Author’s response to reviews

Title: Risk factors for neck pain among forklift truck operators. A retrospective cohort study.

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We would like first to express our gratitude for the extensive work both reviewers have done in relation to our manuscript. The detailed comments have been of value for us and have improved the manuscript. We have done our best to revise our manuscript according to your advice. All the changes in the manuscript are marked with yellow.

Response to reviewer 1, K Walker-Bone:

The authors present a study comparing the prevalence of neck pain 'ever' among workers in warehouses. The two main occupational groups are forklift truck operators and office workers. There are a number of important issues about this study design:

1) 41% of the office workers had previously been forklift operators in the same warehouse. This seems extraordinarily high and, even with the analyses presented in Table 3 attempting to adjust for years of exposure, fail to convince this reviewer that this is a true case-control comparison.
Response 1:
The company where the study is performed is a large international company where great opportunities are given for career development. That is why so many office workers previously have worked as fork lift truck operators. This study is a retrospective cohort study based on two different occupations. The respondents have answered the questionnaire from their current work title at the year when the study started.

Office workers, having got their neck pain one year or less before they started working as office workers, i.e. as forklift operators, were excluded from further analyses of the office workers. This means, that the impact from unnatural neck positions as a forklift operator was not included in the status or answers of the office worker. See the statistics.

2) Response rates were low. It is unclear what was communicated to workers about the means/purposes of the research or whether the workers perceived that the research might impact in some way on their employment. This may well have biased responses.

Response 2:
All workers were invited to participate and answer a questionnaire about experienced health and work environment. We invited every worker independent of health status to participate. We did not specifically ask for those with neck pain. The study was supported both by the union and the human resource manager, informing and encouraging all workers at their staff meetings to participate in the study. At the invitation to the study the workers were guaranteed that their answers of the questionnaire would not appear to anyone else than the research team. An explanation to the low answer frequency might be that a great number of fork lift operators were immigrants with low knowledge in Swedish language. Their low response rate would probably not bias the results of the study, since the immigrant workers would not be expected having more or less neck pain than the native Swedish workers. We have clarified the target group under the method section at page: also explained in the discussion of methodology.

3) Neck/shoulder disorders commonly overlap, as discussed in the Introduction and Discussion. For these analyses, shoulder pain is treated as a risk factor (which is significant) but it would be
really useful to re-analyse the data combining neck and shoulder pain to see what the risk factor profile look like when they are combined.

Response 3:
This study has a focus on foremost ergonomic exposures as risk factors for neck pain, especially in fork lift drivers. The prevalence of reported shoulder pain is presented in table 1. It is also presented as a risk factor in table 2. It has been taken into account in the multiple regression analysis, table 3.
Other risk factors presented in table 1 are only taken care of as possible confounding factors in order to analyze the mere effect from various head postures. In this study we do not have any primary focus on shoulder pain.

4) Three outcomes are discussed: neck pain ever; neck pain in the last 7 days and sick leave attributed to neck pain. Subsequently, results are presented for 'neck pain prevalence' and I assume that the outcome in these analyses is 'neck pain ever'? It would strengthen the manuscript if the analyses with all three outcomes were at least discussed. Without any mention of these, this reviewer suspects that the same associations were not shown?

Response 4:
In table 1 subjects are reported as affirmed having or having had neck pain, thus a measure of prevalence. In table 2 we also present prevalence rate ratios. In table 3 we present incidence rate ratios for neck pain, i.e. developing neck pain. We will clarify these facts in the results and in table 1-3.

5) The authors postulate a 'healthy worker effect' that acts differently between their groups, postulating that the forklift truck drivers are forced to stop these jobs due to their neck pain. Can they provide any results to support these assertions? Given that so many of the office workers seem to have stayed at the warehouse after operating the forklifts in the past, is this really the case? It would be so much cleaner to compare those NEVER exposed to forklift driving with those with say at least 2 years of exposure?
Response 5:
Those forklift operators, who got neck pain and therefore changed to become an office worker, were excluded from the risk calculations for neck pain among office workers.

6) I am surprised that the respondents in both occupational groups report such wide variation in exposure to e.g. sitting. Were they actually doing very different work?
Response 6:
In this large company workers are given possibilities to do different work tasks during their work hours. They can sit or stand while doing their work. For example working with the low lifting order picker one stands while working and, some are order pickers in the warehouse. When it comes to the office workers they use height adjustable work stations, thus varying between sitting and standing. This is explained in the method section.

7) In the Discussion, the importance of 'previous neck pain' as a risk factor for neck pain is reported. I cannot see any clear indication that these results were adjusted for previous neck pain or pain at any site?
Response 7:
Since the aim of the study was to identify new development on neck pain possible connected to the exposed employment time individuals that reported previous neck pain in their life were removed from the multivariate analysis. We have clarified this in the manuscript in statistics.

Anna Grimby-Ekman, PhD (Reviewer 2): Reviewer comments from AGE on "Risk factors for neck pain among forklifting truck operators"

Major revisions
1) In title, and also in the text in the manuscript, it need to be written clearer whether "neck pain" is referring to "having neck pain" or "developing neck pain".
Response 1:
In table 1 subjects are reported as having affirmed having or having had neck pain. Thus, a measure of prevalence. In table 2 we also present prevalence i.e. prevalence rate ratios. In table 3 we present incidence for neck pain, i.e. developing neck pain. We will clarify these facts in the text. We have added the retrospective perspective in the title. We will clarify when we refer to prevalence or incidence in the text (statistics).

2) The questionnaire: Describe what time span the questions ask about. How is time referred to in the questions?

Response 2:
For every question about pain or exposure/employment or other items we have asked about year of start and end. This gives us possibilities to calculate exposed/ unexposed person years up pain onset. A clarification on this is added in the methods chapter.

3) The outcome variable "neck pain" needs to be defined in the methods section, preferably at line 28 after the "study population" section. Deleting the individuals who had neck pain before employment should be described in connection to this (now comes later).

Response 3:
A clarification of this is added in the methods chapter (statistics)

4) Where there information on the time for onset of neck pain for the 18 office workers that were previously fork lifting operators? Were the onset before or after they became office workers and how was their exposure time calculated? If you can work this out and improve the use of your "Control Group" one of the major weaknesses in the manuscript will be improved.

Response 4:
Since we have excluded individuals who have stated neck pain before they have started their current work as an office worker, time from start as an office worker up to year of start for neck
pain is calculated. Thereby we have avoided including neck pain caused by work as a fork lift operator in office workers. We have clarified this in the methods chapter.

5) The issue or risk for bias due to many office workers previously being fork lifting operators need to be both discussed more thoroughly and also addressed with complementary analysis.

Statistics (line 24): There is no justification mentions why the univariate tests are done, presented in Table 1. These kind of "Table 1 tests" are not recommended. See STROBE comment (*at the very end of these comments), specifically see Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and Elaboration, Vandenbroucke et al., Plos One. A relevant citation from this article is as follows:

"Inferential measures such as standard errors and confidence intervals should not be used to describe the variability of characteristics, and significance tests should be avoided in descriptive tables. Also, P values are not an appropriate criterion for selecting which confounders to adjust for in analysis; even small differences in a confounder that has a strong effect on the outcome can be important [144,145].

In cohort studies, it may be useful to document how an exposure relates to other characteristics and potential confounders. Authors could present this information in a table with columns for participants in two or more exposure categories, which permits to judge the differences in confounders between these categories."

Response 5:
The exposed/ unexposed time is only calculated for the current work title. If the pain onset were before that employment, individuals would be excluded from the analysis. Office workers “exposed” time as fork lift operators were not calculated. Univariate analyses were performed to present our population and information. We have read the STROBE article but still we consider it is useful information to present the differences between the fork lift operators and the office workers.

The potential confounders were addressed. Known factors such as psychosocial aspects ( e.g. stress) and heavy workload were adjusted for in the multivariate exposure analysis. See table 3. We have clarified this in the methods chapter.
6) Statistics (line 53): "person years" is mentioned, how is the person years for one individual calculated, is there no censuring …? Describe this under the outcome section or at its current position in the statistics section.

Response 6:
The total length of employment was calculated for each individual from current employment starting year up to 2014 or up to the first year of perceived neck pain (pain onset). The exposure time was calculated from the total amount of time spent with the neck in non-neutral postures. The reference time was the employment time without exposure.

7) If there are censuring the correct analysis would be survival analysis (Cox regression) rather than Poisson regression.

Response 7:
The Poisson regression model offers the possibility to calculate exposed and unexposed time in complex exposure windows and variations. For every individual the exposure to non-neutral neck postures could vary between time periods. One person can provide with reference time and also with exposed time. The Poisson model works with the collective exposure time and collective cases in comparison to the Cox model were you can only take one time-line in consideration for each individual. The Poisson model also take stop date for pain onset into account in a dynamic way.

8) All risk factors presented in the result section should be described in the section "Exposure and risk factors". Now this is done in a general manner.

Response 8:
We have somewhat developed the text under the section method.

9) References to validation and reliability studies of the questions used in the questionnaire should be added.
Response 9:
We have added new references referring to some of the validated questions that we have used. However, some questions were asked to target the specific work postures.

10) At the end of the statistics section (line 14-): Add comment on collinearity checks between factors (exposures, risk factors and confounders). How they were performed and what the result was. Age and exposure time are probably correlated, but how strongly?

Response 10:
The possible confounding factors such as age, social aspects, and work tasks were taken into consideration in the multivariate model. The statistic model used is designed to take exposure time into consideration.

11) Mention if any variables were considered to be confounders. Remember that confounder are not to be interpreted as risk factors.

Response 11:
Potential confounders should not be labelled as risk factors. This is taken into consideration and changed in the manuscript.

12) Is it possible to do a drop-out analysis? Even if not, discuss this in more detail in the discussion.

Response 12:
It is not possible but it is discussed. Tests for power were performed. This is presented in the discussion.

13) Sample size needs also to be discussed as this is a quite small sample for an epidemiological study.
Response 13:
Study design and number of participants were great enough for the regression models used. The strength of the Poisson regression model is that it calculates years of exposure instead of subjects which provides a greater power than a case-control study design using logistic regression models. That in combination with a response variable (neck pain) that is a common outcome in the cohort makes the results less uncertain. The confidence intervals show that the sample size gives enough power. This is explain in methodological discussion. (Discussion above the “Practical implications”)

Minor revisions
1) Background in the abstract (line 11): The number of fork lift operators might not be the most important justification for this study, but that this quite common occupation represents long-term exposure to non-neutral strenuous neck-positions.

Response 1:
We have added further information why this study is of importance. Thank you for your suggestion. This is explain in the results discussion.

2) Statistics (2nd page, line 5): The term incidence rate ratios (IRR) is used. Define this term in detail, as the terminology in epidemiological is not consistent and terms can have several meanings.

Response 2:
We have defined the term and added explanation of the definition in results and in table 3

3) Results (3rd page of results, line 1): The sentence "There was no significant correlation …" is more correct if phrased "There was no statistically significant association …"
Response 3: Good suggestion, this has been corrected

4) Same page on line 39-44: Rewrite this sentences.
Response 4:  Good suggestion, this has been corrected

5) Discussion (2nd page, line 19-): Surprising that the author did not find any studies on office workers or similar groups were factors as stress, social support or hour with computer work were found to be risk factors. Could be other references of interest that are relevant to mention.


Response 5:
In the first version of our submitted manuscript, in the discussion, we referred to McLean et al. (2010), about high job demands and poor social support among office workers as strong risk factors for neck pain…” We also referred to Paksaichol et al (2012). They found only female gender and previous neck pain to be strong factors for the onset of new episodes of neck pain. We added one more review on the topic, Deokhoon et al. (2017) who added additional aspects. We have clarified in the manuscript that the office workers are less exposed.