Increased number of somatic pain sites is associated with poor mental health in 18,104 adolescents: a cross-sectional study

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1. Introduction

Mental health problems are a serious public health concern especially among adolescents. Moreover, depression is the leading cause for disease burden in young people aged 10-24 years [1] while suicide is the second leading cause for deaths within this age group accounting for approximately 6% of total deaths [2]. However, a survey conducted in Europe demonstrated that the degree of coverage for psychiatric services in young people was worse compared to that of adults [3]. This may be due to the fact that young people with depression are reluctant to seek help from professionals for themselves [4]. Thus, it is important for professionals working with adolescents to detect signs of poor mental health in youth. For the purpose of early detection, sensitive and feasible indicators of poor mental health in adolescents are required.

One indicator of poor mental health has been somatic pain. Previous studies have found that somatic pain is a common complaint among adolescents [5-6]. A survey employing a large sample size from the Netherlands showed that approximately 54% of children and adolescents had experienced somatic pain within the previous 3 months [7]. This study also demonstrated an association between somatic pain and poor mental health as well as physical discomfort caused by somatic pain. A recent study reported that abdominal pain was associated with depressive symptoms in schoolchildren [8], while an additional study demonstrated a correlation between low back pain and depression in adolescents [9]. In addition to studies investigating single sites
for pain, several previous studies have simultaneously examined multiple sites for pain. Although a linear relationship between the number of pain sites and level of depression has been suggested in a few previous studies using adolescent samples [10-11], two studies used samples with relatively narrow age ranges [10-11], while one study used a complex question and took only frequent concerns of pain into account [10]. To date, there has been no study that has investigated the association between the number of somatic pain sites and poor mental health using a large sample of adolescents. Additionally, the present study employed a broad age range during adolescence and simple reporting of somatic pain.

While a previous research has demonstrated that children with somatic pain had substantial impairment in their daily lives [12], the association between somatic pain and academic impairment has not been thoroughly examined. Additionally, previous studies have illustrated an inconsistency in results pertaining to the association between academic impairment and somatic pain [13-14]. Although a previous study has shown that students with chronic pain perceived a decline in their academic competence [13], an additional study reported that the level of academic competence in adolescents with chronic pain was consistent with their intellectual ability [14]. Therefore, further study examining the link between academic impairment and somatic pain is warranted.

Thus, the objectives of the present study were to: 1) investigate the association between the
number of somatic pain sites and poor mental health in a large sample of adolescents with a broad range in age using simple reports of somatic pain, and 2) examine the association between the number of pain sites and perceived academic impairment.

2. Methods

2.1 Study design, sample, and survey procedures

The present study employed a cross-sectional design and used a sample of adolescent students. The survey was conducted between 2008 and 2009. The sample consisted of students in 45 public junior high schools (7th-9th grades) and 28 high schools (10th-12th grades) in Tsu City (population 280,000) and Kochi Prefecture (population 790,000) in Japan. Under Japanese law, junior high school education is compulsory, while high school education is not. The present study was approved by the ethics committees of the Tokyo Institute of Psychiatry, the Mie University School of Medicine, and the Kochi Medical School. This research was conducted in accordance with the Helsinki Declaration as revised in 1989. The principal investigators of the present study contacted the heads and administrators of each junior high and high schools for permission to participate in the survey. Subsequently, the administrators and heads of schools consulted with teachers and parents for their consent to participate in the survey.
Instructions and guidelines for the distribution and collection of the questionnaires was provided to the teachers in the participating schools. For each participating school, teachers distributed the questionnaires to students, along with envelopes to place their surveys in when completed. All student responses remained confidential and were handled anonymously. Furthermore, teachers explained that participation in the study was strictly voluntary, and assured confidentiality. Teachers reported on the total number of students who participated on the day of the survey. The research team collected the sealed envelopes from each school.

2.2 Measures

The distributed questionnaire packets included the following items: 1) the Japanese version of the 12-item General Health Questionnaire (GHQ-12) [15]; 2) three sites of somatic pains (headaches, neck and shoulder pain, and abdominal pain); 3) perceived academic competence; and 4) additional variables including demographic characteristics, sleeping time, history of substance use, and the experience of being bullied or being subjected to violence.

2.2.1 The GHQ-12 (General Health Questionnaire score)

The GHQ-12 is one of the most widely used self-report measures for assessing anxiety and depression [16]. The GHQ-12 has been used and validated in younger samples as well as in
adults [17]. Additionally, previous studies have established the validity and reliability of the Japanese version of the GHQ-12 [15]. A 4-point scale using binary scoring (0011) was utilized for the 12 GHQ items. Responses for each question were added together to form a total score, with a range between 0 (best possible) and 12 (worst possible). Individuals with a total GHQ-12 score $\geq 4$ were regarded as having poor mental health according to findings from previous studies [17-18].

### 2.2.2 Three sites of somatic pain

The one-month prevalence of somatic pain was assessed using a list of three main sites for pain experienced including, headaches, neck and shoulder pain, and abdominal pain. Participants were asked to mark all the sites where they had experienced pain in the previous one month. The three sites for somatic pain were chosen based on previous reports of pain with the highest prevalence among adolescents. According to previous studies, headaches and abdominal pain are the two most prevalent somatic pains experienced among adolescents [6, 10]. However, reports on the prevalence of neck and shoulder pain, limb pain, and low back pain have been inconsistent [6-7, 10, 19]. While the prevalence of limb pain and low back pain were similar [6], neck and shoulder pain has been consistently found to be more prevalent than low back pain [10, 19]. Participants who marked a particular site for pain were defined as having that site of pain.
2.2.3 Perceived academic impairment

Perceived academic impairment was assessed using the following questions: “Have you had difficulties in concentrating on your studies recently?” “Do you feel frustrated with a recent decline in your academic performance?” The participants selected one item from the following four responses: “yes”, “yes, likely”, “no, unlikely”, and “no”. The participants who responded “yes” were regarded as having a perceived academic impairment.

2.2.4 Additional variables

One-month prevalence of alcohol use and smoking were assessed using yes/no response. Lifetime prevalence of any drug use was asked using the following question: “Have you ever used any drug?” The participants selected one of the following four items: “no”, “only once”, “twice”, “more than three times”. Those who indicated using at least once were identified as drug users. The experience of being bullied within one year and violence from adult cohabitants within one-month were assessed dichotomously. Sleeping time was assessed using the following question: “Approximately how many hours do you sleep every day?” Sleeping time of 7 hours or less was regarded as a short sleeping time, due to previous reports which have shown an association between somatic pain and sleep problems such as reduced sleeping [20-21].
Additionally, a previous study which revealed that abuse, substance use, and violence during childhood were associated with the adult-onset of headaches [22]. Thus, associations among those variables with and somatic pain have been previously suggested. Demographic characteristics including age, gender, and school grade were also assessed.

2.3 Statistical analysis

One-month prevalence of somatic pains were calculated. The associations between demographic characteristics and somatic pains or the mean of GHQ-12 total scores were examined using cross tabulations. Chi-square tests were performed in order to compare the prevalence of somatic pains between males and females and the different school grades. The prevalence of each somatic pain was compared using the McNemar test. The parametric t test was used for the comparison of means of GHQ-12 total score between the two genders and different school grades.

The association between the number of pain sites and poor mental health was examined using logistic regression in which poor mental health was the dependent variable. Cross tabulations for each variable with reports of somatic pain and poor mental health were performed, and chi-square tests were conducted. Variables which were found to have an association with both somatic pain and poor mental health were selected to be possible confounders. In order to
examine the interaction between age, sex and number of pain sites, stratified odds ratios were assessed and likelihood ratio tests were performed as a test for possible interactions.

The association between each pain site and poor mental health was examined through cross tabulations. Logistic regression was conducted using poor mental health as a dependent variable.

The effect of experiencing somatic pains on perceived academic impairment was investigated using multivariate logistic regression. Three models were developed for the analysis to obtain odds ratios as measures of effect. The first model included only age and sex as confounding variables. The second model included additional confounders based on findings from previous studies [20, 22]. The third model included the total score for GHQ-12 in order to examine the effect of poor mental health on the association between somatic pains and perceived academic impairment.

3. Results

3.1 Descriptive statistics

The schools that agreed to participate in this study were from the following areas in Japan: 13 out of 20 public junior high schools from Tsu City, and 32 out of 118 public junior high schools
and 28 out of the 36 public high schools from the Kochi Prefecture. Among the 19,436 students from the participating schools, 18,638 students were approached at school (798 were absent), of whom 18,250 agreed to participate in the survey. Of these 18,250 participants, 18,104 responses were analyzable (a total of 93.1% of the students from all the schools). Of these 18,104 students, 8,992 were male (49.7%) and 9,112 were female (50.3%). Their age ranged from 12 to 18 years, with a mean age of 15.2 years (SD=1.7 years).

[insert Table 1 about here]

3.2 One-month prevalence of somatic pains and GHQ-12 scores

The one-month prevalence of somatic pains for each sex and school grade are presented in Table 1. For all three somatic pains, the prevalence was higher in females than in males (p<0.01). One-month prevalence of headaches (35.5%) and abdominal pain (35.1%) were higher than that of neck or shoulder pain (19.7%) (p<0.01). Regarding differences among the various school grades, the prevalence of neck and shoulder pain (22.3%) was higher in high school students when compared to junior high school students (16.9%) (p<0.01). The prevalence of headaches and abdominal pain was comparable between junior high and high school students.

The mean total score for GHQ-12 was significantly higher in females (with a total score of 4.25) than in males (with total score of 2.81) (p<0.01). Moreover, the mean total score for the
GHQ-12 was higher in high school students (3.92) than in junior high school students (3.11) (p<0.01).

3.3 Association between the number of somatic pain sites and poor mental health

Stratified odds ratios for each age and gender group are presented in Table 2. According to the test for interaction, there was no evidence of an interaction between age, sex, and number of pain sites (p=0.84 and p=0.31, respectively).

[insert Table 2 about here]

The number of students with poor mental health increased as the number of pain sites increased (Figure 1). A total of 76.2% of students who reported problems with the three pain sites had poor mental health. The odds of poor mental health in students with one pain site was approximately 1.9 times higher than those with no pain site (OR 1.84; 95% CI: 1.70 to 2.00). The OR for those with two pain sites or three pain sites was 3.09 (95% CI: 2.80 to 3.40) and 5.43 (95% CI: 4.65 to 6.35), respectively.

[insert Figure 1 about here]
3.4 Difference between sites of pain and effects on mental health

All three sites of somatic pain increased the odds of having poor mental health in isolation (Table 3). Although the OR for neck and shoulder pain seemed to be slightly higher than the other two pain sites, there was no evidence for a significant difference among the ORs for the three pain sites. With respect to a combination of two different sites of pain, there was no evidence for a significant difference in the OR among the three different combinations.

[insert Table 3 about here]

3.5 Effect of somatic pains on perceived academic impairments

Results demonstrated that difficulties in concentrating on studies increased as the number of somatic pain sites increased (Table 4). However, after adjusting for GHQ-12 total score, there was no evidence of an association between the number of pain sites and difficulties in concentrating. This suggested that the effect of somatic pains on the difficulty of concentrating on studies may have been mediated by poor mental health.

Similarly, frustration regarding a recent decline in academic performance increased as the number of pain sites increased (Table 4). As a result of multivariate logistic regression, a substantial decrease in odds ratio were observed after adjusting for GHQ-12 total score, which also suggested mediating effects from poor mental health.
4. Discussion

The present study was one of the first to utilize a large sample of adolescent students aged 12 to 18 years old and showed that an increased number of somatic pain sites were associated with poor mental health. The important implication from the present study is that simple questions may be used to properly assess the three most prevalent somatic pains reported by adolescents. In turn, somatic pains may be feasible indicators of poor mental health in adolescents. Furthermore, the present findings suggested that the association between an increased number of pain sites and perceived academic impairment was mediated by poor mental health.

4.1 Prevalence of somatic pain sites and poor mental health in adolescents

Since the present study did not restrict pains to only chronic or intense ones, direct comparisons with previous studies which have examined chronic or frequent pain could not be made [6-7, 10, 19]. However, the prevalence of somatic pain from the present study was compatible with those found in previous studies. Additionally, a higher prevalence of somatic pain was found in females when compared to males, which fell in line with previous studies [7, 10, 19]. Moreover, a higher prevalence of somatic pains among older students was found which was also consistent
with previous research [7, 19].

The mean total score for the GHQ-12 was similar to that of previous studies conducted in Japan [17]. With regard to mean differences in the mental health of males and females, the present findings were consistent with past research which has demonstrated a higher prevalence of emotional problems in females than in males [23]. Also, in terms of school grade, the present study’s findings corresponded with a previous study which also found that somatic symptoms increased with age [23].

4.2 Association between the number of pain sites and poor mental health

The present study revealed that the association between number of pain sites and poor mental health was consistent across males and females as well as across a broad age range during adolescence. The observed association between increased number of pain sites and poor mental health was consistent with previous studies [10]. The present study employed a cross-sectional design; therefore, causal relationships between pain and poor mental health could not be made. However, a bidirectional relationship between somatic pain and poor mental health has been shown in several studies using adult samples [24-25].

4.3 Differences in the effects on mental health between sites of pain
Although different criteria were used to assess poor mental health, the ORs for headache and abdominal pain were similar to those found in Härmä’s study [10]. In contrast, the OR for neck and shoulder pain was higher in the present study than in a previous study [10]. Clear indications for the higher ORs observed in the present study have not been found.

4.4 Effect of somatic pain on perceived academic impairment

The association between somatic pain and a perceived academic impairment is comparable to a previous study which showed the association between the number of pain sites and increased functional problems [26]. Additionally, the results from the present study were consistent with a previous study which also showed that a correlation between a decline in academic performance and poor mental health [27]. Thus, the observed mediation by poor mental health suggested the following pathways: 1) somatic pain may have caused poor mental health which in turn decreased concentration on studies and induced a decline in academic performance; 2) decline in academic performance caused poor mental health which induced somatic pains; 3) poor mental health induced both somatic pains and a decline in academic performance; 4) somatic pain/poor mental health induced school absence, which led to a decline in academic performance. Any of the aforementioned pathways seem feasible. However, the last pathway (pathway 4) was also suggested by a previous study which demonstrated that school absence
was most common among children with widespread pain [28].

4.5 Strengths and limitations of the present study

To the best of our knowledge, this was the first study which investigated the association between the number of pain sites and poor mental health using a large adolescent sample with a broad range in age and school grades. Also, this was the first epidemiological study which investigated the association between somatic pains and perceived academic impairment using a large sample of adolescent students. Because the response rate was considerably high, the sample of this study was fairly representative of junior high and high school students within the survey area.

The results from the present study should be taken with a few limitations in mind. For example, the present study examined only three sites for somatic pains based on previous reports of the most prevalent pains, and did not assess other types of somatic pain such as back or limb pain. The addition of various other somatic pains may have made the present study more comprehensive. Additionally, since the present study was based on a cross-sectional design, no causal inferences can be made regarding the association between poor mental health and the number of pain sites. Moreover, the present study included only students who were present at the time of the survey; therefore, a number of students who were absent due to severe mental
and physical problems may have been missed. The present study utilized self-report measures of a perceived decline in academic performance, and did not examine report cards; therefore, the present findings may not reflect actual academic performance.

4.6 Clinical implications

The clinical implication of the present study is that simple questions may be used to accurately identify prevalent somatic pains as good indicators of poor mental health in adolescents. The strength of this method of assessment is the ease and speed in which assessment can be made. Because reporting on pains does not necessarily rely on the ability for deep recall, it is fairly easy to respond. Furthermore, when students complain of a somatic pain, teachers and school nurses should also ask students about other somatic pains experienced. School personnel and staff should also consider depression and anxiety especially when the student has multiple somatic pain sites irrespective of the student’s age or sex. Primary care physicians or pediatricians should also respond in the same manner when encountering similar situations with adolescents. Depressive individuals with comorbid somatic pain tend to use more general medical services than mental health services compared to those without pain [29]. Inquiries about pain may also be beneficial in regard to suicide prevention because previous studies on depressive patients have demonstrated that individuals with somatic pains had a lower quality of
life and higher suicidal ideation [30].

4.7 Recommendations for future studies

Investigations examining the specific factors which contribute to the association between the number of pain sites and poor mental health should be the focus of future scientific research. Additionally, interactions between genetic factors of depression and anxiety and environmental factors should be examined in future studies. Prospective studies are recommended to investigate the causal relationship between the number of poor mental health and number of pain sites. Questions pertaining to a more comprehensive approach to assessing somatic pains may also be beneficial.

5. Competing interests

All coauthors declare that they have no competing interests.

6. Authors’ contributions

SA, SY and AN designed the study and analyzed the data. SS and YO supervised the study. SA wrote the first draft of the manuscript, and all other authors revised the draft and approved the final manuscript.
7. Acknowledgement

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All coauthors declare that they have no conflict of interest.

8. References


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Figure 1  Association between the number of pain sites and poor mental health

<table>
<thead>
<tr>
<th>Number of pain sites</th>
<th>GHQ(^2)</th>
<th>(\chi^2)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>no pain (n=7793)</td>
<td>2.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 pain site (n=5565)</td>
<td>3.67</td>
<td>4.77</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2 pain sites (n=3468)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 pain sites (n=1283)</td>
<td></td>
<td>6.03</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

- \(\chi^2\) = 6.03, \(p < 0.01\)
- GHQ\(^2\) = 4.77, \(p < 0.01\)
- GHQ\(^2\) = 3.67, \(p < 0.05\)
- GHQ\(^2\) = 2.48

* odds ratio\(^a\) 1.84 (1.70–2.00), compared with no pain
** odds ratio\(^a\) 3.09 (2.80–3.40), compared with no pain
*** odds ratio\(^a\) 5.41 (4.65–6.35), compared with no pain

\(^a\) odds ratio adjusted for age, sex, alcohol use, drug use, smoking, experience of being bullied, violence from parents and sleeping time.  \(^b\) mean GHQ score
Additional files provided with this submission:

Additional file 1: Table1 120515.doc, 46K
http://www.biomedcentral.com/imedia/1111784573731573/supp1.doc
Additional file 2: Table2-120515.doc, 55K
http://www.biomedcentral.com/imedia/7581564297315736/supp2.doc
Additional file 3: Table3-120515.doc, 34K
http://www.biomedcentral.com/imedia/1236231177315736/supp3.doc
Additional file 4: Table4-120515.doc, 48K
http://www.biomedcentral.com/imedia/1757829609731573/supp4.doc