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Sources of stress and worry in the development of stress-related mental health problems: A longitudinal investigation from early- to mid-adolescence

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ABSTRACT

Background and Objectives: Stress and stress-related mental health complaints are common and increasing among adolescents, especially girls. Identifying typical sources of stress as well as central intervention targets is an important effort in the development of effective prevention and treatment protocols. This study investigated worry as potential mediator in the development of mental health problems in response to common stressors in adolescence. We also examined to what sources adolescents ascribe their stress over the years from the 7th through the 9th grade.

Design: Prospective cohort study.

Methods: Self-reported subjective stressor load, worry, anxiety and depressive symptoms were assessed in a sample of Swedish 7th graders (N = 1137; 46% girls, mean age 13.2) with follow-up assessments one and two years later.

Results: School was the most common source of stress across all time-points, with girls reporting considerable more stress than boys. Worry mediated the relationship between overall stressor load and depressive symptoms and anxiety over time and was not moderated by gender.

Conclusions: Worry may be an important target in stress prevention and efforts to prevent stress-related problems would benefit from focusing on early adolescence as especially school stress is already relatively common in grade 7.

Adolescent stress and stress-related mental health complaints are common and have been increasing over the past decades. Especially girls in mid- to late adolescence report high levels of stress and stress-related symptoms such as anxiety, depressive symptoms, sleeping difficulties and somatic complaints (MacLean et al., 2013; Ravens-Sieberer et al., 2009; Sweeting, Young, & West, 2009). Studying the sources to which adolescents ascribe their stress as well as cognitive mechanisms driving the development of increases in stress-related mental health problems is an important effort as it will provide insight into possible targets for preventive intervention. Indeed, recent treatment research efforts are starting to direct more attention to adapting CBT treatment models to the prevention of mental health problems in adolescents. For example Topper, Emmelkamp, Watkins, and Ehring (2017) successfully adapted rumination focused CBT to prevent the development of anxiety disorders and depression in adolescents and young adults. However, more research is needed to delineate

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common stressors in adolescence and the processes driving the development of increases in mental health problems. More data on this will give us better knowledge on when to intervene and who and what we should target in preventive interventions.

When asked, adolescents often report that school (e.g., academic demands) is one of the major sources of stress (de Anda et al., 2000; Östberg et al., 2015). But also social stressors, such as conflicts with parents, fitting in with peers and handling romantic relationships increase in both frequency and relevance in adolescence, especially for girls (Rudolph & Hammen, 1999; Stange, Hamilton, Abramson, & Alloy, 2014). Although the link between specific stressor domains and mental health outcomes is well established, fewer studies have investigated the relative importance of different stressor domains longitudinally. Such a focus on the relative importance of specific stressor domains may inform decisions as to when and where to intervene with preventive efforts. Given the transitional nature of adolescence, different domains of stress may be more or less salient depending on time. Adolescence is often divided into early adolescence (10–13), middle adolescence (14–17), and late adolescence (18 until early twenties) (Smetana, Campione-Barr, & Metzger, 2006). For example, conflicts with parents tend to increase somewhat in early adolescence when new boundaries and responsibilities are negotiated (Laursen, Coy, & Collins, 1998) whereas stress due to romantic relationships likely becomes more important later in adolescence when such relationships increase in frequency (Collins, 2003). Knowledge of which stressor domains become prominent at what time-point in development is therefore an important research target. In this study the focus was on early- to mid-adolescence as this may be a crucial time to study the development of stress-related problems given the increase of stressors at the onset of adolescence (Arnett, 1999; Larson & Ham, 1993) and the increases of stress-related mental health problems in mid- to late adolescence (Avenevoli, Swendsen, He, Burnstein, & Merikangas, 2015; Larson & Ham, 1993; Merikangas et al., 2010).

Another crucial question for stress prevention concerns who and what we should target in prevention. After all, although most adolescents experience school- and social stress at some point not all develop stress-related mental health problems (e.g., anxiety and depressive symptoms). Identifying the mechanisms involved in the development of mental health problems in response to stress is thus an important focus of research. A better understanding of mechanisms could assist in both identifying individuals at risk for developing such problems and in developing effective preventive interventions. One potentially central mechanism is the tendency to worry (Brosschot, Gerin, & Thayer, 2006). Worry is a form of repetitive negative thinking which revolves around future events for which the outcome is uncertain but hold the potential of being negative (Sibrava & Borkovec, 2006). Worry is commonly conceptualized as a form of cognitive avoidance where motives often involves to prepare for potential threat and negative outcomes (Borkovec & Roemer, 1995; Sibrava & Borkovec, 2006). By worrying about an upcoming stressful event (e.g., an exam) or the consequences of a past event (e.g., an argument with a friend) stressor related emotions, cognitions and physiological responses are prolonged and intensified (Brosschot et al., 2006; Stange et al., 2014; Verkuil, Brosschot, Gebhardt, & Thayer, 2010). This suggests that worry might be an important mechanism driving the relationship between stress and the development of stress-related mental health problems. Indeed worry has empirically been linked to prolonged and intensified anxiety and depression, stress-related physiology and stress-symptoms (Eisma, Boelen, Schut, & Stroebe, 2017; Ottaviani et al., 2016; Roussis & Wells, 2008; Watkins, 2008). Considering that worry seems to play a role in the maintenance of several of the emotional disorders it is suggested to be a transdiagnostic factor (Harvey, Watkins, Mansell, & Shafran, 2004; McEvoy, Watson, Watkins, & Nathan, 2013; Watkins, 2008). However, while there is convincing evidence that stressors and worry are both linked to the development of mental health problems such as anxiety and depressive symptoms, there is a need for longitudinal research investigating worry as a mediator between common stressors in adolescence and the development of mental health problems. This is important since this might be a crucial period in establishing and shaping specific response styles that may persevere into adulthood. Indeed, perseverative cognitions such as worry and rumination in response to stressors has been
found to increase substantially in early adolescence, especially in girls (Jose & Brown, 2008; Zimmer-Gembeck & Skinner, 2011). Thus, if worry would mediate the relationship between stressors and mental health problems, it could be a marker to identify at risk individuals but would also offer a promising target in prevention of stress-related mental health problems.

Thus, the aim of this study was twofold. The first aim of this study was to longitudinally investigate the relative importance of different stressor domains within both the social and the school context over the years from early- to mid-adolescence. More specifically we investigated relative differences in subjective stressor load in the family-, peer-, romantic-, and school performance domains across gender in adolescents from the 7th through 9th grade. The second aim was to investigate the role of worry in the development of stress-related mental health problems over time. We hypothesized that overall subjective stressor load would predict depressive symptoms and anxiety over time and that part of this relationship would be mediated by worry. We further hypothesized that this relationship would be moderated by gender with girls showing a stronger relation between overall stressor load and increases in worry over time than boys.

Methods
Participants and procedure
This study uses a prospective design, following adolescents from 7th to 9th grade with yearly measurement points. The study sample is a sub-sample of participants of a larger project, an ongoing longitudinal study on the development of psychosocial problems in adolescence. The study targets adolescents in 7th and 8th grade enrolled in public secondary schools in three Swedish communities. All 18 schools within the catchment areas of the three communities were included. The study used active consent from adolescents and passive consent from parents to reduce sampling bias (Shaw, Cross, Thomas, & Zubrick, 2015). This procedure was approved by the regional ethics board (ref. number 2013/384). Parents of eligible children (N = 3336) received a letter informing about the study. If they did not want their child to participate they were urged to return a notification of this included in the letter using a prepaid return envelope. Parents did not consent to participation of their child in 122 cases (3.6%). A total of 446 students (13.4%) either declined or were absent the day of the data collection, leaving a total sample at baseline of N = 2768 (83%). For this study, only data from the 7th graders were used given that we aimed to investigate subjective stressor load within different stressor domains and the development of stress-related mental health problems from grade 7–9 of the Swedish secondary school. This left a sample of N = 1453 (47.4% female) at baseline with a mean age of 13.19 (SD = .42, range 12–15). The majority of the participants were born in Sweden (88.9%), 15.1% had parents that were born outside of Europe and 33% (n = 476) reported that their parents were divorced or separated. The majority of participants reported that they had a bedroom of their own (89.4%) and that they had been away on holiday with their family at least once over the past 12 months (86.5%) which is in accordance with the national population at the time point of the data collection (Statistics Sweden, 2014–2015).

Data was collected in the classrooms during school hours. Trained questionnaire administrators informed each class about the study and its voluntary basis, administered the questionnaires and answered questions when necessary. Teachers were asked to leave the classrooms for confidentiality. Each class received 300 SEK for their class fundraising.

A second and third assessment took place one and two years later following the same procedure. The retention rate was good with 91.9% of the baseline sample participating at the Time 2 assessment (n = 1336), and 81.3% (n = 1181) of the baseline sample participating at the Time 3 assessment. In total, 78.3% (n = 1137, 46% girls) of the baseline sample participated at all three assessment points. Participants who completed only one or none of the follow-up assessments were more likely to have parents that were separated (B = .49, SE = .14, OR = 1.62) or parents that had a non-European background (B = .59, SE = .22, OR = 1.81) than participants who completed all three assessments. They
were also more likely to report higher levels of subjective stressor load ($B = .02$, $SE = .004$, $OR = 1.02$) and depressive symptoms ($B = .02$, $SE = .01$, $OR = 1.02$). However there were no differences in terms of gender, worry, anxiety or being born in Sweden or not ($p < .10$, range .42–.64). Although the overall model was significant ($\chi^2 (8) = 79.64, p < .001$), due to low Nagelkerke $R^2 (.08)$ we expect these differences to have had a fairly low impact on our results.

**Measures**

**Subjective stressor load**

Subjective stressor load was assessed with the Adolescent Stress Questionnaire-Short version (ASQ-S; Anniko, Boersma, van Wijk, Byrne & Tillfors, 2018). The ASQ-S is a 27 item shortened version of the 58 item Adolescent Stress Questionnaire-II (ASQ-II; Byrne, Davenport, & Mazanov, 2007). The ASQ-S asks respondents to indicate how stressful a range of situations have been for them during the past six months. Each item is rated on a Likert scale ranging from 1 = not at all stressful (or has not happened) to 5 = very stressful. The ASQ-S consists of nine separate domains reflecting stress due to arguments at home, school performance, school attendance, romantic relationships, peer pressure, teacher interaction, future uncertainty, school/leisure conflict and financial pressure. For the first aim of this study the domains of stress due to arguments at home (4 items; example item “disagreements between you and your mother”), romantic relationships (3 items; example item “making the relationship with you boy/girlfriend work”) and peer pressure (4 items; example item “being hassled for not fitting in”) were selected to capture social stressor load and the domain of school performance (3 items; example item “keeping up with school work”) was selected to capture school-related stress. For the second aim of the study, to investigate worry as a mediator in the relationship between overall stressor load in the 7th grade and stress-related mental health problems in the 9th grade, the total score of the full ASQ-S was used. Cronbach’s alphas for the four subscales ranged from .77 to .84 at baseline, from .79 to .85 at one year follow-up, and from .84 to .88 at two-year follow-up. For the full ASQ-S Cronbach’s alphas were .93, .93, and .94 respectively.

**Depressive symptoms**

Depressive symptoms were assessed with The Center for Epidemiology Studies Depression Scale for Children (CES-DC; Weissman, Orvaschel, & Padian, 1980). The CES-DC is a reliable and valid measure of depressive symptoms in Swedish adolescents (Olsson & von Knorring, 1997). The CES-DC asks respondents to indicate how often they have experienced each item statement over the past week. It consist of 20 items with response scales ranging from 0 = Not at all to 3 = A lot. The scale has a score range from 0–60, with higher scores indicating more severe symptoms of depression. Cronbach’s alpha for the CES-DC was .94 at baseline, .91 at one year follow-up and .92 at two year follow-up.

**Anxiety**

Anxiety was assessed with the Overall Anxiety and Impairment Scale (OASIS; Norman, Hami Cissell, Means-Christensen, & Stein, 2006). The OASIS is a five item self-report measure of severity and impairment of general anxiety symptoms. The OASIS asks respondents to indicate how often they have experienced each item statement over the past week. Items are rated on a response scale, ranging from 0–4 with different labeling depending on the wording of the item, but with a higher score indicating more severe anxiety or impairment (range 0–20). The OASIS has demonstrated sound psychometric properties with non-clinical as well as clinical samples (Campbell-Sills et al., 2009; Norman et al., 2006). Cronbach’s alpha was .87 at baseline and .88 at one and two year follow-up.

**Worry**

Worry was assessed with the Penn State Worry Questionnaire for Children (PSWQ-C; Chorpita, Tracey, Brown, Collica, & Barlow, 1997). The PSWQ-C is a 14 item self-report scale assessing trait worry. The PSWQ-C asks respondents to indicate to what degree each item statement is true for them in general
with no specific time frame given. Items are rated on a response scale, ranging from 0 = Never to 3 = Always. The maximum score is 42, with a higher score indicating higher levels of trait worry. The PSWQ-C has demonstrated good psychometric properties in non-clinical as well as clinical samples of children and adolescents (Chorpita et al., 1997; Esbjørn, Reinholdt-Dunne, Caspersen, Christensen, & Chorpita, 2013; Pestle, Chorpita, & Schiffman, 2008). In the current sample Cronbach’s alpha was .89 at baseline, .91 at one year follow-up and .92 at two year follow-up.

**Data analysis**

The analyses were conducted in SPSS version 23. Gender differences and associations between stressor load, worry, anxiety and depressive symptoms across the three measurement points were investigated with t-tests and Pearson correlations respectively. Repeated measures analysis of variance (rANOVA) was used to investigate whether differences in symptoms and worry across time points were significant for boys and girls respectively.

Descriptive statistics were used to graph the means for subjective stressor load due to arguments at home, peer pressure, romantic relationships and school performance in the 7th through the 9th grade for boys and girls separately. To facilitate comparison between domains, average responses on the sub-scales were used instead of sum scores. Using the three assessment points we then conducted a repeated measures analysis of variance (rANOVA) for each subscale to investigate changes over time.

Two separate mediation models (one with anxiety and one with depressive symptoms as outcome) were then fitted to test the theoretical model of worry as a mediator in the relation between stressor load and emotional symptoms. These analyses were conducted in PROCESS v 2.16 macro (Hayes, 2013) for SPSS with 5000 bootstrap samples and heteroscedasticity-consistent standard errors. Subjective stressor load in the 7th grade were entered as predictor of emotional symptoms (depressive symptoms or anxiety) in the 9th grade and worry in the 8th grade was entered as a mediator. Baseline levels of emotional symptoms and worry, were entered as covariates in all steps of the models. Last, gender was added as a moderator of the path from stressor load to worry in a conditional process model to test for moderated mediation. The ratio of the indirect effect to the total effect ($P_M$) was used for effect size as recommended by Wen and Fan (2015). The $P_M$ is an indicator of how much of the total effect the indirect effect accounts for. For example if $P_M = .47$, the indirect effect accounts for about half of the total effect (Wen & Fan, 2015).

Multivariate imputation by chained equations in R (mice; Buuren & Groothuis-Oudshoorn, 2011) was used to handle missing data due to internal attrition. In line with Kärnä et al. (2011) a two-step procedure was followed where the quark function in R was initially used to create principal components. These were then used as auxiliary variables in the mice function in R to impute 100 datasets (see Howard, Rhemtulla, & Little, 2015). The average or modal imputed values were then calculated and imputed in the original dataset.

Given our design with participants from 18 different schools, the data of the individuals are nested within schools as well as classes. However as we did not have any a priori multilevel hypothesis and the intra-class correlations were small at both the school (range: .000–.018) and class level (range: .005–.045) we did not proceed with multilevel models.

**Results**

**Descriptive statistics of total stressor load, depressive symptoms, anxiety and worry**

Table 1 presents the means and standard deviations of total stressor load, stress-related mental health problems and worry for the total sample and for girls and boys separately. Girls reported significantly higher levels of stressor load, depressive symptoms, anxiety and worry at all time points. For girls, there was a significant increase in depressive symptoms ($F(1.90, 989.61) = 34.04, p < .001, \omega^2 = .02$), anxiety ($F(1.97, 1022.39) = 36.2, p < .001, \omega^2 = .02$) and worry ($F(1.93, 1005.14) = 68.52, p < .001$, 2015).
$\omega^2 = .04$) over the three time-points. Pairwise comparisons between grades (Bonferroni corrected) showed that depressive symptoms significantly increased from the 7th and the 8th grade ($p < .001$), but not from the 8th to the 9th grade ($p < .10$). Anxiety and worry significantly increased at all time points ($ps < .01$).

For boys, the increase in mean level depressive symptoms ($F(1.87, 1152.03) = 59.56, p < .001, \omega^2 = .04$), anxiety ($F(1.93, 1189.23) = 13.70, \omega^2 = .01$), and worry ($F(1.95, 1200.44) = 25.92, p < .001, \omega^2 = .01$) was significant. Pairwise comparisons showed that depressive symptoms significantly increased at all time points ($ps < .01$), while anxiety increased significantly from the 8th to the 9th grade ($p < .01$) but not from the 7th to the 8th grade ($p > .05$). Worry increased significantly from the 7th to the 8th grade ($p < .01$) but not from the 8th to the 9th grade ($p > .90$).

Table 2 displays the zero-order correlation coefficients between total subjective stressor load, depressive symptoms, anxiety and worry. All measures were significantly correlated with each other cross-sectionally but also over time with medium to large effect sizes.

### Subjective stressor load in the 7th through the 9th grade

Figure 1 displays mean subjective stressor load levels in grade 7 through 9. For girls, there was an overall increase in reported stressor load due to arguments at home ($F(1.90, 985.52) = 37.35, p < .001, \omega^2 = .02$, romantic relationships $F(1.94, 1009.12) = 13.89, p < .001, \omega^2 = .01$, and school performance $F(1.92, 997.18) = 113.07, p < .001, \omega^2 = .07$) while no overall increase was found for stress due to peer pressure ($F(1.95, 1013.96) = 2.64, p = .07, \omega^2 = .00$). Pairwise comparisons between grades (Bonferroni corrected) showed that all increases were significant ($ps ≤ .05$).

For boys, there was an increase in mean level reported stress due to arguments at home ($F(1.93, 1185.10) = 7.94, p < .001, \omega^2 = .01$, romantic relationships $F(1.90, 1165.16) = 16.55, p < .001, \omega^2 = .01$, and school performance $F(1.93, 1186.20) = 21.67, p < .001, \omega^2 = .01$). No increase was found for stress due to peer pressure ($F(1.95, 1197.46) = 1.36, p = .26, \omega^2 = .00$). Pairwise comparisons (Bonferroni corrected) showed that stressor load due to arguments at home and romantic relationships did not significantly increase from the 7th to the 8th grade ($ps > .10$) but did significantly increase from the 8th to the 9th grade ($p < .05$). Stressor load due to school performance significantly increased from the 7th to the 8th grade ($p < .001$) but not from the 8th to the 9th grade ($p > .10$).

### Worry as a mediator between stressor load and stress-related mental health problems over time

#### Depressive symptoms

There was a direct effect of overall subjective stressor load in the 7th grade on depressive symptoms in the 9th grade ($b = .09, p < .001$), controlling for baseline levels of depressive symptoms and worry. There was also an indirect effect through worry $b = .02$, 95% PCa CI [.009; .041] with an effect size of $P_{ni} = .21$, where the total effect of overall stressor load on subsequent levels of depressive symptoms was $b = .11$, 95% PCa CI [.059; .164]. We then added gender as a moderator of the relationship between stressor load and worry in a moderated mediation model (see Figure 2). However, the interaction of gender and stressor load ($b = −.01, p = .68$) was not significant. Given the gender differences found between levels of subjective stressor load within specific stressor domains and worry in the previous analyses, we ran a second set of moderated mediation models but with subjective stressor load within the specific domains (arguments at home, peer pressure, romantic relationships and school performance) as predictors. Results showed a significant interaction of gender ($p < .05$) for the model with subjective stressor load due to peer pressure as a predictor, with an indirect effect through worry for girls ($b = .17$, 95% PCa CI [.05; .31]) but not for boys ($b = .02$, 95% PCa CI [−.06; .11]). For the other domains the interaction of gender and domain specific stressor load was not significant ($ps > .20$). Also, worry was found to mediate the relationship between stress of school performance and depressive symptoms for both genders (Girls: $b = .17$, 95% PCa CI [.059; .290]; Boys:
b = .10, 95% PCa CI [.014; .187]), but the mediational path between the other two domain specific stressors was not significant as neither stress of arguments at home nor stress of romantic relationships predicted increases in worry (ps > .70).

**Anxiety**

There was a direct effect of subjective stressor load in the 7th grade on anxiety in the 9th grade (b = .02, p = .01), controlling for baseline levels of anxiety and worry. There was also an indirect effect through worry b = .01, 95% PCa CI [.005; .016] with an effect size of $P_M = .32$, where the total effect of stressor load on subsequent levels of anxiety was $b = .03$, 95% PCa CI [.014; .050]. We then added gender as a moderator of the relationship between stressor load and worry (see Figure 3.). The interaction was not significant ($b = −.01, p = .66$).

As with depressive symptoms as an outcome, we also ran a second set of moderated mediation models for anxiety and with subjective stressor load within the specific domains as predictors. Results showed a significant interaction of gender ($p < .05$) for the model with subjective stressor load due to peer pressure as a predictor, with an indirect effect through worry for girls ($b = .07, 95%$ PCa CI [.024; .114]; Boys: $b = .04, 95%$ PCa CI [.006; .073]), but the mediational path between the other two domain specific stressors was not significant as neither stress of arguments at home nor stress of romantic relationships predicted increases in worry (ps > .50).

**Discussion**

The first aim of this study was to prospectively investigate the relative importance of common stressors in the social and school context over the years from early to mid-adolescence. Our results show that, although girls in general reported higher levels of stress than boys in both domains, the pattern of salient stressors were similar across gender and grade. School was by far the biggest source of stress, whereas levels of stress due to social factors, such as fitting in with peers and romantic relationships, were relatively low at all time-points. The second aim of this study was to investigate the role of worry in the development of stress-related mental health problems. We hypothesized that overall subjective stressor load would predict depressive symptoms and anxiety over time and that part of this relationship would be mediated by worry. We also hypothesized that this relationship would be moderated by gender with girls showing a stronger relation between stressor load and increases in worry over time than boys.

In line with our first hypothesis, we found an indirect effect of stressor load through worry on both depressive symptoms and anxiety. This suggests that worry is driving part of the relationship between overall stressor load and emotional symptoms in the period from early to mid-adolescence and may thus be important to target in prevention of stress-related mental health problems. Importantly, worry was not found to mediate the relationship between two of the stressor domains (stress of arguments at home and romantic relationship) and depressive symptoms or anxiety. This may suggest that the mechanism between stressor load and stress-related mental health problems may differ depending on different sources of stress. Thus, differentiating between different sources of stress is important in future studies of mechanisms between stressors and stress-related mental health problems.

Contrary to our second hypothesis, the relationship between overall stressor load and worry was not moderated by gender. Still, a closer look at the domain specific stressors suggests a possibly more nuanced conclusion. More specifically, worry was found to mediate the relationship of stress due to peer pressure and increases in depressive symptoms and anxiety for girls but not for boys. Thus, while no overall moderation was confirmed, the influence of worry on the development of depressive
symptoms and anxiety in the face of stressors may differ depending on the type of stressor domain. Specifically, some stressor domains such as stress due to peer pressure only seem to affect the tendency to worry in girls whereas others, such as stress due to school performance affects subsequent levels of worry in both genders.

The current study contributes in several ways to the literature in the area. First, our finding that adolescents consistently rated higher levels of stress due to school performance relative to the other domains is consistent with previous findings where stress of academic achievement and future goals and performance expectations have been found to dominate among mid- to late adolescents (de Anda et al., 2000; Lin & Yusoff, 2013). However, our results also add to the current knowledge. Specifically, our results show that the relative difference in importance of stress due to school and achievement over other types of stressors is prevalent already early on, and that the level of stress in this domain incrementally increases from early to mid-adolescence. Not in the least for girls there is a steep increase in reported stress from school from 7th to 8th grade. These high levels of reported stress due to school performance suggest that prevention efforts aimed at reducing school related stress might be especially potent earlier in adolescence.

Second, we found that levels of stress due to arguments at home and romantic relationships were much lower than stress due to school performance. Similarly, albeit more gradually compared to school performance stress, levels increased over this time period from early- to mid-adolescence. Previous findings suggest that while prevalence of conflicts with parents tends to peak already in early adolescence, conflicts during the period from early to mid-adolescence may become increasingly intense and affect laden (Laursen et al., 1998; Smetana et al., 2006). The increase in the level of reported stress due to arguments at home in our sample could thus reflect changes in the quality of conflict. Also in line with developmental expectation, the gradual increase in stress from romantic relationships over time could reflect an increase in the frequency of experiences with these relationships. Indeed, romantic relationships tend to be rather uncommon in early adolescence but increases with age (Collins, 2003). Somewhat surprising, there was no overall increase in stress due to peer pressure for either boys or girls. Considering that the peer group becomes a more important social arena in adolescence you might have expected this. However, past research has shown that peer influence and victimization may increase more during transitional periods such as the transition from middle to secondary school (Espelage & Holt, 2001; Stapinski, Araya, Heron, Montgomery, & Stallard, 2015). Given that we followed the adolescents from 7th through 9th grade no such transition occurred at a group level at the time of the study. Nevertheless, stress due to peer pressure or fitting in with peers was generally low in comparison to school performance. This indicates that performance related questions and skills to plan and manage school activities should be a primary focus in universal preventive interventions aimed at reducing stress in secondary school students.

Third and of clinical importance, our results lend support to the key role of worry as a mechanism in the development of stress related mental health problems. Our results support that worry mediates the relationship between self-reported overall stressor load and anxiety and depressive symptoms over time. This suggest that worry may be a promising target in preventive efforts aimed to reduce stress-related mental health problems. Prevention protocols that specifically target excessive perseverative cognitions such as worry and rumination have recently been developed with promising results in terms of mental health outcomes in adolescent samples (Topper et al., 2017). More specifically, by helping adolescents become aware of habitual rumination and worry, identifying situations and events that trigger such responses, and teaching alternative responses (e.g., problem solving skills, relaxation, concrete thinking) Topper et al. (2017) found significant reductions in levels of worry and rumination in a group of adolescents. This reduction was in turn related to considerable lower prevalence rates of depression and generalized anxiety disorder in the intervention group compared to a waitlist control group at one year follow-up. Further testing of the feasibility and long-term effectiveness of such protocols to prevent stress-related mental health problems is an important focus within stress prevention. Moreover,
investigating the role of worry in other types of stress-related problems such as somatic complaints or substance use in adolescent samples would also be important to elucidate whether excessive worry has transdiagnostic reach and could be a potential target for stress-related health complaints beyond internalizing emotional symptoms. Further, worry levels may also be a potent marker for adolescents that are at greater risk of developing mental health problems in response to common stressors and could thus be screened for together with overall stressor load in more targeted prevention. Doing so would not only assure that we actually are offering preventive interventions to those most at risk, but might also assure that the intervention is experienced as relevant, and hence improve adherence (Topper et al., 2010).

Interestingly, gender did not moderate the effect of overall stressor load on worry, indicating that although girls both report a higher stressor load and levels of worry at all time points, the effect of overall stressor load on worry is similar across gender. This is in line with more recent findings for rumination. More specifically, boys have been found to be as likely to ruminate in response to stressors as girls (Hamilton, Stange, Abramson, & Alloy, 2015; Michl, McLaughlin, Shepherd, & Nolen-Hoeksema, 2013; Stange et al., 2014). An explanation for the observed gender difference in levels of worry could be that girls are more exposed to stressors, which would be in line with our finding that girls reported a greater overall stressor load at all time points. There is some support for this “exposure” explanation for rumination, at least for dependent social stressors (stressors that are in some way dependent on the behavior or characteristics of an individual such as arguments with friends, as oppose to independent stressors that are beyond the control of the individual such as parental divorce) (Hamilton et al., 2015). More specifically, Hamilton et al. (2015) found that dependent social stressors predicted subsequent levels of rumination in both genders, but that exposure to such stressors was greater in girls which explained the gender difference in rumination.

However, the results of our test for moderation effects at the level of the specific stressor domains are not completely in line with this. Although we did not find interactions between gender and some social stressors (arguments at home or romantic relationships) we did find that gender moderated the effect of stress due to peer pressure on subsequent levels of worry. One explanation for this may be that our study specifically measured subjective stressor load and not frequency of exposure to stressors as was done in the Hamilton et al. (2015) study. Our measure of subjective stressor load may instead reflect girls greater reactivity in response to peer related stressors which is well in line with previous findings (Hankin et al., 2015; Hankin, Mermelstein, & Roesch, 2007). Girls tend to form more close and intimate friendships and to rely more heavily on emotional support in the peer context than boys, which has been suggested to make them more susceptible to disruptions in peer relationships (Maccoby, 1990; Rudolph, 2002). Thus, our results support that girls are more inclined to worry than boys when they experience stress in the peer context which further intensifies and prolongs negative mood and anxiety.

This study also has some limitations. First, our results rely on self-report data and using multiple informants and a multimethod approach (e.g., physiological indicators of stress) would have added to the methodological rigor. However, given the size of our sample and the longitudinal design this was not feasible within this study. Also, given that the measures used are intended to capture internalizing processes it can be argued that adolescents themselves would be the best informers. Second, while we have a generally large and representative study sample, some of our study variables were related to attrition and may influence the external validity of our study. Specifically, adolescents that did not participate in all three time-points were higher on depressive symptoms and overall stressor load. Also, adolescents whose parents were divorced or who had parents of non-European origin, which potential could add to the overall stressor load, were more likely to be absent at follow-ups. It could therefore be that our results do not extend to adolescents with these characteristics. Similarly, caution should be taken before generalizing our results to clinical populations. Anxiety and depressive symptoms as measured in the current study cannot be paralleled to clinical disorders. However, in taking a dimensional approach to mental health problems,
symptoms and mechanisms exists on a continuum. From this approach, it is important to investigate which mechanisms may affect movements up along the continuum whether crossing the cut-off for clinical disorders or not.

Despite these limitations, this study also has considerable strengths. First, we made use of a longitudinal design with a large and diverse sample of adolescents, a high response rate and high quality measures. This enabled us to not only investigate the relative importance of different sources of stress across development, but also the role of worry in the development of stress-related mental health problems over an important developmental time period. Second, we measured a broad range of sources of stress that have previously been identified as typical by adolescents themselves (Byrne et al., 2007). This allowed us to tap into what the most common sources of stress are over this time period. Still, the relatively brief measure of subjective stressor load used in the current study, with only a few items tapping in to each stressor domain, should be considered a limitation. Especially in contrast to semi-structured interview measures commonly used that has been recommended as a gold standard in the stressor measurement literature (e.g., Dohrenwend, 2006; Monroe, 2008). Such measurements would allow for more reliable and in-depth conclusions to be drawn as they tap into both the frequency of actual exposure to a wide range of different stressors and to more objective qualitative differences in severity. However, given the longitudinal design and the relatively large sample size in the current study, the use of semi-structured interviews were not feasible. Moreover, the ASQ-5 have been found to possess similar psychometric properties as the full ASQ-2, making it a viable option for large longitudinal studies (Anniko, Boersma, van Wijk, Byrne, & Tillfors, 2018). Nevertheless, the results from the current study should be viewed in the light of our measure at best capturing how stressful the participants find the measured event categories in general.

In summary, our results indicate that school is the most common as well as increasing source of stress from early to mid-adolescence. Girls report considerably more stress than boys, especially in terms of school performance and arguments at home. High overall stressor load is predictive of higher levels of anxiety and depressive symptoms across this time period and worry mediates this relationship. This suggests that a higher stressor load may lead to increased worry, which in turn negatively affects emotional health. These results implicate that school stress as well as worry may be important targets for preventive interventions aimed to reduce stress-related mental health problems among adolescents. However, our findings also provide some potential nuances and indicate that the role of worry may be dependent on the type of stress as well as gender. This suggest that an important goal for future research would be to further confirm and explore if and why some sources of stress are more likely to lead to increases in worry than others and to identify other important mechanisms between adolescent stress and stress-related mental health problems.

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