

## PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form ([see an example](#)) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below. Some articles will have been accepted based in part or entirely on reviews undertaken for other BMJ Group journals. These will be reproduced where possible.

### ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	<b>Grip Strength and Leg Extensor Power in 19 to 72-year-old Danish men and women. The Health2006 Study.</b>
<b>AUTHORS</b>	Aadahl, Mette; Beyer, Nina; Linneberg, Allan; Thuesen, Betina; Jørgensen, Torben

### VERSION 1 - REVIEW

<b>REVIEWER</b>	<b>Richard W Bohannon</b> Professor University of Connecticut USA
<b>REVIEW RETURNED</b>	07-Jun-2011

<b>GENERAL COMMENTS</b>	<p>Research on muscle performance across the age span is widely published, but it seldom involves population-based samples. Moreover, it rarely addresses power. Consequently, the authors' work adds to what is already known. The Introduction of the paper is written well. The Methods, apart from the statistical analysis, is also presented well. The Results and Discussion are easy to follow. Nevertheless, I have a few comments/recommendations.</p> <p>1) The authors' stated aim (Abstract and Introduction) is far narrower than what they address in their research. It indicates a focus on the association of leisure-time physical activity (LTPA) with hand grip strength (HGS) and lower extensor power (LEP). In fact, the authors look at the association of numerous explanatory variables (most particularly age) with HGS and LEP. The stated aim needs to reflect this reality. The authors make comparisons between men and women. This too is beyond the stated aim and is, quite frankly, old news.</p> <p>2) While quite often done, using the term "leg" as the authors do is technically incorrect. The leg is the lower limb below the knee. The power being measured involves the hip, knee, and ankle. Thus, it is lower limb extension power that is being measured.</p> <p>3) The Statistical Analysis section needs to be inclusive of all analysis performed. At present it is not. While I don't recommend comparisons between genders, if one is done, the authors need to indicate the statistic employed. They also need to inform the reader as to how associations were examined. Granted that linear regression speaks to association, it is unclear whether correlations are zero-order, partial, or multiple.</p> <p>4) The authors indicate that the mean grip strength was greater for those who were left handed than for those who were right handed. This may well be the case, but without controlling for other relevant variables (eg, gender, age, weight) it is difficult to know whether the difference is a function of dominance or a fluke of the distribution of dominance across relevant variables.</p> <p>5) That HGS and LEP were highly correlated, though not an issue within the study's aim, is important. It supports the use of HGS as a</p>
-------------------------	--

	<p>single measure of muscle performance that is more portable, less expensive, and easier to test than LEP.</p> <p>6) The authors begin their discussion by writing that age-related declines in LEP are greater than those in HGS. Perhaps, but I would like to see a statistical comparison.</p> <p>7) The figures strike me as a bit unorthodox. I don't think the titles are warranted other than perhaps the gender labels. For Figure 1 I would label the Y-axis "Lower-limb Extension Power (watts)." For Figure 2, I would label the Y-axis "Grip Strength (kg)." I would use comparable labels for Figures 4 and 5.</p>
--	--

<b>REVIEWER</b>	<p><b>Sarianna Sipilä, PhD</b>          Research director          Gerontology Research Centre          Department of Health Sciences          University of Jyväskylä          Finland</p>
<b>REVIEW RETURNED</b>	15-Jun-2011

<b>THE STUDY</b>	<p>Exclusion criteria remains unclear. It is likely that some diseases and chronic conditions would be contraindicated for muscle force and power measurements, especially among older people.</p>
<b>GENERAL COMMENTS</b>	<p>The manuscript reports muscle strength and power data collected from 19 to 72-year-old Danish men and women and explores the association between strength and physical activity. The topic is of clinical importance, the data collection has been done carefully and the manuscript is relatively well written.</p> <p>The major concern of this study is that it is not particularly innovative and the results do not bring anything new into the current knowledge. Performing different measurements (force and power) in the same study is not scientifically very challenging and the fact that force and power decline with age and that men are stronger than women is already known. A respectable work has been done with the data collection and therefore I sincerely hope that the authors can report something new from this data (e.g. coimpairment of force and power).</p> <p>The authors imply that there are no reference values available for leg extension power in general population. The reader may interpret this sentence in a way that the present study aims to collect them. However, as the subgroup with muscle power assessments was not randomly selected from the total sample, the values obtained are not acceptable for reference values. Moreover, muscle power is highly dependent on the method used.</p> <p>Minor comments</p> <p>The authors write that "the participants underwent an extensive health examination" but no details or results are given.          Did you exclude anyone based on the health status?          In the paragraph describing hand grip force measurement, the last sentence refers to muscle power (p 6, line 24).          What is the rationale for analyzing muscle force and power data in body height and waist circumference categories?          Reproducibility of the methods should be reported.</p>

**VERSION 1 – AUTHOR RESPONSE**

## Point-by point response to reviewers' comments

We thank the editor for the opportunity to submit a revised version of our manuscript entitled 'Grip Strength and Lower Limb Extension Power in 19- to 72-year-old Danish men and women.' We found the reviewers' comments very helpful when revising the manuscript. All changes made in the manuscript are marked. Please find our response to specific reviewer comments below (responses in *italic*):

Managing Editor, BMJ Open

Please note that according to the details provided in the contributorship statement, author BT does not satisfy the ICMJE criteria for authorship and should therefore be listed in the acknowledgements section.

Please see [http://www.icmje.org/ethical\\_1author.html](http://www.icmje.org/ethical_1author.html) - particularly the first criterion: substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data. If BT is moved to the acknowledgements section we will require written confirmation from BT that this is acceptable.

Response: We apologise for this mistake. Co-author B. Thuesen did in fact contribute substantially to analysis and interpretation of data as well as to drafting of the manuscript. We have now corrected this mistake in the contributors' statement in the manuscript.

Reviewer: Richard W Bohannon

Professor

University of Connecticut

USA

Research on muscle performance across the age span is widely published, but it seldom involves population-based samples. Moreover, it rarely addresses power. Consequently, the authors' work adds to what is already known. The Introduction of the paper is written well. The Methods, apart from the statistical analysis, is also presented well. The Results and Discussion are easy to follow. Nevertheless, I have a few comments/recommendations.

1) The authors' stated aim (Abstract and Introduction) is far narrower than what they address in their research. It indicates a focus on the association of leisure-time physical activity (LTPA) with hand grip strength (HGS) and lower extensor power (LEP). In fact, the authors look at the association of numerous explanatory variables (most particularly age) with HGS and LEP. The stated aim needs to reflect this reality. The authors make comparisons between men and women. This too is beyond the stated aim and is, quite frankly, old news.

Response: We thank the reviewer for pointing out that the stated aim is narrower than what we actually address in the manuscript. We have now rephrased the aim and specified the focus on age, leisure time physical activity and body composition. We have omitted the gender aspect from the stated aim and have also removed it from the entire manuscript (please see changes in manuscript). The aim now reads:

'The aim of the present study was to describe muscular fitness, by means of hand grip strength (HGS) and leg extensor power (LEP), in a large population-based sample of 19 to 72-year-old Danish men and women. Furthermore, to explore the associations of HGS and LEP, respectively, with age, leisure time physical activity (LTPA) and body composition.'

2) While quite often done, using the term "leg" as the authors do is technically incorrect. The leg is the lower limb below the knee. The power being measured involves the hip, knee, and ankle. Thus, it is lower limb extension power that is being measured.

Response: We thank the reviewer for pointing out and explaining why 'leg power' is in fact an incorrect term. We have now replaced 'leg extensor power' with 'lower limb extension power'

throughout the manuscript.

3) The Statistical Analysis section needs to be inclusive of all analysis performed. At present it is not. While I don't recommend comparisons between genders, if one is done, the authors need to indicate the statistic employed. They also need to inform the reader as to how associations were examined. Granted that linear regression speaks to association, it is unclear whether correlations are zero-order, partial, or multiple.

Response: As requested by the reviewer, we have now included a description of all the analyses and statistics performed in the study. With respect to the type of correlation used, we have specified that Pearson's correlation coefficient was used to determine the overall correlation between HGS and LEP.

4) The authors indicate that the mean grip strength was greater for those who were left handed than for those who were right handed. This may well be the case, but without controlling for other relevant variables (eg, gender, age, weight) it is difficult to know whether the difference is a function of dominance or a fluke of the distribution of dominance across relevant variables.

Response: We agree that information on differences in mean hand grip strength between left- and right-handed participants needs to be adjusted for other relevant variables, such as age, gender, height etc. In light of this, we decided against further exploration of the left-right dominance aspect in the present study. It is not part of our stated aim and we have no a priori hypothesis to justify it. Therefore, in the results section we still report that 10% of the participants were left-handed, but we have deleted the sentence stating that mean HGS was significantly higher among left-handed than among right-handed .

5) That HGS and LEP were highly correlated, though not an issue within the study's aim, is important. It supports the use of HGS as a single measure of muscle performance that is more portable, less expensive, and easier to test than LEP.

Response: We thank the reviewer for this suggestion. We have included a small paragraph in the discussion section, where the value of HGS as a single measure of muscle performance is discussed.

6) The authors begin their discussion by writing that age-related declines in LEP are greater than those in HGS. Perhaps, but I would like to see a statistical comparison.

Response: We agree that decline in HGS and LEP should not be compared in the discussion section, unless a proper statistical comparison has been made. However, we cannot make a (simple) statistical test for comparison of the age-related decline in HGS and LEP, as they are measured in different units (Kilograms and Watts). Furthermore, as it was not part of our stated aim, we decided to leave out this 'informal' comparison of age-related decline in HGS and LEP.

7) The figures strike me as a bit unorthodox. I don't think the titles are warranted other than perhaps the gender labels. For Figure 1 I would label the Y-axis "Lower-limb Extension Power (watts)." For Figure 2, I would label the Y-axis "Grip Strength (kg)." I would use comparable labels for Figures 4 and 5.

Response: We apologize for the lay-out of the figures. We have now changed the figure- and axis-labels as recommended by the reviewer.

Reviewer: Sarianna Sipila, PhD  
Research director  
Gerontology Research Centre

Department of Health Sciences  
University of Jyväskylä  
Finland

Exclusion criteria remains unclear. It is likely that some diseases and chronic conditions would be contraindicated for muscle force and power measurements, especially among older people.

Response: Pregnancy was the only formal exclusion criteria in the Health2006 Study as such. This means that the study population includes participants with a wide range of chronic diseases and functional limitations. We have now specified that pregnant women were not included, in the Methods section under 'Study Population'.

The manuscript reports muscle strength and power data collected from 19 to 72-year-old Danish men and women and explores the association between strength and physical activity. The topic is of clinical importance, the data collection has been done carefully and the manuscript is relatively well written.

The major concern of this study is that it is not particularly innovative and the results do not bring anything new into the current knowledge. Performing different measurements (force and power) in the same study is not scientifically very challenging and the fact that force and power decline with age and that men are stronger than women is already known. A respectable work has been done with the data collection and therefore I sincerely hope that the authors can report something new from this data (e.g. coimpairment of force and power).

Response:

As also recommended by Dr. Bohannon, we have revised the aim and the results section slightly, so that there is less focus on gender differences. We believe that this and the other changes made, have improved the manuscript.

The authors imply that there are no reference values available for leg extension power in general population. The reader may interpret this sentence in a way that the present study aims to collect them. However, as the subgroup with muscle power assessments was not randomly selected from the total sample, the values obtained are not acceptable for reference values. Moreover, muscle power is highly dependent on the method used.

Response:

We thank the reviewer for pointing this out. In order to avoid any misinterpretation we have removed the sentence from the introduction section, but still conclude that there is a need for reference values at the end of the manuscript.

Minor comments

The authors write that "the participants underwent an extensive health examination" but no details or results are given.

Response:

In The Health2006 study the overall research aims were to collect data for epidemiological studies on lifestyle and physical capacity/fitness in relation to asthma, allergy and cardiovascular disease. The extensive health examination therefore included e.g. measurement of lung function and maximal oxygen uptake, abdominal ultrasound, drawing of blood samples for determination of cholesterol, insulin etc. However, these measures/results are not related to the specific aim of this particular study and we have therefore not reported them.

Did you exclude anyone based on the health status?

We did not exclude anyone a priori. Only if participants were unable to use the Hand Grip Dynamometer or the Leg Extensor Power Rig ( e.g. because of severe knee problems, paralyses or use of prostheses on both legs), did they not perform the tests. This happened very rarely. As also reported in the manuscript (Method section), according to the test protocol Lower Limb extension

power was measured in the right leg, unless the participant had problems/pain in the right leg, in which case the left leg was measured.

In the paragraph describing hand grip force measurement, the last sentence refers to muscle power (p 6, line 24).

Response: We apologize for the mistake. We have now moved the sentence to the paragraph describing measurement of muscle power.

What is the rationale for analyzing muscle force and power data in body height and waist circumference categories?

Response: We wanted to consider differences in body size/ body composition when analysing muscle force and power data. In the literature there seems to be different approaches, sometimes BMI is used, sometimes height and/or bodyweight is used and sometimes % body fat is included as co-variables in multiple linear regression analyses. Among the variables available in our study, we decided to include height and waist circumference in an attempt to consider body size AND degree of obesity. A high bodyweight can be a result of high amounts of fat OR muscle mass, whereas a high waist circumference can generally be ascribed to a high fat mass.

Reproducibility of the methods should be reported.

Response: We have now included information on reproducibility of HGS and LEP measurement in the 'Methods' section under 'physical measurements', including reference to the relevant articles.

#### VERSION 2 - REVIEW

<b>REVIEWER</b>	<i>Richard W Bohannon</i>
<b>REVIEW RETURNED</b>	02-Jul-2011

<b>GENERAL COMMENTS</b>	<p>The authors have conscientiously revised their paper; it is improved. Further comments follow:</p> <ol style="list-style-type: none"> <li>1) I believe the sentence "Data were adjusted for age, height and waist circumference" (page 2 / line 31) would be better placed at the end of the Methods of the Abstract.</li> <li>2) The phrase "lower limb extension power" is first used in the text on page 3 (line 44). I suggest the acronym (LEP) be designated here.</li> <li>3) On page 5 (lines 34 &amp; 36) the authors have neglected to change "leg" to "lower limb."</li> <li>4) On page 6 (lines 11 &amp; 13) the stair climbing limitation strikes me as consistent with an item of the SF-36. If that is its origin, the authors should provide a relevant citation.</li> <li>5) I'm not sure of Journal style, but to be consistent, it seems the authors should write "Grip strength" rather than "Grip Strength." Also, though the units for BMI are well known, it seems they should be indicated. In the footnote I would refer to "Lower limb extension power" rather than "Legrig."</li> <li>6) The first column of Tables 1, 2 &amp; 3 should be labeled "Variable."</li> <li>7) On page 9 (line 16), page 11 (line 40) and page 12 (line 36) replace "leg" with "lower limb." Please examine the entire manuscript to this end.</li> <li>8) On page 13 (lines 9 &amp; 11), write LEP rather than "lower limb extension power."</li> </ol>
-------------------------	--

#### VERSION 2 – AUTHOR RESPONSE

Point-by-point response to reviewer comments (R2):

Reviewer: Richard W Bohannon, University of Connecticut, USA

The authors have conscientiously revised their paper; it is improved. Further comments follow:

1) I believe the sentence "Data were adjusted for age, height and waist circumference" (page 2 / line 31) would be better placed at the end of the Methods of the Abstract.

Response: We have moved the sentence as suggested by the reviewer.

2) The phrase "lower limb extension power" is first used in the text on page 3 (line 44). I suggest the acronym (LEP) be designated here.

Response: The acronym (LEP) is now designated on page 3 as suggested by Dr. Bohannon.

3) On page 5 (lines 34 & 36) the authors have neglected to change "leg" to "lower limb."

Response: We apologise for this mistake. 'Leg' has been changed to 'lower limb'.

4) On page 6 (lines 11 & 13) the stair climbing limitation strikes me as consistent with an item of the SF-36. If that is its origin, the authors should provide a relevant citation.

Response: The question on limitations in stair climbing is indeed a question from the SF-36 (SF-12, version 1). We have now added the proper citation in the methods section, under 'Questionnaire' and accordingly to the reference list.

5) I'm not sure of Journal style, but to be consistent, it seems the authors should write "Grip strength" rather than "Grip Strength." Also, though the units for BMI are well known, it seems they should be indicated. In the footnote I would refer to "Lower limb extension power" rather than "Legrig."

Response: We have now changed the 'Grip Strength' to 'Grip strength'; the BMI unit has been included in table 1; and 'legrig' has been changed to 'lower limb extension power' in the table footnote, as kindly suggested by Dr. Bohannon.

6) The first column of Tables 1, 2 & 3 should be labeled "Variable."

Response: 'Variable' is now included in tables 1, 2 & 3.

7) On page 9 (line 16), page 11 (line 40) and page 12 (line 36) replace "leg" with "lower limb." Please examine the entire manuscript to this end.

Response: We have examined the manuscript and have changed 'leg' to 'lower limb' whenever appropriate, including on page 9, page 11 and page 12.

8) On page 13 (lines 9 & 11), write LEP rather than "lower limb extension power."

Response: We have now substituted 'lower limb extension power' with LEP on page 13.