

Factors associated with the mental health of adolescent university students during COVID-19 quarantine in Japan

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Abstract

Background: University students in Japan have been quarantined during the current COVID-19 pandemic. The resulting social avoidance may increase students' anxiety about the pandemic and adversely affect their mental health. To obtain basic data for a university health policy, we investigated factors associated with the mental health status of 570 students of a national university in Japan during quarantine.

Methods: Participants completed an online questionnaire assessing respondent characteristics (gender, age, department, domicile status), subjective sense of anxiety about COVID-19, and number of social supports. The General Health Questionnaire (GHQ)-12 was used as a marker for mental health status, and sense of coherence (SOC) was used as a marker for stress resistance. Chi-square tests, *t*-tests, Pearson's correlation coefficients, and multiple regression analysis were conducted to identify factors associated with GHQ score. Two-way analysis of variance (ANOVA) was conducted to identify the interaction between anxiety score and SOC scores.

Results: Females showed significantly more adverse mental health than males. Regardless of gender, the strongest factor associated with GHQ score was anxiety about COVID-19, which impaired mental health status, followed by SOC score, which improved mental health status. The ANOVA results showed a significant interaction effect on GHQ scores between anxiety and SOC score in males. High SOC scores mitigated the negative effect of anxiety on mental health more than did low SOC scores, especially in males with low to medium levels of anxiety.

Conclusions: The results indicate that fear of COVID-19 impaired mental health status, but SOC worked as a buffer to mitigate the negative effect of anxiety on mental health, especially among male students. Given the health risks associated with gender, universities should provide psychological care to encourage students to maintain a confident daily routine and to foster higher SOC, especially for male students.

Background

The coronavirus 19 (COVID-19) pandemic has spread worldwide and many countries have implemented lockdowns to prevent its spread. To manage the outbreak of COVID-19, inbound travel restrictions were implemented from late January 2020 in Japan, which resulted in severe economic deterioration in the tourism industry. In late February, major events, including job fairs for students graduating in spring 2021, were cancelled [1]. On February 27, 2020, Prime Minister Abe requested that all schools and universities in Japan close until April [2]. This was followed by a state of emergency and a nationwide lockdown on April 7 [3]. As a result, many university students who relied economically on services industries such as shops and restaurants lost their part-time jobs [4]. In addition, as educational institutions in Japan were closed, students were forced to stay at home and take online classes. During this period, a survey reported that 1 in 13 university students were considering leaving university but had no source of income or financial support [5]. After the government partially reopened grade schools, middle schools, and high

schools, regular classes gradually resumed in early May [6]. However, university administrators are reluctant to resume face-to-face classes with physical attendance at universities. As a result, the government has encouraged online classes and restrictions on social activities because of fears that the younger generation will spread the virus. According to the Ministry of Education, Culture, Sports, Science and Technology, 60% of universities offered online classes and 30% offered online or face-to-face classes as of June 5 [7]. Online classes can overwhelm students with continuous tasks and assignments and may cause various physical problems such as eye fatigue [8]. This unusual period of “suspension of classes and non-stop learning” [9] has had a negative effect on students globally. Previous studies have reported that national/regional lockdowns and travel restrictions have a negative effect on the mental health of students [10], and that these effects vary by age [11] and department [12]. Conversely, social support from family and partners is negatively associated with depression [10]. However, few studies [13] have examined how university students cope with these types of stressful conditions by focusing on their stress resistance during the COVID-19 pandemic. In this study, we measured sense of coherence (SOC), the potential of which has been theoretically indicated [14] and empirically tested during normal periods [14, 15, 16] to investigate the stress resistance of university students and their ability to maintain their mental health status. Antonovsky, who conceptualized SOC [17] defined SOC as “a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one’s internal and external environments in the course of living are structured, predictable and explicable; (2) the resources are available to one to meet the demands posed by the stimuli; and (3) these demands are challenges, worthy of investment and engagement” [18]. SOC is fostered by three types of life experiences: consistency, load balance, and participation, which shape outcomes by general resistance resources (GRRs). Typical GRRs are money, knowledge, experience, self-esteem, healthy behavior, commitment, social support, cultural capital, intelligence, traditions, and view of life. Therefore, SOC is a stress-resistance capacity developed with or by GRRs, whereby one may perceive oneself as able to manage any situation independently of whatever is happening in one’s life to maintain mental health. SOC should be fully exerted under conditions of quarantine because studying away from university, separated from one’s mentors and friends, requires students to exercise self-reliance to maintain a confident routine. The concept of SOC, therefore, is an appropriate measure of students’ capability to cope with unusual daily life routines and to work on overwhelming tasks while facing economic hardship, and while exposed to the chaos surrounding the pandemic and an uncertain future.

In this study, we aimed to investigate the effects of COVID-related anxiety, SOC, and number of social supports on mental health status. The conceptual framework of the study was based on the stress process model of Pearline [19]. This model posits that mental health disparities arise from exposure to psychosocial stress and that stress resistance mitigates the effect of psychosocial stress on health outcomes. In this study, we defined psychosocial stress as subjective anxiety caused by the restrictions on socialization owing to the COVID-19 quarantine. To assess stress resistance, we measured the number of social supports and SOC. As control variables, we included age, university department, and domicile status (living with family/a partner), which have been strongly associated with mental health outcomes

in previous studies [10, 11, 12]. We analyzed the model goodness of fit by gender, as gender is a determinant of stress recognition, choice of coping style [20], and symptoms of depression [21, 22].

Methods

This study investigated how coping strategies affected the mental health outcomes of Japanese university students in COVID-19 quarantine. An anonymous online questionnaire was developed and administered to the study population; the selection procedure is outlined in the following paragraph.

Participants

As the university where the study population was enrolled kept the students' e-mail addresses private, we used the following procedure to conduct stratified random sampling of students. First, we developed a tentative list of students from each department according to the number of undergraduate students published on the university website. Second, each (dummy) variable was given a serial ID number linked to the e-mail address of the individual. Third, a request letter with a link to the online survey was sent to 2,000 students (26.7% of the total number of eligible students (7,488)) sampled from the above database.

Measures

For the online survey, we developed a questionnaire containing questions about (1) the respondent characteristics of gender, age, department (each department was divided into two groups: a medical science major department, which provided medical courses such as virology and/or public hygiene, and a non-medical science major department, which did not provide such courses), and whether students lived alone; (2) the independent variables of COVID-19 subjective anxiety score, SOC, and number of social supports; and (3) the dependent variable, which was the level of mental health status. The General Health Questionnaire (GHQ)-12, which comprises 12 questions rated on a 4-point scale, was used as a marker for mental health status (hereinafter, "GHQ score"). The scale screens for anxiety disorder and depression [23, 24]. We calculated the GHQ score using a Likert-type scale (coded 0–3). Higher GHQ scores are associated with more severe adverse mental health. Subjective anxiety about COVID-19 (hereinafter, "anxiety score") was assessed by one question, which was developed for this study after detailed interviews with several students through telephone conversation.: "How anxious are you that the COVID-19 pandemic may affect or has affected your daily life?" We chose to develop our own measure of general anxiety caused by COVID-19 for the following reasons. First, there are no studies on COVID-19-related anxiety scales. Second, we learned from the interviews that students tended to experience a general anxiety about the overall effect of COVID-19 on their daily lives, rather than recognizing different aspects of this anxiety. We deemed this to be a natural reaction to the emergence of a novel virus, as the phenomenon is too new for students to identify separate sub-causes of anxiety.

The validity of the question was tested prior to the survey by conducting pretests and the criterion-related validity was tested using Pearson's correlations of GHQ scores. The question response was rated on a five-point scale, ranging from 1 (*not at all*) to 5 (*very much*). The number of social supports was

measured using the 12 social support types developed by Shima [25], which include emotional and tangible supports, to suit the sociocultural environment of university students in Japan. SOC was used to measure stress-resistance capacity. The SOC measure comprised questions on manageability, comprehensibility, and meaningfulness; the scale has been translated into various languages and a short version of the scale has been developed. We used the University of Tokyo Health Sociology version of the SOC Scale [26], which comprises three questions rated on a 7-point scale (coded 1–7) (hereinafter, “SOC score”). Higher SOC scores are associated with stronger stress resistance.

Data analysis

We used IBM SPSS Statistics for Windows, Version 25J (IBM Corp., Armonk, NY, USA) for statistical analyses. Descriptive statistics were used to analyze the characteristics of the respondents, and chi-square tests, *t*-tests, and Pearson’s correlation coefficients were used to examine the correlations among GHQ scores, demographic characteristics, and each independent variable. Cronbach’s alpha was calculated to test the internal consistency of scales comprising more than two items.

Multiple regression analysis was used to test the hypothesis by identifying factors associated with GHQ score. The variance inflation factor was used to quantify the severity of multicollinearity. Two-way analysis of variance (ANOVA) was conducted to identify the interaction effect between the anxiety score and SOC. The SOC score was dichotomized at 15/16 based on the mean score (15.3 [standard deviation SD: 2.9]), and the anxiety score was trifurcated by quartile points: under 25% = low anxiety, 25–75% = medium anxiety, and 75% or over = high anxiety. The level of statistical significance was set at $p < 0.05$.

Ethical considerations

Informed consent was obtained online when the student clicked, “I agree to participate in this study,” before proceeding to the online questionnaire.

Ethics approval was granted by the Biomedical Sciences Ethics Board at Nagasaki University (permission number: 20080607).

Results

The characteristics and distribution of anxiety scores, number of social supports, SOC scores, and GHQ scores for all respondents.

A total of 1,839 e-mails reached the total population, of which 576 were answered (response rate: 31.3%). Six responses were excluded from analysis as they were incomplete; therefore, responses from a total of 570 students (336 female, 234 male) were analyzed. In terms of department, 409 (71.8%) students were non-medical science majors and 159 (27.9%) students were medical science majors. A total of 210 students (36.9%) lived with family/partners) and 359 (63.1%) lived alone.

The mean anxiety score (range: 1–5) was 3.8 (SD: 1.0). The average number of social supports (range: 0–12) was 8.6 (SD: 3.4). For SOC score, the Cronbach’s alpha was .75, the range was 6–21, and the

average was 15.3 (SD: 2.9). For GHQ score, the Cronbach's alpha was .87), the range was 1–36, and the average was 16.7 (SD: 6.5).

Bivariate analyses

The characteristics of the respondents by gender are shown in Table 1. Significant differences were observed in the departments in which students were enrolled, domicile status, number of social supports, and GHQ scores. However, there was no difference in SOC scores between males and females.

There were strong correlations between GHQ scores and some independent variables. Males showed a stronger correlation between GHQ scores and anxiety scores ($r = .396, p < 0.001$) than females ($r = .348, p < 0.001$). In contrast, SOC scores among females showed a stronger negative correlation coefficient with GHQ scores ($r = -.321, p < 0.001$) than among males ($r = -.297, p < 0.001$).

Table 1
Respondent characteristics and comparisons by mean demographic variables by gender

Variable	Gender	Range	Distribution		
			n	(%)	<i>p</i> value
Age	Male	≤ 18	42	(17.9)	<i>p</i> = 0.298
		19–20	97	(41.5)	
		21–22	82	(35.0)	
		≥ 23	13	(5.6)	
	Female	≤ 18	69	(20.5)	
		19–20	146	(43.5)	
		21–22	112	(33.3)	
		≥ 23	9	(2.7)	
University Department	Male	Medical Sciences	49	(21.0)	<i>p</i> = 0.001
		Non-Medical Sciences	184	(79.0)	
	Female	Medical Sciences	110	(32.8)	
		Non-Medical Sciences	225	(67.2)	
Domicile status	Male	Lives with family/partners	65	(27.9)	<i>p</i> < 0.001
		Lives alone	168	(72.1)	
	Female	Lives with family/partners	145	(43.2)	
		Lives alone	191	(56.8)	
			Mean	(SD)	
Anxiety about COVID-19 (range: 1–5)	Male		3.7	(1.1)	<i>p</i> = 0.142
	Female		3.9	(1.0)	
Number of social supports (range: 0–12)	Male		7.8	(3.8)	<i>p</i> < 0.001
	Female		9.2	(3.0)	
SOC score (range: 3–21)	Male		15.3	(3.2)	<i>p</i> = 0.993
	Female		15.3	(2.7)	
GHQ score (range: 0–36)	Male		15.9	(6.8)	<i>p</i> = 0.015

Variable	Gender	Range	Distribution		
			n	(%)	<i>p</i> value
	Female		17.2	(6.3)	
SOC = sense of coherence; GHQ = General Health Questionnaire; SD = standard deviation.					

Multivariate analyses

The strongest determinants of the GHQ score were anxiety scores for both males ($\beta = .391, p < 0.001$) and females ($\beta = .295, p < 0.001$). This was followed by SOC scores, which negatively correlated with GHQ scores among both males ($\beta = -.230, p < 0.001$) and females ($\beta = -.282, p < 0.001$). There was a negative correlation between age and GHQ score, which was significant for males ($\beta = -.173, p = 0.008$; Table 2), indicating that younger students experience more adverse mental health than older students.

Table 2
Determinants of GHQ scores by gender

Variables	Male		Female	
	beta	<i>p</i> value	beta	<i>p</i> value
Age	-.173	<i>p</i> = .008	-.034	<i>p</i> = .510
University Department (Non-Medical Sciences = 1, Medical Sciences = 2)	-.011	<i>p</i> = .870	-.078	<i>p</i> = .131
Domicile status (Lives with family/partners = 1, Lives alone = 2)	-.026	<i>p</i> = .662	-.036	<i>p</i> = .488
Anxiety about COVID-19	.391	<i>p</i> < 0.001	.295	<i>p</i> < 0.001
SOC score	-.230	<i>p</i> < 0.001	-.282	<i>p</i> < 0.001
Number of social supports	-.013	<i>p</i> = .825	-.001	<i>p</i> = .988
Adjusted R ²	.258	<i>p</i> < 0.001	.200	<i>p</i> < 0.001
SOC = sense of coherence; GHQ = General Health Questionnaire				

Two-way ANOVA results

On the basis of the multivariate analysis results, we further tested the effects of the SOC and anxiety scores. There were significant interaction effects of anxiety and SOC scores on GHQ score. The interaction was significant ($F(2,221) = 3.528, p = 0.031$) for males (Table 3), but not for females (Table 4). A plot of the interaction effect showed that participants with high SOC scores had lower GHQ scores than participants with low SOC scores, especially males with low to medium levels of anxiety (Figs. 1 and 2).

Table 3
Two-way analysis of variance results for high and low SOC group effects for males

	df	SS	F	<i>p</i>	η^2
SOC	1	653.69	18.65	.000	.078
Anxiety about COVID-19	2	634.68	18.11	.000	.141
SOC × Anxiety about COVID-19	2	123.65	3.53	.031	.031
Table 4. Two-way analysis of variance results for high and low SOC effects for females					
	df	SS	F	<i>p</i>	η^2
SOC	1	251.05	7.23	.008	.022
Anxiety about COVID-19	2	752.58	21.67	.000	.119
SOC × Anxiety about COVID-19	2	49.83	1.44	.240	.009
SOC = sense of coherence.					

Discussion

Anxiety about COVID-19 and its implications for mental health and SOC

The findings indicate that anxiety about COVID-19 had the strongest effect on GHQ scores, regardless of gender. The subjective anxieties measured in this study may be induced not only by worries of virus infection, but also by indirect effects of the nationwide lockdown. Fujimoto [27] reported that more than 73.2% of students were worried very much/much about virus infection, followed by worries that regular classes would not resume (66.8%) and that regular student placement activities for post-graduation would not resume (56.7%). Coping with such multifaceted anxieties, some of which may last for the next few years, requires persistence of students in response to a stressful environment. The results of this

study indicate that students' SOC effectively works as a type of resistance that maintains students' mental health in quarantine, as indicated by the negative correlation between SOC and GHQ scores. Similar results have been observed among people forced to adjust to new life settings, such as refugees [28], widows [29], and cancer patients [30]. In other words, SOC is a resistance strategy that helps individuals to adjust to new environments and reduces the risk of mental health deterioration, even in unfamiliar settings. In addition, SOC may act as a buffer to mitigate the negative effects of anxiety on mental health. The ANOVA results showed a significant interaction effect on GHQ scores between anxiety and SOC scores in males. Participants with high SOC showed lower GHQ scores than did those with low SOC, especially those with low to medium levels of anxiety. A similar tendency has been reported in some previous studies on stressful life events [31, 32]. Therefore, SOC may inhibit the negative effects of daily life stressors on mental health.

Gender differences

The findings indicated that gender must be taken into account in the implementation of mental health care services for university students. Contrary to previous studies [11, 33, 34], the present study found that gender is a direct and indirect determinant of the mental health status of students in quarantine, as shown by the bivariate and multivariate analyses. First, there may be gender differences in mental health status. Female students reported higher GHQ scores than male students; this can be interpreted as indicating that females are more likely to experience mental health deterioration during the quarantine period than males. This interpretation does not contradict the findings by Konno et al. [35] indicating that Japanese females have higher depression scores than males in normal periods. We suggest that this tendency is more pronounced in stressful periods such as the COVID-19 quarantine. In the light of findings from a Chinese population study [36], which indicated that females reported higher posttraumatic stress symptoms than males during the COVID-19 outbreak, we can assume that female respondents of this study showed a similar response pattern. However, we did not assess any somatic symptoms in this study, so additional studies are needed to confirm this hypothesis.

Second, the construction model of mental health may apply differently to males and females. For males, the anxiety score was the strongest indicator, followed by SOC scores and age. In contrast, females did not show any significant association between age and GHQ scores. The effect of anxiety was weaker when SOC was stronger, indicating a balance between the effects of the two variables. Therefore, we generated the following hypotheses to interpret this phenomenon.

The first hypothesis is that the discrepancy between male and female participants stems from their choice of GRRs. For example, gender is associated with unhealthy lifestyles (e.g., smoking addiction), which are more prevalent in males than in females, which may result in differences in health outcomes. The gender differences in COVID-19 death rates [37] may reflect this pattern. However, as we did not examine lifestyles in this study, the effects of a healthy lifestyle on mental health status by gender remain to be studied. The second hypothesis is that the pattern of social support mobilization, and the mental health outcome affected by it, may differ by gender. Female students had significantly more social

supports than males, although the number of social supports was not significantly associated with GHQ scores. We suggest that social support, which Antonovsky [18] identifies as a type of GRR, promotes GRRs to the level at which they strengthen SOC, and SOC inhibits depressive mood in female students. In fact, we found that the number of social supports was positively correlated with SOC score more strongly in females ($r = .256, p < 0.001$) than in males ($r = .206, p < 0.001$). This interpretation reflects findings from a study of the narratives of migrant women [38], who referred to the important role of social support, which enabled them to subjectively perceive life as more consistent, load balanced, and meaningful, despite facing migration, integration, or other adversities. The association between social support and SOC in female students of the present study may reflect their adjustment to a new life setting. However, why this association has a lesser function in male students remains to be clarified. The third hypothesis is that there may be other predictors of mental health status for female students. The goodness of fit of the multiple regression model in the present study was lower for females than for males, indicating that some important predictors were excluded in the model for females. Regarding the depressive symptoms of females, Konno et al. [35] reported that females are more likely to address somatizations, such as insomnia and decreased appetite. Therefore, somatization should be considered to improve the goodness of fit of the multiple regression model for females.

A unique predictor of GHQ for male students was age; younger students experienced a more negative impact on mental health. This may be because the youngest respondents were freshmen, many of whom had not attended the university, even on the first day of enrollment, because the entrance ceremony planned for early April, 2020, was cancelled owing to the pandemic. Therefore, these students had no opportunity to enter the campus to familiarize themselves with their new environment, or to meet their new friends and professors to enhance their GRRs. In contrast, older students (sophomores or above) already had a sense of connection, as they had spent at least a year with their peers in the preceding normal period. Further research is needed on why this tendency is particularly apparent among male students.

Limitations of the study

The study may have been subject to sampling biases. Although information technology education is mandatory in high schools, and the high penetration of cell phone and digital devices made it easier to access the online survey, students who were anxious about completing this questionnaire may have been excluded.

We used an original anxiety measure developed for this study. Therefore, it was difficult to differentiate respondents who had been experiencing anxiety disorders before the pandemic from those who developed a sense of anxiety owing to COVID-19. Further research is needed to clarify the source of anxiety related to COVID-19.

Implications for health policies for university students

The present findings highlight some important issues for the development of an appropriate program to aid students in maintaining mental health during the quarantine period. Universities, an essential source

of GRRs for students, should establish systems to provide students with appropriate support. The following are some recommendations.

To reduce anxiety about COVID-19, sufficient information that meets the needs of students must be provided. For instance, the provision of scholarships could be a rapid response to students' financial problems. To date, many universities in Japan have started to return part of the tuition fee and to provide cash for equipment and living expenses [39]. Universities could assist students who are seeking information about placement interviews for post-graduation jobs by providing information about online job fairs. Providing job fair information to each student through e-mail would ensure that such information reaches students. The provision of emotional support together with evidence-based information is necessary to relieve students' anxiety about infection. As there is still much uncertainty about the virus, universities should help students to extract useful information from distracting sources. Such care should be provided through telephone and/or the Internet [40, 41] to facilitate the accessibility of such services, especially during quarantine. We suggest that these support systems should particularly target younger male students, as the present findings show they are vulnerable in terms of mental health status.

Conclusions

The present findings indicate that COVID-19 affects the mental health of all individuals, not only patients infected with the disease [42], but also those receiving online education during the quarantine. They also indicate that SOC contributes differentially to mental health status in males and females. Therefore, universities should consider measures to allocate health professionals to provide psychological care, encourage students to maintain a confident daily routine, and foster a SOC with which they can maintain good mental health.

List Of Abbreviations

SOC: Sense of coherence

GHQ-12: General Health Questionnaire-12

ANOVA: Analysis of variance

GRRs: General resistance resources

SD: Standard deviation

Declarations

Ethics approval and consent to participate

Ethics approval was granted by the Biomedical Sciences Ethics Board at Nagasaki University (permission number: 20080607).

Consent for publication

Not applicable.

Availability of data and materials

Data will be released upon completion of the study and is available upon reasonable request from the first author.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

KA and SO developed the questionnaire and conducted the analysis under the instruction of YH. YH wrote the first draft of the manuscript.

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Figures

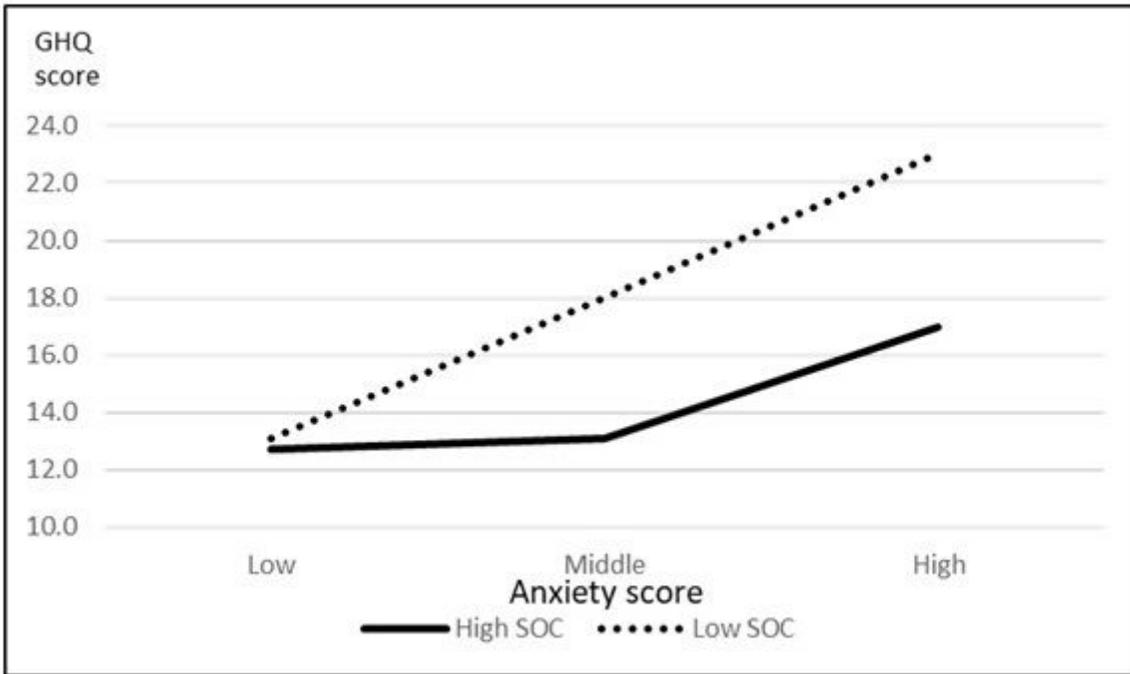


Figure 1

Interaction plot for GHQ scores (males). GHQ = General Health Questionnaire; SOC = sense of coherence.

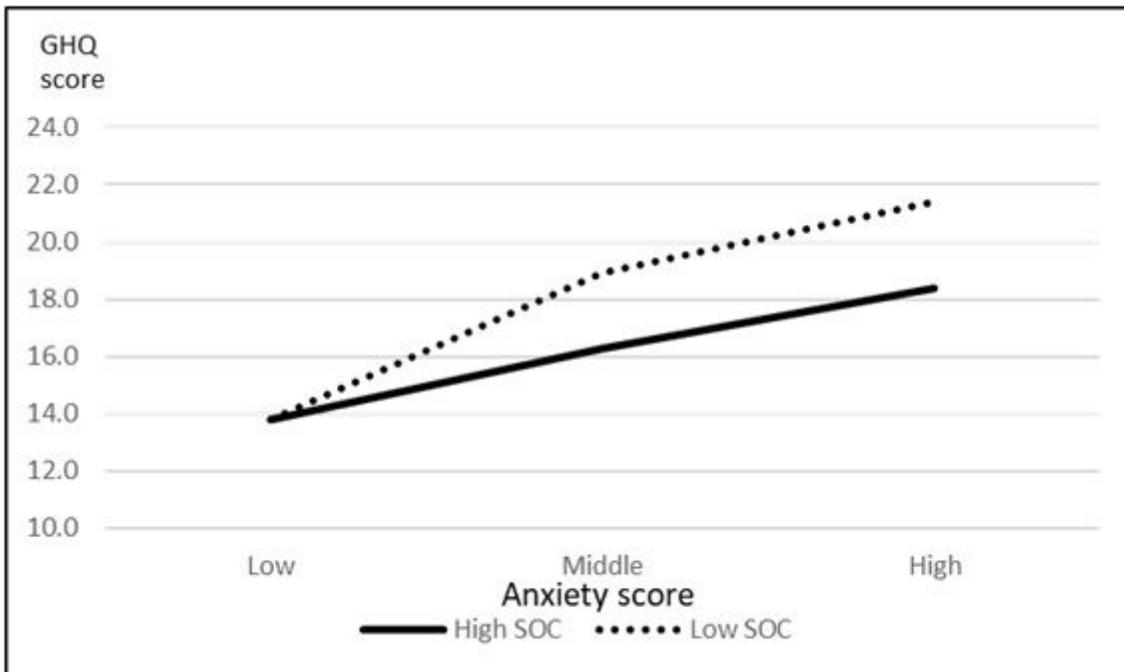


Figure 2

Interaction plot for GHQ scores (females). GHQ = General Health Questionnaire; SOC = sense of coherence.