Author's response to reviews

Title: Aetiology and risk factors of musculoskeletal disorders in physically active conscripts: a follow-up study in the Finnish Defence Forces

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Version: 2 Date: 19 April 2010

Author's response to reviews: see over
Dear Editor:

Thank you for your e-mail including the comments on our manuscript entitled “Aetiology and risk factors of musculoskeletal disorders in physically active conscripts: a one-year follow-up study in the Finnish Defence Forces”.

We thank the reviewers for their constructive criticism and comments. We have revised the manuscript according to the reviewers’ suggestions in blue font. Our point-by-point responses below are given in italics in the same order as the suggestions given in your letter.

We hope that the revision and responses given are satisfactory and that the revised manuscript is now acceptable for publication in the *BMC Musculoskeletal Disorders*.

We appreciate the opportunity to revise the manuscript and look forward to hearing from you soon.

Yours sincerely,

Henri Taanila
Our point-by-point responses below are given in italics in the same order as the suggestions were given in the comment letter.

**Comments from the editorial office:**

This manuscript seems to be an analysis based on the same data set as another publication from your group; PMID: 19624829. Therefore we were surprised to see that the original article had not been cited. If it is indeed the same dataset you should cite the original article and make it clear under the Methods that the set of participants has been described before.

*Thank you for these editorial comments.*

*The data overlap with a previous study by our group, but there were some minor changes and additions for the risk factor analyses. We now cite the previous article in the Methods section.*

*In addition, the style of written English was rechecked by a professional.*
Reviewer #1 comments:

GENERAL COMMENTS: The article examines injury incidence, injury rates, and injury risk factors in two groups of Finnish conscripts over 6-months of their active duty. The paper is generally well written, well referenced, and authors have generally given proper credit and referencing for past work. However, there are a number of variables that are not clearly defined, a number of definitional problems, and the statistical analysis could benefit from some modification as discussed in the Specific Comments.

Authors cite the tables out of sequence and this should be corrected. The authors have a series of additional files (Additional files 2, 2, 3, 4 [note that two files are both labeled “Additional File 2”). These are the univariate results which should be integrated into the paper to increase understanding of the data. They, in fact, show that the adjustment for age, company, smoking, alcohol intake, baseline medical conditions, school success, father’s occupation, and prior physical activity have little influence on most (but not all) of the HRs.

Thank you for your careful review of the manuscript!
The variable definition has now been improved and the definition problems are discussed in the Specific comments. We thank you for your suggestions regarding the statistical analyses.

The sequence of tables and the titles of the tables have been corrected. The univariate results are now integrated into the Results section as suggested.

SPECIFIC COMMENTS:
Abstract
1. The title implies a one-year study. Yet, there were 2 cohorts followed for 6 months each. Is this not a 6-month study of 2 cohorts?

   Thank you for the precise comment. This has now been corrected in the title as well as in the manuscript.

2. Line 14 and 17 - Define CI (confidence interval), and HR (hazard ratio) on first use.

   These abbreviations are now defined.

3. Line 18 – “Abdominal Obesity” is not the measure. Waist circumference is the measure?

   This has now been corrected as suggested.

4. Line 21 – “Poor school success” is not well understood by the reader at this point. This should be better defined in the abstract (perhaps combined educational level plus grades?)

   Thank you for pointing this out. This has now been corrected in the Abstract and in the Methods section.

5. Line 24 – I assume the authors mean “…improve aerobic and muscular fitness prior to conscript training”.

   This has now been clarified.
Background
6. The Background is generally well written and to the point.
   Thank you!

7. Page 3, Line 11-12 – Is this correct? 94/1000 per year would mean that 9.4% of conscripts were hospitalized every year.
   This result is reliable and based on the previous hospital discharge register study of Mattila and colleagues. They have checked the accuracy and coverage of the data.

   The reference has now been added.

9. Page 4, Line 6 – Also include here References 1,3,4,6,7,10,14,15,16,18,19,20,25,35 and probably others. Include a few of these.
   Some of the references have been added as suggested.

10. Page 4, Line 8 – I am not sure what “content of military service” means
    We meant to say that we assume that practices and training schedules used in a conscription army probably differ from those of professional armies. This has been now clarified.

11. Page 4, Line 12-13 – The general hypothesis seems limited given the number of other intrinsic risk factors obtained in the study(tobacco use, drinking, education, self-assessed soldier demands, etc.)
    The sentence has now been revised as follows: “The general hypothesis is that low levels of physical fitness and detrimental health behaviour factors prior to conscription are associated with MSDs during military training.”

Methods
12. Page 4, Bottom; Page 5, Top – While most companies are well understood by military observers, Private Company is not. Define this.
    ‘Private company’ has now been changed to ‘Infantry company’.

13. Page 5, Line 15 – Remove “(ref R06063)”.
    This has now been removed.

14. Page 6, Line 4-5 – The authors say the conscripts had 19 hours/week physical training. Assuming 6 days of training/week, this is 3.2 hours/day. Is this correct?
    The calculation is broadly correct. We have added “involving moderate or heavy physical loading” to the sentence on page 6 in the second paragraph. In addition, conscripts performed other physical exercises for an average of seven hours per week.

15. Page 6, Line 6 – Despite the fact that the data was collected over 1 year, the 2 cohorts were only followed for 6 months. Is this correct? If so, it is a 6 month and not 1-year study.
    Thank you for this comment. This has now been corrected in the title as well as in the Methods section.
16. Page 6, Line 11-13 – What is the difference between “type” and “diagnosis”?
Type of MSD is a higher-level category for different diagnoses. For example, overuse conditions of shin, knee, and ankle with different diagnoses were combined to create a higher-level category of lower limb overuse injuries.

17. Page 6, Line 19-22 and beyond – The use of the term “musculoskeletal disorder (MSD) is somewhat problematic. There are some injuries listed here that do not involve muscles or the skeleton. Sprains generally involve ligaments, cartilage, and other structures; wounds are dermatological. Many authors use this but it can be somewhat misleading.
Only musculoskeletal disorders were included in the analysis. For example, only those wounds that were direct consequences of musculoskeletal contusions are included as MSDs, which is now clarified on page 7 in the first paragraph.

18. Page 6, Line 22; Page 7, Line 1 - What is the difference between a sprain (involving the knee) and a “knee ligament rupture”?
Knee ligament rupture was expressed as an example of a more severe sprain, but this has now been omitted to avoid misunderstanding.

19. Page 8, Lines 2-3 – These figures can be eliminated as the tests are well known. Provide a general description of each test (e.g. For the push-up, a conscript was required to lower his body in a generally straight line to a point where his upper arm was parallel to the ground, and then return to the starting point with elbows fully extended. For sit-up…”).
The general description of the tests is now clarified in the text. We have kept the figures, however, based on the suggestions of the other reviewers.

20. Page 8, Lines 4-6 – It is not clear how the MFI is calculated. How are “individual muscle test points” acquired? (e.g., scaled, # of the repetitions on each test, etc.)
The muscle fitness index (MFI) was calculated as the sum of points according to fitness category ratings of individual results of push-up, sit-up, pull-up, standing long jump, and back muscle tests. Poor results in individual muscle fitness tests equated to 0 points, a fair good result to 1 point, a good result to 2 points, and an excellent result to 3 points. We added following sentence “To calculate the muscle fitness index (MFI), the points of individual muscle fitness test results (push-ups, sit-ups, pull-ups, standing long jump, and back lift) were added together (Excellent=13–15 points, Good=9–12 points, Fair good=5–8 points, Poor=0–4 points)” on page 9 in the second paragraph.

21. Page 8, Lines 7 – Check the grammar here. The sentence makes no sense and the formula in Table 1, footnote 6 provides the calculation much better.
The sentence has now been corrected and a reference to Table 1 has been added.

The tests are now described in the text. We have kept the figures according to the wishes of the other reviewers, but if necessary we will omit the figures.

23. Page 8, Line 17 – Body composition was not measured in this study. Body composition is usually taken to mean (at a minimum) body fat and fat-free mass
(usually measures from skinfolds, anthropometry, densitometry, or dual X-ray absorptometry).

Thank you for this correction. This has now been revised; “…height, weight and waist circumference were measured during the first two weeks of service.”

24. Page 8, Line 20 – Reference the fact that WC is a “mark of abdominal obesity and excessive visceral fat”, or leave out.

The reference has now been added.

25. Page 8, Last Line – Table 3 is cited before Table 2. Tables should be in sequence.

Thank you for the accurate observation. The presentation sequence of the tables has now been corrected.

26. Table 3 – Correct the “]” and uppercase the “2” in “Body mass index (BMI=(kg) / (m)^2]. Columns 4-7 should also be labeled “HR” (also in Tables 4-6)

These have now been corrected as suggested.

27. Page 9, Pre-information Questionnaire – Two variables are not well defined. These are health and health behavior. Provide a better definition of these, similar to the one provided for “school success”. But, even “school success” has some vagueness. For example, Lines 13-15 say “Conscripts who attended [certain schools] and reported excellent or good school success were categorized as having excellent school success”. The use of “school success” twice is confusing. Is the first “school success” grades or something else? If grades, what grades constitute excellent or good?

The definition of school success categories has now been rewritten on page 11 in the first paragraph. “Health” and “Health behaviour” are headings for a group of variables that are listed in parentheses on page 10. A more complete description of the variables can be found in Tables 2 and 4.

28. Page 10, Lines 14-16 – “Occurrence rate” is not a rate since it has no time interval. This is better called “MSD incidence” (see: Last JM, Abramson JH, Friedman GD, Porta M, Spasoff RA, and Thuriaux M (Eds.). A Dictionary of Epidemiology New York: Oxford University Press, 1995.)

Thank you for the clear comments regarding the terminology of rates and incidences. This has now been revised as suggested.

29. Page 10, Lines 16-19 – “Person-based incidence” might be better termed “incidence rate”. The authors define this as the number of conscripts with a MSD/exposure time. Thus it is an incidence/time, and time makes it a rate.

The person-based incidence has now been changed to person-based incidence rate.

30. Page 10, Lines 19-21 – “Event-based incidence” might be better termed “event-based incidence rate” for reasons similar to above.

This has now been corrected as suggested.

31. Page 11, Lines 7-10 – MSDO might be better stated as musculoskeletal disorder incidence (MSDI).
The MSDO term has now been corrected as suggested. Thank you for your advice.

32. Page 11, Line 13 and beyond – I have some concern about the statistical analysis. The authors say they took “known risk factors” into account in their analysis and they cite age, smoking, alcohol intake, baseline medical condition and other factors into account. Yet, they say in their introduction that the data on age is conflicting (I think the conflict is minor—in most studies, basic training older age is associated with higher risk) and they do not mention alcohol intake (data on this is rare, although there are a few studies). Further, the footnotes to Tables 3-6 cite other variables that were controlled for that are not mentioned here. A much better approach would have been to run the univariate analysis, take those variables that were significant and put those variables into the multivariate model. Additional variables that have been reported to be significant in other studies (e.g., older age, cigarette smoking, physical inactivity, physical fitness [aerobic and muscular endurance]) could have been included regardless of significance.

Thank you for these comments regarding the statistical analysis. In the introduction, a sentence considering age as a risk factor has been added: "Older age is associated with a higher risk for injuries in most studies [1,8,11,21,24,26], but conflicting results are also reported [3,25,27]."

A new adjusting model has now been constructed as suggested and the following paragraph was added on page 13: “Only possible significant variables (P <0.20) in the initial univariate-models were included in the multivariate model: company, father’s occupational group, urbanisation level of the place of residence, self-assessed health, opinion about physical demands for a soldier, last degree achieved in school sports, belonging to a sports club and self-assessed physical fitness were included in the multivariate model as possible confounders. Smoking status (previous or current regular smoker), poor baseline medical condition (sports injury during the last month before military entry, chronic impairment or disability due to prior musculoskeletal injury, earlier musculoskeletal symptoms, chronic disease), not participating in individual aerobic sports and low physical activity during the previous three months before military entry were entered into the multivariate model as known risk factors. We considered poor school success (educational level and grades combined), participation in competitive sports, height and high frequency of drunkenness before military service as possible risk factors after univariate modelling and entered these variables into the multivariate model although data considering these variables as risk factors of MSDs during military training are sparse. In addition, high waist circumference and older age were considered possible risk factors and were therefore included in the multivariate model although results from previous studies are to some extent conflicting. A P value of < 0.05 was considered statistically significant when interpreting the results from Cox’s proportional hazard models.

Results
33. Page 12, Type and Anatomical Location… - Do not repeat data that is in Tables. Thus, the first sentence could be reworded: “Most MSD were in the lower extremities followed by the back, upper extremities (including shoulders), head, and other parts of the body (Table 2).”

Thank you for editing the Results section. We have now shortened Results section by removing the redundant presentation of data.
34. Page 13, Lines 13-17 – The “causes” of acute injuries the authors list amount to 63%. What were the other “causes” of acute injuries?

There were a number of other causes of MSDs, explaining 1% to 3% of the acute injuries. These are not listed in the text to keep the text concise. In 12% of acute MSDs, the immediate cause remained unclear as stated on page 15. The data considering “causes” of MSDs were obtained from the electronic medical records and sometimes the information was not available and “causes” remained unclear. We have checked the figures, however, and they are correct.

35. Page 13, Lines 17-22 – The “causes” of overuse injuries the authors list amount to 79%. What were the other “causes” of overuse injuries?

There were a number of other activities associated with overuse-related MSDs, explaining 1% to 3% percent of the overuse MSDs. These were not listed to keep the text more concise. In 27% of overuse-related MSDs, the associated activity remained unclear due to the gradual onset of the MSD as stated on page 15.

36. Page 14, Risk Factors of MSD, Paragraph 2 and beyond – Do not repeat data that is in tables. Thus, Paragraph 2 could simply read “For health, increased risk of MSD occurrence (incidence) was associated with high BMI, high WC, sports injury in the last month, and clear musculoskeletal symptoms. Increased risk of long term MSDO was associated with…” This provides the reader with a concise overview and the precise HRs and CIs can be obtained from the table. Also, describe the variables in the order presented in the tables to make it easier for the reader to follow. I had to constantly shift focus up and down the tables which was VERY time consuming.

Thank you for your comments to help us make the article more reader-friendly. The majority of HRs and CIs have now been omitted from the Results section and variables are described in the order that they are presented in the tables.

37. Integrate univariate results (Additional Files) into the Results section.

The univariate results have now been added into the Results section and to Tables 2-5.

38. Page 14, Paragraph 3 – The authors do not mention father’s unclear or unemployed status which was associated with MSD occurrence (incidence).

This has now been corrected.

39. Page 15, Lines 1-8 – Physical activity and engagement in aerobic sports are likely to covary so it is not surprising that after controlling for physical activity there was little association.

The authors agree. However, we considered that introducing only one adjusted model is more reader friendly and prior physical activity is a part of that final model.

40. Page 15, First Paragraph - The authors have not addressed last degree in school, self-assessed fitness and belongs to sports club which were also associated with injury.

These have now been corrected.

41. Page 15, Lines 19-20 – The authors ignore in this sentence the Cooper test which also “after conceptual adjustment … maintained …significance for both outcomes”.

Thank you for your comments to help us make the article more reader-friendly. The majority of HRs and CIs have now been omitted from the Results section and variables are described in the order that they are presented in the tables.
Discussion

42. Page 16, Line 11-14 - Consider another word or phrase modification for “respectable”. Perhaps …tests were highly associated with MSD.”
   
   Thank you for this comment. This has now been revised as suggested.

43. Page 16, Lines 14-16 – Also previous studies show cigarette smoking, and physical fitness are associated with injury. The fitness association in this study was also a dose-relationship.
   
   The first paragraph of the Discussion was revised according to the updated Results.

44. Page 16, Lines 16-19 – Also Company.
   
   This has now been revised.

45. Page 16, Lines 20-23 – Also entry-level physical fitness is a modifiable risk factor.
   
   This has now been corrected as suggested.

46. Page 17, Lines 13-16 – Actually, the standing long jump measures leg power (the authors allude to this in the following sentences). Both tests were significantly associated with injury in the univariate analysis. These two tests represent separate and independent components of physical fitness and so it is not surprising that combining them resulted in a stronger association with injury risk.
   
   As you mentioned, the standing long jump and Cooper’s test represent separate and independent components of physical fitness. This has been indicated to the reader by showing that the combination of these results is more strongly associated with injury risk than any single test. This finding has clinical implications for the use of this combination.

   Other significant combinations of muscle fitness tests and Cooper’s test are shown in Table 5. Combinations of pull-up or sit-up tests together with Cooper’s test were not significant and are therefore not listed in Table 5.

   A sentence has now been added on pages 9-10 to clarify why we combined Cooper’s and muscle fitness test results into a single variable: “In addition, Cooper’s and individual muscle fitness test results were combined into a single variable to explore whether a combined fitness variable, representing co-impairment, is more strongly associated with the occurrence of MSDs.”

47. Page 17 Lines 20-23. Top Page 18 – I think the authors could “correct” their run and leg power data using suggestions from Vanderburgh et al. (Ref 39) to see how that affects injury risk. This is not necessary but might add to the paper.
   
   Thank you for this comment. Vanderburgh et al. studied the “corrections” of US Army Physical Fitness Tests, therefore it would be difficult to adapt these corrections to the physical fitness tests performed in the Finnish Defence Forces (i.e., standing long jump, Cooper’s test, back lift test, pull-up test).

48. Page 18, Line 13-14 – Check grammar.
   
   This has now been corrected.
49. Page 19, Middle Paragraph – It may also be that the association between injuries and BMI is a “J” shape. That is, those with very low BMI are at risk, those of middle BMI at lowest risk and risk increases as BMI increases. Does high BMI eliminate a potential conscript from military service in the Finnish Army? If not, this may be why the authors could demonstrate the relationship while the results are not as clear as in US professional Army where entry level BMI is restricted.

   This is an interesting question. In the present study, however, the risk for MSDs among the group of underweight conscripts was not higher than that of the group of normal weight conscripts. We have now added a short description of the role of a high BMI as an obstacle to military service in that paragraph. There are currently no clear BMI limits in the Finnish Defence Forces.


   This has now been corrected.

51. Page 22, Line 3 – Define RCT.

   This has now been corrected.


   Thank you for these interesting references. These references are now cited on pages 23-24.
Reviewer #2 comments:

Dear authors and editors,

In answer to the nine points to consider for reviewing manuscripts for BMC, this is in general an excellent study and I shall mainly explain the four main problems I have with it. It is otherwise a relevant study, well executed, honestly reported and the language is smooth and clear. Doubtlessly, the manuscript could be published as is but I think that it would become more reader friendly if the following two comments were taken into account:

1. The tables containing the hazard ratios are supposed to have bold lettering for significant findings. You need to agree with yourselves if a confidence interval of 1.0 is or is not a significant finding, as you have been inconsistent throughout the tables on this issue. This is of course also relevant when you interpret your own data, which might need to be checked.

   Thank you for the careful review of the manuscript and very friendly expressed comments regarding the manuscript!

   A sentence has now been added at the end of the Methods section: “A P value of <0.05 was considered statistically significant when interpreting the results from Cox’s proportional hazard models”. The confidence interval’s lower limit of 1.0 can be statistically significant depending on the exact P-value. For example CI 1.04 is rounded down to 1.0 as well CI 0.96 is rounded up to 1.0. The exact P-values are not expressed in the Tables as CIs generally include the same information.

2. Your tables are fine but your result section is very confusing. May I suggest that you make it easy also for simple souls like me to read it without feeling stupid. I have two suggestions: For each table try to draw out some sort of overall pattern of findings instead of going straight into the details. It would be interesting to see if there is a story that repeats itself for both simple reports of MSD and the more longlasting ones. If there is a general picture that makes sense, it does not really matter if the findings are significant all over or not. If however, there is a marked difference between the two outcome variables, this difference should make sense in order to appear “real”. This is my first suggestion.

   Secondly, I would like a more systematic approach to what happens when you control for the various extraneous factors. In fact, it would have been useful to have your univariate findings in these tables (3-6) to be able to compare them with what happens when you do the controlling trick. And why did you do two models of control? Small differences of estimates, on such small subgroup numbers as you have, do not necessarily mean that there are real differences. Overlapping confidence intervals usually mean there is no real difference between estimates, unless of course the findings are consistent all over and are able to tell a “story”. Would it not be possible to start the interpretation of each table, in the result section, by giving an overall picture as to what happens here? Thereafter, I would be willing to deal with the major details.

   Thank you for the comment to help us to develop the article to be more reader friendly. Due to reviewer Joseph Knapik’s constructive comments regarding the adjustments of our multivariate models, the Results section has now been rewritten and we have tried to pick up the message instead of going straight into the details. The
univariate results have been integrated into the Results section and only the final multivariate model is presented, as suggested.

3. Your interpretation of data, the first paragraph in the discussion section ignores the various findings that you have throughout the study, all of which were not necessarily related to fitness. You do discuss it later but you are very enthusiastic about the fitness data in the beginning. This could be more balanced.

The Cooper's test plus the standing long jump test that together give an odds ratio of 3.5 make well be measuring the same thing. You did not give any other variables the same chance of boosting the results, such as being a drinker, a smoker and having poor marks at school. What would happen if a person has one, two, three etc. of the significant risk factors?

Yes, we are enthusiastic about the fitness because it is a modifiable and independent risk factor of MSDs. In the army environment, there are no means to affect the school success of conscripts and as we have discussed in the article, smoking and alcohol intake are probably indicators of risk-taking behaviour rather than causal risk factors for MSDs among the young men during military training.

A sentence has now been added on page 9 to clarify why we combined Cooper’s and individual muscle fitness test results into one variable: “In addition, Cooper’s and individual muscle fitness test results were combined into a single variable to explore whether the combined fitness variable, representing co-impairment, would be more strongly associated with the occurrence of MSDs.”

4. Interpretation of results. You state somewhere that alcohol and and smoking may be indicators for risk taking behaviour rather than causal risk factors MSD. Then how could MSD be prevented by changing health habits? In order to change the risk taking behaviour you probably need to do some genetic manipulation! Unfortunately, people who exercise regularly out of own will, may also have a psychological profile that is causally linked with MSD, and perhaps seeking care for MSD. Changing their BMI and fat depots in the body, will not help on such a basic cause, if there is one. In a recent study, we have shown that the consequences of spinal pain (neck, thoracic as well as low back) has a strong genetic component, so it may be more complicated than just getting these young men to live a health life.

Thank you for the instructive comment. The sentence “However, smoking and alcohol intake are modifiable risk indicators and should not be overlooked when planning future interventions” has now been omitted from the Discussion.

Minor issues: Please check the order of your tables and additional files. Have they all been correctly numbered and do they sit where they should in the text?

Thank you for the precise comment. The sequence and titles of the tables have now been corrected.

Question: Would it be possible to work out why the different companies have different outcomes? Some sort of explanation?

Some military tasks involve higher risks for MSD than other tasks and this is the main reason behind the finding as expressed in the first paragraph of the Discussion.
Another possible explanation is that there are differences in the baseline level of physical fitness as well as other lifestyle and socioeconomic variables, as the data shown in Table 1 suggest. The multivariate model, however, was adjusted for these differences and company was still independently associated with MSDs, so the first explanation is probably more likely.

Why include the univariate tables and in one instance you even mention such a finding in the text? Not relevant, if you have taken your data the step further of adjusting for other variables.

The univariate results have now been integrated into the Results.

Your title appears incorrect. It should be "Aetiology and risk factors of seeking care for musculoskeletal ....", as this is your main and only outcome variable.

Although the majority (69%) of disorders were classified as minimal, leading to a maximum 3-day exemption from military training, only 10% of MSDs resulted in an exemption from military service. Exemptions from military service are given only after careful physical examination, so the proportion of "pretended" MSDs was probably quite low. You are right that the threshold for seeking medical care may vary between individuals as mentioned in the second to last paragraph of the Discussion, but we would prefer not to change the title.

Question: Last sentence first page in Discussion: You say that some variables were protective of MSD "in all companies". Did you really test this?

In smaller companies (Mortar, Infantry, Logistic companies), these associations were not statistically significant (p < 0.20), but we would like to keep this sentence because the direction or trend of the association was observed in all of the companies.

Hope these comments make sense and that they can help making this good paper a really excellent one. I shall tick the option "accept after minor essential revisions" well knowing that some of these changes are more than minor. My point is, though, that I leave to the judgement of the authors to do or not do these changes.

Thank you for your constructive comments which have helped to improve the paper.
Reviewer #3 comments:

Major Compulsory Revisions
1. Page 3 “Given that 80% of young men complete their military service in Finland, the high number of MSDs affects public health.” I am unsure what this sentence means. I believe you are trying to say that military service is compulsory in Finland for young men, and that 80% of them stay in Finland during and after military service, thus injuries as part of military service affect Finland’s overall public health. In the US, where military service is voluntary currently, accession into the military is done quite differently, and therefore, affects background public health quite differently. The point you are making might be extremely important, and may be worth explaining in more detail.

   Thank you for your careful review of the manuscript!

   We have now revised the paragraph as many of the reviewers have suggested:

   “Military service in Finland is compulsory for all male citizens over 18 years of age, with the duration of service varying from six to twelve months. Given that 80% of young men in Finland complete their service period, the high number of MSDs affects public health [2].” We hope that our point is now more clearly expressed.

2. Page 4, top: I would change your hypothesis to, “The general hypothesis is that low levels of physical fitness and sedentary lifestyle prior to conscription are associated with MSDs during training”, or something like this statement, which is more specific than what you have. It is an established fact that low levels of physical fitness and sedentary lifestyle are associated with MSDs in general. Your study is specific to the condition in which conscripts with a history of low levels of physical fitness and a sedentary lifestyle enter an environment of high physical activity and suffer subsequent MSDs that may affect both them and the military for years. I feel you should emphasize this unique and important contribution in your hypothesis statement.

   Thank you for this helpful comment. The general hypothesis has now been revised as follows: “The general hypothesis is that low levels of physical fitness and detrimental health behaviour factors prior to conscription are associated with MSDs during military training.”

3. You describe how you obtain injury information on the study participants, and how you classify it once it is identified, on pages 6-7. Although you provide a lot of information, it isn’t exactly clear to me. It appears that you used some sort of search terms to identify injury-related visits from electronic medical records. Did you use ICD10 codes? I do not understand where the following sentence comes into play: “After careful clinical examination, necessary diagnostic tests and radiological graphs, the most accurate diagnosis was selected by a physician according to the 10th Revision of the International Classification of Diseases and Related Health Problems (ICD-10).” Is that before or after you search the electronic medical records? If you are using ICD-10 codes as a way of initially identifying MSD injuries in a search, please list the codes you used.

   The sentence “After careful clinical examination, necessary diagnostic tests, and radiological graphs, the most accurate diagnosis was selected by a physician
We chose the 2-week run-in period because we wanted to eliminate severe MSDs that occurred before entry into the military service leading to premature discharge from the military during the first 2 weeks of service. During the first 2 weeks, the health status of each of the conscripts was checked by routine medical screenings performed by a physician as stated on page 5 in the second paragraph. There were no clear seasonal peaks for MSD occurrence and we did not find signs that earlier MSDs were more likely to lead to long-term problems.

The conscripts who did not have MSD (or long-term MSD) were followed for 180 days or until discharged from the military and their exposure times were counted accordingly. The Cox regression is a survival analysis so the follow-up of conscripts who got their first MSD (or long-term MSD) ended with that event and their exposure times were not equal to their service time as this was used for conscripts who did not have an MSD.

Due to Joseph Knapik’s constructive comments regarding the adjustments of our multivariate models, the Results section has now been rewritten and we made efforts to present the larger picture of the results prior to presenting the details. The univariate results have now been integrated into the Results section and only the final multivariate model is presented, as suggested by several reviewers.

5. Overall methods section: I am having trouble understanding the study timeline/design. This is what I believe:

In July 2006, 359 new conscripts were invited for recruitment, and in January 2007, 603 were invited. The first two weeks (of July 2006 for the first group, and of January 2007 for the second group), medical data were gathered about these groups. For the first 8 weeks (roughly July-August 2006 for the first group, and January-February 2007 for the second group), there was 17 hours per week of...
military training which was physical, and increased in intensity over the 8 weeks. The next 4 months (Sept-Dec 2006 for the first group, and March-May 2007 for the second group) were spent in individual training programmes, but the programmes were comparable in terms of high-intensity physical training.

I see in the middle of Page 6, under “Musculoskeletal disorder registration”, that you say “The data was collected between July 2006-July 2007”. Do you mean that this is the period of follow-up – meaning that all injuries in this study occurred between those two dates? If this is true, are you counting injuries after the training period (e.g., after Dec 2006 but before August 2007 for the first group, and after May 2007 but before August 2007 for the second group)? If not, follow-up for the second group is quite a bit shorter than the first group.

You also say on page 5, “All subjects were followed for six months starting from the first day of service.”

I am also now noticing in your abstract that you say, “During the one-year study period…” The phrase “one-year follow-up study” is in your title. Did I count wrong, and the training actually lasts a year?

You also classify severity of MSD by days of limited duty. Are you only counting these in the time period that they were in training (July-Dec 2006 for the first group, and Jan-May 2007 for the second)?

Your study is well done, but due to the timing involved, it can be difficult to describe the study design. Consider using a flow diagram, table, or some other presentation to clarify the design, follow-up periods, and the study flow. It may efficiently communicate a multitude of ideas while freeing up space in the text for other information.

Thank you for this comment. Your understanding of the timeline/design is essentially correct and we hope that the revised paragraphs in the Methods section on pages 5-6 now provide the answers to your questions. In addition, we have added a flow diagram (Fig. 1) to clarify the design and follow-up periods. The flow of conscripts has now been rechecked using the original list of conscripts that was received from the Brigade, and the second paragraph in the Subjects section has been revised based on this recheck. In addition, we have revised the title as suggested and modified the first sentence in the Musculoskeletal disorder registration section based on the data collection: ” The data of the first arrival were collected from July 10th 2006 to January 5th 2007 and for the second arrival from January 8th 2007 to July 6th 2007.”

Considering the question of MSD severity classification, we only counted those days of limited duty that occurred during the follow up period (1st cohort; July 10th 2006–January 5th 2007 and 2nd cohort; January 8th 2007–July 6th 2007). However, releases from military service due to musculoskeletal injuries were registered as severe MSDs as expressed in the last paragraph of Musculoskeletal disorder registration section.

6. I thought a lot about your data presentation, and while it is comprehensive and very well done, I feel like your story is getting lost. I feel like you need to look at how low baseline fitness is a risk factor for MSDO after adjustment for everything
else that needs to be taken into account.

In this sense, you would be first determining some way of quantifying a “fitness” exposure – either using one of the physical fitness tests given to the conscripts, or using some composite score from several of them. If you prefer the former, you could choose more than one, and develop slightly different models. You mention in your discussion that Cooper’s test and the standing long jump test seemed to be the best predictors; perhaps you could consider these in your fitness variable.

You have already chosen outcome variables; you could then model a chosen fitness variable against the outcome variables, and use the other variables (BMI, waist circumference, self-reported health, etc.) to introduce into the model. You could still construct univariate and conceptual models for your fitness/MSDO model, but you would also add a final model, adjusted for everything you feel it needs, and could report HRs for all of the covariates in the final model (as well as HRs for those covariates where they may fall in other models, as well, including the covariates already provided in the conceptual models).

Certainly, BMI, height, and waist circumference are somewhat co-linear; choices would have to be made so that the most parsimonious final model is constructed. The covariates that survive in the final model reported would then become the ones you report other information on, such as univariate results for just that covariate (e.g., univariate results for various categories of BMI). The other covariates that did not survive in the final model, and do not appear in the conceptual model, could then be presented in your additional files.

I think this would tighten up your story, and reduce the amount of data that needed to be presented to provide a clear picture. It would also allow you to look at interactions. Additionally, it will allow you to move a lot of your discussion to your background, and tighten the focus of your paper to the unique contribution to the question of fitness as a protective factor against injury provided by your study, and how your results create or settle contradictions with respect to the existing literature. For example, a hypothesis exists that in individuals with a high BMI, a high fitness level can counteract the risk conferred by the high BMI, and these individuals may not experience higher rates of injury as a result. Questions such as these could be addressed.

Currently, it seems both your background and discussion try to cover too much ground, and do not seem to follow a logical progression. Focusing on answering this one question would help organize the paper. Explorations of other important questions you try to cover, such as how low education may be a risk factor for injury, could be done in a different article.

Thank you for the careful review and constructive suggestions regarding the data presentation. As mentioned earlier, due to other reviewer’s constructive comments considering the adjustments of our multivariate models, the Results section has now been rewritten and we have tried to more carefully convey the overall message instead of going straight into the details.
A new sentence has now been added on page 9 in the second paragraph to clarify why we combined Cooper’s and individual muscle fitness test results into one variable: “In addition, Cooper’s and individual muscle fitness test results were combined into a single variable to explore whether a combined fitness variable, representing co-impairment, would be more strongly associated with the occurrence of MSDs.”

Your question of whether a high fitness level can counteract the risk conferred by the high BMI cannot not be answered based on the results of this study, because only a few conscripts that had a high BMI were also highly fit. We divided the conscripts into high fitness (upper 50% of conscripts according to conscript’s physical fitness test results) and low fitness (lower 50%) groups, and ran separate Cox regression analyses to answer the question. Because only 5 conscripts belonged to the upper 50% fitness group and had a BMI over 30, however, this group was too small for statistical comparisons and the results of the divided analyses are not presented.

We hope that the Results section has now been improved and that the intended message is now clear to the reader.

7. On page 16, you say, “Higher waist circumference (WC), high BMI, earlier musculoskeletal symptoms and poor school success were all clearly associated with MSDs giving clarity for some equivocal findings.” I do not completely agree; I feel these items are confounded. For example, high BMI and higher waist circumference are co-linear – which one of them is the most explanatory of the outcomes you saw? Without a multivariate model modeling just the relationship of fitness to the outcome (adjusted for necessary confounders), this is hard to claim.

You are correct that BMI and waist circumference (WC) are co-linear (in the present study $\chi^2$ statistics; $p<0.001$). In that sentence, we intended to say that obesity (defined by both BMI and WC) is associated with MSD. In earlier studies, contradictory results are represented reporting no association between BMI and injuries [24,50], and that lower BMI is associated with injuries [21], as stated on page 20 in the last paragraph.

When BMI and WC were entered in the same model, the strong co-linearity attenuated the association between MSDs and BMI or WC as predictive variables. When entered into the same model, the $P$-values of both predictors were $>0.20$, so there was no sense in putting these variables into the same model. We chose to include WC in the multivariate model, because it is better associated with fat mass than BMI (i.e., a high BMI is often associated with increased muscle mass).

8. In your conclusion, once you redo the analysis as I have described, I think it will be very easy for you to make concrete recommendations. For example, if you do find that low baseline fitness, after adjustment for all necessary confounders, is predictive of MSD, you could propose a “pre-training” program for those who have low fitness at baseline (defined by your exposure variable, such as the Cooper’s test). The pre-training program could have the goal of getting the conscript to the point that he can score in a higher fitness category on the Cooper’s test. Once the conscript meets that goal, he can join the next training group. Currently, your conclusion does not have the impact it could.

Thank you for this inspiring suggestion. Military service is compulsory for all male citizens in Finland, therefore it is not possible to set specific limits for physical fitness
before entry into the military or after leaving the basic training period in the Finnish Defence Forces. We have now added a sentence at the end of the Conclusions, however, as suggested: “The present results suggest that a good result (≥ 2600 m) in the 12-minute running test is a desirable goal in a pre-training programme before entering the military service.”

Minor Essential Revisions
1. Additional files: Additional file 1 is identified as 2 on the heading of the document.

   Thank you for your careful review. This has now been revised.

2. Page 4, top: replace “In spite of large number…” with “In spite of a large number…”

   This has now been corrected as suggested.

3. Page 6, middle: replace “The data was collected between…” with “The data were collected between…”

   This has now been corrected as suggested.

4. On page 12 you say…”and the person-based incidence was 7.1 (95% CI: 6.8–7.4), respectively.” 7.1 per how many people? 1,000? 7.1 per 1,000 would seem low to me, I would be expecting higher, given that the percentage of conscripts who got injured was 69%. I feel you need to contextualize your rates in the Discussion by comparing them to injury rates in other military studies.

   Thank you for this comment. Yes, we meant per 1000 person-days and have now clarified this. Because most conscripts had a follow-up of 180 days, the person-based incidence rate was not higher than 7.1 per 1000 person-days (652 conscripts with MSD divided by the sum of exposure times). The incidence per 1000 persons (690) or 69% is also reported in the Results.

   We think that the present study is, foremost, a risk factor study, so we considered it is better to focus on the risk factors in the Discussion and not to compare our MSD rates to rates from other military studies that may have other event definitions.

Discretionary Revisions
1. Abstract: replace “The strongest factors associated with MSDs…” with “The strongest baseline factors associated with MSDs”. I think this emphasizes your intent on predicting MSDs at the time the training starts. Also, in the conclusion, you may want to restate “An appropriate intervention based on the present study would increase both aerobic and muscular fitness” adding “prior to the beginning of the training program” to the end of the sentence. I think this is what you mean…?

   This has now been revised as suggested. In addition, the word ‘baseline’ has now been added to the Conclusions.

2. Page 5, top: “The baseline characteristics of the companies are presented in Table 1”. Also a reference to Table 1 on page 11: “There were statistically
significant differences between companies in the baseline characteristics”. You also point the reader to results tables throughout your Methods section. I normally do not refer to results in the Methods section; this might be more appropriate as an opening for the Results section.

Because the three other reviewers did not comment on the fact that we refer to the Tables in the Methods section, we decided to leave the tables in the Methods section. If you feel that this absolutely necessary, however, we will agree to move the tables to the Results section.

3. Table 1 – it would be helpful to include some assessment of person-days contributed by each company.

Table 1 shows the baseline characteristics, therefore information about person-days contributed by each company would not be baseline information and so we opted to omit this information.

4. Table 1 or Table 2 – it would be helpful to include the absolute number of conscripts who suffered an MSD. I see on the headings of other tables that it is 652 for short term, 194 for long-term.

We considered this also, but because Table 1 shows the baseline characteristics and Table 2 (Table 6 in the revised manuscript) is about anatomical distribution, it may be confusing to the reader if too many outcomes are presented in the same table. The absolute numbers are now reported, however, in the beginning of the Results section.

5. This is not a revision; rather, I want to make sure to note several strengths I see in your study design and analysis. Classifying acute vs. overuse MSD’s is challenging with medical records data. You handle this eloquently in your study design and discussion. You also very clearly describe how you classified clinic visits such that you could identify unique new injuries vs. follow-up for existing injuries. You provide a person-based as well as person-time-based event rate, which is extremely helpful in understanding your results. You categorize continuous variables into logical categories, rather than only modeling them continuously, which can provide a more useful picture when the continuous data do not have a strict linear relationship with the outcome. You very clearly describe your data presentation, and your tables are very clear and comprehensive.

Thank you for these positive comments!

6. Page 10 bottom: “The incidences with 95% confidence intervals (CI) were expressed per 1000 person-days.” I see your incidences in Table 2, but not the 95% CI, although those are reported in the text. Maybe they should be on the table?

The 95% confidence intervals have now been added to Table 2 (Table 6 in the revised manuscript).

7. On page 13, you say that in 12% of acute MSDs, the immediate cause remained unclear, and in 27% of overuse-related MSDs, the associated activity remained unclear due to the gradual onset of the MSD. From where were these data obtained – from an abstraction of the electronic medical record, or from some other way? Lacking immediate cause of acute MSDs in 12% seems high,
unless the only source was the medical record, and this lacked that information.

You are correct that the data were obtained from the electronic medical records and therefore sometimes the information was not available and “causes” and associated activities remained unclear. We have checked the figures, however, and they are correct.
Reviewer #4 comments:

1. On page 3, first paragraph in the Background Section. ‘Given that 80% of young men complete their military service in Finland, the high number of MSDs affects public health.’ This sentence would be served by further detailing exactly how the percentage affects Finland’s public. Are MSDs more likely to be self-limiting, which would resolve without long term residual sequel? Or are they more likely to be chronic in nature, inhibiting normal activities of daily living?

   Thank you for this comment. We have now revised the sentence as many of the reviewers suggested: “Military service in Finland is compulsory for all male citizens over 18 years of age, with the service duration varying from six to twelve months. Given that 80% of young men in Finland complete their service period, the high number of MSDs affects public health [2].” Your question is important and certainly a small proportion of MSDs results in disabilities requiring long-term rehabilitation and functional impairment leading to premature discharge from military service as mentioned in the abstract. Actual data of the long-term consequences of discharges due to MSDs, however, are sparse.

2. On page 4, the general hypothesis; ‘low levels of physical fitness and sedentary lifestyle are associated with MSDs’ would be served by further describing the population that this hypothesis applies to in context of this study. “Among Finland’s conscript’s between July 2006-2007, those conscript’s who demonstrate low levels of physical fitness and/or maintain a sedentary lifestyle are at increased risk/rate of MSDs when compared to conscript’s who do not demonstrate low levels of physical fitness and/or maintain a sedentary lifestyle.’

   The general hypothesis has now been revised as follows: “The general hypothesis is that low levels of physical fitness and detrimental health behaviour factors prior to conscription are associated with MSDs during military training.”

3. On page 4 Methods/Subjects: The private company is a nebulous term to me. Please define this company in much greater detail. Daily activities, etc.

   Thank you for the comment. ‘Private company’ has now been changed to ‘Infantry company’.

4. On page 7: Please explain the decision algorithm that determined how MSD severity was categorized according to the number of days of limited duty. Why were the particular cut-points chosen?

   We followed the principle reported by Soligard et al. [30], which was recently published in BMJ. In the beginning, we had three categories of MSD severity according to the severity definition of Ekstrand and Gillquist (Med Sci Sports Exerc, 1983, 15, 267-70), but we decided to change the definition to four categories to provide more information.

5. Page 13: What particular ICD 10 codes were assigned to the different MSD categories?

   The date, anatomical location, type, aetiological circumstances, severity, and diagnosis of each MSD were registered in electronic patient records. After that, we selected the ICD codes relating to a certain anatomical location (e.g., lower extremity) and combined the ICD-code with the information regarding onset (acute, overuse) of MSD. This is how the categories in Table 6 were determined. Because
each anatomical location was part of the patient records, we were able to confirm that those ICD codes, which can be related to many anatomical locations (e.g. M 24.4 Recurrent dislocation and subluxation of joint), were associated with the appropriate body part.

6. Page 13: Unclear what decisions were made for categorizing musculoskeletal injuries when a conscript presents with multiple injuries which occurred at the same time. For example if the individual suffered a knee, foot, and shoulder injury during one event. Please describe.

   The presentation of multiple injuries resulting from a single event was rather rare. There were 1629 MSDs, of which 183 (11%) occurred at the same time as another MSD. In these cases, both of the MSDs were registered in the data and analysed in the same way as other MSDs. None of the conscripts had more than two MSDs at the same.

Minor Essential Revisions
1. On page 4, ‘In spite of large number’ should be written as ‘In spite of a large number.’

   This has now been corrected.