Author's response to reviews

Title: Physical activity is associated with a low prevalence of musculoskeletal disorders in the Royal Norwegian Navy: a cross sectional study

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Physical activity is associated with a low prevalence of musculoskeletal disorders in the Royal Norwegian Navy: a cross sectional study”.

Dear EDITOR,

Thank you very much for considering our manuscript for publication in your journal, and for your comments regarding our article. Based on the comments from the reviewers, we have now revised our manuscript.

The abstract is included.

On the next pages you will find a point-by-point description of the changes made. In the letter we refer to the revised manuscript.

With kind regards

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Reviewer 1 (Jan Hartvigsen):
Thank you very much for your comments.

Major Compulsory Revisions

I. Cross sectional study
We agree that a cross sectional design has great limitations in studying physical activity as the possible cause of musculoskeletal disorders. Anyway, in our opinion the associations between the factors could give some valuable information to be followed up in a longitudinal study.

II. Prevalence of MSD
Hartvigsen wrote: “The fact that the employees in the navy has high prevalence of MSD…”

We did not find a high prevalence of MSD in the navy. In the Discussion section, 6th paragraph we have written:

“The one-year prevalence of 32% of frequent MSD in one or more parts of the body among workers in the Navy is rather low compared to other working populations”.

II. Healthy worker effect
Hartvigsen wrote: “… the civilians have more MSD since civilian jobs are probably less strenuous so these people tend to stay in the job in spite of MSD.”

In Results, 1st paragraph (last sentence), we did describe the possible more strenuous jobs among the civilians compared to the military:

“We analysed each question in the physical stressors index and found that civilians reported more twisted positions (Pearson $\chi^2$, $P = 0.001$) and work above shoulder height (Pearson $\chi^2$, $P < 0.001$) both in the Navy and outside the Navy, but not more heavy lifting.”

In the logistic regression analysis of the association between physical activity and MSD we adjusted for the possible confounder of strenuous jobs by the “physical stressors index”. We found that the civilians still had more MSD than the military in the neck and lower back. By a mistake this adjustment was not specified in the Method section (but was included in Table 3). This is now specified in Statistical methods, the 3rd paragraph. Anyway, we agree that there might be a healthy worker effect and we did discuss this in Discussion, 5th paragraph:

“The difference between civilians and military personnel might be explained by the selection of military personnel due to requirements for fitness for duty. The requirement of fitness among military personnel probably leads to a selection of healthier persons to the military group.”
Reviewer 2 (Karin I Proper):
Thank you very much for your comments.

Major Compulsory Revisions

I. Representative sample
1) Recruitment:
All employees in the Navy were invited to the study. This was described only by a number of persons, but is now specified in the Method section, 1st paragraph:

“In 2002, all employees working in the Royal Norwegian Navy (3878 persons) were invited…”

2) Low response rate (58%)
We agree that the response rate have to be discussed. A discussion of the low response rate and a possible selection bias is now included in Methodological considerations, 2nd paragraph:

“The response rate in this study was 58%. A selection bias might have been present if those who did not answer our questionnaire had a different prevalence of MSD and a different degree of physical activity compared with those who responded. Similarly a different association between physical activity and MSD for the responders and non-responders could create such bias. Since the survey was a part of a general health survey among employees and not specifically about MSD and physical activity we do not believe that the selection bias was a major issue.”

II. Measurements and definitions
1) The reference of the physical activity questionnaire used is Kurtze et al 2003. This is now included in the text in the Method section, 3rd paragraph.

2) The actual questionnaire on physical activity has been validated, but the results are not published yet.

3) Health-related effect assumed of light activity?
To find more information about the importance of light activity, we have performed more analyses and included the following sentence in the Results section, 4th paragraph:

“The odds ratios for the inversed association between physical activity and MSD were weakened when the data on light physical activity was excluded from the analysis.”

In the Discussion section, 1st paragraph, is included the following sentence:
“Both heavy and light physical activity were inversely associated with MSD.”

4) Associations of the physical activity measures separately
We repeated the multiple logistic regression analysis of the association between physical activity and MSD with physical activity by the four independent variables (light physical activity at work/ at leisure, heavy activity at work/at leisure) (not described in the text). In this analysis, light physical activity showed significant association with MSD for more body parts than heavy physical activity. We think this supports the significance of light physical activity as mentioned previously.

III. The rationale for choosing the study population
We have revised larger parts of the Background section to clarify our rationale for the study. The rationale for a choosing the study population is the fact that they have possibility for physical activity at work. We expected a difference between civilian and military personnel.
due to the fitness test (3rd paragraph). We agree that military could have a higher risk to develop sports injuries, but we assume that sports injuries will be reported among self-reported MSD as focused in our study. We have tried to clarify the difference between sports injuries and MSD by definitions in the Background section:

1st paragraph:
“Musculoskeletal disorders (MSD), defined as self-reported musculoskeletal symptoms…”

2nd paragraph (two last sentences):
“However, sporting activities and physical training are also sources of musculoskeletal injuries [19]. Musculoskeletal injuries are defined as any physical complaint sustained by a person as a result of sport training [20], and many of these might be included among self-reported MSD.”

Minor Essential Revisions

Introduction
A. Positions
We have included some more viewpoints to clarify our rationales for the study in the introduction (2nd paragraph):

“Review studies on dose-response relationship between physical activity and health conclude that several health parameters are related to the amount of physical activity in a graded fashion... Guidelines on physical activity recommend longer duration of moderate-intensity physical activity to achieve the same health benefits as for vigorous intensive activities.”

B. Definition of MSD.
We have now tried to clarify our definition of MSD in the beginning of the Background section:
“Musculoskeletal disorders (MSD), defined as self-reported musculoskeletal symptoms…..”

The inclusion of injuries is described above (point III in this letter)

C. Studies of physical activity….(page 2, line 7 in the first manuscript):
We have tried to clarify what we stated by changing to the following sentence in Background section, 2nd paragraph (4th sentence):
“…studies of physical activity are often limited to either leisure activity or physical activity at work.”

D. Page 2: ref #9 (1st manuscript).
We have added the reference from Pate et al 1995(ref 12)

E. Page 3, 1st paragraph (1st manuscript): Conclusions of the studies.
We have changed and included the following sentences to be more precise regarding the conclusions of the referred studies (Background, 3rd paragraph):
“However, some studies conclude with a high prevalence of MSD among military personnel [23-25] … Several studies describe frequent musculoskeletal injuries caused by physical training among military personnel [19-22].

Methods
A. Page 4.
A more precise description of the recruitment of the study population is given. See our answer to your first point.

B. Page 4 (1st manuscript).
Measurement of MSD.
We agree about the advantage of asking about more details like intensity, severity and duration of MSD. As part of a large study of health and work environment in the Navy with a lengthy questionnaire, there were demands for brief instruments. Anyway, we think that our way of asking give information that is valuable for testing some associations between physical activity and MSD.

In the Method section, 2nd paragraph, we also have tried to explain that the duration of symptoms might be unnecessary in this study as frequency seem to correspond with number of days:
The frequency of symptoms as response options for low back pain has been tested to correspond well with the number of days with symptoms [28].

We agree that the validity of the MSD in the head might be low. “Head” was not included in the original Nordic Questionnaire but added to a Norwegian version. Due to the uncertainty of what kind of disorders this is about, we have decided to exclude “head” from the study, as we have done in previous studies.

C. BMI and smoking
We have followed your advice and changed the variables BMI and smoking into two and three categories respectively. We have performed new analyses and changed tables and text according to this.

D. Page 6 (1st manuscript), the physical activity scale.
We have performed separate analyses on the physical activity variables. This is described above (point II.4).

Results
I. Page 7 (1st manuscript).
Testing differences between military and civilians.
We wanted to find whether there where differences between military and civilians to show the need for adjusting for working status in the further analysis. The main analysis of association between physical activity and MSD is performed with both military and civilians, and not separately.

II. Page 9 (1st manuscript).
In the multiple regression analysis we have adjusted for age, gender, BMI, smoking status, education and physical stressors index in addition to employment status (military/civilian). To make this clear we have added the word “multiple” under Statistical methods.
Reviewer 3 (Alex Burdorf):
Thank you very much for your comments.

Major Compulsory Revisions
1. The abstract is now included.

2. Classification of physical activity.
The description on classification of physical activity is now moved from Statistical analysis to The questionnaire and variables.

Our questionnaire on physical activity is used in several Norwegian studies and is in the process of validation. The validity study is not published yet. The correspondence with often used guidelines is therefore not well known at this moment.

In Table 2 we use the variable “physical activity” categorically, and since there was a linear trend we decided to use “physical activity” as an ordinal scale in the logistic regression. (Due to comment from another reviewer, we have repeated the analysis with three categories instead of five and revised the table).

3. Physical activity in leisure time and work.
We have discussed the validity of the questionnaire in Methodological considerations, 3rd paragraph:
“Physical activity was measured by a questionnaire, and the validity and reliability of this method may be questionable [40]. However, a questionnaire may be the only feasible method of assessing physical activity in large populations. We asked about physical activity during work, and this might include physical activities that both benefit and harm musculoskeletal health.”

Regarding the now called “physical stressors index” (due to advice from another reviewer), we actually did analyse our data without this index before entering it into the model. When we entered it into the model the estimates for the associations between physical activity and MSD became marginally stronger. We think this is a result of adjusting for unhealthy physical activity included in the physical stressors index (i.e. heavy lifting, working in twisted positions and hands above shoulders). We agree that ideally the question should have been stated as current exposure.

Assumed linearity of “physical stressors index”:
We have now categorised the physical stressors index and performed the multiple logistic regression analysis with the categorised variable (The questionnaire and variables, 4th paragraph):
“The 6 physical stressors questions were transformed into a physical stressors index ranging from 0 to 24. The physical stressors index was characterised as very low for scores 0-4, low for 5-8, high for 9–12 and as very high for scores 13–24.”

See also Table 3.

Minor Essential Revisions
1. Reference 11. We have changed the sentence in Background section (2nd paragraph) to be less definite:
“A review study on worksite physical activity programmes concluded with positive effect on MSD [14].”
2. Guidelines on physical activity.  
We have included CDC guidelines in the Background section (ref number 13).

3. A reference for the measurement of physical activity is included in Questionnaires and variables, 2\textsuperscript{nd} paragraph (Kurze et al. 2003, ref number 32).

4. Reference for the Nordic questionnaire.  
The reference used for the Nordic questionnaire was really a mistake and is now changed to Kuorinka 1987. Thank you!  
The word “reduced mobility” was not focused in our questionnaire and has been removed from the text.

5. The description of Table 1 and Table 3 in the text is now reduced.

6. Table 1. Physical activity is presented as a linear ordinal variable in Table 1, since this is how it was used in the multiple logistic regression. Although we used it as a categorical measure in Table 2 we decided not to present the categorical values in Table 1.

7. Table 3. “Head” is excluded from the whole study, based on advice from another reviewer.

**Discretionary Revisions**
1. “More exposure to physical risk factors” is removed since we have changed the text regarding physical stressors (See Questionnaires and variables, 4\textsuperscript{th} paragraph)
Reviewer 4 (Linda A Merlino):
Thank you very much for your comments.

Major Compulsory Revisions
1. We have now moved the description of the scale of physical activity from the Statistics section to the Questionnaires and variables as recommended by another reviewer. Hopefully, this will make the construction of the scale easier to understand.

Linear association (Table 2):
We have now collapsed the categories into three instead of five. The expected count is now above five in all cells.

2. The low response rate
We agree that we need to discuss the response rate. A discussion of the low response rate and a possible selection bias is now included in the Discussion section (Methodological considerations, 2nd paragraph):

“The response rate in this study was 58%. A selection bias might have been present if those who did not answer our questionnaire had a different prevalence of MSD and a different degree of physical activity compared with those who responded. Similarly a different association between physical activity and MSD for the responders and non-responders could create such bias. Since the survey was a part of a general health survey among employees and not specifically about MSD and physical activity we do not believe that the selection bias was a major issue.”

Minor Essential Revisions
3. Use of the term musculoskeletal disorders.
We have now tried to clarify our definition of MSD in the beginning of the Background section:

“Musculoskeletal disorders (MSD), defined as self-reported musculoskeletal symptoms….”

4. The term “physical workload” is now changed to “physical stressors” during the whole manuscript. We agree that this may help clarifying the content of the concept.

5. Methods. The 5-point scale range.
We have specified the 5-point scale under Methods as follows:

“A five-point response scale “never, seldom, sometimes, often, very often” was used.”

6. The median values for the physical activity variable for civilians and military are included in Results, 1st paragraph.

7. Page 8 (in 1st manuscript): “Negatively” is replaced by “inversely”:
“…In the logistic regression analysis (Table 3), physical activity was inversely associated with MSD…”

Discretionary Revisions
8. Background page 2 (1st manuscript)
”a high degree of variability into measurable units…”
is changed into
”a high degree of variability of measurable units…”

9. Second to last sentence before study aims (1st manuscript).
We have revised the Background section and used parts of your suggested changes.
10. Page 6, second paragraph (1st manuscript).
We have changed text regarding physical stressors. See The questionnaires and variables, 4th paragraph.

11. Discussion, 1st paragraph:
Since this study is cross-sectional we have tried to avoid expressions that might be interpreted as cause – effect relationship.

12. Discussion, 5th paragraph
The sentence is changed according to your suggestion:
“In the Navy, civilians had a higher prevalence of MSD than military personnel. An association between being a civilian and having MSD persisted for the neck…”

14. Methodological considerations, 3rd paragraph:
The last sentence “However, a questionnaire …” is moved to after the first sentence according to your suggestion.