Author’s response to reviews

Title: Associations between overweight, obesity, health measures and need for recovery in office employees: a cross-sectional analysis.

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Author’s response to reviews: see over
We would like to thank the reviewers for their valuable comments and suggestions. Please see our detailed response below, also indicating the actions taken. In the revised manuscript, the revisions are captured by track changes.

Reviewers’ comments

Reviewer 1 – Karen Lamb

This article addresses an interesting topic and is generally well written. However, there are a number of questions I have about the article, particularly relating to the methodology, which I hope that you will be able to address.

MAJOR COMPULSORY REVISIONS

1. Dependent variable
I had difficulty understanding how the outcome measure was defined and used in the analysis and I hope you can clarify some of these issues for me.

a. Firstly, you define NFR as a scale computed by summing up the scores of the 11 items for those who provided data for at least 8 of the 11 items. How did you treat non-response when developing this scale? Can you provide further information about how the scores were transformed to the 0-100 scale?

COMMENT: Thank you for this comment. Non-response was not frequently seen within the NFR scale. From the 412 participants, there were 9 participants who provided data for 10 of the 11 items, one participant who provided data for 9 of the 11 items and one participant who provided data for 8 of the 11 items. The remaining 401 participants answered all 11 items of the NFR questionnaire.

ACTION TAKEN: We have added the following to the second paragraph of the methods section: The NFR scale was computed by summing up the scores of the 11 items, of those providing data for at least 8 of the 11 items. The NFR total score was standardised to a score ranging from 0-100, based on the number of items with valid data. When three items are missing, the total score is expressed as percentage of the eight items, instead of the eleven items (the number of scored points was divided by the number of answered items and multiplied by 100). Higher scores indicate a higher NFR after work.
b. Secondly, you describe a dichotomy for the NFR score, grouping individuals into low or high and only present descriptive statistical information for NFR based on this dichotomy, not for the whole scale. However, you mention that you use linear regression to conduct the analysis which leads me to believe that you treated NFR as a continuous outcome variable. If NFR was indeed treated as a continuous variable in the analysis, please add further clarification in the text as Table 2 makes it appear that the dichotomy was adopted. Did the NFR scale have to be transformed to be used as a response variable? Please provide detail on how you verified the model assumptions.

If, however, you considered the dichotomous response of Low/High NFR, then a linear regression is not appropriate to fit to this type of response and a logistic regression model should be used instead. I would also check how sensitive your results are to the dichotomy you have selected should you adopt this approach over the continuous outcome.

COMMENT: In table 1 ‘Characteristics of the study population’ both the numbers with corresponding frequencies (low versus high NFR) and the mean with corresponding SD for the continuous scale are presented. We are sorry for the confusion, we did treat NFR as a continuous outcome variable in the analyses and therefore we have used linear regression. The NFR was positively skewed, but because transformation did not solve this we chose, in line with previous studies, not to transform our scale. We verified the model assumptions by testing the linearity and multi-collinearity.

ACTION TAKEN: We have added to the methods section to clarify the use of the NFR scale in the analyses. The text now reads as follows:

Descriptive analyses were performed to summarize the characteristics of the population using means and standard deviations or percentages. For the outcome variable (NFR), a square root transformation was formally applied as its distribution was positively skewed, due to the high number of respondents scoring the minimum score of NFR 0-20 (37.7%). This percentage is consistent with other studies on NFR [12]. However, the square root transformation did not meaningfully improve the distribution and therefore no transformation of original values was applied, which is in line with research of de Croon et al. [12]. Univariate linear regression analyses were used to determine the associations with NFR, which was treated as a continuous outcome variable, and each independent variable.

2. Independent variables

a. Body mass index

I would suggest also considering BMI as a continuous predictor for NFR in the analysis. This would increase the sensitivity to detect differences. You mention in the discussion the difficulties with using BMI as a categorical variable so it would seem logical to consider BMI as a continuous predictor.
COMMENT: Thank you for this suggestion. We did consider using BMI as a continuous variable in the analysis. However, we did not expect a linear relationship between BMI and NFR, but rather BMI above a cut off (overweight/obesity) would be associated with NFR. The World Health Organization BMI cutoff-points we have used are well established and often used in the occupational setting. We do realized that by using the term BMI, we have not made this sufficiently clear. To clarify this, we have changed BMI into overweight/obesity throughout the whole manuscript.

ACTION TAKEN: We have changed BMI into overweight/obesity throughout the text, e.g.:

...and was included as potential confounder in the relationship between overweight/obesity and NFR.

b. I would also suggest considering underweight as a category in the analysis and perhaps super obese (if there are sufficient numbers) to see how sensitive your results are to the categories you have adopted.

COMMENT: Thank you for this suggestion. Unfortunately, our numbers did not allow to make separate categories for extreme obesity or underweight (underweight (<18.5 kg/m²): n=6, extreme obesity (≥35 kg/m²): n=9).

ACTION TAKEN: We have added the following to the Independent variables paragraph:

Body weight and body height were assessed by self-report. BMI was categorized into three categories: normal body weight (cut-off point: <25 kg/m²), overweight (cut-off point: 25-<30 kg/m²), and obesity (cut-off point: ≥30 kg/m²) [33]. Those participants (1.9%) categorized as underweight (<18.5 kg/m²) were included in the normal body weight category because the number of participants did not allow a separate category (n=6). For the same reason, participants categorized as extremely obese (≥ 35 kg/m², n=9), were included in the overweight category. Normal body weight was chosen as reference category in the analyses.

c. General health and mental health

The same point as raise for the dependent variable: how was non-response treated when developing the scale as individuals only had to provide data for at least 3 of the 5 scores?

COMMENT: Non-response was treated in the same way as for the dependent variable. The personal scale average is calculated only when at least 3 out of 5 items have been answered. This scale is calculated by dividing the score on the valid items by the total number of valid items.
ACTION TAKEN: We have added the following to the methods section:
Both the general and mental health scale were computed by summing up the scores of the 5 items (in those providing data for at least 3 of the 5 items). The general and mental health total scores are transformed to a 0-100 range (as percentage of maximum total score) and all items are averaged in the same scale together. When items are missing, the scale average is filled, assuming that the respondent would have answered this item in a similar way as the others. Certain items were transformed such that higher scores indicate a better health status.

d. You mention general health twice in the methods—once as a health measure to be investigated and once as a potential confounder. It is not clear to me how these two measures differ or what the definition is of the general health measure in the potential confounders section. I believe that the first health measure is a perceived measure so perhaps the second measure is more objective. However, if the data are from self-reported questionnaires, do these two measures differ greatly? Further detail is required of how the general health confounder is defined and how similar it is to the perceived measure.

COMMENT: These two mentions of general health refer to only one measure; self-reported general health measured by the Rand-36 measure of health-related quality of life.

ACTION TAKEN: We have added to the Potential Confounders section as follows:

**General health** was self-reported and measured by items of the Dutch validated version of the Rand-36 measure of health-related quality of life, and was included as potential confounder in the relationship between overweight/obesity and NFR.

e. Did you consider an interaction between BMI and general health?

COMMENT: Yes, we did consider an interaction between BMI (overweight/obesity) and general health. The possible interaction between overweight/obesity and general health was tested by performing an analysis of variance (two way ANOVA F-test). No significant interaction at the level of p<0.05 was observed.

ACTION TAKEN #1: We have added the following to the methods section:
Thereby, the interaction between overweight/obesity and general health was examined by performing an analysis of variance (two-way ANOVA F-test). The level of significance was set at p<0.05. Data were analysed using SPSS Version 20.0 (SPSS Inc., Chicago, IL, USA).

ACTION TAKEN #2: We have added the following to the results section:

No effect modification for age and gender was observed and no significant interaction between overweight/obesity and general health was found.

3. Potential confounders

You used a measure of educational level as a confounder. Did you have information available on job type which could be important? While you mention that all participants are from a financial service provider, you don’t mention whether or not they are of a similar job category. This could potentially be a factor in the analysis and I would adjust for this in the analysis or add a comment about this point if the jobs are all of a comparable nature/skill level.

COMMENT: Thank you for this comment. We have asked respondents to fill in their job type. Since this was an open ended question, the job types were diverse. As the job types within the financial service provider are related to educational level, we chose to examine educational level as a proxy for job type.

ACTION TAKEN: We added a comment about the diversity in job categories, and the text now reads as follows:

Sociodemographic variables, such as gender, marital status (married/cohabitating, in a relation, no cohabitating, single, divorced, widowed) and educational level were self-reported. Educational level was divided into lower education (no education, primary school, lower vocational education or lower secondary school), middle education (intermediate vocational education or intermediate/higher secondary education) and higher education (higher vocational education and university). Although all from one single service provider, a great diversity in job types was found among respondents. As the job types within the financial service provider are related to educational level, educational level was examined as a potential confounder as a proxy for job type/skill level. Age was calculated by extracting the self-reported date of birth from the date of completion of the questionnaire by participant.

4. Statistical procedures

In addition to the issues I have with how the response variable was dealt with in the analysis, I struggled with some of the descriptions of the statistical procedures. In particular, the description of
expanding models by adding an interaction term between NFR and the respective variables did not make sense to me. Is NFR not your response variable? If so, I don’t understand how you fitted an interaction term with NFR. Some further work is required in this section to detail precisely what models were fitted. Also, it is not clear where the p-value comes from for Table 2 as it is simply entitled descriptive outcome measures. You need to clarify what methods you have adopted in the analysis in this section of the paper.

COMMENT: Thank you for pointing out this incorrect description. NFR is indeed our response variable and we have added an interaction term to the linear regression model by crossing a predictor (e.g. BMI, general health) with a modifier (e.g. age, job demands). Table 2 was meant to illustrate the (statistical) differences in outcomes between respondents with a low and respondents with a high NFR and the p-value represents the level of significance.

ACTION TAKEN: The title of table 2 has been revised and the representation of the p-values has been clarified. (Also see reviewer 1 point 6). Furthermore, we have replaced the explanation regarding effect modification and the text now reads as follows:

Furthermore, potential effect modification by age, gender and job demands was tested in the adjusted models. For each effect modifier, a linear regression model was fitted by crossing a predictor (overweight, obesity and health measures) and a modifier and adding this interaction term to the regression model. The level of significance was set at p<0.05.

5. Results

a. The results section needs a bit of work to clarify the findings of the study. You put more emphasis on ‘significant’ results than you perhaps should given the fact that p-values are on a continuous scale and that a p-value of 0.05 is simply an arbitrary threshold. In the adjusted analysis of BMI and NFR, the lower confidence limit for obesity is 0.01 and the strength of the association is substantially reduced after adjustment (p-value increased from 0.005 to 0.05). You should highlight this feature and not overstate your findings.

ACTION TAKEN: Thank you for this comment, we have adjusted the Results section to clarify the associations examined and highlight the associations in which the strongest evidence was found:

**Overweight and Obesity & Health measures**

Results of the unadjusted and adjusted linear regression models are shown in table 3. Unadjusted analyses showed significant associations for all health measures (general health, mental health, sleep quality, stress and vitality) and obesity with NFR.
Adjusted analyses also showed significant associations between health measures and NFR; significant positive associations (p<0.001) were observed between general health, mental health, sleep quality and vitality, and NFR. These results suggest that a better general health, better mental health, better sleep quality and a better vitality are all associated with a lower NFR. On the contrary, the significant negative association (p<0.001) between stress and NFR suggests that self-reported stress is associated with a higher NFR. After adjustment for confounding by age, educational level, job demands and general health, the significant positive association between obesity and NFR observed in the unadjusted analysis (B=13.45, 95%CI:4.03, 22.88, p=0.005) changed into a borderline significant positive association (B=8.77, 95%CI:0.01, 17.56, p=0.05), with normal body weight as the reference category. This finding suggests that obesity as compared to normal body weight is associated with a higher NFR.

b. Clearly, there is much stronger evidence of an association between each of the health measures and NFR than between BMI and NFR since the p-values are <0.001. You should highlight this fact.

ACTION TAKEN #1: Thank you for pointing this out. We have re-written the results section to highlight the association between each of the health measures and NFR. The text now reads as follows (see also point 5a):

Adjusted analyses also showed significant associations between health measures and NFR; significant positive associations (p<0.001) were observed between general health, mental health, sleep quality and vitality, and NFR. These results suggest that a better general health, better mental health, better sleep quality and a better vitality are all associated with a lower NFR. On the contrary, the significant negative association (p<0.001) between stress and NFR suggests that self-reported stress is associated with a higher NFR.

ACTION TAKEN #2: We have thereby added the following to the Discussion:

After additionally adjusting for general health in the association between overweight, obesity and NFR, the positive association (p=0.05) between obesity and NFR remained significant, although the association observed was attenuated. This indicates that obesity is independently associated with NFR, but that obesity is also partly associated with NFR as a result of poor underlying general health. Given the substantial reduction of the strength of the association after adjustment for confounding, this result has to be interpreted with caution.

c. Your statement of “No associations with NFR were evident in overweight compared to normal body weight subjects in neither unadjusted nor adjusted models” is not quite right. What you mean
is that you have not found strong evidence to support an association between overweight and NFR compared to normal weight.

**ACTION TAKEN:** Thank you, we have clarified this in the Results section:

No strong evidence was found to support an association between overweight and NFR, compared to normal weight. A significant interaction in the adjusted model was identified for job demands in the association between NFR and sleep quality ($B=-14.06$, 95%CI: -16.60, -11.51) and vitality ($B=-10.58$, 95%CI: -13.29, -7.89). Subgroup analyses revealed different associations between sleep quality, vitality and NFR in employees with high job demands and employees with low job demands, with the strongest significant negative association found in employees with high job demands. No effect modification for age and gender was observed and no significant interaction between overweight/obesity and general health was found.

d. The writing in this section needs clarification at times. For example, “Unadjusted analyses showed significant associations for obesity and all health measures” is vague. Clarify that the association is with NFR.

**ACTION TAKEN:** We have adjusted the text as follows:

Unadjusted analyses showed significant associations for all health measures (general health, mental health, sleep quality, stress and vitality) and obesity with NFR.

6. Table 2

The table title is not informative and needs to be revised. Clarification of what the p-values represent is required.

**COMMENT:** This table was meant to illustrate the (statistical) differences in overweight/obesity and health-related characteristics between respondents with a low and respondents with a high NFR and the p-value represents the level of significance between respondents with low and high NFR (also see reviewer 1 point 4).

**ACTION TAKEN:** The title of the table has been revised and the representation of the p-values has been clarified. The table now reads as follows:

**Table 2 – Comparison of overweight, obesity and health-related characteristics between participants with low and high need for recovery (NFR)**
### Low NFR (n (%))^+  | High NFR (n (%))^++ | p-value
--- | --- | ---
BMI categories (n=408) | | |
Normal body weight | 190 (60.3) | 48 (51.6) | 0.135
Overweight | 101 (32.1) | 26 (28.0) | 0.454
Obesity | 24 (7.6) | 19 (20.4) | <0.001*

NFR; need for recovery,^+ Low NFR; score ≤ 54.5, ^++ High NFR; score > 54.5; *; significant difference at the level of p<0.001

### Low NFR (Mean(SD))^+  | High NFR (Mean (SD))^++ | p-value
--- | --- | ---
General Health | 70.5 (16.8) | 57.6 (17.0) | <0.001*
Mental Health | 77.0 (12.4) | 61.3 (16.7) | <0.001*
Stress | 2.1 (0.6) | 2.8 (0.7) | <0.001*
Sleep quality | 4.9 (0.8) | 3.9 (1.0) | <0.001*
Vitality | 5.2 (0.8) | 4.6 (1.0) | <0.001*

General health and mental health were measured by items of the Dutch validated version of the Rand-36 measure of health-related quality of life [34]. ... the Rand-36 measure of health-related quality of life has shown satisfactory internal consistency...

MINOR DISCRETIONARY REVISIONS

7. General health and mental health
Please state the RAND-36 measure of health related quality of life, rather than simply Rand-36 when you mention this on page 6.

**ACTION TAKEN**: Thank you, the text now reads:

*General health and mental health* were measured by items of the Dutch validated version of the Rand-36 measure of health-related quality of life [34]. ... the Rand-36 measure of health-related quality of life has shown satisfactory internal consistency...

**Reviewer 2** – **Zuzanna Pieniak**

This is an interesting well-written study investigating associations between BMI, health measures and need for recovery in office employees.
MAJOR COMPULSORY REVISIONS

1. More details about the sampling method and collection of data is needed. Was it self-administrated? On-line or off-line, etc.

**ACTION TAKEN:** We have added additional information about the sampling method and collection of data and the text now reads as follows:

...In September 2011, all 1,182 office employees (> 18 years) of a single financial service provider received an invitation to participate in the project. Those on sick leave for more than four weeks were not eligible to participate. **An off-line questionnaire was administered at baseline, including measures of NFR, daily physical activity, general health, mental health, sleep quality, stress and vitality. All data were self-reported.** A total of 412 employees (response rate: 35%) from 19 departments signed the informed consent form, completed the baseline questionnaire and were included in the Be Active & Relax project. This study was approved by the Medical Ethics Committee of the VU University Medical Center Amsterdam. The development and design of the Be Active & Relax project has been described in full detail elsewhere [27].

2. I’m not convinced whether the NFR scale is measured in the best way: dichotomous scale gives obviously little answers. What about people who are not certain or doubt about their answer? Wouldn’t be better to use e.g. an agreement scale?

**COMMENT:** The NFR scale is a validated scale which has been widely used for research purposes. According to the developers of this scale, the simplicity of dichotomous answering categories (yes/no) was preferred to a polychotomous scale, because of the intended application at the individual level in occupational health: the scale had to be as easy to fill in and score as possible.

3. P.7, vitality; the scale you report is not a Likert scale!

**ACTION TAKEN:** Thank you, the text now reads as follows:

**Vitality** was assessed using a part of the Utrecht Work Engagement Scale (UWES) [37], which contains 6 items (e.g. “At my work, I feel myself bursting with energy”) that had to be answered on a **7-point scale** (“never” to “always”).

MINOR ESSENTIAL REVISIONS
4. Page 5, section ‘dependent variable’: Dutch abbreviation of the questionnaire is mentioned as VVBA and VBBA. Which one is the correct one?

ACTION TAKEN: Thank you, the correct wording is VBBA. We have replaced the abbreviation VVBA with VBBA in the text as follows:

In this study, need for recovery (NFR) was assessed using the Need for Recovery after Work scale of the Dutch version of the Questionnaire of the Experience and Evaluation of Work (Dutch abbreviation: VBBA). The used subscale of the VBBA, a questionnaire on the perception and judgement of work...

5. Page 8, please explain what are the corresponding low, middle and high educational levels

ACTION TAKEN: Thank you for pointing this out. We have clarified this in the paragraph describing the sociodemographic variables in the Potential Confounders section as follows:

Sociodemographic variables, such as gender, marital status (married/cohabitating, in a relation, no cohabitating, single, divorced, widowed) and educational level were self-reported. Educational level was divided into lower education (no education, primary school, lower vocational education or lower secondary school), middle education (intermediate vocational education or intermediate/higher secondary education) and higher education (higher vocational education and university).