Author's response to reviews

Title: Association between Socioeconomic Status and Pain, Function and Pain Catastrophizing at Presentation for Total Knee Arthroplasty

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Author's response to reviews: see over
Response to Reviewers

The authors would like to thank the Editor and the two reviewers for their comprehensive and thoughtful comments. We have conducted additional analyses and incorporated our findings and feel that this has strengthened our manuscript.

Reviewer 1 (Dr. Wise):

1) The authors frequently use descriptors that emphasize the magnitude of findings (e.g. the first sentence of the abstract conclusion "...area-level SES had considerably lower pain..."; the first sentence of the Background "...hip joint arthroplasty are rising substantially..."; 3rd paragraph of Conclusions "...and coping are strongly associated...."; etc). This feels unnecessary to me and I would eliminate these modifiers.

Response 1: We have modified the text in a number of places to eliminate this.

Abstract, page 3, line 43: "In this cohort, patients with higher individual- and area-level SES had lower pain and higher function at the time of TKA than lower SES patients. Further research is needed to assess what constitutes appropriate levels of pain and function to undergo TKA in these higher SES groups."

Background section page 4, line 54: "In the U.S. population, rates of total knee and hip joint arthroplasty continue to rise with persistent racial, ethnic and geographic disparities in procedure use and outcomes [1-4]."

Background section page 5 line 81: “Increased pain and functional limitations at presentation for arthroplasty are predictive of poorer postoperative outcomes [16-18].”

Conclusion section page 14, line 309: “A number of studies also describe a relationship between psychological health and SES[35, 37].”

Conclusion section page 15 line 324: “Psychological health and pain catastrophizing, a reflection of stress and coping, are associated with outcomes follow joint replacement [19-22, 40].”

2) In the second paragraph of the Background, the authors describe a study showing "an association between lower social class and increased progression of knee pain and disability over time". I assume that the authors mean increase rate of progression, but perhaps they can make this explicit, since rate of change factors into some of their arguments about why they see the differences by SES that they do.
Response 2: In the referenced article, the authors looked at change scores on an instrument at the beginning and end of a seven-year period. We do not believe they factored rate of change into their analyses. We have clarified our sentence to reflect this (page 3, line 72):

“One study based in New Zealand found that individuals from lower social classes experienced a greater increase in knee pain and disability over a seven-year period, compared to those from higher social classes.[14]"

3) In the second paragraph of the Statistical Analysis section, the authors say they "performed a second set of multiple linear regression analyses that permitted more facile interpretation at the individual subject level". Usually I think of "facile interpretations" as referring to interpretations that oversimplify and thereby obscure the underlying meaning of something. I think the authors may mean instead that their regression permits a clearer understanding at the individual subject level.

Response 3: We appreciate the suggestion and have revised the wording of this (page 9, line 184):

“Two distinct sets of analyses were performed, separately for individual and area-level SES. In the first set of analyses, we defined the outcomes of interest as functional status, pain, and pain catastrophizing, expressed as continuous variables. We performed a second set of multivariate linear regression analyses that allowed for interpretation at the individual subject level and for adjustment by key covariates.”

4) The authors measured the MHI-5 and report on it, but ultimately excluded from adjusted models but did find important associations with functional status. It would improve the paper to include a paragraph discussing potential reasons for the negative and positive findings they report for MHI-5.

Response 4: We agree with the reviewer that the role of mental health, as measured by the MHI-5 required further explanation in our manuscript. We have therefore added a number of sections, in addition to additional analyses where we included MHI-5 in our adjusted models. The associations we found between SES both at the individual and area-level did not change significantly when we added MHI-5 to the model however we agree that this is an important factor to consider.

We addressed this further in our methods section page 9, line 190:

“Regression analyses included patient factors identified a priori (age and BMI) given their statistically significant relationship with both SES and the outcomes of interest. We chose to include sex based on prior studies that demonstrate differences by SES and by our outcomes of interest, although the relationship between sex and SES was not significant in our preliminary analyses. The relationship between SES and mental health (MHI-5) was significant at the individual level and of borderline significance at the area level. We felt that the role of depression specifically as a potential confounder of the relationship between SES and the outcomes of interest was less clear and we therefore conducted multivariate analyses both with and without adjustment by MHI-5.”

We described our findings in the results section page 13, line 282:
“We conducted additional analyses of the associations between education or area-level SES and our three dependent variables, in which we added mental health, as measured by the MHI-5, as a covariate to age, sex and BMI. The adjusted mean percentages of subjects with high pain, low function or high PCS were virtually identical with and without adjustment for MHI5. (Appendix Tables 1 and 2).”

We included two tables as appendices that include MHI-5 in our model pages 28-29:

Appendix, Table 1: Unadjusted and adjusted models indicating the percentage and 95% CI of subjects with high pain (WOMAC >55), low function (WOMAC >55) or high pain catastrophizing (PCS >16) stratified by individual-level SES

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted Model</th>
<th>Model Adjusted by Age, Sex, BMI</th>
<th>Model Adjusted by Age, Sex, BMI, MHI-5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Pain</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than college</td>
<td>36.5 (24.9-48.2)</td>
<td>33.8 (22.5-45.2)</td>
<td>32.6 (21.3-43.9)</td>
</tr>
<tr>
<td>Some college</td>
<td>29.7 (19.2-40.1)</td>
<td>30.1 (20.7-40.9)</td>
<td>29.9 (19.9-40.0)</td>
</tr>
<tr>
<td>College graduate</td>
<td>20.1 (14.1-26.1)</td>
<td>20.5 (14.6-26.3)</td>
<td>21.1 (15.3-26.9)</td>
</tr>
<tr>
<td>p-value*</td>
<td>&lt;0.01</td>
<td>0.02</td>
<td>0.046</td>
</tr>
<tr>
<td><strong>Low Function</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than college</td>
<td>38.5 (27.4-49.5)</td>
<td>36.1 (25.2-47.0)</td>
<td>34.2 (23.5-44.8)</td>
</tr>
<tr>
<td>Some college</td>
<td>26.6 (16.6-36.6)</td>
<td>27.1 (17.4-36.8)</td>
<td>25.8 (16.3-35.3)</td>
</tr>
<tr>
<td>College graduate</td>
<td>16.5 (10.8-22.2)</td>
<td>17.0 (11.4-22.5)</td>
<td>17.9 (12.5-23.4)</td>
</tr>
<tr>
<td>p-value*</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>High PCS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than college</td>
<td>47.1 (35.1-59.0)</td>
<td>46.5 (34.4-58.6)</td>
<td>42.9 (31.6-54.2)</td>
</tr>
<tr>
<td>Some college</td>
<td>38.1 (27.3-48.9)</td>
<td>38.6 (27.8-49.3)</td>
<td>36.0 (26.0-46.1)</td>
</tr>
<tr>
<td>College graduate</td>
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<td>21.9 (16.1-27.6)</td>
</tr>
<tr>
<td>p-value*</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

p-value* determine by test for trend across education groups
Appendix, Table 2: Unadjusted and adjusted models indicating the percentage and 95% CI of subjects with high pain (WOMAC >55), low function (WOMAC >55) or high pain catastrophizing (PCS >16) stratified by area-level SES

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted Model</th>
<th>Model Adjusted by Age, Sex, BMI</th>
<th>Model Adjusted by Age, Sex, BMI, MHI-5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Pain</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES 1</td>
<td>38.1 (29.1-47.1)</td>
<td>34.6 (25.6-43.6)</td>
<td>34.2 (25.3-43.1)</td>
</tr>
<tr>
<td>SES 2</td>
<td>26.7 (17.8-35.7)</td>
<td>25.9 (17.3-34.6)</td>
<td>25.6 (17.0-34.2)</td>
</tr>
<tr>
<td>SES 3</td>
<td>15.6 (8.6-22.6)</td>
<td>18.2 (11.3-25.1)</td>
<td>18.6 (11.8-25.5)</td>
</tr>
<tr>
<td>p-value*</td>
<td>&lt;0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Low Function</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES 1</td>
<td>34.5 (25.8-43.3)</td>
<td>31.1 (22.4-39.8)</td>
<td>30.5 (22.1-39.0)</td>
</tr>
<tr>
<td>SES 2</td>
<td>20.9 (12.3-29.6)</td>
<td>20.0 (11.6-28.4)</td>
<td>19.5 (11.3-27.7)</td>
</tr>
<tr>
<td>SES 3</td>
<td>15.6 (8.9-22.3)</td>
<td>18.2 (11.5-24.9)</td>
<td>18.9 (12.4-25.4)</td>
</tr>
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<td>&lt;0.01</td>
<td>0.03</td>
<td>0.049</td>
</tr>
<tr>
<td><strong>High PCS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES 1</td>
<td>32.5 (23.0-42.1)</td>
<td>31.2 (21.5-41.0)</td>
<td>30.0 (21.0-39.1)</td>
</tr>
<tr>
<td>SES 2</td>
<td>35.3 (25.8-44.8)</td>
<td>34.8 (25.3-44.2)</td>
<td>33.7 (25.0-42.5)</td>
</tr>
<tr>
<td>SES 3</td>
<td>21.3 (13.9-28.6)</td>
<td>22.5 (15.0-30.0)</td>
<td>23.7 (16.8-30.6)</td>
</tr>
<tr>
<td>p-value*</td>
<td>0.04</td>
<td>0.12</td>
<td>0.22</td>
</tr>
</tbody>
</table>

SES 1 is lowest area-level socioeconomic status, SES 3 is the highest
*p-value determine by test for trend across SES groups

We have also expanded on this further in our discussion section, page 14, line 316:
“A number of studies also describe a relationship between psychological health and SES[35, 37]. Lower individual and area-level SES contributes to increased psychological stress and poor mental health [38]. Conversely, prolonged poor psychological health may result in lower SES [39]. In our cohort, while lower scores on the mental health index were associated with increased pain and decreased function, the relationship with SES was of borderline significance. We observed little difference in the relationship between SES and pain, function and pain catastrophizing in our models that adjusted for MHI-5 compared to those that did not, suggesting that SES effects are independent of mental health.

5) It is also of interest that the authors found that older age was associated with better functional status and lower pain catastrophizing scores. Again, this probably merits some discussion in the conclusions section.

Response 5: We appreciate the reviewers thought here. We chose not to focus on this since it was not the primary goal of the paper but rather an attempt to determine the relationship between confounders and the exposure (SES) and outcomes of interest in bivariate, unadjusted analyses.

We have added the following sentence to our discussion, page 19, line 459:
“...We also identified an association between older age and better function and lower catastrophizing which is an important topic to examine further in future research.”
6) The authors should consider either starting or finishing the Conclusions section with a paragraph that restates in simple language their main findings in a couple of sentences. This serves to reinforce the central point of the paper.

Response 6: We appreciate this suggestion and have added the following paragraph to the end of our paper, page 19, line 443:

“Overall, in our cohort, we found that individuals with higher educational attainment and from higher SES areas were significantly less likely to present for TKA with high pain and poor function compared to individuals with low educational attainment and from low SES areas. We also found a significant relationship between higher educational attainment and lower pain catastrophizing scores. Overall, this is the first U.S.-based study to specifically examine the association between individual and area-level SES and pain, function, and pain catastrophizing among individuals undergoing TKA. These factors have been shown to be important predictors of TKA outcomes. Additional strengths of this study include the use of both individual and area-level geocoded measures to allow for a multifaceted understanding of the relationship of SES with our outcomes of interest. In addition, we conducted our analyses using a relatively large cohort of individuals with complete, comprehensive demographic information and validated survey measures. Further studies are necessary to confirm a trend of less severe pain and better function at baseline among individuals with higher individual and area-level SES compared to lower. Additional research is also needed to develop and apply appropriateness criteria to examine potential sociodemographic disparities in TKA use and outcomes.”

7) The authors propose that one explanation for their findings is that TKA may not have been indicated for some of the higher SES persons presenting for TKA. This is an interesting possibility and may in some cases be true, and the authors delve into this in detail, presenting explanations for why this may be the case in paragraphs 4 and 5 of the Conclusions section. However, another explanation for the findings might be that higher SES individuals are presenting mostly at appropriate times for TKA, but lower SES persons are waiting beyond the point at which consideration of TKA is appropriate, either due to financial considerations, lack of access, differences in work environments, etc. I think it would behoove the authors to explore this possibility in the Discussion section as well.

Response 7: We agree that this is an important alternative explanation. We have added the following to our discussion section, page 17, line 393:

“Another potential explanation for our findings may be that higher SES individuals undergo TKA surgery at appropriate times while lower SES individuals wait too long for their procedure, which may result in poorer outcomes.[5-8] It is plausible that individuals with higher SES may have both better access to orthopedic care and a lower threshold to seek TKA surgery compared to those with lower SES. A slight improvement in quality of life might be seen as readily attainable and therefore desirable. The loss of work during recovery may be less of a factor for higher SES individuals, and caretakers and social support may be more available. One study examined outcome expectations for joint replacement surgery and found that the differences by race were attenuated when employment status, income and education were added to the regression model[13]. Certain factors that we observed, such as less smoking and lower BMI among higher SES individuals may also render them better surgical candidates increasing the
likelihood that the TKA would be offered. In our cohort, the majority of patients are Medicare recipients and therefore insurance status likely plays less of a role for both the patient and the surgeon.”

8) The authors give an extensive "limitations" paragraph. However, there is no corresponding "strengths" paragraph. Given that substantial strengths do exist in their study, I would suggest adding such a paragraph toward the end of the Conclusions section.

Response 8: We have added the following section to page 19, line 447:

“Overall, this is the first U.S.-based study to specifically examine the association between individual and area-level SES and pain, function, and pain catastrophizing among individuals undergoing TKA. These factors have been shown to be important predictors of TKA outcomes. Additional strengths of this study include the use of both individual and area-level geocoded measures to allow for a multifaceted understanding of the relationship of SES with our outcomes of interest. In addition, we conducted our analyses using a relatively large cohort of individuals with complete, comprehensive demographic information and validated survey measures. Further studies are necessary to confirm a trend of less severe pain and better function at baseline among individuals with higher individual and area-level SES compared to lower. Additional research is also needed to develop and apply appropriateness criteria to examine potential sociodemographic disparities in TKA use and outcomes.”

Reviewer 2 (Dr. Campbell)

1) Page 5, line 85 – Wording “…aimed to investigate the impact”, I feel “impact” is a little too strong for a cross sectional design and “association” be used instead.

Response 1: We agree with the reviewer and have changed the sentence to reflect this, page 5 line 85:

“We therefore aimed to investigate the association of SES, both at the individual and area levels, with preoperative pain, function and pain catastrophizing.[23] We hypothesized that a gradient may exist whereby greater SES would be associated with lower levels of pain and better function at presentation for TKA, possibly as a result of better access to orthopedic care.”

2) Figures 3 and 4 legends mention that adjustment occurred for age, sex, BMI and depression but within the statistical analysis section the authors state that they did not adjust for depression? In addition, the authors suggest that depression was not included because it did not associate with “both SES and outcomes”, however neither did sex (SES 0.89) but this was added to the model. There seems to be a lack of consistency in the analysis.

Response 2: Thank you for raising this important point. We have clarified this in the methods section and in the results section. In addition, we conducted additional analyses including MHI-5. The associations we found between SES both at the individual and area-level did not change significantly when we added MHI-5 to the model however we agree that this is an important
factor to consider. Figures 3 and 4 are age, BMI and sex adjusted, not MHI-5 adjusted and we have corrected this.

We addressed this further in our methods section page 9, line 190: “Regression analyses included patient factors identified a priori (age and BMI) given their statistically significant relationship with both SES and the outcomes of interest. We chose to include sex based on prior studies that demonstrate differences by SES and by our outcomes of interest, although the relationship between sex and SES was not significant in our preliminary analyses. The relationship between SES and mental health (MHI-5) was significant at the individual level and of borderline significance at the area level. We felt that the role of depression specifically as a potential confounder of the relationship between SES and the outcomes of interest was less clear and we therefore conducted multivariate analyses both with and without adjustment by MHI-5.”

We described our findings in the results section page 13, line 282: We conducted additional analyses of the associations between education or area-level SES and our three dependent variables, in which we added mental health, as measured by the MHI-5, as a covariate to age, sex and BMI. The adjusted mean percentages of subjects with high pain, low function or high PCS were virtually identical with and without adjustment for MHI5. (Appendix Tables 1 and 2).

We included two tables as appendices that include MHI-5 in our model pages 28-29 (see Response to Reviewer 1, #4 for the tables).

We have also expanded on this further in our discussion section, page 14, line 316: “A number of studies also describe a relationship between psychological health and SES[35, 37]. Lower individual and area-level SES contributes to increased psychological stress and poor mental health [38]. Conversely, prolonged poor psychological health may result in lower SES [39]. In our cohort, while lower scores on the mental health index were associated with increased pain and decreased function, the relationship with SES was of borderline significance. We observed little difference in the relationship between SES and pain, function and pain catastrophizing in our models that adjusted for MHI-5 compared to those that did not, suggesting that SES effects are independent of mental health.

3) Page 4, line 60, sentence “In the UK...” onward to end of paragraph. The authors report evidence of a review study, and then go on to describe evidence from a Canadian based study to support their argument on the effects of SES. I feel that they could structure their argument a just little more clearly here, and spell out what the implications are, it just does not feel clear enough.

Response 3: We have revised the first paragraph of the background section to make our argument clearer, beginning on page 4, line 54: “In the U.S. population, rates of total knee and hip joint arthroplasty continue to rise with persistent racial, ethnic and geographic disparities in procedure use and outcomes [1-4]. Studies to date have examined a number of factors relating to socioeconomic status (SES) and joint arthroplasty including differences in access, need, willingness to undergo the procedure, and
outcomes. Prior studies based in Europe and Australia examined the influence of SES on joint arthroplasty and demonstrated that the lowest income individuals and those from the most deprived areas presented for surgery with the poorest health-related quality of life, had the lowest rates of surgery, and experienced more post-operative adverse events than higher income individuals and those from less deprived areas [5-8]. A Canadian-based study surveyed individuals with moderate-to-severe knee and hip osteoarthritis and found that less education and lower income were associated with increased need for arthroplasty (based on Western Ontario and McMaster Universities Arthritis Index (WOMAC) score ≥39 without a contraindication to surgery), and that these lower SES individuals were equally willing to undergo the procedure as their higher SES counterparts [9]. In the UK, a review of hospitalizations for primary and revision hip and knee replacements between 1991 and 2001 demonstrated that the most deprived fifth of the population experienced significantly lower incidence rates of surgery.[5] In each of these studies, lower SES was shown to be associated with reduced arthroplasty use or with adverse outcomes.”

4) Table 1. I have no sense of the spread or distribution of the values and I would like to ask if the median values could be entered.

Response 4: We have added the median values to Table 1 and to the results section, page 10, line 229:

“There were 316 individuals enrolled in the combined cohort; the mean age was 65.9 (SD 8.7) the median was 65.8, 186 (59%) were female, and 278 (88%) were Caucasian (Table 1). The mean BMI was 30.5 (SD 6.3), the median BMI was 29.6, 8 percent were current smokers, 17 percent had less than college education, 21 percent had some college and 62 percent were college graduates. The overall mean MHI-5 score for this cohort was 76.2 (SD 17.2) and the median was 80. There were 239 individuals (76.4%) with MHI-5 scores ≥68.”

We added the median values for the overall cohort to Table 1, page 25:
5) Whilst the authors report the non-significant relationship between SES and MHI-5, this was for area level, was this the same for individual level?

**Response 5:** There was a significant relationship between individual SES and MHI-5. We have added this to our methods section, page 10, line 213:

“The relationship between SES and mental health (MHI-5) was significant at the individual level and of borderline significance at the area level. We felt that the role of depression specifically as a potential confounder of the relationship between SES and the outcomes of interest was less clear and we therefore conducted multivariate analyses both with and without adjustment by MHI-5.”

We have also added this to our results section, page 11 line 238:

“The MHI-5 was significant across individual-level SES groups (p=0.04) and of borderline significance across area-level SES groups (p=0.06).”

6) Page 14, line 272. Authors state that “SES remained an important correlate of these outcomes [outcomes in the study] after adjusting for these factors”. This sentence is within a general discussion of the effect of mental health however, the measure of mental health was not entered into the multivariate analysis because it had a non-significant relationship with SES. I wonder if the authors would tailor this slightly to reflect this?

**Response 6:** We have conducted additional multivariate analyses as per the reviewer’s suggestion the include MHI-5 and we changed discussion to reflect this, page 14, line 331:

“A number of studies also describe a relationship between psychological health and SES[35, 37]. Lower individual and area-level SES contributes to increased psychological stress and poor mental health [38]. Conversely, prolonged poor psychological health may result in lower SES [39]. In our cohort, while lower scores on the mental health index were associated with increased pain and decreased function, the relationship with SES was of borderline significance. We observed little difference in the relationship between SES and pain, function and pain catastrophizing in our models that adjusted for MHI-5 compared to those that did not, suggesting that SES effects are independent of mental health.

7) Whilst the general trends within figures 3 and 4 are similar there are also some differences and I feel it would be good to discuss reasons for those differences in terms of the two types of SES. For example area level SES does not appear to factor for catastrophising but at an individual level it does, why might this be?

**Response 7:** We agree with the reviewer that this is important to note and have added the following to our discussion, page 15, line 356:

“In our adjusted analyses, we found a significant association between higher educational attainment and lower pain catastrophizing scores. However we did not find a significant
relationship between area-level SES and pain catastrophizing. We are not sure why neighborhood characteristics appear to play less of a role than individual-level factors on this aspect of psychological health, and suggest this as an important area for further inquiry.”

8) Pg6, Individual Level SES section. Whilst the authors offer a reference that shows educational attainment can be used as a proxy for SES, can they give any details of the specific questions they used, have they been used previously?

Response 8: We have added to our description of educational attainment, page 6, line 136: “Educational attainment, a frequently used proxy for individual-level SES [23], was obtained by self-report in response to the question: “What is the highest level of education you achieved?” and included the categories of 1) did not graduate from high school, 2) graduated from high school but did not attend college or technical school, 3) graduated from high school and attended college or technical school and 4) graduated from high school and graduated from college or technical school. Given the small number of individuals indicating less than high school education in our cohort, the first and the second groups were combined and categorized as “less than college.” This question of highest level of education achieved, with the aforementioned categories, is widely used in U.S.-based studies of adults as a relatively static, well-demarcated measure across the U.S population of individual-level SES.”

9) It would have been nice to have some indication whether adjustment in the multivariate models attenuated the relationship between SES and outcome at all.

Response 9: We have included descriptions of the unadjusted model, the model adjusted by age, sex and BMI and the model additionally adjusted for MHI-5, both in the results section and in Tables 1 and 2 of the Appendix.

In the results section, we have added the following, page 12, line 273: “We then conducted a series of unadjusted and adjusted analyses examining the percentage of subjects, stratified by SES, with high pain (WOMAC >55), low function (WOMAC >55) and high pain catastrophizing (PCS≥16). In our unadjusted analyses, at both the individual and area-level, we found statistically significant trends between higher SES and lower percentages with high pain, low function and high pain catastrophizing (Appendix Tables 1 and 2). Multivariate analyses, adjusted for age, sex, and BMI, showed significant associations between lower individual-level SES and poor function (WOMAC >55), high pain (WOMAC >55) and high pain catastrophizing (PCS≥16). We found that 33.8% of subjects (95% CI 22.5-45.2) with less than college education (lowest SES) and 20.5% (95% CI 14.6-26.3) of college graduates (highest SES) presented with high pain (p=0.02), while 36.1% (95% CI 25.2-47.0) with the lowest SES and 17.0% (95% CI 11.4-22.5) with the highest presented with poor function (p<0.01) (Figure 3). We also observed significantly higher mean pain catastrophizing scores among patients with less than college level education compared with college graduates (p<0.01). Compared to our unadjusted model, at the individual SES level, we saw a slight attenuation in percentage of those in the lowest SES group with high pain, low function and high PCS, however values were within less than 7% for all SES strata and statistical significance was consistently achieved.

In parallel adjusted analysis that examined area-level SES, we found that 34.6% (95% CI 25.6-43.6) with the lowest area SES and 18.2% (95% CI 11.3-25.1) with the highest presented
with high pain (p=0.01), while 31.1% (95% CI 22.4-39.8) with the lowest area SES and 18.2% (95% CI 11.5-24.9) with the highest presented with poor function (p=0.03) (Figure 4). We did not observe a statistically significant trend in the relationship between area-level SES and pain catastrophizing scores (p=0.12).

We conducted additional analyses of the associations between education or area-level SES and our three dependent variables, in which we added mental health, as measured by the MHI-5, as a covariate to age, sex and BMI. The adjusted mean percentages of subjects with high pain, low function or high PCS were virtually identical with and without adjustment for MHI5. (Appendix Tables 1 and 2).

10) Page 14, line 284. “...income the low rate areas”, should the “the” be “than”?

Response 10: We have changed this.