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A Randomized Controlled Trial Comparing two Cognitive-Behavioral Programs for Adolescent Girls with Subclinical Depression: A School-Based Program (Op Volle Kracht) and a Computerized Program (SPARX)

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Abstract

Limited research has indicated the effectiveness of the school-based Cognitive Behavioral Therapy (CBT) prevention program ‘Op Volle Kracht (OVK)’ and the computerized CBT program ‘SPARX’ in decreasing depressive symptoms. Therefore, a randomized controlled trial of the effectiveness of OVK and SPARX was conducted among Dutch female adolescents ($n = 208$, mean age = 13.35) with elevated depressive symptoms. Participants were randomly assigned to one of four conditions: OVK only ($n = 50$), SPARX only ($n = 51$), OVK and SPARX combined ($n = 56$) and a monitoring control condition ($n = 51$). Participants in the first three conditions received OVK lessons and/or the SPARX game. Depressive symptoms were assessed before interventions started, weekly during the interventions, and immediately after the interventions ended, with follow-up assessments at 3, 6 and 12 months. Intention to treat results showed that depressive symptoms decreased in all conditions ($F(12, 1853.03) = 14.62, p < .001$), with no difference in depressive symptoms between conditions. Thus, all conditions, including the monitoring control condition, were equally effective in reducing depressive symptoms. Possible explanations for the decrease of depressive symptoms in all conditions are discussed and suggestions for future research are provided. Dutch Trial Register: NTR3737.

Keywords: Prevention; Adolescence; Depression; Randomized controlled trial; Cognitive-behavioral; Video game

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and a Computerized Program (SPARX)

Globally depression is among the leading causes of disease burden (Mathers et al., 2004; Murray & Lopez, 1997; Vos et al., 2012), and it is the leading cause of disease burden in young people aged 10 to 24 years old (Gore et al., 2011). Moreover, subclinical depressive symptoms cause significant impairment in adolescents' school performance and social interactions, and subclinical depression is an important risk factor for major depressive disorder (Gotlib, Lewinsohn, & Seeley, 1995; Nolen-Hoeksema & Girgus, 1994; Wesselhoeft, Sørensen, Heiervang & Bilenberg, 2013). Prevalence of subclinical depression is estimated to be between 20% and 50% in adolescents, with depressed mood showing a sharp increase in 13 to 15 year olds (Kessler, Avenevoli, & Merikangas, 2001; Petersen et al., 1993). Female adolescents appear especially vulnerable, as their depressive symptoms by mid-adolescence are markedly higher than those of male adolescents (Nolen-Hoeksema & Girgus, 1994; Wade, Cairney, & Pevalin, 2002). Therefore depression prevention may be especially relevant for girls during early adolescence.

Not surprisingly, extensive research has aimed to identify effective prevention programs, with meta-analyses demonstrating that depression prevention programs have small to moderate positive effects on depressive symptoms (Horowitz & Garber, 2006; Merry et al., 2011). Additionally, the reduction in onset of depressive disorders through depression prevention programs is clinically relevant (Van Zoonen et al., 2014). By definition, prevention programs target individuals that are not currently affected by a disorder and aim to eliminate the risk of developing a disorder (Muñoz, Cuijpers, Smit, Barrera, & Leykin, 2010). Three levels of prevention are frequently distinguished; (1) universal prevention, aimed at the entire population, (2) selective prevention, aimed at individuals who are at risk for developing

a disorder, and (3) indicated prevention, aimed at individuals with early symptoms of a disorder (Merry et al., 2011). Although Merry and colleagues (2011) found effectiveness for universal, selective and indicated programs, selective and indicated prevention are often found to be more effective than universal prevention (Horowitz & Garber, 2006). Moreover, as clinical depression is often not identified and/or treated (Merry et al., 2011), Muñoz and colleagues (2010) argue for increased efforts to identify depressive symptoms early on and provide adequate early treatment or indicated prevention to limit the adverse consequences of clinical depression. However, when comparing prevention programs to active control programs, showing effectiveness for all levels of prevention remains a challenge (i.e. to be more effective than programs that are not aimed at preventing depression; Brunwasser, Gillham, & Kim, 2009; Manassis et al., 2010; Merry et al., 2011). Additionally, prevention programs most often find treatment effects (i.e. depressive symptoms decrease in the intervention condition compared to the control condition which remains stable), rather than true prevention effects (i.e. depressive symptoms in the control condition increase, while depressive symptoms in the intervention condition do not increase or increase less; Horowitz & Garber, 2006). However, prevention effects may become visible if participants are followed for a longer time (Horowitz & Garber, 2006).

The current study investigated the prevention effects of two depression intervention programs, a school-based program designed to prevent depression, and a computerized program shown to be effective in treating mild to moderate depression, among an indicated sample of Dutch female adolescents with elevated depressive symptoms. Furthermore, the effectiveness of both programs delivered simultaneously was studied. Long-term effectiveness was studied up to one year after program completion.

Cognitive-Behavioral Interventions

According to cognitive behavioral principles, attitudes and assumptions (schemas) are distilled from an accumulation of previous experiences (Beck, Rush, Shaw, & Emery, 1979). Cognitive-Behavioral Therapy (CBT) assumes that present cognitions and interpretations of events are based on these schemas (Beck et al., 1979). Certain schemas can become dominant in a person through accumulation of (negative) experiences and determine how a person interprets and reacts to a wide range of events. This can occur even when this schema is irrelevant to the situation, and leads to distorted and dysfunctional schemas, which in turn develop into misconceptions and maladaptive cognitions. Consequently, these maladaptive cognitions (e.g., 'nobody likes me') and dysfunctional reactions to events (e.g., avoiding social interactions) cause distress and lead to the development and maintenance of depression as long as dysfunctional schemas continue to be used (Reinecke, Ryan, & DuBois, 1998).

CBT aims to expose and change these maladaptive cognitions and behaviors through cognitive and behavioral techniques. Clients engaged in this form of therapy are acquainted with CBT principles and learn to challenge and alter distorted cognitions, which should over time, alter dysfunctional schemas (Beck et al., 1979). Research has shown that CBT is effective in treating depression in adolescents (e.g. Reinecke et al., 1998); For example, ACTION, a CBT treatment program intended for young adolescent girls, led to remission in more than 80% of participants (Stark, Streusand, Arora, & Patel, 2011). In addition, CBT shows promise for preventing depression (Brunwasser et al., 2009). Thus, even when maladaptive cognitions are not yet fully formed, or have not yet affected daily functioning, CBT may instill more adaptive cognitions and may counteract future maladaptive cognitions. In this way, CBT principles may be utilized to prevent clinical depression in those suffering from subclinical depression.

School-based prevention. Several large scale studies have tested the effectiveness of school-based CBT prevention programs with mixed results. Spence, Sheffield and Donovan

(2003) showed that a CBT-based prevention program implemented in 8 schools effectively decreased depressive symptoms at post intervention compared to a monitoring control group, however these effects were not maintained across the four year follow-up period (Spence, Sheffield, & Donovan, 2005). Two other universal CBT-based prevention programs in schools were found to be no more effective than a monitoring control condition in decreasing depressive symptoms across one year (Sheffield et al., 2006), and a three year period (Sawyer et al., 2010). Additionally, Sheffield and colleagues (2006) showed that both indicated and combined universal and indicated school-based CBT prevention programs were not effective in decreasing depressive symptoms in high risk adolescents in the consequent year.

In contrast, one of the most studied prevention programs based on CBT principles, the Penn Resiliency Program (PRP), seems to be linked to preventing depression among a range of populations (Brunwasser et al., 2009). Although, in comparison to active controls, PRP has yet to show a superior effect (Brunwasser et al., 2009). PRP is a school-based universal program for children aged 10 to 14 years. PRP has been translated into Dutch, and has been adapted to ensure cultural relevance in the Netherlands and improve the program. The Dutch version of the program is called 'Op Volle Kracht' (OVK; Tak et al., 2012).

Recent Randomized Controlled Trials (RCTs) on the effectiveness of OVK have also had mixed results. On the one hand, two RCTs showed that OVK was not effective in a universal trial (Tak, Lichtwarck-Aschoff, Gillham, Van Zundert & Engels, 2015), and a selective trial among adolescents in high-risk neighborhoods (Kindt, Kleinjan, Janssens & Scholte, 2014). On the other hand, in an indicated RCT, OVK was shown to be effective in reducing depressive symptoms among girls with elevated depressive symptoms for up to six months (Wijnhoven, Creemers, Vermulst, Scholte & Engels, 2014) and positive effects of OVK were also found in the selective trial for adolescents whose parents had psychopathology (Kindt et al., 2014). Thus, further replication of the effectiveness of OVK as

an indicated prevention program is warranted, especially in comparison to active controls or alternative prevention programs.

Computerized prevention. Computerized prevention is promising due to its low costs and potential appeal to adolescents used to modern technology. Research on computerized interventions has shown potential efficacy in adults for both anxiety and depression (Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010; Richards & Richardson, 2012). However, research on the effectiveness of computerized prevention of depression in adolescents is limited (Merry et al., 2012; Richardson, Stallard & Velleman, 2010). Evidence from two small reviews has shown early support for computerized interventions (Richardson, Stallard & Velleman, 2010) and internet-based prevention programs and interventions (Calear, & Christensen, 2010) as effective depression treatments among children and adolescents. For example, the internet-based program MoodGYM, a universal depression prevention program for adolescents showed effectiveness in comparison to the normal school curriculum, although these effects appeared stronger for boys than for girls (Calear, Christensen, Mackinnon, Griffiths, & O’Kearney, 2009; O’Kearney, Gibson, Christensen, & Griffiths, 2006; O’Kearney, Kang, Christensen, & Griffiths, 2009). Additionally, a recent review by Li, Theng and Foo (2014) on digital game-based interventions indicated effectiveness of game-based interventions for depression. Furthermore, the appealing aspects of video games may attract adolescents to interventions and keep them engaged in treatment (Granic, Lobel & Engels, 2014).

At present, SPARX is the only available game-based intervention that was specifically developed for adolescents with depressive symptoms and that has been tested. Other game-based interventions identified in the review of Li and colleagues (2014) were either aimed at adults or not targeted at depressive symptoms (e.g. games targeting anxiety or commercial entertainment games). SPARX is an interactive fantasy-based video game that allows

adolescents to actively practice CBT principles in order to alleviate depressive symptoms (Merry et al., 2012). Although the content of OVK and SPARX, both CBT-based programs, are comparable, their formats are entirely different.

The first study on SPARX showed that depressive symptoms decreased in adolescents using SPARX, and outcomes did not differ significantly between face-to-face therapy (usual care) and SPARX treatment for young people seeking help for depressive symptoms (Merry et al., 2012). Another RCT found that SPARX was effective in reducing depressive symptoms and achieving remission in comparison to a waitlist control among adolescents excluded from mainstream education with depressive symptoms (Fleming, Dixon, Frampton, & Merry, 2012). These results are promising and need further replication. Their implications for prevention purposes is also an important question to explore.

Combining school-based and computerized prevention

Both OVK and SPARX have promise as depression prevention programs. Further, combining the two programs may lead to additional benefits. SPARX may provide a stimulating and attractive addition to the conventional prevention efforts of OVK. The extra practice afforded may help to consolidate the material, and automatize new skills, enhancing prevention effects. Also, SPARX may be more effective when combined with OVK because OVK provides professional support and group support. Although some studies confirmed that professional support enhances the effects of computerized CBT, the results are inconsistent (Richardson, Stallard, & Velleman, 2010). Thus, the present study tested the effectiveness of OVK and SPARX separately, as well as in combination.

Design and hypotheses

The current study used a factorial RCT design with four parallel conditions including: OVK only, SPARX only, OVK & SPARX combined, and a monitoring control, to which adolescent girls with subclinical depressive symptoms were randomly allocated. The control

group received no formalized program but rated their depressive symptoms digitally every week; thus, this control condition was referred to as an active monitoring control group. The main hypothesis in the current study was that depressive symptoms would be lower in female adolescents who participated in OVK and/or SPARX compared to the control condition one year after the interventions. No specific hypotheses were put forth about the differences among the intervention conditions.

Method

Participants

In the present study 208 girls with elevated depressive symptoms between 11 and 16 years old ($M = 13.35$, $SD = 0.71$) were included. All participants were enrolled in the first or second grade of secondary education in The Netherlands; 4.3% attended unsegregated secondary education, 12.5% attended low secondary education, 18.8% attended low to intermediate secondary education, 3.4% attended intermediate secondary education, 27.9% attended intermediate to high secondary education and 33.2% attended high secondary education. The vast majority of participants were born in The Netherlands (94.7%).

Procedure

The sample size was similar to the sample size used in the OVK study by Wijnhoven and colleagues (2014). Post-hoc power analyses using G*Power 3.1.7 (Buchner, Erdfelder, Faul, & Lang, 2013) showed that a power of 0.97 was achieved for small effect sizes (partial $\eta^2 = .01$; correlation among repeated measures = .67; $\epsilon = .53$; number of measurements = 13) when including the 159 participants who completed all assessments. Seven secondary schools in selected cities and towns in The Netherlands agreed to participate in the study. Adolescent girls in the first two years of these schools (grade 7 and 8) and their parents received information regarding the study and could withdraw from the study before screening.

Additionally, participants and parents gave active written consent for study participation past the initial screening.

In total, 962 girls were screened (T0) during November and December 2012, at school during class-time, using the Reynolds Adolescent Depression Scale (RADS-2; Reynolds, 2002). To be eligible for further participation in the study, girls had to score at or above the 70th percentile on depressive symptoms within the sample (RADS-2 score ≥ 59 , $n = 297$). Exclusion criteria were suicidal ideation (score 2 on Children's Depression Inventory item 9, $n = 2$) and currently receiving mental health care ($n = 26$). Girls indicating suicidal ideation at screening, or any time point within the study, were contacted along with their parents and were provided information on possible mental health care services they could access. Girls were informed of this procedure at the start of the study. Suicidal ideation ($n = 6$) during intervention or at follow-up was not an exclusion criteria.

The 269 girls meeting inclusion criteria were contacted to participate in the study, of which 46 declined to participate and fifteen could not be contacted (see Figure 1). In the end, 208 girls were enrolled in the study. Participants were randomly assigned to one of four conditions (OVK $n = 50$, SPARX $n = 51$, OVK & SPARX $n = 56$, and the monitoring control condition $n = 51$) by an independent researcher using random number generation. Randomization was conducted at a school level, with a predetermined number of conditions per school, to ensure adequate group size with equal ratios within schools. The number of conditions per school ranged from one to four and conditions were assigned to schools in a random order by an independent researcher. Participants were informed of group allocation before pre-test (T1). After randomization, seven participants withdrew from the study before the programs started, due to scheduling problems with the OVK lessons ($n = 5$) and refusing participation ($n = 2$). Due to the clear differences in program delivery models, it was not possible for participants, researchers, and therapists to be blinded to intervention assignment.

Girls in the OVK condition were given the first eight lessons of the OVK program by professional psychologists. Lessons were provided weekly at schools during or after class time and lasted approximately an hour per week. The SPARX condition consisted of weekly game play of SPARX. Girls were provided with a CD-ROM containing the game and could play the game at home at a time of their choosing. They were asked to complete one level (approximately 20 to 40 minutes) per week, starting in the second week of the study (after the first weekly questionnaire). The combined OVK & SPARX condition consisted of both the 8 sessions of OVK and weekly use of SPARX. Interventions were provided from January to May 2013. The control condition did not consist of a formal program, and thus participants could participate in the intervention of their choice after the final follow-up assessment.

Depressive symptoms were measured at pre-test (T1), weekly throughout the interventions (T2-T8), at post-test in the week after the end of the interventions (T9) and at the 3, 6 and 12 month follow-ups (T10-T12). Questionnaires were part of a larger set of assessments (see trial registration NTR3737), which were filled out digitally on a secured website. With the exception of screening, all questionnaires were filled out at home. Of the 208 randomized participants, 159 participants (76.4%) filled out all questionnaires and 186 participants (89.4%) completed at least twelve out of thirteen questionnaires. More information on participant completion rates and dropouts are provided in Figure 1.

Participants received €22.50 (approximately US\$16.50) for their participation up to post-test, and €7.50 (approximately US\$5.50) for each of the three follow-up questionnaires. The ethical committee of the Faculty of Social Sciences at Radboud University Nijmegen approved this study (ECG2012-2711-069) and the trial was registered at the Dutch Trial Register (No. NTR3737).

Interventions

Op Volle Kracht (OVK). OVK is a depression prevention program adapted for Dutch adolescents from PRP (Tak et al., 2012). The full program consists of sixteen lessons including homework, of which the first eight lessons teach CBT principles and the last eight lessons focus on social problem solving. A recent study showed that the first eight lessons alone are effective in reducing depression symptoms in adolescent girls with elevated depressive symptoms (Wijnhoven et al., 2014). In these first eight lessons adolescents learn to recognize their own emotions and cognitions, and how they relate to each other and to events the adolescents may experience. In addition, adolescents practice skills to change maladaptive cognitions into more adaptive ones. In the current study only the first eight lessons were provided to decrease the length of the program, replicate the study of Wijnhoven and colleagues (2014), and to provide a better match to the SPARX program. Participants in the OVK and OVK&SPARX conditions who completed the program were present at an average of 6.77 ($SD = 1.17$) out of 8 lessons with a minimum of 4 lessons received by all participants.

SPARX. SPARX is a CBT-based treatment for clinical depression in the form of an interactive fantasy game intended for adolescents (Merry et al., 2012). The program consists of seven levels in which balance needs to be restored in a fantasy world plagued by negative thoughts. CBT principles are introduced and practiced through challenges, educational interactions with a guide, and real-life homework tasks. Participants in the SPARX and OVK&SPARX conditions completed an average of 6.48 ($SD = 1.27$) out of 7 levels according to participants' self-report. One participant in the OVK&SPARX condition did not play the game, and another participant in the same condition reported completing only the first level. All remaining participants completed at least three levels of SPARX, with 78.8% of participants reporting they completed all seven levels. All participants were included in the analyses.

Instruments

Depressive symptoms. The RADS-2 consists of 30 items measuring depressive symptoms severity with good psychometric qualities (Reynolds, 2002). Items (e.g. ‘I feel sad’ and ‘I feel that other children don't like me’) are answered using a four-point scale (from *almost never* to *most of the time*). Seven items are reverse scored. A total score is calculated from the summed responses, with a range of 30 to 120. Higher scores indicate more depressive symptoms. Cronbach’s alpha across measurements ranged from .73 to .92.

Suicidal ideation. Suicidal ideation was indicated on a three point scale (*I don't think about ending my life* = 0, *I think about ending my life, but I would never do it* = 1, *I want to end my life* = 2) using item 9 of the Children’s Depression Inventory (CDI; Kovacs, 2001).

Evaluation of the programs. At post-test participants rated statements regarding their satisfaction with OVK and SPARX on a five-point scale (from *strongly disagree* to *strongly agree*). Three statements were comparable across the programs: ‘I liked the classes of OVK/playing SPARX’, ‘I think OVK/SPARX is attractive for other adolescents’ and ‘I can use OVK/SPARX in my daily life’.

Statistical analyses

First, missing data were imputed using multiple imputation with auxiliary variables to create more accurate standard errors (Graham, 2009). SPSS 19 was used to impute the dataset twenty times with predicting mean matching. Next, to examine group clustering effects intraclass correlations (ICC) were calculated for the schools. The ICC for depressive symptoms were low, with a mean of .01 (minimum < 0.001; maximum = 0.04, SD = 0.02), indicating that school factors accounted for about 1% of the variance. Thus, in all Latent Growth Curve Modeling (LGCM) analyses, school was controlled for as a clustering factor.

Differences between the four conditions in depressive symptoms were tested at each measurement point with one-way ANOVA’s. Main analyses for Completers Only (CO) and Intention-to-treat (ITT) were done on depressive symptoms with 2 x 2 between subjects

factorial ANOVA repeated measures, which were used to contrast on the one hand conditions with OVK (OVK and OVK&SPARX) and those without OVK (control and SPARX), as well as conditions with SPARX (SPARX and OVK&SPARX) and those without SPARX (control and OVK). Greenhouse-Geisser correction was used if Mauchly's test for sphericity was significant, meaning that the assumption of sphericity was violated.

Next, LGCM analyses using Mplus version 6.11 (Muthén & Muthén, 1998–2007) were performed for depressive symptoms. LGCM analyses were used to estimate mean trajectories of depressive symptoms for all participants from individual growth curves. First, it was attempted to create a model with a good fit ($\chi^2 p \geq 0.05$, RMSEA < .05, CFI > .90) in which intercept and slope were regressed on all assessments. In this basic model, no predictors or control variables were included. Linear and quadratic slopes were tested to assess change from the start of the interventions. The intercept was set at pre-test (T1). Second, the intercept and slope(s) were regressed on the screening level of depressive symptoms and on condition, to control for differences at screening and to assess the effect of condition. Again the model fit was assessed and it was tested whether conditions were associated with change in depressive symptoms and the level of depressive symptoms at the final follow-up (T12).

Results

Descriptive statistics

Table 1 shows the descriptive statistics for demographic variables per condition. No significant differences were found between conditions on the demographic variables of age ($F(3, 204) = 1.66, p = .18$), education level ($X^2(3, n = 208) = 0.71$), born in the Netherlands ($X^2(3, n = 208) = 1.60$), religion ($X^2(3, n = 208) = 1.20$), and gaming frequency (measured on a five-point scale (from *never* to *almost every day*); $F(3, 204) = 1.11, p = .35$). Therefore, these demographic variables were not used as covariates in the analyses.

Table 2 shows descriptive statistics for depressive symptoms from screening to one-year follow-up per condition. Depressive symptoms did not significantly differ between conditions at screening ($F(3, 204) = 2.08, p = .10$) or any other time point. Of the participating girls, 43 showed depressive symptoms in the clinical range at screening (RADS-2 score ≥ 76).

Repeated measures ANOVA

For the main outcome analyses, depressive symptoms were compared across conditions using a 2 (OVK condition) x 2 (SPARX condition) between subjects factorial ANOVA design with repeated measures. The CO analysis showed that the assumption of sphericity was violated according to the Mauchly's test $\chi^2(77) = 682.788, p < 0.001$, therefore the Greenhouse-Geisser correction was used ($\epsilon = .53$).

There was a significant main effect of time: Depressive symptoms decreased significantly over time from screening to one-year follow-up with a medium effect size, $F(6.31, 977.71) = 24.31, p < .001$, partial $\eta^2 = .14$. There was no significant interaction of time with the OVK condition ($F(6.31, 977.71) = 0.81, p = .57$, partial $\eta^2 = .01$) and no significant interaction of time with the SPARX condition ($F(6.31, 977.71) = 1.70, p = .11$, partial $\eta^2 = .01$). Finally, there was no significant three-way interaction of time with the OVK condition and with the SPARX condition ($F(6.31, 977.71) = 1.13, p = .34$, partial $\eta^2 = .01$).

For the ITT analysis SPSS Mixed Models was used to perform the ANOVA and results were pooled with the SPSS macro by Van Ginkel and Kroonenberg (2014). ITT results replicated the CO analysis, with a significant main effect of time ($F(12, 1853.03) = 14.62, p < .001$), no significant interaction of time with the OVK condition ($F(12, 1981.87) = 0.29, p = .99$), no significant interaction of time with the SPARX condition ($F(12, 2357.96) = 1.08, p = .37$) and no significant three-way interaction of time with the OVK condition and with the SPARX condition ($F(12, 1903.73) = 0.54, p = .89$). Figure 2 shows the mean depression scores for each of the four conditions from screening to the one-year follow-up.

Latent Growth Curve Modelling

In the first model all measures of depressive symptoms from pre-test to one year follow-up were used to estimate a mean growth curve of symptoms across the entire study. The model showed a poor fit ($\chi^2(73) = 441.05, p < 0.001$; RMSEA: $M = .16, SD = .01$; CFI: $M = .78, SD = .02$). Therefore, a quadratic slope was added to the model. Model fit improved but remained poor ($\chi^2(69) = 353.41, p < 0.001$; RMSEA: $M = .14, SD = .01$; CFI: $M = .83, SD = .02$). However, global fit indices can be misleading when using individual growth curves and poor fitting models may still offer a good approximation of the data (Coffman & Millsap, 2006). Unfortunately, no individual fit indices are provided by Mplus. Therefore the model was accepted¹. This first model in which the intercept was set at pre-test ($M = 62.37, SD = 0.93, p < .001$) showed that depressive symptoms decreased over the course of the interventions ($M = -1.52, SD = 0.30, p < .001$). However, the mean of the quadratic slope showed that the decrease in symptoms slowed down across the study period ($M = 0.11, SD = 0.02, p < .001$). Variances of the intercept ($133.93, p < .001$) and linear slope ($3.97, p < .05$) were significant, indicating that participants had different levels of depressive symptoms at pre-test and had different linear growth rates, although no individual differences in the quadratic slope were found ($0.02, p = .068$).

Next, the intercept and slopes of depressive symptoms were regressed on the level of depressive symptoms at screening (T0) and on condition. For this second model the intercept

¹ As there were large differences in the time between assessments, additional analyses were done separately for T1 to T9 and T9 to T12. Model fits of these models were acceptable when symptoms at screening and conditions were included (Intervention phase: $\chi^2(60) = 96.29, p < 0.01$; RMSEA: $M = .05, SD = .02$; CFI: $M = .98, SD = .01$; Post-intervention phase: $\chi^2(5) = 7.31, p = 0.20$; RMSEA: $M = .04, SD = .03$; CFI: $M = .99, SD = .01$). Results were similar to the single quadratic model, with no difference visible between conditions on slope or at the one year follow-up intercept.

was set at the one-year follow-up. Model fit remained poor ($\chi^2 (105) = 412.59, p < 0.01$; RMSEA: $M = .12, SD = .01$; CFI: $M = .85, SD = .01$). None of the conditions were associated with either the linear or quadratic slope (Table 3), indicating that the conditions did not have different growth trajectories. Additionally, conditions were not associated with the intercept. Thus, depressive symptoms of participants in all conditions changed at similar rates and participants in all conditions had similar depressive symptoms at one-year follow-up. Depressive symptoms at screening were associated with depressive symptoms at the one-year follow-up, but did not affect the rate of change. Higher levels of depressive symptoms at screening still predicted higher levels of depressive symptoms at one-year follow-up. Analyses were repeated with the intercept at post-test, 3 month follow-up, and 6 month follow-up and showed that depressive symptoms were the same across conditions at all post-intervention assessments.

Suicidal ideation

Suicidal ideation (CDI item 9 score 2) was monitored during the study to assess possible adverse effects and was reported by 3 participants in the OVK&SPARX condition and 1 participant in each of the other three conditions. A Kruskal-Wallis test showed no significant differences between conditions in suicidal ideation ($\chi^2 (3) = 1.66, p = 0.65$).

Evaluation of the programs

Agreement with statements regarding the satisfaction of participants was compared between the OVK and SPARX programs using ANOVAs (see Table 4). Participants rated their liking of the two conditions similarly. OVK was rated as a more attractive option for adolescents and was perceived as more useful in daily life than SPARX.

Discussion

The main aim of the current study was to test the effectiveness of the OVK and SPARX programs as indicated depression prevention for adolescent girls with subclinical

depressive symptoms. Depressive symptoms decreased significantly in all conditions during the study period with a medium effect size. The analyses showed no difference in depressive symptoms across conditions, including the monitoring control condition, indicating that all conditions were equally effective in reducing depressive symptoms. Thus, although the study aimed to show prevention effects, these could not be identified as the control condition did not show an increase in depressive symptoms, but instead appeared to show a treatment effect similar to the other conditions (Horowitz, & Garber, 2006).

Intervention effects

When we compare the results of the current study to research on OVK and PRP, the original prevention program on which OVK was based, some interesting insights emerge. Unlike findings of an earlier PRP meta-analysis (Brunwasser et al., 2009), results of the current study showed no greater decrease in depressive symptoms in OVK than the control condition. Our findings are similar to the results of both a universal (Tak et al., 2015) and a selective study of OVK (Kindt et al., 2014) which showed that OVK was not superior to a control group. Additionally, a similar pattern of equal decline in depressive symptoms between intervention groups and a monitoring control group was also reported in a study that evaluated another indicated CBT-based prevention program (Spence et al., 2006). However, the current study was designed in part to replicate Wijnhoven and colleagues' (2014) indicated prevention study, which showed that OVK was superior to a control group. The inconsistent results of our study and Wijnhoven et al. (2014) may be explained by the stricter inclusion criteria that was used in the Wijnhoven and colleagues study; their participants' showed higher depressive symptoms at baseline than our current sample. Considering earlier mixed results of both OVK and PRP it may be important to pay close attention to the selection of participants for the OVK program. It is possible that only when symptom levels are sufficiently high the content of OVK is personally relevant for adolescents, and exercises in

the program can be realistically practiced. Additionally, it may be that higher symptom levels are necessary for adolescents to feel motivated to change. Using strict selection criteria, and thus selecting only those adolescents most at risk may be necessary for OVK to be effective.

Next, the results of the SPARX program can be compared to earlier studies of SPARX. In the study by Merry and colleagues (2012), SPARX was compared to a usual care control group. In the current study SPARX was compared to OVK, a CBT-based program. In both studies we see a similar pattern. Depressive symptoms decreased by the same magnitude as standard or CBT treatment. Merry and colleague's (2012) study did not include a no intervention group, but a study by Fleming and colleagues (2012) did and – contrary to the improvements we found in our monitoring control group they showed no such improvements in their control group. In fact, participants in the control condition in Fleming and colleagues' study reported an increase in depressive symptoms over the course of the program. This increase may be attributed to the increased number of risk factors and stressors participants in the study by Fleming and colleagues may have faced during the study due to their exclusion from mainstream education. Moreover, as we will discuss in the following section, our control group may have been more active than the control group in the Fleming and colleagues study leading to the decrease in symptoms in this group.

Alternative explanations for why SPARX did not seem to be more effective than the monitoring control group may be attributed to the game itself or the study design. First, although SPARX was translated into Dutch, no further cultural adjustments were made to increase the fit of the program for Dutch adolescents, which may have reduced the effectiveness of SPARX. For example, the Guide character who leads the participant through the program, and introduces CBT concepts, was portrayed as a leader from a Māori (indigenous New Zealand) cultural perspective, and Dutch adolescents may have experienced difficulty relating to, and identifying with this character. Second, the appeal of the game for

adolescents was lower than expected. Less than half the participants indicated they liked SPARX or thought it was attractive, in contrast to the feedback on the New Zealand SPARX version. Compared to when the game was originally developed, when it included graphics and mechanics comparable to many of the games on the market at that time, SPARX may have already been outdated by the standards of Dutch adolescents during our trial. As commercial video games are continuously evolving and becoming more and more sophisticated and realistic, an applied game such as SPARX, may have become outdated relatively quickly, and therefore may have lost its initial appeal and capacity to engage adolescents. Additionally, it may be that offering SPARX as a treatment raises a different set of expectations than when SPARX is provided in a prevention setting to adolescents who are not actively seeking help for a low mood.

Alternative explanations

The present study showed a similar decrease in depressive symptoms in all conditions including the control condition; this decrease in symptoms may be attributed to several mechanisms. One factor may have been attention, which participants in all conditions received through personalized emails, telephone questionnaire reminders, and in the case of OVK, through contact with the therapist. Arrindell (2001) suggests that attention by researchers may have therapeutic effects and may ameliorate symptoms. Additionally, the frequent assessment of depressive symptoms may have made participants more aware of their symptoms and this may have triggered them to seek further informal support. Spence and colleagues (2003) suggested in a similar vein, that the lack of the long term-effectiveness of their universal prevention program could partly be explained by attention for and monitoring of depressive symptoms in the control condition. Moreover, participation in a study that focuses on the improvement of well-being may have elicited support from the adolescents' environment. Both the participants as well as their friends and family may have reacted to this

inclusion through seeking/providing additional support. All of these explanations are consistent with the increasing depressive symptoms in the follow-up phase, as attention and assessments were less frequent during this period.

Furthermore, the similar decrease in all conditions may be due to the control condition used in this study, which may have operated as an effective early intervention for depression, as recent studies indicate. Participants in this study were confronted with their depressive symptoms weekly, through the questionnaires, in effect experiencing a self-monitoring intervention. Studies have recently shown that self-monitoring, by means of repeated mood questionnaires, can effectively reduce depressive symptoms (Kauer et al., 2012; Kramer et al., 2014). Although most recent self-monitoring interventions utilize more frequent measurements (e.g. four measurements a day for two to four weeks Kauer et al., 2012; or ten measurements a day, during three days a week, for a total of six weeks Kramer et al., 2014) than the weekly measurements used in the current study, earlier self-monitoring interventions showed decreases in depressive symptoms and even suicidal ideation with a minimum amount of questions only once a day (Clum & Curtin, 1993; Hammen & Glass, 1975); and several effective self-monitoring therapies also rely on self-monitoring once a day (Dimidjian, Hollon, Dobson et al., 2006; Fuchs & Rehm, 1977; Rehm, Kornblith, O'Hara, Lamparski, Romano, & Volkin, 1981). So far, no study has examined the optimal or minimal dose of self-monitoring interventions required to affect depressive symptoms. Although self-monitoring occurred only once a week in the current study, questionnaires were detailed and asked participants to report both depressive symptoms and stressful events experienced in the past week (see trial registration NTR3737). Self-monitoring has been found to raise awareness of patients own emotions, making it a promising intervention for mild depressive symptoms (Kauer et al., 2012). The more reflective nature of the questionnaires in the current study, may have stimulated participants awareness of their own emotions at a more global level. As most

adolescents in the current study were experiencing only mild depressive symptoms, the self-monitoring intervention may have been sufficient to reduce depressive symptoms, leaving little room for the CBT based interventions to show superior effects.

Therefore, although decreases in depressive symptoms were similar in all conditions we cannot conclude that OVK and SPARX have no effect at all, as symptoms did decrease and the monitoring control condition may have been an effective intervention as well. Both OVK and SPARX were shown to have beneficial effects in previous studies (e.g. Brunwasser et al., 2009; Fleming et al., 2012; Merry et al., 2012; Wijnhoven et al., 2014) and are based on CBT, a recommended treatment for depression (National Institute for Health and Clinical Excellence, 2005). Additionally, a recent meta-analysis of CBT school-based depression interventions showed that on average control conditions in indicated prevention studies showed a significant decrease in depressive symptoms up to post-test with an effect size (g) of 0.26 with 95% CI [0.04, 0.48], $p < .05$ (Mychailyszyn, Brodman, Read, & Kendall, 2012). However, similar within-group effect sizes in the current study fall outside of the 95% CI of the average control group effect (SPARX $g = 1.02$; OVK $g = 0.67$; OVK&SPARX $g = 0.75$; control $g = 0.96$). This may be an indication that all conditions showed effectiveness beyond what may be expected from a waitlist control, although we cannot draw firm conclusions.

Hence, there is a strong need for additional research to disentangle working mechanisms. Research studying the effects of frequent assessments of depressive symptoms are warranted as well as studies comparing different versions of the interventions that leave out or add elements that are expected to be crucial for effects (e.g., behavioral assignments or psycho-education on cognitive errors). Additionally, the time interventions optimally require is important to study. Although SPARX and OVK were similar in the number of weeks actively spent on the program (eight weeks for OVK versus seven weeks for SPARX), the

amount of time during each week was quite different (approximately 0.5 hour for SPARX, 1 hour for OVK and 1.5 hour for the combination).

Strengths, Limitations, and Future Directions

The present study has a number of important strengths. First, we partially replicated and extended the SPARX study by Merry and colleagues (2012) and the indicated OVK study by Wijnhoven and colleagues (2014). Second, the study design allows for comparison of the effects of the interventions, as well as providing the possibility to show effectiveness beyond a control group. Especially in research focusing on applied games, there is a strong need for RCT designs (Baranowski, 2014). The current study demonstrates the necessity of varied control conditions, including an attention only one, because without this we would not have been able to conclude that in the studied population OVK and SPARX are equally effective, as well as equally effective to a monitoring control condition.

A further strength of this study is the measurement of the main outcome after each intervention session. This allows the study to examine profiles of change across the course of the two interventions (Kazdin, 2009; Kazdin, & Nock, 2003). Although we did not find differences in these profiles of change, the frequent assessment points allowed us to look for these differences in the first place, which has not previously been done for OVK or SPARX. Finally, the three follow-up assessments allowed us to study long-term effectiveness of the programs.

Although the current study has a robust RCT design, some limitations should be noted. The generalizability is limited as schools were not randomly selected to participate, and participation among invited schools was low. Also, randomization was done at the school level to ensure adequate group sizes, limiting the random allocation of participants. However, there were no differences at screening between the conditions, and retention rates were high.

Additionally, the sample size of the current study was too small to distinguish subgroups of adolescents for whom specific programs may be more effective. Also, the current study focused on female adolescents, arguably the most at-risk group for depression, but male adolescents are also vulnerable to subclinical depressive symptoms (Nolen-Hoeksema, & Girgus, 1994; Twenge, & Nolen-Hoeksema, 2002). Future studies, should aim to include male adolescents, especially when using applied games. Young men are more likely to play video games than young women (Ellis et al., 2012), and young men have a preference for self-help and action-oriented approaches over more traditional mental health services (Ellis et al., 2012; Ellis et al., 2013). Hence, this type of intervention may be especially appealing to male adolescents and this could enhance effectiveness.

Moreover, it is important for future research to study mechanisms through which depression prevention promotes change (Brunwasser et al., 2009). Knowledge of change mechanisms will provide opportunities for improving programs, as well as explain differences in short- and long-term effectiveness. In addition, programs should be tested that not only include individual risk factors for depressive symptoms, but also target risk and protective factors in adolescents' social environment, their homes and schools (Sheffield et al., 2006), since the environment influences to what extent a person can benefit from the prevention program. Considering the limited attractiveness of OVK indicated by participants in the current study, it may be promising to look for add-ons or adaptations to the program in order to increase both attractiveness and effectiveness (e.g. using more personal examples during exercises, using more active exercises, and/or making the overall feel of the program less negative by focusing on successful coping behavior).

Similarly, regarding the emerging field of applied game-based prevention, it will be valuable to disentangle what aspects of games are most effective in the intervention context. This will help improve future game-based interventions. In the current study, SPARX was

considered less attractive than OVK, which may partially be attributed to the didactic elements of the program. One of the major potential advantages of video game-based interventions is their attractiveness both in terms of motivation and effectiveness. Despite the attempts to address this in the design of SPARX, and the success of the program in New Zealand, this appeal did not appear to translate well in the Dutch version. It would be useful to explore the reasons for this, so that future interventions can be designed that are optimally engaging to the target group, and endeavor to meet the high expectations young people have of video games (e.g. limiting the use of didactic explanations, and providing game-play that is sufficiently challenging).

Furthermore, the current study used the RADS-2 to assess depressive symptoms as opposed to the CDI (Kovacs, 2001) which is used in most depression studies (Lee, Krishnan, & Park, 2012). The CDI includes externalizing symptoms to assess depression (Craighead, Smucker, Craighead, & Ilardi, 1998), whereas the RADS-2 has a stronger focus on internalizing symptoms. Additionally, the CDI has been found to be less sensitive and reliable in assessing low to mild depressive symptoms, perhaps in part due to its 3-point scale (e.g. 0='I sometimes feel like crying', 1='I feel like crying most days', 2='I feel like crying everyday') (Lee et al., 2012). In contrast, the RADS-2 uses a 4-point scale (e.g. 'I feel like crying'; 1= almost never, 2=rarely, 3= sometimes, 4=often), and appears more sensitive in assessing lower levels of depressive symptoms. The assessment of depressive symptoms in the current study therefore deviates from many earlier studies (e.g. Wijnhoven et al., 2014) and this may have influenced results.

In conclusion, the present study showed no difference between OVK, SPARX or a monitoring control condition in the prevention of depressive symptoms. The results from the present study lend further weight to the call for caution in implementing depression prevention programs on a large scale (Stallard, 2013). Mechanisms that lead to a decrease in

depressive symptoms in the programs are still unclear, and placebo responses are high in depression and must be accounted for in suitably controlled trials.

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ACCEPTED MANUSCRIPT

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Table 1

Descriptives (Means and Standard Deviations or Percentages) and Chi-Square or F-values for Demographic Variables per Condition at T0.

	Control (n = 51)	OVK (n = 50)	SPARX (n = 51)	OVK& SPARX (n = 56)	Chi-Square (3, n = 208)	F (3, 204)
Age	13.22 (0.64)	13.43 (0.74)	13.26 (0.81)	13.47 (0.61)		1.66
Education level					0.71	
Low	37.3%	40.0%	43.1%	35.7%		
High	62.7%	60.0%	56.9%	64.3%		
Born in the Netherlands					1.60	
Yes	98.0%	94.0%	94.1%	92.9%		
No	2.0%	6.0%	5.9%	7.1%		
Religious					1.20	
Yes	19.6%	20.0%	19.6%	26.8%		
No	80.4%	80.0%	80.4%	73.2%		
Frequency of video game play	3.08 (1.31)	2.92 (1.29)	3.02 (1.27)	3.36 (1.34)		1.11

Table 2

Descriptives (Means and Standard Deviations) and F-values for RADS-2 Scores per Condition at T0-T12.

	Control		OVK		SPARX		OVK& SPARX		F
	M	(SD)	M	(SD)	M	(SD)	M	(SD)	
T0	68.02	(7.98)	66.94	(7.09)	69.33	(8.37)	70.59	(8.38)	2.08
T1	61.90	(11.97)	63.35	(10.39)	62.61	(11.97)	66.89	(12.59)	1.84
T2	61.22	(11.74)	62.69	(9.46)	63.45	(12.88)	64.42	(13.54)	0.60
T3	60.72	(12.22)	62.76	(9.83)	63.06	(12.59)	63.74	(13.73)	0.56
T4	59.58	(13.21)	61.15	(12.66)	61.53	(11.20)	63.55	(17.23)	0.69
T5	59.66	(13.11)	61.09	(11.54)	60.57	(12.79)	62.37	(16.38)	0.35
T6	57.63	(11.26)	60.30	(12.21)	59.87	(11.92)	61.47	(15.36)	0.76
T7	58.32	(13.28)	61.05	(12.96)	60.27	(12.97)	62.06	(17.38)	0.60
T8	56.86	(12.92)	59.61	(14.05)	58.79	(13.05)	58.85	(16.45)	0.33
T9	57.74	(12.56)	59.33	(13.27)	57.88	(12.57)	60.32	(17.30)	0.38
T10	56.06	(13.04)	57.98	(12.94)	54.78	(10.30)	57.28	(15.38)	0.56
T11	57.62	(13.33)	58.98	(13.11)	58.17	(12.72)	60.24	(17.05)	0.32
T12	61.22	(15.03)	62.44	(12.77)	57.08	(14.21)	63.22	(17.75)	1.57

Table 3

*Estimates of Predictors and Depressive Symptoms at Screening for the Intercepts and Slopes;
Intention-to-treat Analyses*

	Depressive Symptoms		
	Intercept	Linear Slope	Quadratic Slope
	β (<i>p</i> -value)	β (<i>p</i> -value)	β (<i>p</i> -value)
DS at S	0.76 (.000)	0.03 (.336)	0.00 (.365)
OVK	2.73 (.210)	-0.02 (.977)	-0.00 (.975)
SPARX	-4.33 (.098)	-0.55 (.447)	-0.01 (.807)
OVK & SPARX	-0.39 (.880)	0.05 (.923)	0.01 (.770)

Note. DS = depressive symptoms. S = screening.

Table 4

Descriptives (Means and Standard Deviations) and F-values of the Evaluation of SPARX and OVK.

	OVK		SPARX		F (1, 192)
	M	(SD)	M	(SD)	
Program liking	3.13	(1.09)	3.16	(1.35)	0.04
Program attractiveness for other adolescents	3.12	(1.17)	2.77	(1.16)	4.35*
Program usefulness in daily life	3.07	(1.19)	2.72	(1.26)	4.10*

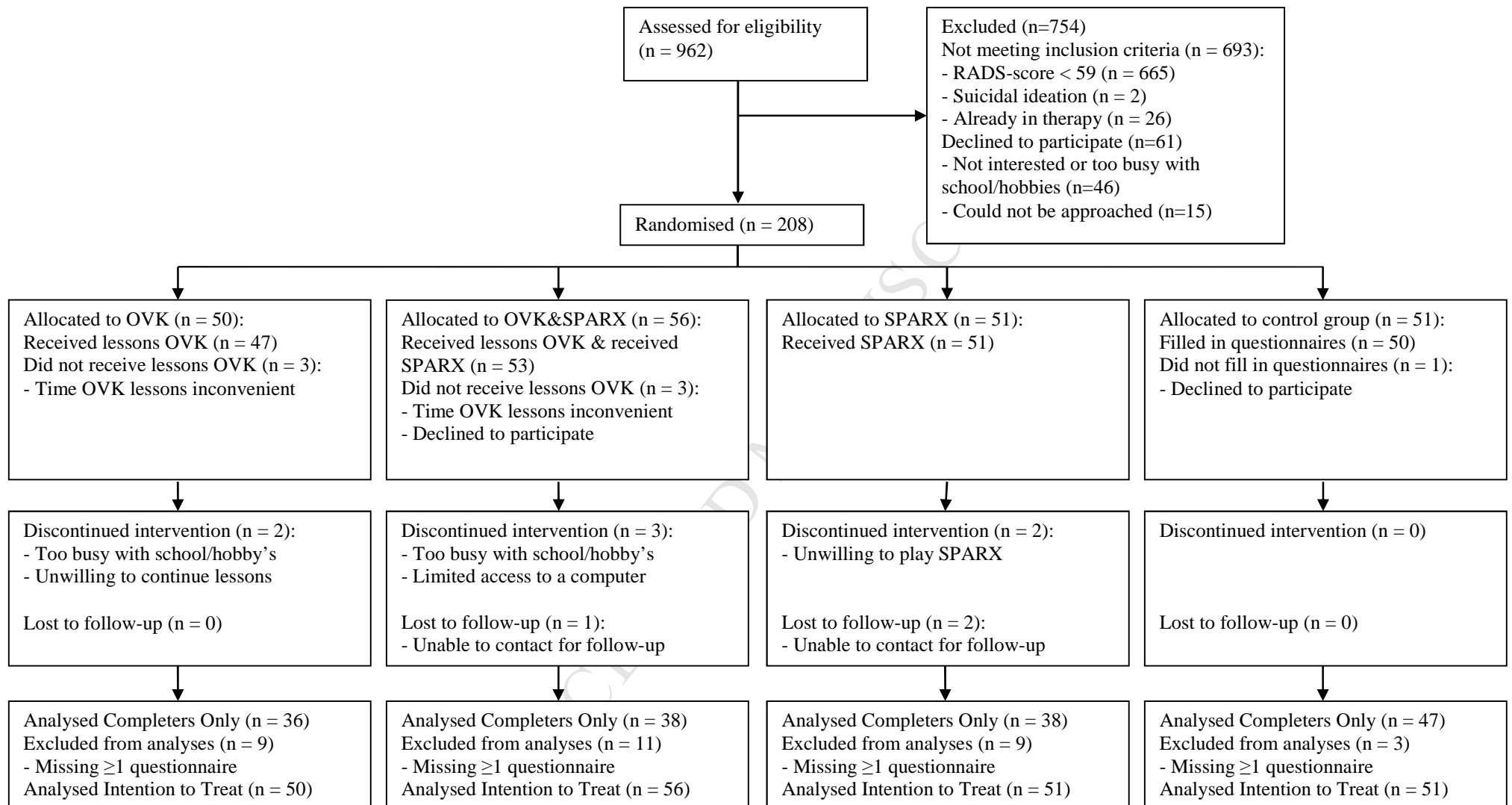
* $p < .05$

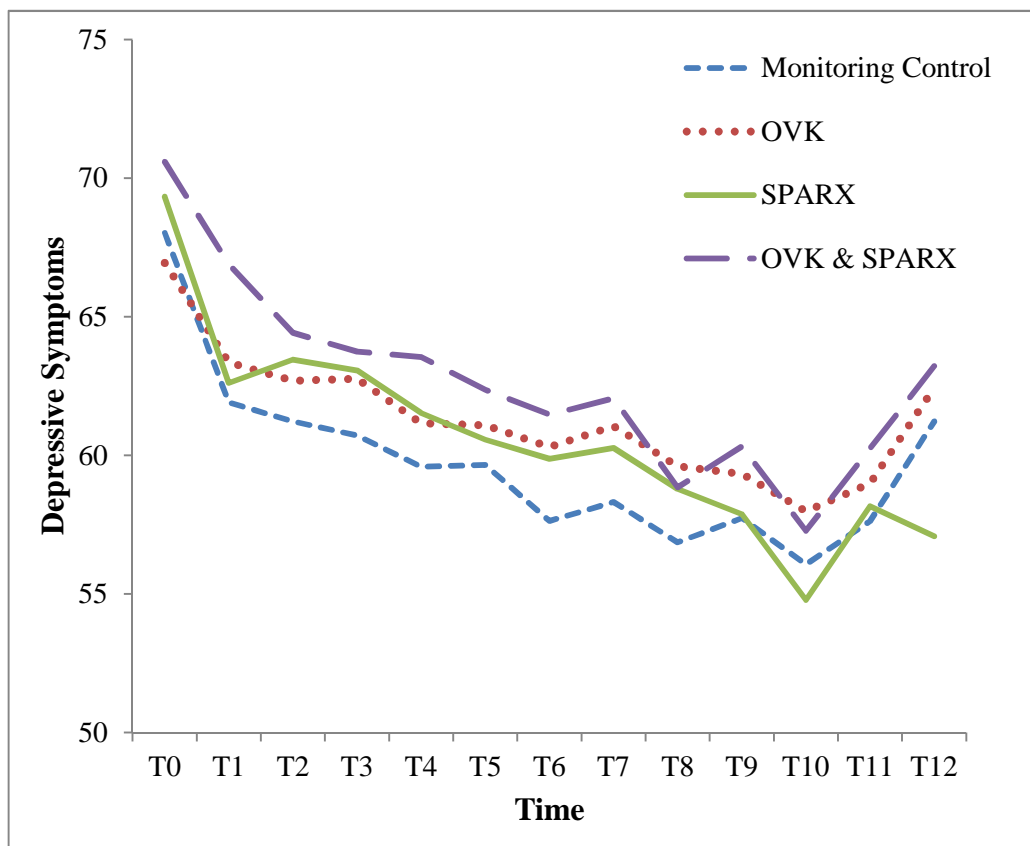
Figure Captions

Figure 1. Flow chart participants from T0 to T12

Figure 2. Trajectories of mean RADS-2 (depressive symptoms) scores by condition

ACCEPTED MANUSCRIPT





- A RCT of the depression prevention effects of two CBT programs
- Participants were Dutch female adolescents with elevated depressive symptoms
- Depressive symptoms decreased in all conditions, including monitoring controls
- No difference in depressive symptoms between conditions were found after one year
- Explanations for similar decreases in symptoms in all conditions are discussed

ACCEPTED MANUSCRIPT