific groups make Internet delivery potentially very attractive for increasing adherence. Despite the problem with completion, this study did not find that the benefits of MoodGYM were related to the number of modules completed. The amount of available access may have reduced chances for students to complete a module while still giving them exposure to enough of the module's content.

We recognize the limitations to the generalizability of the findings because they come from only one, relatively high social status, school. In addition, the overall number of participants is small for detecting effects after 20 weeks. These criticisms are weekened by the high prevalence of girls reporting levels of depression above the high depression cut-off (25%) and high participation rate. We acknowledge that the assignment to personal development classes was not a random process although it was carried out before the study commenced and did not involve streaming of students. It is not possible to rule out some systematic bias in this assignment. The allocation to groups on the basis of speed of curriculum completion could also introduce bias. We tried to minimize this by deciding on the method of allocation before recruitment, concealing allocation method from the participants, researchers, and class teachers until after initial

TABLE 2. Random effects estimates (β), standard error of estimate, *Z*, and *P* value for Time, and Time by Group variables from the Multilevel models for CESD, Depression Status, CASQ-R, Depression Literacy, and Attitudes to depression for the total sample and for those with high and low initial CESD scores

	Time				Time by group			
	β	*SE*	*Z*	*P*<	β	*SE*	*Z*	*P*<
Total Sample								
CESD	−.120	.056	2.14	.04	−.200	.090	2.22	.02
Dep. status	−.011	.018	0.61	.52	−.057	.037	0.81	.42
CASQ-R	.017	.020	0.85	.40	.033	.056	0.59	.56
Dep. literacy	−.018	.034	0.53	.40	.069	.056	1.23	.22
Attitudes	.003	.016	0.30	.76	.006	.017	0.35	.28
High initial depression								
CESD	−.385	.131	2.96	.004	−.564	.211	2.67	.006
Dep. status	−.097	.036	2.69	.008	−.107	.073	1.47	.14
CASQ-R	.073	.049	1.42	.16	.104	.078	1.33	.18
Dep. literacy	.000	.000	.000	0	.000	.000	.000	0
Attitudes	−.049	.129	0.26	.78	.066	.209	0.33	.74
Low initial depression								
CESD	−.030	.055	0.54	.58	−.155	.088	1.31	.18
Dep. status	.077	.036	2.14	.02	.000	.017	.000	0
CASQ-R	.001	.020	0.05	.96	.014	.033	0.42	.66
Dep. literacy	.004	.012	0.33	.74	−.007	.020	0.35	.72
Attitudes	−.01	.022	0.45	.66	.066	.35	0.19	.84

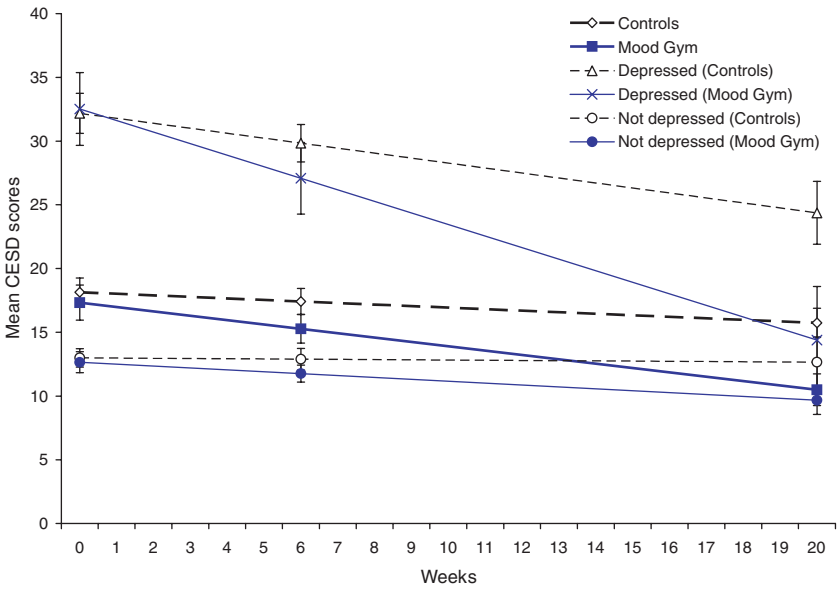

Figure 2. Trajectories of mean CESD scores by group for total sample, those with high initial CESD scores and those with low initial CESD scores. Points represent estimated mean scores; vertical lines depict standard errors of the mean.

assessment. Nevertheless, some factors affecting, the speed of curriculum completion such as teacher effectiveness and group cohesion may have impacted on the rate of change in self-reported depression. In undertaking evaluation research in a real world school setting, the risks arising out of school determined allocation need to be balanced against the benefits of developing a partnership with the school. In this case the partnership was invaluable in ensuring the high rate of student recruitment and the efficient implementation of the trial.

The single school design also risked between-group contamination. Although there were no changes to usual rates of MoodGYM use via the community during the study, some students in the control group may have accessed the site or received information from the MoodGYM participants. These factors may have biased the study's outcome toward null results. In addition, the numbers lost to post-assessment may have resulted in reduced power and favored a null outcome. The loss to follow-up of the more depressed girls from the control group but not from the MoodGYM group is likely to increase the relative difference at follow-up in favor of MoodGYM indicating that the significant benefits of MoodGYM observed at follow-up are robust.

Overall, the study's results offer encouragement to the development of effective school-based interventions for reducing depression in adolescences via the Internet. MoodGYM provides an additional resource for reducing the high level of depressive symptoms in adolescent girls. Such developments are necessary if we are to overcome the limitations of scope and sustainability inherent in face-to-face programs.

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