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Neuroticism prospectively predicts pain among adolescents: Results from a nationally representative sample

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Abstract

Objective—The purpose of this study is to assess the prospective relationship of neuroticism to frequency of headaches and stomachaches in adolescents.

Methods—Participants were 3,676 adolescents sampled from Wave 1 (mean age 16) and Wave 2 (mean age 17) of the National Longitudinal Study of Adolescent Health (i.e., Add Health), a comprehensive, nationally representative, longitudinal data set. Binary variables were created to isolate participants who reported high versus low/medium frequency of pain. Subsequently, Wave 2 pain variables were modeled based on Wave 1 neuroticism, controlling for Wave 1 pain and demographics.

Results—Elevated neuroticism at Wave 1 prospectively predicted increased odds of high frequency of headaches (odds ratio = 1.4, 95% CI [1.2, 1.8], $p = .001$) and stomachaches at Wave 2 (odds ratio = 1.5, 95% CI [1.1, 2.0], $p = .004$).

Conclusions—This is the first known study to examine and find evidence for the prospective relationship between neuroticism and pain among a nationally representative sample of adolescents. Results indicated that after controlling for baseline pain, elevated neuroticism longitudinally predicted increased odds of high frequency of pain, one year later. Given recent advances in treatment for neuroticism, clinicians should be aware of these relationships and incorporate multidisciplinary treatments in the care of adolescents who experience high levels of pain.

Keywords

Pain; Neuroticism; Adolescents

Pain is a major health problem in adolescents associated with increased healthcare costs and psychiatric morbidity [1,2]. Prevalence estimates of child and adolescent headaches and stomachaches, the two most common sites for pain among adolescents [3,4], vary from 8% to 83% and from 4% to 53%, respectively. Consistent with the biopsychosocial model of pain, previous research identifies that psychosocial factors are key in the development of pain symptoms [5,6].

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Research suggests that higher-order personality factors may protect or exacerbate the presentation of pain [7]. Specifically, the underlying latent structure of anxiety and mood disorders, neuroticism—the predisposition toward experiencing intense negative affect and exhibiting strong negative reactions to emotional experiences—underscores the development of these disorders [8]. Neuroticism may influence how people cognitively process the meaning of pain in their life, influencing the extent of suffering [8,9]. Furthermore, neuroticism may be more malleable than previously thought [8], and treatments exist to specifically address such underlying vulnerabilities to treat a wide range of emotional disorders in both adults [10] and adolescents [11].

The relationship between neuroticism and pain in adolescents is inconclusive. Several studies suggest that adolescents with chronic pain report high neuroticism, and that neuroticism accounts for a considerable amount of variance in pain catastrophizing, one of the most salient predictors of chronic pain and disability [12–15]. Still, other studies yielded mixed results, reporting inconsistencies amongst gender and causal relationships [16,17]. A number of methodological limitations exist within the majority of the current literature, including reliance on small, geographically restricted samples.

To date, no known longitudinal, nationally representative study addressing the prospective relationship between neuroticism and pain exists within an adolescent population. This is important as it may lead to improved treatments for adolescents with pain [18]. Thus, the purpose of the current study is to address the existing gaps in the literature and clarify the prospective relationship between neuroticism and pain in adolescents. We hypothesized that neuroticism at Wave 1 (W1) will predict high headache and stomachache frequency at Wave 2 (W2), after controlling for potential covariates.

Methods

Participants

The present study was conducted using data from participants in the National Longitudinal Study of Adolescent Health (Add Health) [19,20], a multi-wave, nationally representative, longitudinal data set of U.S. adolescents/young adults. Participants were 3,676 American adolescents (1779 males, 1897 females) sampled from two assessment time points, W1 (1994–1995; mean age 16 years, $SD = 1.7$) and W2 (1996; mean age 17 years, $SD = 1.6$). The 3,676 participants in the current study represent a subsample of the larger Add Health database ($N = 6,504$). A complete case analysis was used, that is, only data from participants who had complete data at W1 and W2 were utilized. Thus, the retention rate was 100% in the current study compared to 71% in the parent study. See Table 1 for additional demographic variables.

Procedure

Data were extracted from W1 and W2 of the Add Health database including data from 1994 to 2009 across 80 U.S. high schools and 52 U.S. middle schools. Schools were stratified with regard to country region, school size, school type, urbanicity, and ethnicity. For the

purposes of the current study, only W1 and W2 were examined, given that personality and pain items were unavailable in subsequent waves.

Measures

Pain—There is support for assessing pain frequency within broad-based epidemiologic adult, adolescent, and child cohorts [19,21–23]. In the current study, pain was measured by two available items, assessing headache and stomachache frequency in the past year. Response options were as follows: “never,” “just a few times,” “about once a week,” “almost every day,” “every day,” and “refused.” This Likert scale has been previously used to assess pain frequency in adolescents in large longitudinal and cross-national studies [4,19]. To isolate “high” frequency of pain, we bifurcated response options into “almost every day” and “every day” versus all other responses.

Neuroticism—Neuroticism was assessed via a measure developed by Young and Beaujean [24]. Items revealed a unidimensional factor structure and internal consistency similar to those scores from NEO personality inventories [25]. Specifically, the neuroticism measure was found to have high internal consistency ($\alpha = .86$), and factor analyses determined that all items loaded on a single factor. The scale is comprised of six items, with higher averaged scores denoting increased neuroticism. Responses consist of a 5-point scale ranging from “1” strongly agree, to “5” strongly disagree. Items were as follows: “you have a lot of good qualities,” “you have a lot to be proud of,” “you like yourself just the way you are,” “you feel like you are doing everything just about right,” “you feel socially accepted,” “and you feel wanted and loved”. These items possess content validity as compared to established measures of personality (e.g., NEO-PI-R) [24].

Statistical analyses

Data were modeled within generalized linear models (SPSS Version 22). Two independent models were analyzed, corresponding to each of the dependent variables (i.e., high headache pain status, and high stomachache pain status). Given that both dependent variables were binary, binomial distributions with logit links were employed. Robust estimation was used for calculating standard errors. In each model, W2 pain frequency (headache or stomachache) was the dependent variable, with the following W1 variables entered as predictors: pain, neuroticism, biological sex, ethnicity, race, and parental income. By controlling for pain status and demographic variables at W1, we are able to parcel out the variance in W2 pain status that is accounted for by pain and demographic variables at Wave 1. Although this approach cannot speak to causality, it does provide an improvement over cross-sectional designs in regard to temporal prediction. An overall model is determined to be significant if the Likelihood ratio χ^2 test is $p < .05$. Finally, odds Ratios (OR) and their 95% confidence intervals (CI) were computed.

Results

The overall model testing high-frequency headache was significant, $\chi^2 = 258.7$, $p < .0001$. Neuroticism at W1 significantly predicted high-frequency headache at W2, OR = 1.4, 95% CI (1.2, 1.8), Wald $\chi^2 = 10.6$, $p = .001$. This finding indicates that as neuroticism at W1

increased, the odds of reporting high-frequency headache at W2 increased by 1.4 odds. The overall model testing high-frequency stomachache was significant, $\chi^2 = 117.4$, $p < .0001$. Neuroticism at W1 significantly predicted high stomachache status at W2, OR = 1.5, 95% CI (1.1, 2.0), Wald $\chi^2 = 8.1$, $p = .004$. This finding indicates that as neuroticism at W1 increased, the odds of reporting high-frequency stomachache at W2 increased by 1.5 odds.

Discussion

The current study revealed that controlling for baseline pain and demographics, elevated neuroticism longitudinally predicted increased odds of high headache and stomachache frequency, one year later. This suggests that neuroticism is an important construct in the development of pain. It is possible that these findings may further imply a relationship between neuroticism and chronic pain, as frequency is an important component of chronic pain [26].

Although important, these results should be viewed in light of several limitations. Neuroticism was assessed with a measure that, although internally consistent, has not been extensively examined psychometrically [24]. Additionally, data on pain and neuroticism were not available for Wave 3 or Wave 4, thus limiting ability to further assess the longitudinal relationship between neuroticism and pain. A complete case analysis was used for the purposes of the study. Other advanced statistical analyses available make use of all data available (e.g., mixed level modeling). However, because the sampling inherent to Add Health is complex, and since 3 or more waves of data were not available, other statistical analyses could not be utilized. Only frequency of pain data was available within the data set, thus limiting ability to study pain in its entirety. Ideally, future studies should assess pain intensity, duration, frequency, and interference with a longer follow-up period in order to allow for a comprehensive assessment of pain. Additionally, although one cannot fully control for the effect of time, future research may wish to replicate these findings with a current historical cohort. Finally, as pain status was dichotomized in the current study, further research may wish to utilize a more continuous or ordinal measure of pain.

Despite these limitations, the current study may have clinical implications. Neuroticism may increase attention and sensitivity to bodily symptoms thus leading to hypervigilance and amplification of symptoms, which are key components in development of pain. Given that neuroticism is associated with vulnerability to various mental health conditions in addition to pain, it would be important for medical providers to screen patients for neuroticism and either refer patients for treatment or provide educational information on strategies to cope in order to prevent development of pain as well as additional mental health conditions. The longitudinal relationship between neuroticism and pain symptoms also reinforces the need of a multidisciplinary approach to the treatment of pain. Often adolescents present with stomachaches and headaches first at their primary care clinic doctors. Assessing psychological factors at this stage and facilitating referrals for psychosocial treatment can drastically improve quality of life in adolescents and potentially prevent chronicity and reduce health care costs. Rather than focusing on differentiating diagnoses between anxiety and mood, directly targeting neuroticism within a unified approach across all emotional

disorders may be more economical and effective in addressing pain in adolescents, although future investigations are necessary to address these claims [11,27].

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Table 1

Sample characteristics

Variable	<i>N</i> (%)
Race	
White	2630 (72)
Non-White	1046 (28)
Ethnicity	
Non-Hispanic	3287 (89)
Hispanic	389 (11)
Pain status W1	
High-frequency headache	263 (7)
Low/medium frequency headache	3413 (93)
High-frequency stomachache	131 (4)
Low/medium frequency stomachache	3545 (96.5)
Pain status W2	
High-frequency headache	248 (7)
Low/medium frequency headache	3428 (93)
High-frequency stomachache	135 (4)
Low/medium frequency stomachache	3541 (96)
	<i>M (SD)</i>
Parental income	\$48,250 (\$57,210)
Neuroticism W1	1.87 (.59)

Note. *M* = mean, *SD* = standard deviation, *N* = number of participants, W1 = Wave 1, W2 = Wave 2.