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Research paper

Adolescent stress and symptoms of anxiety and depression: Resilience explains and differentiates the relationships

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ABSTRACT

Background: Some adolescents exhibit resilience even in the face of high levels of stress exposure. Despite this relationship, studies that investigate explanations for how resilience interacts with risk to produce particular outcomes and why this is so are lacking. The effect of resilience across the relationship between stress and symptoms of anxiety and stress and symptoms of depression was tested to provide explanations for how resilience interacts with stress and symptoms of anxiety, and depression.
Method: In a cross-sectional survey, 533 Ghanaian adolescents aged 13–17 years ($M=15.25$, $SD=1.52$), comprising 290 girls and 237 boys completed the Resilience Scale for Adolescents, Adolescent Stress Questionnaire, Spielberger State Anxiety Inventory, and Short Mood Feeling Questionnaire. Mediation and moderation analyses were conducted.
Results: The results indicated that resilience partially mediated the relationship between stress, and symptoms of anxiety, and depression. Effects of stress were negatively associated with resilience, and positively associated with symptoms of anxiety and depression. In a differential moderator effect, resilience moderated the relationship between stress and symptoms of depression but not stress and symptoms of anxiety.
Limitations: Although the findings in this study are novel, they do not answer questions about protective mechanisms or processes.
Conclusions: Evidence that resilience did not have the same effect across stress, and symptoms of anxiety and depression may support resilience as a dynamic process model. Access to different levels of resilience shows that enhancing resilience while minimizing stress may improve psychiatric health in adolescents' general population.

1. Introduction

The study of how resilience relates to risk and vulnerability has flourished over several decades. Strong research evidence in adolescent resilience models spans only about four decades ago. Some contributors to the field include Garmezy (1971, 1974), Masten et al. (1990, 1993), Masten and Wright (2009), Rutter (1985, 1987, 1999, 2006) and more recently how adolescent resilience relates to anxiety and depressive symptoms by Hjemdal et al. (2001, 2006, 2007 2011). As a process-oriented model rather than a (personality) trait model (Masten and Wright, 2009; Zimmerman and Brenner, 2010) adolescent resilience is a process of (i) in response to stressful events, the ability to bounce back to regain functional equilibrium in a state of health – *recovery* and, (ii) sustenance of this recovery trajectory leading to positive developmental adaption even in the face of significant threat and/or adversity – *sustainability*. Taken together, the resilient adolescent is expected to beat the odds even in the face of high risk, stress, threat or adversity (Masten et al., 1990; Masten and Wright, 2009; Zimmerman and Brenner, 2010).

1.1. Models of resilience

Three major models of resilience have been proposed namely compensatory, protective, and challenge models (Fergus and Zimmerman, 2005; Luthar et al., 2000). The compensatory model (Hjemdal et al., 2007; Zimmerman et al., 1998) indicates that the direct effects of resilience counteract the direct negative effects of risk factors such as stress (Zimmerman and Brenner, 2010). The protective model (Brookmeyer et al., 2005; Gorman-Smith et al., 2004; Hjemdal et al., 2006) suggests that the protective effects of resilience buffer the negative outcomes of risk exposure and adversity, such that adolescents who score higher on resilience have

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a lower risk of adverse outcomes (Masten et al., 1990; Zimmerman and Brenner, 2010). The challenge model proposes that the individual when exposed to risk, but not so much that it is impossible to overcome, learns to deploy resources to overcome future stress (Fergus and Zimmerman, 2005). Cross-sectional studies (Hjemdal et al., 2007; Zimmerman et al., 1998) have mainly reported direct effects – *compensatory model*, while longitudinal studies (Brookmeyer et al., 2005; Gorman-Smith et al., 2004; Hjemdal et al., 2006) have reported moderating effects – *protective model*. A compensatory model is typically tested by examining unique direct effects while a protective model is typically tested with an interaction term in multiple regressions. The challenge model is tested with polynomial terms in multiple regressions (Fergus and Zimmerman, 2005). Over the years, these models of resilience have shaped the formulation of research questions and analysis of data (Zimmerman and Brenner, 2010). The compensatory and protective models were tested in this study.

1.2. Diatheses – stress perspective

Adolescence is a fragile developmental stage sometimes characterized by exposure to stressful life events and their debilitating mental health effects (Byrne et al., 2007). Stressful life events in adolescence are associated with negative outcomes such as decreased well-being, impaired mental health, anxiety and depression (Troy and Mauss, 2011). Adolescent stress has been linked to negative mental health outcomes such as anxiety (Byrne et al., 2007; Grant et al., 2004b) and depression (Bouma et al., 2008; Waaktaar et al., 2004). However, even upon exposure to higher levels of stress a significant proportion of adolescents exhibit resilience (Troy and Mauss, 2011). The relationship among stress, anxiety and depression is much elucidated in the extant literature on cognitive models which emphasize negative or maladaptive belief system (Hammen and Rudolph, 2003; Hankin and Abela, 2005; Hankin and Abramson, 2001). Other vulnerability factors may include but not limited to genetic factors, biological processes, deficits in emotion regulation, and insecure attachment (Hankin and Abela, 2005). The cognitive vulnerability–stress paradigm asserts that psychosocial and environmental stressors interact with cognitive factors to increase the risk for psychopathology (Grant et al., 2004b). Grant et al. (2004b) found a bidirectional relationship between exposure to stress and depression among adolescents. Thus, stressful experiences predicted depression; depression in turn predicted increases in stressful experiences (Grant et al., 2004b).

There is a paucity of evidence for adolescent mental health demographics in Africa (Mutumba et al., 2014) including Ghana. The 2008 Global School-based Health Survey (GSHS; Owusu, 2008), surveyed 5,765 students between the ages of 13 and 15 years. The GSHS survey in Ghana found that over 80% of adolescents in 75 high schools across the country reported experiencing various mental health conditions, such as stress, anxiety, feeling worried, hopelessness and feeling sad, emotional and interpersonal problems which affected their daily functioning. A total of 15.2% of the students reported feeling lonely most of the times or always during the past 12 months and 13.3% worried about something and therefore could not sleep. A total of 37.5% students felt so sad or hopeless almost every day for two weeks or more in a row that they stopped doing their usual activities during the past 12 months, and 14.6% of students seriously considered attempting suicide in the past 12 months (Owusu, 2008; Owusu et al., 2008).

A recent study (Cole et al., 2014) in Ghana found a positive relationship between stress of academic performance, and anxiety and depression but negatively related to mindfulness and ego resilience. Mindfulness was defined as being aware of what is taking place in the present (Brown and Ryan, 2003) and ego resilience was defined as ability to overcome obstacles and engage the world in a positive way with openness to experience (Block and Kremen, 1996). Mindfulness moderated the relationship between stress and depression but not anxiety while ego resilience moderated the relationship between stress and anxiety but not depression. Simple slope analysis showed the effect of stress on depression was significantly higher for low levels of mindfulness than for high levels of mindfulness while the effect of stress on anxiety was significantly higher for low levels of ego resilience than for high levels of ego resilience (Cole et al., 2014).

1.3. Mediating and moderating effect of resilience

Some studies have investigated either the mediating or moderating role of resilience in the relationship among affective symptoms in both adolescents and adults. A recent cross-sectional study (Klibert et al., 2014) found that resilience partially mediates the relationship between perceptions that others hold high and unrealistic expectations for one's own behavior and emotional distress. Another cross-sectional study (Lee and Cranford, 2008) found that the effect of parental problem drinking on adolescents' problem behavior is moderated by resilience. Simple slope analyses showed that (i) the effects of parental problem drinking on externalizing behaviors were significant only for low levels of resilience and (ii) the effects of parental problem drinking on internalizing behaviors were significant for low and average levels of resilience.

As noted above, there is evidence of cross-sectional studies which investigated the mediating (Klibert et al., 2014) or moderating (Lee and Cranford, 2008) role of adolescent resilience in the relationship among symptoms of psychopathology. However, there is a dearth of evidence on the mediating and moderating effect of adolescent resilience in the relationship between stress, and symptoms of anxiety and depression. This is not surprising since researchers rarely perform both mediation and moderation analyses on the same dataset; some researchers perform mediation analyses with some variables while other researchers perform moderation with the same variables (Al Nima et al., 2013). Additionally, the preponderance of previous studies has been conducted in Western cultures. Therefore it is important that research on the topic is explored in non-Western cultures.

The aim of this study was to investigate the mediating and moderating role of resilience in the relationship between stress and symptoms of anxiety and depression in a sample of adolescents. This was to answer the questions of how is resilience related to the relationship between stress, and symptoms of anxiety and depression while providing explanations for when does resilience (low, average or high levels) modifies the relationship between stress and symptoms of anxiety and depression.

Questions of 'how' are typically approached using mediation analyses to investigate how the relationship between a predictor (*stress*) and outcome variables (*symptoms of anxiety and depression*) can be explained by their relationship to a third variable (i.e. mediator, – *resilience*), whereas questions of 'when' (i.e. to determine when a level of a moderator variable, *resilience* – low, average or high is combined with the effect of a predictor variable, *stress* – on an outcome, *symptoms of anxiety, and depression*) are approached using moderation analyses (Hayes 2012).

1.4. Hypotheses

The following hypotheses were tested:

1. Resilience will mediate the relationship between stress and symptoms of anxiety, and between stress and symptoms of depression.

2. The relationship between stress and symptoms of anxiety, and stress and symptoms of depression will be modified at high level of resilience, average and low levels.

2. Methods

2.1. Participants

A total of 628 high school students from six schools in the Greater Accra region of Ghana participated in this study indicating a response rate of 98%. Participants with more than 15% missing values were deleted scale by scale for the analyses. Consequently, out of the 628 participants, 33, 27, 22, and 13 cases were deleted from the resilience measure, symptoms of anxiety measure, stress measure and symptoms of depression measure respectively due to missing data. The remaining missing data points were replaced by participant's corresponding mean scale scores. A similar approach has been used elsewhere such as using the scale mean score (Olstad et al., 2015), and using the scale mode (Moksnes et al., 2010b). The final study sample consisted of 533 participants. The participants were aged between 13 and 17years ($M=15.25$, $SD=1.52$), five participants did not report their age. There were 290 girls and 237 boys, six participants did not report their gender.

2.2. Measures

2.2.1. Resilience scale for adolescents (READ)

The READ (Hjemdal et al., 2006) is a 28-item self-report scale with all items positively phrased and comprises 5 subscales. The READ is scored on a 5-point Likert type scale with response categories ranging from 1 (Totally disagree) to 5 (Totally agree). Total score ranges from 28 to 140. Example items include "I know how to reach my goals", "In my family we like to do things together", "I am good at organizing my time". The READ has established reliable construct validity (Friborg et al., 2005) and predictive validity in a prospective study (Hjemdal et al., 2006). The READ has also shown adequate psychometric qualities with internal consistency score of .91 (Hjemdal et al., 2011). Protective factors measured by READ namely personal dispositions, family warmth and coherence, and external support systems are relevant to the prediction of anxiety and depression symptoms (Hjemdal et al., 2007).

2.2.2. Adolescent stress questionnaire (ASQ)

The ASQ (Byrne et al., 2007) consists of 58 items which make up 10 subscales. The ASQ assesses adolescents on subjective stressor load. The ASQ is scored on a 5-point Likert type scale with response categories ranging from 1 (Not at all stressful or is irrelevant to me) to 5 (Very stressful). Scale scores are derived by summing the affirmed responses to each item across all items defining any particular scale with high sum scores indicating high stressor experience. Total score ranges from 58 to 290. Example items include "Disagreements between you and your father", "Not being taken seriously", "Little or no control over your life". (Byrne et al., 2007).

2.2.3. Short mood feeling questionnaire (SMFQ)

The 13-item SMFQ (Angold et al., 1995) was used in assessing symptoms of depression. All 13 items are negatively phrased and rated on a 3-point Likert type scale with response categories ranging from 0 (Not true) to 2 (True). Total score ranges from 0 to 26. High sum scores indicate high severity of levels of depression symptomatology (Angold et al., 1995; Messer et al., 1995). Example items include "I felt miserable or unhappy", "I did everything wrong". The SMFQ is a unifactorial measure with high reliability score: $\alpha=.90$ (Costello et al., 1991). The SMFQ has been found to differentiate between depressed adolescents and non-depressed adolescents in the general population (Angold et al., 1995).

2.2.4. Spielberger state-trait anxiety inventory (STAI)

The state anxiety inventory of the Spielberger State-Trait Anxiety inventory (Spielberger, 1983) was used in the assessment of symptoms of anxiety. The STAI is rated on a 4-point Likert type scale with response categories ranging from 1(Not at all) to 4 (Very much so). Total score ranges from 20 to 80 (includes reverse scored items). Example items include "I feel at ease", and "I feel nervous". It consists of 20 items measuring respondents' level of state (current) anxiety. Higher sum scores indicate more symptoms of current anxiety. The STAI has been widely used in adolescent samples with internal consistencies ranging from .83 to.91 (Barnes et al., 2002; Byrne et al., 2007; Moksnes et al., 2010a, 2010b).

2.2.5. Socioeconomic status

Socioeconomic status was measured by adding together the current employment status of fathers and mothers, or guardians in the case of adolescents who are not living with their biological parents and the highest education attained by fathers and mothers, or guardians. Educational level was classified as (7) University PhD or Professional Doctorate, (6) Master's degree, (5) Vocational/Technical college (4) Skilled courses for recognized trades, (3) High School (Junior/Lower) (2) Primary School, (1) Pre-Primary (Kindergarten). A similar approach has been used in a sample of adolescent Ghanaians by Glozah and Pevalin (2014). Employment status was classified as (1) Working or (0) Not working. A composite score was then computed for levels of socioeconomic status. Total score ranged from 2 to 16 with higher scores indicating better socioeconomic circumstances. The results were collapsed into (≤ 6) low, (7–12) average and (≥ 13) high socioeconomic status.

2.2.6. Procedure

This study was approved by the Regional Committee for Medical Research Ethics (REK) in Norway and the Ghana Health Service Ethics Review Committee (GHS–ERC) in Ghana. Parental or guardian consent was sought and the heads/principals of each school were briefed about the nature and scope of the study. The students received information letters and written consent forms that explained the purpose of the study to be given to their parents or guardians to be signed and returned. In addition, respondents gave assent to participation. Participation was voluntary and anonymous, and participants were guaranteed confidentiality. Data collection was completed in whole class groups during April 2015. Participating schools received various library supplies.

2.2.7. Statistical analyses

Frequencies and mean scores were analyzed on all measures. Pearson product-momentum correlation was used to explore bivariate associations between the variables in the study. We investigated (i) how resilience explains and, (ii) moderates the relationship between stress, and symptoms of anxiety and depression and whether resilience supports a compensatory or protective model. Two mediation analyses were performed. The first tested whether the relationship between stress and symptoms of anxiety was mediated by resilience. The second tested whether the relationship between stress and symptoms of depression was mediated by resilience. The mediating effect of resilience (Fig. 1) in the relationship between stress and symptoms of anxiety and stress and symptoms of depression while controlling for gender and age was tested using structural equation modelling (SEM modelling) to fit a single model for each of the two relationships to estimate the indirect, direct and total effects. A significant

mediating effect was established when the 95% bias-corrected bootstrap confidence interval based on 1000 bootstrap samples did not contain zero. This procedure provides bootstrap confidence interval and standard errors for the mediated effects and has advantages over the traditional approaches in testing mediation (Hayes, 2012) such as the causal steps approach or the test of joint significance approach popularized by Baron and Kenny (1986) and the product of coefficients approach (Sobel, 1982, 1986).

In the moderation analyses two series of nested models in multiple linear regression analyses were conducted in four steps. In step 1, age was entered. In step 2, gender was entered. In step 3, three separate analyses were conducted in which stress and resilience were entered separately to ascertain their individual explained variance, and then altogether to test the compensatory model while the interaction (stress by resilience) term was entered in step 4 to test the protective model. In series one, symptoms of anxiety was the outcome variable while symptoms of depression was the outcome variable in series two. Both stress and resilience variables (all continuous) were centered (Fergus and Zimmerman, 2005; Frazier et al., 2004) before they were entered in the analyses to test the interactional effect. All analyses were conducted using Stata 14 (StataCorp, 2015). Cronbach's alpha was computed to estimate the internal consistency of all measures used.

3. Results

A total of 57 (about 11%) of the respondents were in the low socioeconomic category while 311(about 58%) were in the average and 165 (about 31%) were in high socioeconomic categories respectively.

Table 1 displays the means, standard deviations and Cronbach's alphas of the measures used their inter-correlations.

The results indicate that stress had a significant negative correlation with resilience. Additionally, stress had significant positive correlations with symptoms of anxiety and depression. Resilience had significant negative correlations with symptoms of anxiety and depression.

3.1. Mediation analyses

Two mediation analyses were performed using SEM modelling. Firstly, we tested whether the relationship between stress and symptoms of anxiety was mediated by resilience. The estimates of 95% bias-corrected bootstrap CI and results summary for the relationship between stress and symptoms of anxiety mediated by resilience are presented in the left column of Table 2, and dash line in Fig. 1.

There was a significant indirect effect of stress on symptoms of anxiety through resilience. In partial support of our first hypothesis, resilience partially mediated the relationship between stress and anxiety symptoms as: (i) the direct effect was smaller than the total effect of stress on symptoms of anxiety, and (ii) there was no zero in the 95% bias-corrected bootstrap confidence interval for the indirect effect.

Secondly, it was tested if the relationship between stress and symptoms of depression was mediated by resilience. The estimates of 95% bias-corrected bootstrap CI and results summary for the relationship between stress and symptoms of depression mediated by resilience are presented in the right column of Table 2, and solid line in Fig. 1.

Table 1
Table of means, standard deviations, Cronbach's alpha estimates and correlations for all the measures (N=533).

	Variable	*M*	*SD*	*α*	1	2	3	4	5	6
1	Gender				–	.12**	−.04	−.01	−.02	−.11*
2	Age	15.25	1.52			–	.01	−.02	.08	.02
3	ASQ	156.78	42.46	.94			–	−.32**	.19**	.22**
4	READ	4.00	.50	.85				–	−.32**	−.19**
5	STAI	41.25	10.40	.78					–	.56**
6	SMFQ	9.89	5.78	.84						–

* $p < .05$.
** $p < .01$.

Table 2
Mediating effects of resilience in the relationship between stress and symptoms of anxiety, and depression (N=533).

Effect	Symptoms of anxiety			Symptoms of depression		
	B (SE)	*p*-value	Bias-corrected bootstrap 95% CI	B (SE)	*p*-value	Bias-corrected bootstrap 95% CI
a	−0.00 (.00)	< .001		−0.00 (.00)	< .001	
b	−6.29 (.95)	< .001		−1.70 (.54)	.002	
c	.05 (.01)	< .001		.03 (.01)	< .001	
c^i	.02 (.01)	.025		.02 (.01)	< .001	
axb	.02 (.01)	< .001	[.013,.034]	.01 (.00)	.008	[.002,.011]

Note. B=Unstandardized path coefficient. SE=Standard Error. CI=confidence interval; *a*=effects of stress on resilience; *b*=effects of resilience on symptoms of anxiety and, depression after adjusting for stress; *c*=total effects of stress on symptoms of anxiety and, depression; c^i=direct effects of stress on symptoms of anxiety and, depression; *axb*= mediating effects of resilience in the relationship between stress and symptoms of anxiety and, depression (i.e. the indirect effect of stress through resilience on psychiatric symptoms).

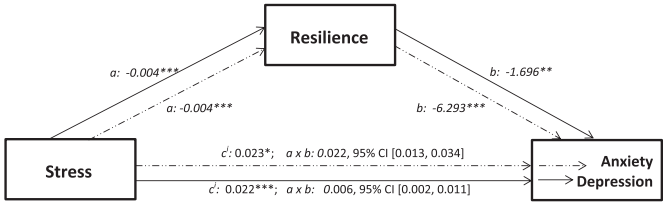

Fig. 1. Mediating effects of resilience in the relationship between stress and symptoms of anxiety (dash line) and between stress and symptoms of depression (solid line) (*N*=533). *Note.* Values are unstandardized path coefficients. *$p < .05$; **$p < .01$; ***$p < .001$.

There was a significant indirect effect of stress on symptoms of depression through resilience. In further partial support of our first hypothesis, resilience partially mediated the relationship between stress and symptoms of depression as: (i) the direct effect was smaller than the total effect of stress on symptoms of depression, and (ii) there was no zero in the 95% bias-corrected bootstrap confidence interval for the indirect effect.

3.2. Moderation analyses

The results from the moderation analyses are presented in Table 3. The left column of Table 3 displays the results of six separate nested models in multiple linear regressions analyses with symptoms of anxiety as the dependent variable while the right column of Table 3 displays the results with symptoms of depression as the dependent variable.

For symptoms of anxiety, the results showed that stress and resilience significantly predicted symptoms of anxiety individually and collectively. In all analyses stress was positively and resilience negatively related to anxiety symptoms. Significant direct main

Table 3
Moderation analyses of main and interactional effect using STAI and SMFQ as dependent variables (N = 533).

		Symptoms of anxiety				Symptoms of depression			
		ΔF	ΔR^2	β	t	ΔF	ΔR^2	β	t
1	Age	3.55	.00	.08	1.88	.22	.00	.02	.47
2	Gender	.36	.00	−.03	−0.60	7.67	.01	−.12	−2.77**
3	Stress	18.27	.03	.18	4.27***	23.08	.04	.21	4.80***
3	Resilience	58.14	.10	−.32	−7.63***	19.79	.04	−.19	−4.45***
3		31.58	.11			16.65	.06		
	Stress			.09	2.15*			.16	3.61***
	Resilience			−.29	−6.59***			−.14	−3.13**
4	Stress × resilience	1.04	.00	−.04	−1.02	9.26	.02	−.13	−3.04**

Note: To explore the main effect model, the stress factor score and the resilience factor score were entered in the third block. The interaction between the stress factor and the resilience factor was entered in the fourth block to explore the protective effect (interactional) model.

* $p < .05$;
** $p < .01$;
*** $p < .001$.

effects support a compensatory model of resilience.

For symptoms of depression, the results showed that gender was negatively associated with symptoms of depression. This means that girls reported higher levels of symptoms of depression compared to boys. Stress and resilience significantly predicted symptoms of depression individually and collectively. In all analyses stress was positively and resilience negatively related to symptoms of depression. Significant main effects support a compensatory model of resilience.

Partially consistent with our hypothesis, resilience moderated the relationship between stress and symptoms of depression as the product term for the two-way interaction between stress and resilience was significant and negatively associated with symptoms of depression. A significant interaction term between stress and resilience supports a protective model of resilience. To gain further understanding of the interactional effect between stress and resilience on symptoms of depression, simple slope analyses (Aiken et al., 1991) were conducted for low (i.e., 1 *SD* below the mean), average and high values (1 *SD* above the mean) of resilience. The results from the simple slope analysis are presented in Table 4 and Fig. 2.

The effect of stress on symptoms of depression for low and average levels of resilience was positive and statistically significant. At high levels of resilience, the association between stress and symptoms of depression was also positive but statistically non-significant.

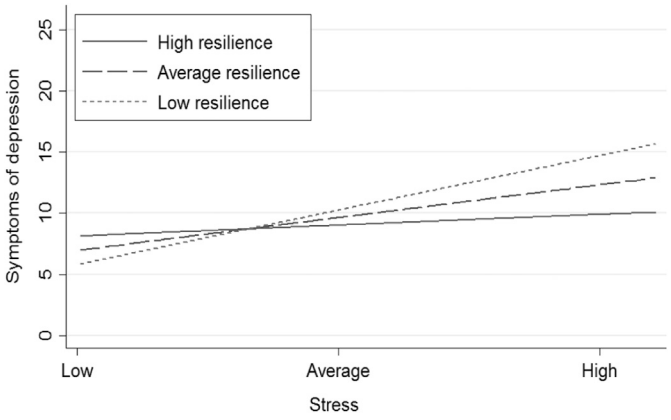

Fig. 2. Unstandardized simple slopes for the association between stress and symptoms of depression at low, average and high levels of resilience. Note: The categories are for low resilience (i.e., 1 SD below the mean), average resilience and high resilience (1 SD above the mean).

4. Discussion

The results from this study showed that while resilience (concerning personal dispositions, family warmth and coherence, and external support systems) partially mediated the relationships between stress and anxiety symptoms, and between stress and depressive symptoms, it also differentiated the relationship between stress and anxiety symptoms from stress and depressive symptoms. For the relationship between anxiety symptoms and stress the results supported a compensatory model of resilience. For depressive symptoms and the relationship with stress, the results supported both compensatory and protective models of resilience. This shows that a protective model may also show main effects (Masten and Wright, 2009). These findings indicate interesting differences in the stability of resilience across stress and anxiety symptoms and stress and depressive symptoms.

Findings from this study showed that resilience explained portions of the variance between stress and symptoms of anxiety, and also between stress and symptoms of depression indicating partially mediated effects. That resilience partially mediated stressful events and affective symptoms has also been found in previous studies (Klibert et al., 2014). As expected, stress was positively associated with symptoms of anxiety, and depression. This is consistent with previous studies of anxiety (Byrne et al., 2007; Cole et al., 2014; McLaughlin and Hatzenbuehler, 2009) and depression (Bouma et al., 2008; Cole et al., 2014; Grant et al., 2004b; Tram and Cole, 2000). When resilience was taken into account as a mediator it was found that higher levels of stress were associated with lower levels of resilience, which in turn was positively associated with anxiety and depressive symptoms. We can argue that Ghanaian adolescents with higher levels of anxiety and depressive symptoms may at least in part have low access to

Table 4
Effects of stress on symptoms of depression at low, average and high levels of resilience (N = 533).

Level of moderator variable	*B*	S. E.	*t*
Low resilience	.04	.01	5.38***
Average resilience	.03	.01	4.47***
High resilience	.01	.01	1.21

Note: The categories are for low resilience (i.e., 1 SD below the mean), average resilience and high resilience (1 SD above the mean)

*** $p < .001$

navigate through and negotiate stress to overcome adverse outcomes. This may suggest that increased resilience among adolescents could decrease the effect from stress thereby reducing the impact on anxiety and depressive symptoms.

Resilience did not moderate the effect of stress on anxiety symptoms but moderated the effect of stress on depressive symptoms. The former is inconsistent with a previous study in Ghana which found that ego resilience moderated stress and symptoms of anxiety even though both ego resilience and resilience are conceptualized as having positive effects for wellbeing. This may be due to two reasons, (i) because, ego resilience is measured as a personality trait, which is the capacity to adapt to events, whereas resilience was not measured as a personality trait in the present study, (ii) the previous study used sample that are older than the samples in the present study. Additionally, for anxiety symptoms, unlike symptoms of depression there were unequally larger variations in stress and resilience to produce statistically significant interactions as a statistical interaction requires variations in the independent and moderator variables (Rutter, 2006).

Various factors that make possible a disordered state facing students in Ghana include factors such as feeling worried, hopelessness, emotional and interpersonal problems (Owusu, 2008). These psychological factors including problems of student – teacher interactions (interpersonal) (Dei and Opini, 2007), are exacerbated in the larger group of students from poor and working-class families due to financial constraints and low parental education among others, whereas the very small group of students from privileged families are able to successfully navigate through and negotiate some of these vulnerabilities. This may show that for anxiety symptoms, the sample in the present study, in a pre-existing stressful environment are exposed to levels of stress vulnerabilities which preclude any multiplicative interaction with resilience to account for anxiety symptoms.

For depressive symptoms, resilience moderated the relationship between stress and depressive symptoms indicating that some adolescents in this study may withstand the effect of stress on depressive symptoms more than others. Alternatively, the effect of the relationship between stress and depressive symptoms is reduced for adolescents with higher levels of resilience. Thus, adolescent who score higher on resilience may muster resilience resources to cope with the effect from stress and overcome adverse consequences. Ultimately it would contribute to lower the levels of depressive symptoms, compared to those who score lower on resilience. This may be associated with protective resources of the individual Ghanaian adolescents concerning personal dispositions, family warmth and coherence, and external support systems to contribute to *recovery* and *sustainability*. Simple slope analyses (See Fig. 2 and Table 4), showed that the effect of stress on depressive symptoms for adolescents who score higher on resilience was low and non-significant whereas adolescents who score lower on resilience showed significant higher scores in the relationship between stress and depressive symptoms. Therefore interventions aimed at reducing the effects of stress on depressive symptoms should be directed toward groups of adolescents who show lower levels of personal dispositions, family warmth and coherence, and external support systems. Also, strategically targeting high stress and low resilience adolescents may probably contribute to making the largest difference.

Resilience accounted for more than double of the variance in anxiety symptoms compared to depressive symptoms which shows that resilience seems to be more important in explaining anxiety symptoms than depressive symptoms. This is consistent with findings from the Penn Resilience Program (Reivich et al., 2013) in which students were trained to use skill set to improve their problem solving and to enhance their ability to navigate daily stressors, as well as to overcome major setbacks such as parental loss or divorce. It was found that resilience significantly reduced anxiety, accounting for more variation in anxiety symptoms, but not depressive symptoms. In the present study, resilience accounting for an important part of the variation in depressive symptoms but even larger variations in anxiety symptoms may suggest that interventions should target ways to enhance resilience and at the same time minimize the effects of stress. When considering interventions that promote resilience in the general populations, it may be more relevant to adolescent who show anxiety symptoms as a result of the direct effects of stress. Interventions should holistically focus on students – (i.e. the individual, peers and teacher interactions – particularly on low and average resilient students in the interventions designed for depression), relationship between schools and families – (i.e. collaboration and connectedness), and the community or external environment – (i.e. supporting leisure and physical activity among others). In the school settings students can be taught ways to promote autonomy and self-regulation to successfully navigate through and negotiate out of negative peer influence, stress of academic demands, school life, teacher interactions, and the environment to overcome adverse consequences.

While some studies have investigated the interaction between risk and promotive factors in resilience research, a key component that has been overlooked for more than a decade is investigating explanations for how promotive factors or resources interact with risk to produce particular outcomes (Luthar et al., 2000) and why this is so (Fergus and Zimmerman, 2005). To the best of our knowledge, this is the first study to provide explanations for how resilience interacts with stress by showing how resilience explains and operates in the relationship between stress, and anxiety and depressive symptoms in a non-Western population that hitherto to this study received little attention in resilience research. Additionally, previous cross-sectional studies mainly reported direct main effects supporting a compensatory model of resilience. This cross-sectional study has showed evidence for both direct main effects and interactional effects to support both the compensatory and protective models of resilience respectively. Future studies are required, especially in similar samples, with research designs and statistical models that will account for the shared and unique aspects of symptoms of anxiety, and depression.

4.1. Limitations

We acknowledge a number of limitations to the study. Anxiety and depression were not clinically assessed. Nonetheless, the STAI and SMFQ are well established measures of anxiety and depressive symptoms. The use of self-report measures without further clinical observations may only point towards the levels of symptoms and not necessarily imply a clinical diagnosis. Using a clinical sample or differentiating clinical from non-clinical sample may have different results. Additionally, the levels of stress and resilience in such samples may have variations that can produce statistically significant interactions in anxiety symptoms. There is a paucity of evidence on the mental health of adolescent samples from Africa including Ghana (Mutumba et al., 2014). As a result there was inadequate evidence for strong psychodemographics of adolescent samples in Ghana for literature review. This would have provided useful measures and shaped the formulation of research questions and data collection.

The findings in this present study, although novel, should be interpreted with adequate caution since the findings do not answer questions about protective mechanisms or processes. Longitudinal studies are needed in which the mediational versus moderational role of resilience is explicitly investigated as a function of symptoms of anxiety and depression, not only in

adolescent samples from Ghana, but also adult samples.

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Contributors

Frederick Anyan designed the study, wrote the protocol, managed literature searches and statistical analyses. Odin Hjemdal contributed to statistical analyses and draft review. All authors have approved the final manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

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