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Life events, perceived stress and depressive symptoms in a physical activity intervention with young adult women

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Abstract

Objective—Examine interactive effects of life events, perceived stress and depressive symptoms during a randomized controlled aerobics intervention among women (aged 18–30) in the urban U.S. Midwest, 2006–2009.

Method—Participants [n=372 at baseline and n=303 at follow up] completed perceived stress, depressive symptoms and life events scales at baseline and 5–6 month follow-up. Life events were correlated with perceived stress and depressive symptoms scales using Pearson correlation. Multivariate linear regression tested the relationship between the 20 most common life events with perceived stress and depressive symptoms. Regression models explored relationships between life events, perceived stress and depressive symptoms and the intervention effect.

Results—Higher levels of perceived stress and depressive symptoms correlated with more life events. At baseline, for every additional life event, depressive symptoms were higher; follow-up showed marginal significance with depressive symptoms, but a strong positive association with perceived stress. In the stratified model, for every life event at follow up, the perceived stress scale increased by 0.68 in the exercise group, but not in the controls. For every life event at follow-up, depressive symptoms were higher in controls, but not in the exercise group.

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Conclusion—Perceived stress and depressive symptoms co-occurred with life events at baseline and follow-up for participants. At follow up, perceived stress increased significantly among exercisers; depressive symptoms were significantly higher among controls. Findings suggest that new participation in structured physical activity entails a change in daily life that may buffer against depressive symptoms in relation to life events but not perceived stress.

Keywords

life events; adult women; exercise intervention; perceived stress; depressive symptoms

Introduction

The benefits of physical activity for mental health include lower risk of stress and depression (Augestad, Slettemoen, & Flanders, 2008; Azar, Ball, Salmon, & Cleland, 2008; Beydoun & Wang, 2010; de Wit et al., 2010; Mikkelsen et al., 2010; Penedo & Dahn, 2005; Schnohr, Kristensen, Prescott, & Scharling, 2005; Teychenne, Ball, & Salmon, 2008). Both stress and depression are particularly high among young people and among women (Allgower, Wardle, & Steptoe, 2001; Angell, 2004; Parker & Brotchie, 2010; Piccinelli & Wilkinson, 2000). Mean levels of stress, as measured by self-report, are higher among women, compared to men, and higher among women aged 18–29 than all other female age groups (Cohen, 1988). Higher levels of stress and depression among young, non-clinical populations may occur in response to the many transitional life events affecting them. A review of 19 studies found life events associated with lower physical activity among adults of all ages (Allender, Hutchinson, & Foster, 2008). Changes in employment status, physical status, relationship and family structure were found to be the most common. Both major life events and minor daily hassles have been found to adversely affect health practices (Aldana, Sutton, Jacobson, & Quirk, 1996; Johnson-Kozlow, Sallis, & Calfas, 2004; Oman & King, 2000). Even happy events are disruptive and can interfere with healthy practices (Redinbaugh, 1997). Major life events of marriage, having children, starting adult work result in lower levels of physical activity among women (Brown, Heesch, & Miller, 2009; Lim, Norman, Clifton, & Noakes, 2008).

Relatively few studies have examined the effects of life events on physical activity in the context of an intervention. An exercise intervention with midlife adults found 3–4 life events significantly reduced adherence (Oman & King, 2000). A study with college students examining whether life stress moderated the effects of physical activity intervention indicated that stress-relieving instructions in the intervention group may have helped men with high stress to be more physically active (Johnson-Kozlow et al., 2004). A study of stressful life events and habitual physical activity among older adults in Japan found negative correlations of daily step count and duration of physical activity with life events (Yoshiuchi et al., 2010).

This study aimed to examine the interactive effects of life events, perceived stress and depressive symptoms in the context of a randomized controlled physical activity intervention among young women. We hypothesized that perceived stress and depressive symptoms would be higher in association with a greater number of life events. We also hypothesized that in relation to a similar number of life events, exercise participants would show lower levels of perceived stress and depressive symptoms compared to control participants.

Methods

Study design and sample

Data for this study came from the “Women in Steady Exercise Research” (WISER) clinical trial, which examined the effects of aerobic exercise training on physiological parameters hypothesized to lie on the causal pathway between the purported association of exercise and breast cancer risk. Details of the trial are reported elsewhere (Arikawa et al., 2010). Briefly, the women participants in the WISER trial (N = 391) were aged 18–30 years; healthy but insufficiently active (reporting exercising two days or fewer per week during the prior six months); had a body mass index (BMI) between 18 and 40; stable weight; were nonsmokers; reported consuming no more than seven alcoholic beverages per week; and had no medical conditions or medications prohibiting participation in a vigorous program of weight bearing aerobics exercise (Chisholm, Collis, Kulak, Davenport, & Gruber, 1975). Recruitment was primarily conducted through a state university emailing.

Fifty-five percent of participants were randomized into an exercise group and asked to complete 30 minutes of weight-bearing aerobic exercise 5 times weekly for approximately 16 weeks at a gym convenient to them (and paid for by the study). Exercise intensity was set at 65–70% of age predicted maximum heart rate for the first four weeks of exercise, 70–75% of the maximum heart rate for weeks 5–8, 75–80% of the maximum heart rate for weeks 9–12, and 80–85% of the maximum heart rate for the final stage, which ranged from two to six weeks depending on each participant’s menstrual cycle length. Participants were asked to wear a Polar Heart Rate monitor during each session (Polar Electro Inc., Lake Success, NY) and to keep an exercise log to record the date, average heart rate obtained from a heart rate monitor, duration of workout and stretching and equipment used. The options for exercise were to use the any of the following equipment: the elliptical, stair stepper or treadmill. Walking or jogging outdoors was not permitted except when participant travel precluded use of gym facilities and equipment. Certified fitness professionals worked with participants to provide ongoing support and monitor adherence to the protocol. The trainers were paired with participants, and met with each one at the start of the program and once every four weeks to provide instruction on the equipment and the next stage of the intervention. Trainers also collected the exercise logs weekly to check adherence and regularly provided feedback to encourage and monitor adherence. The intervention was administered individually.

Measures

All participants who completed WISER filled out a composite life events scale at baseline and follow up. To improve on the content validity of the survey by capturing life events of this population, the 50 items of this survey were drawn from the *Social Readjustment Rating Scale* (30 items, (Holmes & Rahe, 1967)), the *College Student Life Events Scale* (10 items, (Levine & Perkins, 1980)) and the *Transitions* study of adolescents (10 items, (Booker, Gallaher, Unger, Ritt-Olson, & Johnson, 2004)). Participants were asked to include life events over the previous 12 months at baseline and over the time period of the study (5–6 months) at follow up. Items cover a wide range of domains (school, employment, close relationships, family dynamics and changes, violence, financial changes, health). An event might affect the person directly (e.g., was fired or laid off from work) or those in the person’s network (illness or injury in my family). Events concern qualitatively different kinds of experiences. They include ones that might be considered routine (trouble with home life-- such as problems with roommates, landlord, etc.) or major (got pregnant, divorce). Instructions for the adapted life events scale did not ask participants to indicate their assessment of the extent of the impact of a life event experience on them, nor were items pre-assigned a normed value of the event’s magnitude. For these reasons we chose to

confine our analysis to registering the number of life events (from a possible range of 0 to 60 events), and we determined means and frequency (see also Omar and King 2000). A copy of the WISER life events scale is available on request.

Participants also filled out the *Center for Epidemiologic Studies Depression Scale - CES-D* (20 items, (Radloff, 1977)) and the *Perceived Stress Scale* (14 items, (Cohen, Kamarck, & Mermelstein, 1983)) at baseline and follow up. The CES-D items refer to the prior week. The response categories and scoring values range from “rarely or none of the time” (0) to “more or all of the time (5–7 days)” (3). The scale is summed; there are four items indicating positive affect, which are reverse scored. The possible range of scores is 0–60. A score of 16 suggests a possible clinically significant level of distress. The scale indicates depressive symptoms, but does not diagnose depression. About 20 percent of the general population is expected to score at 16. The Perceived Stress Scale response categories refer to the prior month. The response categories range from “never” (0) to “very often” (4). The score is summed; positive items require reverse scoring. The possible range of scores is 0–56. This scale was originally tested for reliability and validity on three samples: two of college students and one of community participants in a smoking cessation program (Cohen, Kamarck, & Mermelstein, 1983). There is no cut off point of stress levels indicating possible clinical significance. The mean scores were about 23 in the student sample and 25 in the smoking-cessation sample. Mean scores for women were somewhat higher: 23.6 and 25.7 in the student samples and 25.6 in the other sample. The gender difference was not significant in this sample; however a later study found that women of all ages scored significantly higher than men; it also found the highest scores was found among younger age groups and that stress decreased with age (Cohen & Williamson 1988).

Participants provided socio-demographic information at baseline. The study was approved by the Institutional Review Board of the University of Minnesota.

Analysis

The quantitative analysis was conducting using StataIC v.10 [StataCorp (2005). Stata Statistical Software: Release 10.0. College Station, TX, StataCorp LP]. We used exploratory factor analysis on the composite life events instrument to identify underlying latent constructs representing different aspects of transition as suggested in the descriptive analysis. No latent constructs were apparent. Therefore, we identified the 20 most common life events reported and summed the total number of life events reported to obtain a continuous measure of life events. Descriptive statistics were calculated for the variables of interest at baseline and follow-up for the full sample at each time point and by intervention condition. Each of the most frequent life events reported and the total number of life events per participant were correlated with the Perceived Stress Scale and CES-D depression scale using Pearson correlation.

We tested three sets of models. First, we conducted repeated cross-sectional analyses using multivariate linear regression to test the relationship between the 20 most common life events with perceived stress and depressive symptoms, adjusted for marital status, college degree, race, age, income, student status, and intervention condition. The second set of models consisted of both repeated cross-sectional and longitudinal analyses on the relationship between the total number of life events and perceived stress and depressive symptoms. This set of models included three cross-sectional models: unadjusted model, an adjusted model using the covariates identified above, and a model that accounted for the co-occurrence of perceived stress and depressive symptoms, as well as longitudinal analyses of predictors of perceived stress or depressive symptoms. In the final set of models we tested for an interaction between condition and life events to determine whether the relationship

between life events and perceived stress or depressive symptoms differed by intervention condition.

Results

No significant differences were found in baseline levels of perceived stress or depressive symptoms by intervention condition. Those lost to follow-up did not differ in baseline levels of perceived stress or depressive symptoms compared to those who remained in the study. No significant differences were found in the number of life events reported between intervention or control condition participants at baseline or follow-up.

Table 1 presents the sample socio-demographic characteristics and stress, depressive symptoms and life events data. Approximately 37% of participants were under the age of 24 years, 70% were white and 83% were single. The majority of participants were college students. Half the sample made less than \$20,000 per year. The CES-D and Perceived Stress scales were normally distributed. CES-D scores at baseline and follow-up for all WISER participants, and for intervention and control participants examined separately, were above 22; these scores indicate the presence of depressive symptoms, as compared to scores of lower than 16. There were no significant differences in depressive symptoms or perceived stress using a t-test between intervention and control participants at baseline or follow-up. The mean total number of life events reported at baseline was 6 (recalling events from the prior 12 months), and at follow-up was 3 (recalling events from the prior 5–6 months). The most common life events reported at both time points were changes in work, living situation, sleep habits, troubles with home life and change in eating habits. There were no significant differences in the number of total life events using a t-test between intervention and control participants at baseline or follow-up.

Table 2 presents the correlation coefficients between individual life events, total number of life events and perceived stress and depressive conditions. At baseline, 11 life events were significantly correlated with perceived stress and with depressive symptoms. The strongest correlations with perceived stress were trouble with home life and major change in sleep habits. The strongest correlations with depressive symptoms were trouble with home life and decreased closeness with family. It appears from baseline data that life events were more related to reported depressive symptoms than perceived stress. A similar pattern of 10 life events correlating with perceived stress and depressive symptoms was observed at follow-up, although the strongest correlations with perceived stress were decreased closeness with family and changes in finances, while with depressive symptoms, the strongest correlations were with decreased closeness with family and a change in arguments with a significant other. Higher levels of perceived stress and depressive symptoms were correlated with a greater number of reported life events at baseline and follow-up.

Tables 3 and 4 present the multivariate linear regression models of each of the most common life events on perceived stress and depressive symptoms. Once adjusted for individual characteristics, the number of cross-sectional significant associations decreased. At baseline, trouble with home life and romantic feelings were associated with higher perceived stress levels. Major change in sleep, trouble with home life, decreased closeness with family and trouble with employment were associated with depressive symptoms. At follow-up, changes in living situation, decreased closeness with family and financial changes for the worse were associated with perceived stress, while decreased closeness with family and trouble with academics were associated with depressive symptoms.

Table 5 presents staged models of the repeated cross-sectional and longitudinal effects of total life events on perceived stress and depressive symptoms. At baseline, for every

additional life event, perceived stress increased significantly both in the unadjusted model (Model 1) and in the model adjusted for demographic factors (Model 2). Adding depressive symptoms to the model (Model 3) attenuated the effect of life events on perceived stress. Depressive symptoms were significantly associated with higher perceived stress. A similar pattern was observed for total life events associated with depressive symptoms. As the number of life events increased, reported depressive symptoms significantly increased in the unadjusted model (Model 1) and in the adjusted model (Model 2). Depressive symptoms were attenuated when perceived stress was included in the model, and perceived stress was associated with depressive symptoms (Model 3). When we examined follow-up data only, Models 1–3 for both perceived stress and depressive symptoms reflected a similar pattern of significance. Life events, however, were significantly associated with perceived stress, but not with depressive symptoms at follow up.

Model 4 adjusted for baseline perceived stress or depressive symptoms, included the co-occurrence of perceived stress or depressive symptoms and included the intervention condition. When we examined perceived stress as the dependent variable, we found more life events were associated with higher perceived stress at follow-up, adjusting for baseline perceived stress, depressive symptoms, condition and covariates (coeff=0.39 (0.11), $p<0.001$). Depressive symptoms, adjusted for baseline perceived stress, condition and life events, were associated with perceived stress (coeff=0.38, (0.03) $p<0.001$), but intervention condition was not (coeff=0.63(0.58), $p=0.27$).

When we examined depressive symptoms as the dependent variable, we found that life events were not associated with depressive symptoms, adjusting for baseline depressive symptoms, perceived stress, intervention condition and covariates. However, perceived stress was significantly associated with depressive symptoms (coeff=0.72 (0.06) $p<0.01$), as was intervention condition. After accounting for life events, baseline depressive symptoms, perceived stress and covariates, those in the control group reported 1.73 points higher on the perceived depressive symptoms scale compared to the intervention participants (coeff=1.73, SE=0.81, $p<0.01$).

Finally, we tested Model 4 for interaction between life events and the dependent variables by condition. There was a significant interaction ($p<0.05$) with perceived stress and depressive symptoms, so we stratified the models by condition. We found there was a statistically significant association between perceived stress and life events, after adjusting for baseline perceived stress and depressive symptoms, in the exercise group alone (life events coeff = 0.68, SE=0.16, $p<0.001$). For every life event, the perceived stress scale increased by 0.68 among the exercise participants. With depressive symptoms as the primary dependent variable, we found there was a significant association in the control group between depressive symptoms and life events, after adjusting for baseline depressive symptoms and perceived stress (life events coeff= 0.72, SE=0.26, $p=0.01$; data not shown.)

Discussion

In this study, we found that perceived stress and depressive symptoms co-occurred with life events as reported by intervention and control participants. At baseline for every additional life event, depressive symptoms and perceived stress increased significantly both in the unadjusted model and in the model adjusted for demographic factors. This finding supports our first hypothesis that perceived stress and depressive symptoms would be higher in association with a greater number of life events. Our second hypothesis predicting that there would be an intervention effect on perceived stress and depressive symptoms at the same level of life events was partially supported. In final models, adjusting for life events and other covariates, depressive symptoms were higher among control participants, whereas the

life events-depressive symptoms link appears to have been disrupted through the intervention. This finding, of a disruption of the association between life events and depressive symptoms through physical activity, differs from, yet extends, the well-documented decrease in depression through physical activity. On the other hand, there was an interaction between life events and intervention condition which revealed, in stratified models, that participants in the exercise intervention reported a significant association between life events and perceived stress. Another study finding was a slightly larger correlation between life events and mental health outcomes at follow up compared to baseline. This difference is to be expected. Events that occurred during the study were more proximal and more likely to show a greater link with perceived stress and depressive symptoms.

Other data produced some conflicting results. Life events appeared to be more related to reported feelings of depressive symptoms than perceived stress at baseline. At follow up, more life events were significantly associated with increased perceived stress, even after including depressive symptoms, demographics and intervention condition into the models. However, more life events were not significantly associated with feelings of depressive symptoms ($p=0.07$) after taking into account perceived stress and the other covariates. Given the similarity in life events that were most commonly reported at the two time points, the differing results are puzzling.

There are a number of possible explanations for these discrepant findings of perceived stress and depressive symptoms with life events at baseline compared to follow up. One possible interpretation is that as participation in the intervention was relatively new and to some extent entailed a change in lifestyle or at least a change in daily routine, it contributed to increased stress. Or it may be more generally that events in the immediate past provoked a sense of stress more than depressive symptoms, while those in the longer time frame were more associated with depressive symptoms than perceptions of stress. Another possibility stems from the vast heterogeneity in life events, making it difficult to compare across participants and conditions. This heterogeneity in life events may explain the lack of difference in depressive symptoms using a cross-sectional t-test and a model that includes adjustment for life events. Moreover, life events can be differentially related to perceived stress and depressive symptoms. We therefore conducted an analysis in which we subdivided the 20 most frequent life events reported into four categories (interpersonal, work/school, health, financial). This analysis did not produce any significant differences in levels of perceived stress or depressive symptoms. Other possible reasons for the different results could stem from survey administration. At baseline participants were asked to recall events of the prior 12 months, whereas at follow up, the time frame was the 5–6 month period of the study. Also, as follow up measures were just 5–6 months after baseline, participants may have blurred the boundaries. Finally, the difference in results could simply relate to the sample size, such that perceived stress emerged as significant, while depressive symptoms were marginally so.

Our study findings compare to an intervention with college students finding a similar set of life events affecting them over a two year time period (Johnson-Kozlow et al., 2004). These included changes in sleeping habits, finances (for the worse), recreation, social activity, eating habits, work, residence, minor legal violations, relationship break up, less closeness with family members. The study conducted by Johnson-Kozlow et al did not show a consistent interaction between stressful life events and physical activity. It did show that the intervention was more successful among highly stressed men. The authors suggest that for men, being physically active was a means of coping with these stressful events. Our findings in a study of women's physical activity differed as we found perceived stress higher among exercise participants.

A physical activity intervention for middle-aged adults showed stressful life events were associated with decreased levels of activity in the maintenance, but not in the adoption period (Oman and King 2000). That study found an impact on adherence from 3–4 life events. The researchers consider that the kind of life event may matter to adherence, as well as individual coping abilities and strategies. The authors also suggest that even minor stressors can negatively affect physical activity adherence because such events disrupt daily life routines. Our study findings of increased perceived stress among exercise participants lead us to consider that the intervention itself might have been a minor stressor. Our study did not extend into the maintenance period. We might speculate, in keeping with the findings of Oman and King, that the higher perceived stress reported by our exercise participants during the adoption period could have led to an impact post-intervention of reduced physical activity. Our research differed from these two studies, as we did not examine differences in perceived stress levels by adherence. In our study, all exercise participants who completed follow up measurements had adherence levels of 80% or above, as calculated by the average minutes of exercise that participants reported as having completed per week for each of the four stages of exercise intensity. Analysis of study adherence and withdrawal was the subject of a separate examination (Arikawa et al., 2012). Most research has shown an inverse relationship between depressive symptoms and physical activity (e.g., Dunn 2005), as well as between perceived stress and physical activity (Aldana, 1996). A prospective study of depressive symptoms in relation to middle-aged women's physical activity showed that over a 5 year time period CES-D scores decreased and mental health scores increased with higher levels of activity (Brown, 2005). Our study findings were similar in that control participants reported higher levels of depression than exercise participants in the fully adjusted longitudinal model. Our findings differed in that exercise participants reported higher levels of perceived stress.

The study had limitations. In this study we did not examine levels of adherence to the intervention because all who remained in the study were adherent at 80% or above. Another limitation of this study was that the survey did not have participants indicate how negative or disruptive the individual life events were. The majority of participants in this study (two-thirds) were college students.

We believe this study was the first to examine interactive effects of measures of perceived stress, depressive symptoms and life events in a randomized controlled exercise trial with young women. We believe that one novel finding of this study is that participation in the exercise intervention disrupted the link between stressful life events and depressive symptoms. Another novel finding was that participation in the intervention did not buffer against perceived stress. Future research could compare the impact of minor hassles as well as major life events on physical activity. Doing so would help further our understanding of the effects of disrupted routines compared to significant life events on physical activity, as well as offer insight into the role of physical activity and inactivity in coping strategies.

Conclusion

In this study, perceived stress and depressive symptoms co-occurred with life events as reported by exercise and control participants in a physical activity intervention for young women. This study indicated a somewhat complicated relationship between life events and perceived stress or depressive symptoms and participation in an intensive exercise intervention. Based on study findings, new participation in structured physical activity did not afford a buffering of perceived stress in relation to life events for exercise participants but tempered depressive symptoms in conjunction with life events. The findings of this study contribute to a fuller understanding of the effects of health behavior change, specifically, increased physical activity, on mental health among young women, a

population known for high levels of perceived stress and depressive symptoms. When preparing young adults for increased physical activity, including participation in physical activity interventions, it may be helpful to acknowledge such possible effects in advance as well as strategize ways to maintain physical activity to ensure they receive the protective effects of physical activity on depressive symptoms and perceived stress.

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Highlights

- We model interactions of life events, perceived stress and depressive symptoms in an exercise trial.
- We found life events were significantly associated with perceived stress and depressive symptoms.
- With added life events, depressive symptoms increased significantly in the control group.
- With added life events, perceived stress, but not depressive symptoms, increased significantly in the exercise group.

Table 1
Sample description at baseline and follow-up for full sample and by intervention condition, WISER study, U.S. Midwest, 2006–2009

	Full Sample						Baseline				Follow-up			
	Baseline (n=372)		Follow-up (n=303)		Intervention (n=203)		Control (n=169)		Intervention (n=162)		Control (n=141)		Intervention (n=162)	
	n	%	n	%	%	%	%	%	%	%	%	%	%	%
Age	138	37.1	107	35.3	37.9	35.8	36.1	35.8	34.8	34.8	34.8	34.8	34.8	34.8
24 year or older	234	62.9	196	64.7	62.1	64.2	62.1	64.2	65.2	65.2	65.2	65.2	65.2	65.2
Race	269	72.3	223	73.6	71.9	74.1	72.2	74.1	73.1	73.1	73.1	73.1	73.1	73.1
White	103	27.7	80	26.4	28.1	25.9	72.8	25.9	26.9	26.9	26.9	26.9	26.9	26.9
Other	63	16.9	51	16.8	16.8	15.4	17.2	15.4	18.4	18.4	18.4	18.4	18.4	18.4
Marital status	309	83.1	252	83.2	83.2	84.6	82.8	84.6	81.6	81.6	81.6	81.6	81.6	81.6
Single/Divorced	186	50.0	147	48.5	50.7	50.0	49.1	50.0	46.8	46.8	46.8	46.8	46.8	46.8
Less than \$20,000	110	29.6	97	32.0	29.1	31.5	30.2	31.5	32.6	32.6	32.6	32.6	32.6	32.6
\$20,000 – 39,999	76	20.4	59	19.5	20.2	18.5	20.7	18.5	20.6	20.6	20.6	20.6	20.6	20.6
\$40,000 or more	131	35.2	99	32.7	36.0	32.7	34.0	32.7	32.6	32.6	32.6	32.6	32.6	32.6
Education	241	64.8	204	67.3	64.0	67.3	66.0	67.3	67.4	67.4	67.4	67.4	67.4	67.4
College degree	238	64.0	99	32.7	36.0	32.1	34.0	32.1	33.3	33.3	33.3	33.3	33.3	33.3
School														
Full time or Part Time														
Life Events Experienced*														
Not a student	134	36.0	204	67.3	64.0	67.9	66.0	67.9	66.7	66.7	66.7	66.7	66.7	66.7
Changed work	235	63.2	140	46.2	62.6	46.9	63.9	46.9	45.4	45.4	45.4	45.4	45.4	45.4
Changed living situation	178	47.9	87	28.7	49.8	25.9	45.6	25.9	31.9	31.9	31.9	31.9	31.9	31.9
Major change in sleep habits	107	29.8	63	20.8	30.5	29.9	26.6	29.9	14.9	14.9	14.9	14.9	14.9	14.9
Trouble with home life	104	28.0	65	21.5	30.1	21.0	25.4	21.0	22.0	22.0	22.0	22.0	22.0	22.0
Illness or injury in family	102	27.4	51	16.8	26.1	15.4	29.0	15.4	18.4	18.4	18.4	18.4	18.4	18.4
Change in eating habits	97	26.1	69	22.8	28.6	19.2	23.1	25.9	19.2	19.2	19.2	19.2	19.2	19.2
Argued with friends	93	25.0	51	16.8	30.1	15.6	18.9	17.9	15.6	15.6	15.6	15.6	15.6	15.6
Romance: attracted to someone who doesn't share feelings	87	23.4	43	14.2	23.2	12.8	23.7	15.4	12.8	12.8	12.8	12.8	12.8	12.8
Love relationship break up	78	21.0	44	14.5	18.7	16.3	23.7	13.0	16.3	16.3	16.3	16.3	16.3	16.3
Borrowed a lot of money	77	20.7	34	11.2	23.7	9.9	17.2	12.4	9.9	9.9	9.9	9.9	9.9	9.9

Full Sample			Baseline				Follow-up			
Baseline (n=372)			Follow-up (n=303)				Intervention (n=169)			
	n	%	n	%			n	%	n	%
Started new school	71	19.1	22	7.3	21.7	16.0	8.0	6.4		
Decreased closeness with family	68	18.3	33	10.9	19.7	16.6	11.7	9.9		
Argument change with partner	66	17.7	38	12.5	14.3	21.9	8.0	17.7		
Death in family	63	16.9	28	9.2	16.8	17.2	5.6	18.5		
Family members argue a lot	61	16.4	31	10.2	18.7	13.6	10.5	9.9		
Trouble with academics - grades	59	15.9	41	13.5	17.2	14.2	10.5	17.0		
Change in finances, worse off	57	15.4	25	8.3	16.3	14.2	8.6	7.8		
Sexual difficulties	51	13.7			10.8	17.2				
Change in husband/partner job	51	13.7	28	9.2	14.8	12.4	9.3	9.2		
Trouble with employment	50	13.4	24	7.9	12.8	14.2	9.3	6.4		
Absent partner			23	7.6			8.0	7.1		

	Mean	SD	Mean	SD	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age (mean(SD))	25.2	3.5	25.3	3.5	25.2 (3.5)	25.2 (3.5)	25.4 (3.7)	25.3 (3.6)
Depression Scale	22.9	9.9	22.6	10.1	23.6 (9.7)	22.1 (10.2)	21.6 (9.1)	23.7 (11.1)
Perceived Stress Scale	32.8	9.9	32.7	7.5	33.4 (7.0)	32.2 (7.7)	32.2 (7.5)	33.3 (7.4)
Total Number of Life Events	6.0	4.1	3.0	2.8	6.3 (4.1)	5.8 (4.0)	3.7 (2.6)	3.7 (2.9)

* Participants could check all that apply. This list reflects the 20 most common life events.

Table 2
Life events correlated with Perceived Stress and Depressive Symptoms Scales at baseline and follow-up, WISER study

	Baseline (n=372)		Follow-up (n=303)	
	Perceived Stress Scale	Depressive Symptoms Scale	Perceived Stress Scale	Depressive Symptoms Scale
Changed work	0.0451	0.0735	0.0762	0.0195
Changed living situation	0.0257	0.1005	0.2121 *	0.0913
Major change in sleep habits	0.2025 *	0.2067 *	0.0934	0.0486
Trouble with home life	0.2122 *	0.2609 *	0.2069 *	0.1359 *
Illness or injury in family	0.1038 *	0.0663	-0.0044	0.0462
Change in eating habits	0.1386 *	0.1177 *	0.0826	0.0978
Argued with friends	0.0786	0.1066 *	0.1561 *	0.1024
Romance: attracted to someone who doesn't share feelings	0.1401 *	0.1356 *	0.1970 *, 0.1938 *	
Borrowed a lot of money	-0.0325	-0.0506	0.0907	0.0283
Love relationship break up	0.0274	0.1159 *	0.1624 *	0.1214 *
Started new school	0.0168	0.0315	-0.0475	-0.0507
Decreased closeness with family	0.1617 *	0.2161 *	0.2654 *	0.2250 *
Argument change with SO	0.1241 *	0.1654 *	0.1767 *	0.1968 *
Death in family	0.0590	0.0282	0.0649	0.1140 *
Family members argue a lot	0.1288 *	0.1776 *	0.1060	0.1481 *
Trouble with academics - grades	0.1779 *	0.1666 *	0.1939 *	0.1892 *
Change in finances, worse off	0.1210 *	0.0758	0.2134 *	0.1754 *
Sexual difficulties	0.1280 *	0.0749		
Change in husband/partner job	0.0145	0.0528	-0.0522	-0.0843
Trouble with employment	0.0654	0.1850 *	0.1408 *	0.1235 *
Absent partner			0.0738	0.0721
Total number of life events	0.2328 *	0.2997 *	0.3640 *	0.3154 *

*
p<0.05

Table 3

Multivariate linear regression model of the association between the top 20 reported life events and perceived stress and depressive symptoms at baseline, WISER study.

	Perceived Stress Scale			Depressive Symptoms Scale		
	Coeff	SE	P	Coeff	SE	P
Changed work	0.42	0.82	.61	0.57	1.11	.61
Changed living situation	-0.73	0.84	.38	0.25	1.12	.82
Major change in sleep habits	1.78	0.95	.06	2.63	1.28	.04
Trouble with home life	1.84	0.95	.05	3.20	1.27	.01
Illness or injury in family	1.63	0.90	.07	0.60	1.21	.62
Change in eating habits	0.20	0.99	.84	-1.38	1.34	.30
Argued with friends	0.06	0.95	.95	0.15	1.28	.91
Romance: attracted to someone who doesn't share feelings	2.05	0.98	.04	1.24	1.31	.34
Borrowed a lot of money	-0.80	0.97	.41	-1.58	1.30	.22
Love relationship break up	-1.92	1.05	.07	-0.34	1.40	.81
Started new school	-1.25	1.01	.22	-0.76	1.35	.58
Decreased closeness with family	2.03	1.06	.06	3.52	1.42	.01
Argument change with SO	1.13	1.10	.31	2.40	1.48	.11
Death in family	0.49	1.06	.65	0.01	1.43	1.00
Family members argue a lot	0.21	1.11	.85	1.34	1.49	.37
Trouble with academics - grades	0.99	1.18	.40	0.72	1.56	.64
Change in finances, worse off	1.47	1.12	.19	0.38	1.51	.80
Sexual difficulties	1.47	1.16	.21	0.26	1.56	.87
Change in husband/partner job	-0.50	1.14	.66	-0.26	1.53	.86
Trouble with employment	0.32	1.18	.78	3.55	1.55	.02

Note. Adjusted for marital status, college degree, race, age, income, currently a student

Table 4

Multivariate linear regression model of the association between the top 20 reported life events and perceived stress and depressive symptoms at follow-up, WISER study.

	Perceived Stress Scale			Depressive Symptoms Scale		
	Coeff	SE	P	Coeff	SE	P
Changed work	0.07	0.83	.94	-0.45	1.14	.69
Changed living situation	2.29	0.97	.02	0.69	1.33	.61
Major change in sleep habits	0.60	1.12	.59	-0.72	1.54	.64
Trouble with home life	1.32	1.10	.23	0.06	1.49	.97
Illness or injury in family	-0.97	1.14	.39	0.30	1.57	.85
Change in eating habits	0.20	1.07	.85	1.70	1.48	.25
Argued with friends	1.87	1.13	.10	1.29	1.56	.41
Romance: attracted to someone who doesn't share feelings	1.57	1.24	.21	3.24	1.72	.06
Borrowed a lot of money	1.50	1.30	.25	0.58	1.80	.75
Love relationship break up	1.85	1.29	.15	1.20	1.78	.50
Started new school	-1.81	1.59	.26	-2.87	2.20	.19
Decreased closeness with family	4.79	1.37	<.01	5.42	1.87	<.01
Argument change with SO	-0.79	1.42	.58	0.82	1.97	.68
Death in family	0.89	1.51	.56	2.84	2.05	.17
Family members argue a lot	1.55	1.40	.27	2.97	1.92	.12
Trouble with academics - grades	2.58	1.34	.06	3.68	1.83	.05
Change in finances, worse off	4.00	1.51	.01	3.99	2.09	.06
Absent Partner	0.99	1.55	.53	1.49	2.14	.49
Change in husband/partner job	-1.52	1.43	.29	-3.41	1.98	.09
Trouble with employment	1.90	1.59	.24	2.62	2.20	.23

Note. Adjusted for condition, marital status, college degree, race, age, income, currently a student

Table 5

The relationship between life events and perceived stress and depressive symptoms in unadjusted and multivariate linear models at baseline and follow-up, WISER study

	Baseline			Follow-up			
	Model 1: Unadjusted (Crossectional)	Model 2: Adjusted for demographics (Crossectional)	Model 3: Model 2 + cooccurrence of perceived stress and depressive symptoms (Crossectional)	Model 1: Unadjusted (Crossectional)	Model 2: Adjusted for demographics (Crossectional)	Model 3: Model 2 + cooccurrence of perceived stress and depressive symptoms	Model 4: Intervention Effect (Longitudinal)
	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)	Coeff (SE)
Stress							
Life Events	0.44 (0.11) [*]	0.45 (0.11) [*]	0.08 (0.09) [*]	1.03(0.15) [*]	1.01 (0.15) [*]	0.43 (0.12) [*]	0.39 (0.11) [*]
Depression			0.44 (0.03) [*]			0.48 (0.03) [*]	0.38 (0.03) [*]
Condition							0.63 (0.58)
Depression							
Life Events	0.78 (0.14) [*]	0.79 (0.15) [*]	0.41 (0.12) [*]	1.02 (0.15) [*]	1.19 (0.21) [*]	0.31 (0.17)	0.23 (0.16)
Stress			0.86 (0.06) [*]			0.89 (0.06) [*]	0.72 (0.06) [*]
Condition							1.73 (0.80) [*]

Note. Adjusted for marital status, college degree, race, age, income, currently a student. Model 4 includes the baseline value of the primary dependent variable.

* $p < .001$