ORIGINAL RESEARCH AND REVIEWS

Integrative Internet-Based Depression Prevention for Adolescents: A Randomized Clinical Trial in Primary Care for Vulnerability and Protective Factors

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Abstract

Background: Adolescent depression is both a major public health and clinical problem, yet primary care physicians have limited intervention options. We developed two versions of an Internet-based behavioral intervention to prevent the onset of major depression and compared them in a randomized clinical trial in 13 US primary care practices. **Methods:** We enrolled 84 adolescents at risk for developing major depression and randomly assigned them to two groups: brief advice (BA; 1-2 minutes) + Internet program versus motivational interview (MI; 5-15 minutes) + Internet program. We compared pre/post changes and between group differences for protective and vulnerability factors (individual, family, school and peer). **Results:** Compared with pre-study values, both groups demonstrated declines in depressed mood; [MI: 21.2 to 16.74 (p < 0.01), BA: 23.34 to 16.92 (p < 0.001)]. Similarly, both groups demonstrated increases in social support by peers [MI: 8.6 to 12.1 (p = 0.002), BA: 7.10 to 12.5 (p < 0.001)] and reductions in depression related impairment in school [MI: 2.26 to 1.76 (p = 0.06), BA: 2.16 to 1.93 (p = 0.07)]. **Conclusions:** Two forms of a primary care/Internet-based behavioral intervention to prevent adolescent depression may lower depressed mood and strengthen some protective factors for depression.

Key words: depressive disorder, adolescents, prevention, Internet, primary care, intervention

Résumé

Contexte: Bien que la dépression des adolescents soit à la fois un problème majeur pour la santé publique et les services cliniques, les interventions des médecins de première ligne sont limitées. Deux versions d'un programme d'intervention comportementale sur Internet destiné à prévenir l'apparition des symptômes de dépression grave ont été comparées lors d'un essai clinique aléatoire mené dans 13 centres de soins de première ligne aux États-Unis. **Méthodologie:** Quatre-vingt-quatre adolescents à risque de dépression grave ont été répartis de manière aléatoire en deux groupes: un groupe recevait de brefs conseils (BC: 1-2 minutes) et suivait le programme de prévention de la dépression sur Internet ; l'autre groupe participait à des sessions d'entrevue motivationnelle (EM: 5-15 minutes) et suivait le programme de prévention de la dépression sur internet. Nous avons comparé les changements constatés dans les facteurs de protection et de vulnérabilité (individuels, familiaux, scolaires et relations avec les pairs). **Résultats:** La comparaison des données avant l'essai indiquait, pour les deux groupes, une baisse dans l'humeur dépressive; [EM: de 21,2 à 16.74 (p < 0,01); BC: de 23,34 à 16.92 (p < 0,001)]. De même, les deux groupes affichaient une hausse dans le soutien social par les pairs [EM: de 8,6 à 12,1 (p = 0,002); BC: de 7,10 à 12,5 (p < 0,001)] et une baisse du handicap scolaire lié à la dépression [EM: de 2,26 à 1,76 (p = 0,06) ; BC: de 2,16 à 1,93 (p = 0,07)]. **Conclusion:** Les deux formes d'intervention comportementale en première ligne/sur Internet conçues pour prévenir la dépression des adolescents font diminuer le nombre de sujets souffrant d'humeur dépressive et renforcent certains facteurs de protection contre la dépression.

Mots clés: trouble dépressif, adolescents, prévention, Internet, première ligne, intervention

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Introduction

Depression is the most common mental disorder in adolescence with 8-10% of adolescents experiencing an episode each year (Kessler & Walters, 1998). Depression is a recurrent chronic disorder with a substantial adverse impact on social, educational, and health outcomes during adolescence and beyond (Hankin, 2006). Even with treatment, 30-40% of depressed adolescents fail to attain full remission (March et al., 2004). Increasingly, primary care physicians are expected to screen and intervene for depressive episodes in adolescents (Richardson & Katzenellenbogen, 2005; Zuckerbrot et al., 2007). However, many primary care physicians have concerns about prescribing anti-depressant medications to adolescents. Availability of high quality mental health specialty care for children is often limited by scarcity of providers in many geographic areas and/or cost containment strategies of managed behavioral health organizations (Grembowski et al., 2002; Sturm, Ringel, & Andreyeva, 2003; Van Voorhees, Wang, & Ford, 2003). One way of addressing these difficulties would be to develop a depression prevention intervention for primary care physicians.

CATCH-IT (Competent Adulthood Transition with Cognitive-behavioral and Interpersonal Training, Figure 1) was developed as a low cost, easily disseminated preventive intervention for primary care environments and demonstrated favorable trends in three vulnerability factors in a pilot study (Van Voorhees, Ellis, Stuart, Fogel, & Ford, 2005). Adolescent adherence to mental health treatments is known to vary in consistency and reliability (Asarnow, Jaycox, & Anderson, 2002) and adolescent participation in Internet interventions is often inconsistent (Clarke, 2002; Santor, Poulin, LeBlanc, & Kusumakar, 2007). With this in mind, we sought to determine what form of engagement and amount of physician time is required to effectively engage youth in an Internet-based preventive program. Brief advice (BA) and motivational interviewing (MI), two primary care based approaches to behavior change, are possible methods of engagement. They vary considerably in terms of time (1-2 minutes versus 5-15 minutes), training requirements, and cost/feasibility.

The purpose of this study is to determine which primary care approach is more efficacious in reducing vulnerability of major depressive disorder as measured by pre/post changes in vulnerability factors. Our first hypothesis was that the MI would enhance willingness to prevent depressive disorder while the BA would not. The second hypothesis was that MI would be more effective in combination with the Internet intervention in reducing ambient depressed mood. In the third hypothesis, we proposed that MI would be superior in demonstrating a greater pre/post changes in vulnerability and protective factors such as social support and automatic negative thoughts. We conducted a randomized controlled trial comparing MI + Internet prevention intervention versus BA + Internet prevention intervention in terms of ratings of perceived helpfulness and motivation, depressed mood, vulnerability, and protective factors.

Methods

Study Design: We conducted a randomized controlled trial comparing BA + Internet program versus MI + Internet program. This was a phase II clinical trial focused on determining the optimal primary care exposure to maximize benefit in preparation for a phase III efficacy trial whereby the optimal intervention would be compared to a treatment as usual control. We recruited 13 primary care practice sites within five different health systems in four states (US Midwest and South). Practices were directly called or contacted through physician leaders within health care systems. Practices
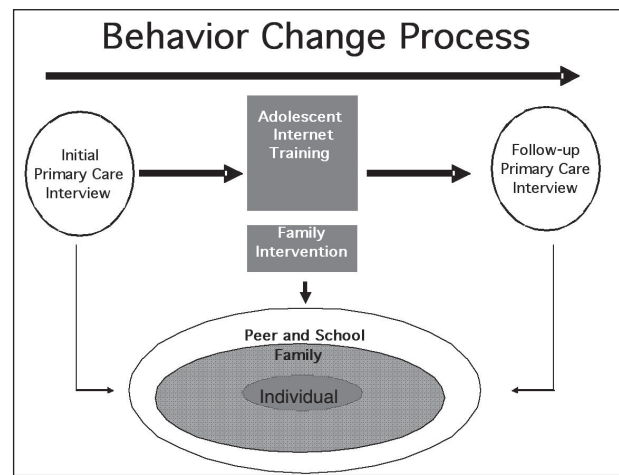

Figure 1: Intervention Model

could elect either to have their own physicians conduct the interview (N=10 practices) or to have the study principle investigator (primary care physician, N=3 practices) conduct the interview. We evaluated a self-administered post-study questionnaire at 4-8 weeks. All protocols had IRB approval.

Adolescent Recruitment: Recruitment occurred from February to November 2007. The screening instrument was a two-item questionnaire based on the Patient Health Questionnaire Adolescent (PHQ-A) core depression symptom items (Johnson, Harris, Spitzer, & Williams, 2002). Those reporting any core depressive symptom (depressed mood, loss of pleasure or irritability) of depressive disorder lasting a minimum of a few days in the last two weeks were considered positive screens. Study staff contacted those with positive screens who granted permission (and parent if participant was below age 18) by phone to conduct an eligibility assessment which included the full PHQ-A assessment.

Adolescent Inclusion and Exclusion Criteria: Participants were between the ages of 14-21 years and experienced persistent sub-threshold depression (> 1 core symptoms of depression) at both the screening and eligibility assessment (1-2 weeks after initial screening). Exclusion criteria included meeting criteria (or undergoing active treatment) for major or minor depression, expressing frequent suicidal ideation or intent, or meeting criteria for the following: bipolar, conduct, substance abuse, generalized anxiety, panic, or eating disorders. Individuals who reported *symptoms* of conduct disorder, generalized anxiety disorder, or past substance abuse were not excluded. Primary care physicians were granted some discretion in enrolling individuals with borderline major depression and/or generalized anxiety disorder.

Primary Care Intervention and Training: We trained physicians in one hour programs using a lecture and example video tapes. In the BA condition (1-2 minute interview), the physician advises the adolescent that the adolescent is experiencing a depressed mood, that the adolescent should go to the website and complete the intervention, and that the adolescent should have a follow-up visit and interview in 4-6 weeks. In the MI (5-15 minutes interview), the physician helps the adolescent identify a personal rationale for completing the Internet program by facilitating the adolescent's development of favorable attitudes towards participation and completion of the intervention. The adolescent in the MI group also receives three motivational phone calls from a social worker case manager, who received a similar course of training in MI.

Internet Intervention: The intervention included 14 Internet-based modules based on Behavioral Activation and Cognitive Behavioral Psychotherapy (CBT) (Clarke, 1994; Jacobson, 2001), Interpersonal Psychotherapy techniques (Mufson , 2004; Stuart, 2003) and a community resiliency concept. (Bell, 2001) To develop the intervention, we employed evidence-based interventions of established efficacy based on established principles of effective community-based preventive interventions (Nation et al., 2003). CATCH-IT teaches adolescents how to reduce behaviors that increase vulnerability for depressive disorders (e.g., procrastination, avoidance, rumination, pessimistic appraisals, and indirect communication style) and increase behaviors that are thought to protect against depressive disorder (e.g., behavioral scheduling, countering pessimistic thoughts, activating social networks, and strengthening relationship skills). We also provided a parent workbook to the parents of adolescents under age 18. This workbook focused on supporting the development of resiliency in the adolescent (Beardslee, Gladstone, Wright, & Cooper, 2003), understanding the relationship between depressed mood in the adolescent and other family members, and building family resiliency. This intervention was extensively revised based on results and feedback from an initial pilot study (Van Voorhees et al., 2007).

Internet Intervention Structure: We employed instructional design theory (Briggs, Briggs, Gagne, & Wager, 1992) to actively engage adolescents in reducing vulnerability/ enhancing protective factors (Reinecke & Simmons, 2005). Instructional design intends to 1) gain attention of the learner, 2) inform the learner of objectives, 3) strengthen recall of essential knowledge, 4) provide needed stimulus material, 5) offer learning guidance, 6) measure performance, 7) offer feedback on performance correctness, 8) evaluate performance, and 9) increase transfer and retention

(Briggs et al., 1992). In the intervention, each module included learning goals, review, core concept explanation, adolescent stories to illustrate the lessons, skill building exercises, a summary, feedback on the experience and an Internet-based reward. After providing the core concepts, we stimulated recall, understanding and retention with narratives ("teen stories") based on the principles of vicarious learning theory that illustrated the concept in realistic situations and reflection exercises (Briggs et al., 1992). The teen stories were written in first person or intimate third person style so as to connect directly with the experience of the reader. The Internet site is open for public viewing at http://catchit.bsd.uchicago.edu.

Consent, Enrollment, and Randomization: Following a positive screening, adolescents (and their parents if applicable) underwent the informed consent process. Participants were randomized by sealed envelope (blocked by physician in physician interview practices and by gender in principal investigator interviewer practices). Participants were assigned a private username and access code to allow them to enter the Internet website. Participants could not be blinded to group assignment, but the two groups were described as "long" and "short" interviews with equal access to the Internet website.

Fidelity Assessment: We report fidelity to the interview model and adherence to the Internet intervention for both groups. We selected 13 taped interviews from each condition and two raters reviewed them based on a standard assessment instrument (conflicts resolved by consensus). We report the percentage visiting the site, mean time on site, number of modules visited, percentage of exercises completed, number of characters typed, number of safety phone calls, and the number of motivational calls.

Data Collection: Baseline questionnaires were completed before any study intervention was received, except in the case where time restraints required the adolescent to take it home for completion. Follow-up was completed between 4-8 weeks after enrollment. In a few cases, follow-up occurred several months later. Because of wide dispersion of clinics, adolescent reluctance to complete lengthy questionnaires and voluntary cooperation of primary care clinic staff, some post-study data collection was incomplete. A clerical error omitted some items for several vulnerability instruments from the questionnaires of several participants. Additionally, phone assessments of mood and depressive disorder were done at 6, 12, 24, and 52 weeks.

Sample Characteristics: We obtained information on age, ethnicity, birth order, parents marital status, living situation, years of school completed (by adolescent and each parent). We also asked, "Have you ever been treated (with medication or counseling) for depression?" and "Have any of your family members (mother, father, sister, brothers) ever been treated for depression that lasted at least four weeks?" We also report the percentage with a depressive disorder and mean symptoms scores.

Study Outcomes:

Individual Vulnerability and Protective Factors: We collected baseline and follow-up assessments of individual vulnerability and protective factors including symptoms of other mental disorders, mood and affect regulation, cognition and self-efficacy. To assess motivation, we used ratings from standard assessments of importance, self-efficacy, readiness for change, and stages of change (Miller & Rollnick, 2002). For symptoms of other mental disorders, we asked questions (yes/no responses) with regard to generalized anxiety (In the past four weeks, have you been very anxious, nervous or panicky?), panic disorder symptoms (In the past four weeks, have you had an episode or spell when you had the sudden panic?), and problem drinking (In the last month, have you "had > five drinks/day?" or "been drinking more than usual?"). Regarding mood and affect regulation, we report Center for Epidemiologic Studies Depression (CES-D, 20 item scale) scores (Radloff, 1991), CES-D subscales (e.g., depressed mood, somatic, happy, and interpersonal) and moodiness frequency ("How often have you felt moody in last 12 months?", 0=never to 3=almost all the time). If the post study self-administered survey CES-D score was not available, we used the CES-D score from the 6 week phone call, N=9). Regarding cognition, we report Automatic Negative Thoughts Questionnaire-Revised (Kendall, 1989) and self-efficacy (1=strongly agree to

4=strongly disagree, higher number on scales indicates greater self-efficacy) (Pearlin, Menaghan, Lieberman, & Mullan, 1981). Items in each category were obtained from the National Longitudinal Study of Adolescent Health (ADHEALTH), in which these items predicted future risk of depressive disorder (Van Voorhees et al., 2008). These items include: self-rated health ("In general how is your health?" with 1=excellent to 5=poor) self-rated intelligence (1=below to 6=above average) and problem-solving skills (rational solving, 0=never to 3=nearly all the time) and self-efficacy with regard to affect regulation through behavior change ("I can change my depression by changing my behavior," 1=strongly disagree to 5=strongly agree).

Family, Peer and School, Vulnerability and Protection: Adolescents reported the level of perceived family social support *(*Procidano & Heller, 1983*)* and rated closeness to "Mom" and "Dad" and level of desire to leave home (1=not at all to 5=quite a bit) in items used in the ADHEALTH questionnaire (Van Voorhees et al., 2008). Adolescents rated perceived peer social support (Procidano & Heller, 1983*)* and from the ADHEALTH survey, items with regard to social acceptance ("I feel socially accepted"), and closeness to classmates (I feel close to people at my school) (1=strongly agree to 5=strongly disagree). Additionally, we report level of school impairment related to depressed mood, based on items derived from the ADHEALTH survey and interviews with emerging adults (Kuwabara, Van Voorhees, Gollan, & Alexander, 2007). These items included reports of most recent grades and agreement with the stem statement, "Feeling down or sad has affected my ability to do well in school" in the following ways (such as "concentrating in class" or "getting along with teachers," with 1=not at all to 4=a lot). The items with regard to impairment were combined into a scale as described below. Adolescents reported their most recent grades (1=A to 4=D or lower) in English and Math.

Statistical Analysis: We compared outcomes between baseline and post-study within randomized groups and between randomized groups at the same time points in a per-protocol analysis. For categorical outcomes, we used the McNemar's test (and when relevant of fewer than 5 observations per cell, the exact version of the McNemar's test) to compare repeat measures within the same group and as appropriate the Pearson chi square test or the Fisher's exact test for between group comparisons. For continuous outcomes, we used paired t-tests to compare repeat measures and analysis of variance (ANOVA) to compare between the groups. Results are reported for all participants who completed the study and relevant items using a per-protocol analysis. The Mann-Whitney test was used when comparing non-parametric data. We report the number of individuals available for analysis in the second column of the tables. Scales were generated by creating a summative score for all the variables in the scale if at least half of the items had been responded to.

Evaluation of Missing Data: We completed several analyses to evaluate the effect of missing data. We compared non-responders (either to the post-study survey or to the social support questionnaire) by age, ethnicity, educational level, parent education, parent marital status, past treatment for depression, and baseline CES-D score. To determine if non-responders were less likely to experience improvement in depression symptoms, we compared post-study CES-D scores and change in CES-D scores between responders and non-responders. Finally, we completed analyses again using the last observation carried forward to determine if missing values might change interpretation of key results (Baron, Ravaud, Samson, & Giraudeau, 2008).

Results

Demographics: We enrolled 84 individuals (MI, N=44; BA, N=40) and follow-up data were available for mood on 77/84 (91%), and 72/84 (86%) completed at least part of the post-study questionnaire (Figure 2). The sample included significant ethnic minority representation (37%) and was divided approximately equally by gender (Table 1). There were no significant differences between the two groups at baseline.

Assessment of Interview Fidelity and Internet Participation: Physician adherence to the MI scripts was excellent with very little contamination of the BA condition with MI elements (MI and BA significantly differed with regard to MI ratings, Table 2). There was a nonsignficant
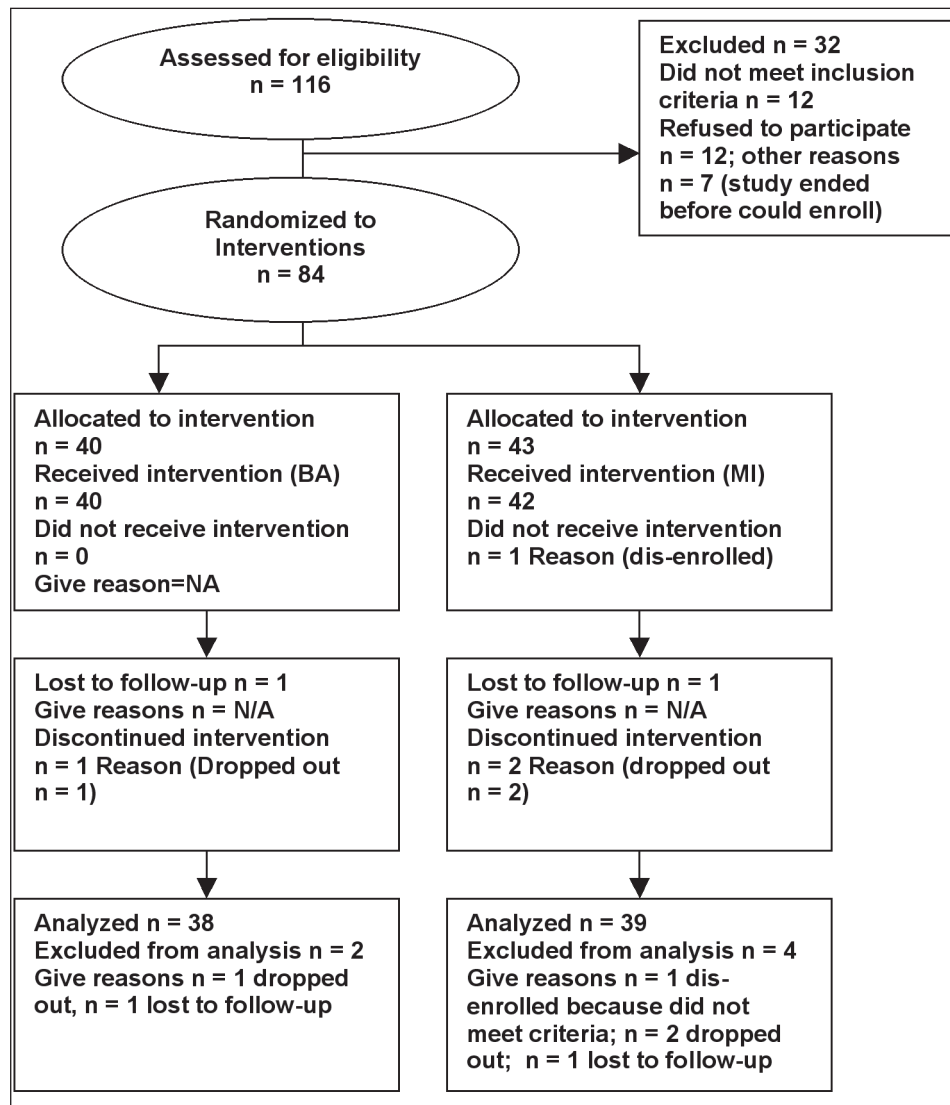
Figure 2: CONSORT Diagram

trend toward greater levels of participation on the Internet site by those in the MI group (i.e., visiting site 90.7% versus 77.5%, p = 0.13 and time onsite 143 minutes (SD=108.1) versus 98.4 minutes (SD=124.6) p = 0.08).

Individual Vulnerability and Protective Factors: Depressed mood declined significantly in both groups while motivation only increased in the MI group (Tables 3, 4 and 5). There was a significant increase in all ratings of motivation (importance, self-efficacy, and readiness) and in stage of change for the MI, but not BA group (Tables 4 and 5). The percentage of those reporting symptoms of panic disorder and generalized anxiety symptoms (borderline significance) declined significantly in the BA group but not in the MI group. Depressed mood declined

significantly in both groups (Figure 3 and Tables 3, 4, and 5) with moderate pre/post effect sizes (MI: effect size -0.44, 95% CI: -0.88, 0.01; BA: -0.56, 95% CI: -1.01, -0.09; all, -0.50, 95% CI: -0.82, -0.18). The MI and BA groups demonstrated differing patterns of change in affect. The MI group demonstrated significant increases only in the happy (positive affect) subscale while the BA group only demonstrated declines in the depressed affect and somatic subscales. The frequency of moodiness declined significantly in the BA group, but not the MI group. Automatic negative thoughts, perceived intelligence, problem solving, and general self-efficacy showed no significant change in either group. There were no significant between group differences at follow-up.

Characteristic	All Baseline Percentage	Number	Motivational Baseline Percentage	Number	Brief Advice Baseline Percentage	Number	Group Comparison P-value
Gender							0.83
Male	43.82	36	44.19	19	42.5	17	
Female	56.18	47	55.81	24	57.5	23	
Ethnicity							0.56
White	57.83	48	59.52	26	62.16	23	
Black	22.89	19	19.05	8	29.73	11	
Hispanic	4.82	4	7.14	3	2.7	1	
Asian	5.68	5	5.68	4	2.7	1	
Native American	0.00	0	0.00	0	0.00	0	
Other	3.75	3	3.41	1	2.70	1	
Age (mean and SD)	17.44	2.04	17.05	2.02	17.90	2.02	0.89
Family Information							
First born	46.25	37	45.24	19	48.65	19	0.76
Parents Marital Status							0.72
Married	56.41	56.41	59.52	25	50	18	
Divorced	19.23	19.23	21.43	9	19.44	7	
Separated	0	0	2.38	1	2.78	1	
Widowed	2.56	2.56	0	0	0	0	
Never Married	21.79	21.79	16.67	7	27.78	10	
Teen Living Situation							0.12
At home with Parents	68.75	55	61.9	26	76.32	29	
Alone	2.5	2	0.00	0.00	5.26	2	
With Friends or Roommates	18.75	15	26.19	11	10.53	4	
Other	10	8	11.9	5	7.89	3	
Father's Education							0.12
High School at least 2 years	6.76	5	2.63	1	11.43	4	
Finished high school	33.78	25	26.32	10	40	14	
College at least 2 years	12.16	9	18.42	7	5.71	2	
Finished college	47.3	35	52.63	20	42.86	15	
Mother's Education							0.99
High School at least 2 years	6.58	5	7.69	3	5.56	2	
Finished high school	27.63	21	25.64	10	27.78	10	
College at least 2 years	26.32	20	28.21	11	25	9	
Finished college	39.47	30	38.46	15	41.67	15	
Teen's Education							0.92
High School at least 2 years	57.53	42	57.89	22	60	21	
Finished high school	13.7	10	13.16	5	11.43	4	
College at least 2 years	27.4	20	28.95	11	25.71	9	
Finished college	1.37	1	0	0	2.86	1	
Depression History							
History of depression treatment	27.5	22	26.19	11	29.73	11	0.73
Prior Counseling	30.77	24	24.39	10	38.89	14	0.11
Prior Medication	17.81	13	16.22	6	19.44	7	0.72
Family history of depression	29.87	23	22.5	9	38.89	14	0.17
Depressive Disorder							
Depressive disorder (any)	11.69	9	13.16	5	10.53	4	1
Major Depression	3.90	3	2.63	1	5.26	2	0.58
Minor Depression	8.80	6	10.53	4	5.30	2	0.38
Dysthymia	1.33	1	2.7	1	0	0	0.31

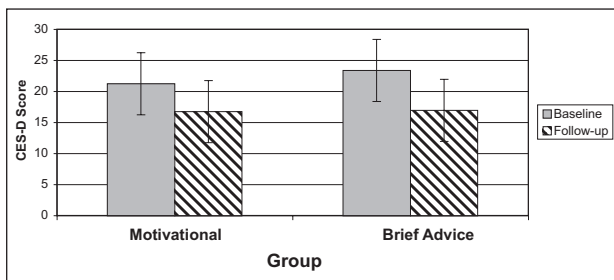Table 1: Sample Characteristics

Figure 3: Depressed Mood Baseline and Follow-up

Family: There was no change in the family social support scale in either group. There was a reduction in desire to leave home in the entire cohort and this approached significance in the MI group, but not the BA group (Tables 3, 4 and 5). Conversely, there was an increase in closeness to mother in the BA group (borderline significance for the entire cohort), but no change noted in closeness to father in either group.

Interview	Motivational		Brief Advice		P-value
	Mean/(Percent)	SD/(N)	Mean/(Percent)	SD/(N)	Comparison
Motivational Interview Fidelity Rating Scale (alpha=0.90)	4.21	0.83	1.02	0.07	0.003
Interview Length (minutes)	5.96	1.90	1.79	0.45	0.002
Percentage visiting the site	(90.7)	(38)	(77.5)	(31)	0.130
Mean time on site (minutes)	143.70	109.05	98.40	124.60	0.020
Number of modules completed	7.00	5.70	5.28	6.00	0.160
Percentage of exercises completed	(61)	(37)	(67)	(23)	0.110
Number characters typed into exercises	3532.74	2985.27	1915.90	2326.00	0.004
Telephone calls					
Number safety calls	2.08	1.09	2.11	0.94	0.600
Number motivational calls	2.23	0.92	N/A	N/A	N/A

Table 2: Intervention Adherence and Fidelity

	Number Responding	Pre Mean/ (Percentage)	SD/ (number)	Post Mean/ (Percentage)	SD/ (number)	Pre vs. Post P-value	Group Comparison P-value
Motivation							
Importance of preventing depression	63	7.64	2.64	8.41	1.78	0.01	0.68
Self-efficacy in preventing depression	63	7.51	2.26	8.03	1.63	0.07	0.12
Readiness to prevent depression	61	7.41	2.09	7.79	1.81	0.16	0.12
Stage of change	68	2.70	1.35	3.28	1.50	<0.004	0.24
Symptoms of other Mental Disorders and General Health							
Generalized anxiety symptoms	63	(48.05)	(37)	(43.08)	(28)	0.65	0.24
Panic disorder symptoms	43	(25.32)	(20)	(20.31)	(13)	0.37	0.16
Problem drinking (> 5 drinks)	75	(11.84)	(9)	(6.25)	(4)	0.26	0.95
Problem drinking (more alcohol than usual)	30	(6.33)	(5)	(4.69)	(3)	0.48	0.64
Affect Regulation							
Moodiness frequency in last 12 months	43	2.96	0.93	2.43	0.70	<0.004	0.31
CES-D depressed affect subscale (alpha=0.830	64	5.21	3.70	4.09	3.87	<0.0002	0.24
CES-D Happy (positive affect subscale) (alpha=0.79)	64	7.01	3.08	7.93	2.79	0.02	0.35
CES-D Somatic and retardation subscale (alpha=0.67)	64	6.91	3.56	5.83	3.98	0.01	0.82
CES-D Interpersonal Subscale (alpha=0.69)	64	1.73	1.68	1.59	1.92	<0.002	0.47
CES-D 20 (alpha= 0.91)	77	22.28	11.43	16.83	10.20	<0.001	0.97
Cognition and Self-efficacy							
Automatic Thoughts Questionnaire-Revised Score (alpha=0.95)	63	60.18	24.27	59.23	22.90	0.74	0.52
Generalize Self-efficacy scale (alpha= 0.73)	29	6.32	3.53	7.07	3.33	0.26	0.33
Self-rated health	62	2.57	1.09	2.79	1.01	0.06	0.59
Self-rated intelligence	47	4.29	1.19	4.07	1.10	0.15	0.66
Problem solving	43	2.32	0.97	2.51	0.91	0.49	0.56
Self-efficacy in affect regulation	31	3.22	0.95	3.42	0.98	0.19	0.78
Family							
Perceived Social Support Family Scale (alpha= 0.90)	47	5.48	5.80	5.00	5.08	0.28	0.49
Want to leave home	43	3.06	1.22	2.65	1.27	0.02	0.74
Closeness to residential mother	42	3.95	0.99	3.67	1.08	0.09	0.07
Closeness to residential father	40	2.93	1.47	3.08	1.33	0.58	0.42
Peer							
Perceived Social Support Peers (alpha= 0.82)	46	7.76	4.84	12.50	3.82	<0.001	0.62
Social acceptance	46	2.29	1.08	2.37	1.07	0.11	0.90
Closeness to people at school	45	2.57	0.98	2.42	0.91	0.52	0.31
School							
Perceived Academic Impairment (school scale)	34	11.07	0.78	3.60	9.19	3.45	0.42
Most recent English grade	34	2.17	1.00	2.04	1.04	0.23	0.41
Most recent math grade	33	2.38	1.10	2.24	1.09	0.36	0.28

Table 3: Pre/post Changes in Protective and Vulnerability Factors for Entire Sample

Peer and School: Adolescents in both groups demonstrated significant improvements in social support from peers with moderate to large effect sizes (MI: 0.76, 95% CI: 0.18, 1.32; BA: 1.39, 95% CI: 0.75, 1.99; all: 1.09, 95% CI: 0.64, 1.52) (Figure 4). There was a statistically borderline trend toward lower acceptance (higher score) by peers in the MI group. Perceived impairment of school performance declined significantly in the entire cohort and borderline significance in both groups with moderate effect sizes (MI: -0.77, 95% CI: -1.37 0.14; BA: -0.30, 95% CI: -0.95, 0.36; all: -.052, 95% CI: -0.97, -0.07). For the MI group there was a borderline trend toward higher most recent math grade. There were no significant between group differences at follow-up.

Adverse Events: There was one suicide attempt (one week after enrollment) in the BA arm who never visited the Internet site and who had a prior history of self-harm behavior. The Data Safety and Monitoring Board (DSMB) elected to stop enrollment at 84 (N of intended=96) because it believed that individuals with past psychiatric hospitalizations or attempts should not be enrolled in future

	Number Responding	Pre Mean/ (Percentage)	SD/ (number)	Post Mean/ (Percentage)	SD/ (number)	Pre vs. Post P-value
Motivation						
Importance of preventing depression	23	7.63	2.61	8.50	1.73	0.01
Self-efficacy in preventing depression	33	7.68	2.14	8.32	1.61	0.05
Readiness to prevent depression	33	7.28	2.05	8.12	1.84	0.04
Stage of change	33	2.85	1.31	3.49	1.38	0.01
Symptoms of other Mental Disorders and General Health						
Generalized anxiety symptoms	24	(40)	(16)	(50)	(17)	0.16
Panic disorder symptoms	39	(21.95)	(9)	(27.27)	(9)	0.56
Problem drinking (> 5 drinks)	14	(10.26)	(4)	(6.06)	(2)	0.56
Problem drinking (more alcohol than usual)	23	(2.44)	(1)	(5.88)	(2)	0.56
Affect Regulation						
Moodiness frequency in last 12 months	33	2.88	0.90	2.33	0.76	0.11
CES-D depressed affect subscale (alpha=0.830	32	4.88	3.54	4.44	3.62	0.10
CES-D Happy (positive affect subscale) (alpha=0.79)	32	7.34	3.12	8.38	2.54	<0.001
CES-D Somatic and retardation subscale (alpha=0.67)	32	6.73	3.24	6.00	4.26	0.64
CES-D Interpersonal Subscale (alpha=0.69)	32	1.78	1.72	1.69	1.91	0.01
CES-D 20 (alpha= 0.91)	39	21.24	10.80	16.74	9.62	0.01
Cognition and Self-efficacy						
Automatic Thoughts Questionaire-Revised Score (alpha= 0.95)	32	59.96	22.77	60.06	22.46	0.98
Generalize Self-efficacy scale (alpha= 0.73)	21	6.49	3.49	7.47	3.45	0.37
Self-rated health	34	2.88	1.05	2.87	1.14	0.33
Self-rated intelligence	24	4.28	1.32	4.00	1.04	0.36
Problem solving	15	2.27	0.95	2.43	1.08	0.39
Self-efficacy in affect regulation	14	3.33	0.66	3.38	0.99	0.85
Family						
Perceived Social Support Family Scale (alpha= 0.90)	22	6.21	5.76	5.86	5.44	0.59
Want to leave home	23	3.22	1.27	2.71	1.16	0.06
Closeness to residential mother	22	3.85	1.04	3.96	0.93	1.00
Closeness to residential father	21	3.30	1.17	3.24	1.37	0.41
Peer						
Perceived Social Support Peers (alpha= 0.82)	25	8.55	4.95	12.08	4.30	<0.001
Social acceptance	25	2.27	1.03	2.39	1.12	0.07
Closeness to people at school	29	2.75	0.93	2.29	0.95	0.50
School						
Perceived Academic Impairment (school scale)	29	11.31	3.34	8.78	3.16	0.06
Most recent English grade	28	2.28	1.03	2.17	1.17	0.26
Most recent math grade	33	2.32	1.16	2.08	1.08	0.06

Table 4: Pre/post Changes in Protective and Vulnerability Factors for the Motivational Interview Group

primary care/Internet studies. They believed that the major study endpoints had been reached (significant pre/post changes in measures of depressed mood in both groups).

Evaluation of Effect of Missing Data: We found no relationship between being a responder and non-responder and demographic or depression related variables (baseline or follow-up). When missing values were imputed using last observation carried forward, there was no change in statistical significance for the main results.

Discussion

Both versions of this primary care Internet-based intervention for adolescent depression demonstrated favorable pre/post changes in individual, and peer/school factors. There was a significant increase in motivation to prevent depressive disorder in the entire cohort and in the MI group supporting hypothesis one. Depressed mood and frequency of moodiness declined significantly in both groups (borderline for moodiness in MI), contrasting with expectations in hypothesis two. There were no changes

in automatic negative thoughts or general self-efficacy. In terms of family relationships, there was a decrease in desire to leave home in the MI group while closeness to mother increased in the BA group (trend for whole cohort). In terms of peers and school, there was an increase in peer social support and decrease in perceived school impairment in both groups which did not support hypothesis three that only the MI group would demonstrate improvement.

Depressed mood declined in both groups while panic disorders decreased in the BA group and motivation increased in the MI group, but without changes in established vulnerability factors such as automatic negative thoughts or general self-efficacy. The improvement in motivation is consistent with a "doctor" effect (Moreau, Boussageon, Girier, & Figon, 2006) and consistent with prior work in substance abuse in adolescence (Erol & Erdogan, 2008; Feldstein & Forcehimes, 2007; Skaret, Weinstein, Kvale, & Raadal, 2003) but is new for depressive disorder. These declines in depressed mood are consistent with findings with studies of self-directed interventions in

	Number Responding	Pre Mean/ (Percentage)	SD/ (number)	Post Mean/ (Percentage)	SD/ (number)	Pre vs. Post P-value
Motivation						
Importance of preventing depression	29	7.65	2.72	8.31	1.87	0.26
Self-efficacy in preventing depression	30	7.31	2.41	7.69	1.61	0.56
Readiness to prevent depression	29	7.57	2.15	7.41	1.72	0.71
Stage of change	19	2.54	1.39	3.06	1.61	0.15
Symptoms of other Mental Disorders and General Health						
Generalized anxiety symptoms	20	(56.76)	(21)	(35.48)	(11)	0.08
Panic disorder symptoms	31	(28.95)	(11)	(12.9)	(4)	0.03
Problem drinking (> 5 drinks)	29	(13.51)	(5)	(6.45)	(2)	0.33
Problem drinking (more alcohol than usual)	25	(10.53)	(4)	(3.33)	(1)	0.18
Affect Regulation						
Moodiness frequency in last 12 months	19	3.06	0.97	2.55	0.60	0.01
CES-D depressed affect subscale (alpha=0.830	32	5.55	3.88	3.74	4.13	0.01
CES-D Happy (positive affect subscale) (alpha=0.79)	32	6.67	3.05	7.48	0.75	0.20
CES-D Somatic and retardation subscale (alpha=0.67)	32	7.09	3.90	5.66	3.75	0.049
CES-D Interpersonal Subscale (alpha=0.69)	32	1.69	5.02	1.50	1.95	0.04
CES-D 20 (alpha= 0.91)	16	23.34	12.09	16.92	10.89	<0.001
Cognition and Self-efficacy						
Automatic Thoughts Questionnaire-Revised Score (alpha= 0.95)	31	60.41	26.11	58.37	23.70	0.65
Generalize Self-efficacy scale (alpha= 0.73)	18	6.12	3.61	6.63	3.20	0.50
Self-rated health	16	2.22	1.05	2.70	0.86	0.09
Self-rated intelligence	25	4.30	1.11	4.15	1.18	0.29
Problem solving	20	2.38	1.01	2.60	0.68	1.00
Self-efficacy in affect regulation	19	3.11	1.19	3.45	0.99	0.08
Family						
Perceived Social Support Family Scale (alpha= 0.90)	25	4.83	5.88	4.24	4.72	0.35
Want to leave home	21	2.89	1.15	2.58	1.43	0.19
Closeness to residential mother	20	4.04	0.95	3.35	1.18	0.01
Closeness to residential father	23	2.61	1.64	2.89	1.29	1.00
Peer						
Perceived Social Support Peers (alpha= 0.82)	21	7.10	4.75	12.85	3.40	<0.001
Social acceptance	20	2.32	1.16	2.35	1.04	0.62
Closeness to people at school	19	2.36	1.02	2.58	0.84	0.11
School						
Perceived Academic Impairment (school scale)	18	10.79	3.91	9.65	3.77	0.07
Most recent English grade	20	2.06	0.97	1.91	0.90	0.58
Most recent math grade	21	2.44	1.05	2.42	1.10	1.00

Table 5: Pre/post Changes in Protective and Vulnerability Factors for the Brief Advice Group
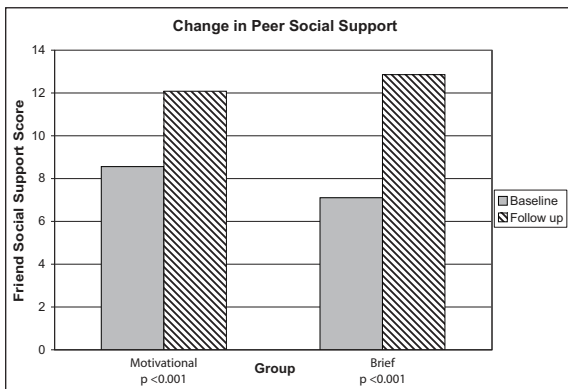

Figure 4: Friends Social Support Baseline and Follow-up

adults in primary care (Christensen, Griffiths, & Jorm, 2004; Willemse, Smit, Cuijpers, & Tiemens, 2004), and face-to-face interventions for adolescents (Jaycox, Reivich, Gillham, & Seligman, 1994; Spence, 2003; Stein, Zitner, & Jensen, 2006). The lack of change in automatic negative thoughts or general self-efficacy is consistent with results from a school-based program (Possel, Horn, Groen, & Hautzinger, 2004). Declines in panic disorder and depressed mood CES-D subscales in the BA group while the MI group demonstrated only increases in positive affect may suggest alternate pathways to improvement unrelated to measures such as automatic negative thoughts or self-efficacy. Perhaps the BA group employed a behavioral activation approach to reduce negative emotions while the MI group was encouraged by the interviewer to focus on goal-oriented behavior that produced more frequent rewards and generated positive affect (Jacobson, 2001). This is supported by the borderline increase in affect regulation self-efficacy in the BA group but not the MI group and conversely the enhancement in motivation in the MI but not the BA group.

Improvements in peer social support, lowering of desire to leave home, and declines in school impairment have not been reported in prior studies of depression prevention in primary care settings. Results for social and problem solving skills for preventive interven-

tions in schools have been inconsistent with regard to pre/post changes (Possel et al., 2004; Spence, 2003). At least one other study of adolescents failed to demonstrate changes in coping skills (Horowitz, Garber, Ciesla, Young, & Mufson, 2007). While family social support did not change, the finding that adolescents had less desire to leave home is consistent with the finding that parent and child family training can reduce internalizing symptoms and increase relationship satisfaction in adolescents (Beardslee et al., 2003). Again, the finding that closeness to mother increased only in the BA group and desire to leave only significantly decreased in the MI group suggests alternate pathways to protection and reduction in depressed mood in the two conditions.

The greatest strength of this study is the evaluation of an intervention preventing depressive disorder that can easily be disseminated to diverse practice settings, with adolescent participants representing the range of geography, ethnicity, and education in the US. The intervention was implemented with high fidelity by physicians and the great majority of adolescents engaged in the Internet program. The greatest limitation of this study is the fact that many post study observations of vulnerability factors are missing. While some of the missing data can be explained by clerical error and challenges of implementing a complex study with voluntary cooperation of community clinics, the possibility of systematic bias must be considered. While there was no variation by socio-demographic factors or depressed mood, there may be systematic bias favoring those who had improved responding, thus biasing results toward pre/post effects in the risk factors other than depressed mood. In this case, there was no evidence of systematic bias of this type (no variation of degree of CES-D change). Similarly, using the most conservative method of imputation (last observation carried forward), the observed main results did not change. Also, as this is a preventive intervention and primarily intended to compare differences within groups over time, we saw limited if any differences between groups at follow-up.

Conclusions

There is substantial evidence based on pre/post changes in mood, changes in vulnera-

bility factors, and ratings and from adolescents and parents that participants benefited from participation from the depression prevention model. Depression prevention investigators should consider alternative, bottom-up community models which harness natural care systems and the adolescents' capacity for independent change and "self-organization" (Holden, 2005) which contrasts the highly structured curricular models which have prevailed in the field. Models such as this, based on Complex Adaptive Systems theory, have been proposed for functional disorders (e.g. fibromyalgia) in primary care (Martinez-Lavin, Infante, & Lerma, 2008) and for structures to support child mental health (Earls, 2001). Primary care physicians' options for the mild to moderately depressed adolescent are currently constrained by concerns related to black box warnings for medications and limited availability of psychotherapy referrals. The results from this study suggest that preventive intervention with self-directed learning and motivational engagement in primary care may be an important future model. Clinicians should consider engaging mildly-moderately depressed youth at risk for progressing to major depression with self-help books or Internet-based programs along with close follow-up. Policy makers should consider developing new reimbursement approaches to cover "hybrid" services that include Internet and primary services, as well as new public health approaches to prevention involving Internet-based learning. Such approaches can allow the primary care physician to better impact the mental health of adolescents. The complete intervention is available for free public access and use at the website of http://catchit-public.bsd.uchicago.edu.

Acknowledgements/Conflict of Interest

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