Author's response to reviews

Title: Socio-demographic and behavioural correlates of physical activity perception in individuals with recently diagnosed diabetes: results from a cross-sectional study

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Author's response to reviews: see over
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26th of April 2013

The Editorial Board
BMC Public Health

Dear Mr. Vargas and Dr. Imenez-Pavon,

Re: Socio-demographic and behavioural correlates of physical activity perception in individuals with recently diagnosed diabetes: results of a cross-sectional study

Thank you for inviting us to revise our paper and re-submit to BMC Public Health. We are delighted that the reviewers thought that our article was “an interesting study on a relevant subject” and addressed an important research question. Please find attached a revised version of the paper with major changes highlighted in yellow, along with a detailed response to each point raised by the reviewers below. We have included a Supplementary Table for clarity in our response to Reviewers, but would prefer not to include it in the final paper to avoid confusion. We look to the Editors to decide whether this Table should be included in the manuscript/as an online appendix.

Thank you very much for your consideration of this manuscript. We look forward to hearing from you.

Sincerely yours,

Gráinne H. Long
Søren Brage
Nicholas J Wareham
Esther van Sluijs
Simon J Griffin
Stephen Sutton
Rebecca K Simmons
**Reviewer's reports in italics**

**Reviewer 1: Lilian Lechner**

The paper presents an interesting study on a relevant subject. The study has several merits, as rightfully described in the discussion. There are also some concerns that need to be addressed.

**Major points**

1) “Data were used from an existing intervention project, the ADDITION-Plus cohort. For the current paper data were used from the one year follow-up...I do not find any information on how these interventions might have influenced the current results, nor can I find any remarks on this issue in the discussion of the results. I can well imagine that if people received such intensive interventions, this would influence their PA behavior or their awareness of this PA behavior. In other words; how did the interventions undergone influence the results of the current study?...Would it not have been better to use the baseline data of the project, without any influence of the interventions?”

Pragmatic reasons prevented us from using baseline data, as objective measures of behaviour were only available at the one-year assessment. In addition, our decision to pool the data into a single trial cohort was based on several factors. First, models were run separately by trial arm and, as results were not dissimilar, data were pooled and presented for the whole cohort. Second, we included ‘study group’ (trial arm) as an *a priori* confounder in all our cross-sectional analyses to ensure all our findings take randomisation of study participants to different interventions into account. Thus, any significant findings presented here are over and above the effect of trial arm. Third, the ADDITION-Plus trial paper is currently in submission, and shows that the behaviour change intervention did not improve objectively measured health behaviours - including objective physical activity - over one year (Griffin, Simmons et al. in submission), although we acknowledge that the effects on the outcome of interest in the current paper, PA disparity, was not assessed. Fourth, our primary outcome, PA disparity, did not differ between trial arms, suggesting the intervention did not significantly affect PA awareness and is not likely to affect our results or conclusions.

For clarity we have now used the word ‘trial arm’ rather than study group throughout the manuscript and Tables. We have now added a sentence to clarify why one year data was used in the Methods section (p10). We have also added sentences in the Methods (p12) to clarify that trial arm was controlled for in all analyses and sentences in the Results (p15) section to clarify that PA disparity did not differ significantly between trial arms.

**Methods (p10):**

*This objective measure of physical activity was only available at one year of follow-up.*

**Methods (p12):**

*Sex, age and trial arm were considered *a priori* confounders and included in all models.*
Results (p15):

‘PA disparity’ (the absolute difference between objective and self-reported PAEE) captures the magnitude of the difference between the two PA measurements and did not differ between trial arms (difference between mean PA disparity: 1.62 (1.43) kJ · kg\(^{-1}\) · day\(^{-1}\), t=1.13, \(p=0.26\)).

2) “A major concern is that two measures of PA were used that concern a very different time frame. One measure assesses PA in the last 6 months, while the objective measure assesses PA the last 4 days, which is very incomparable…It is impossible to know whether differences that were found between the two measures were really caused by people not being aware of their PA, or simply by the fact that PA from very different time periods was compared. Although authors mention this weakness shortly in the discussion, they do not discuss the possible impact and consequences of this issue. Simply mentioning the issue as a weakness is unsatisfactory.”

Previous literature on the topic of people’s awareness of their PA levels has relied on self-reported and self-rated assessments. We have attempted to extend previous work by incorporating an objective measure of PA and comparing it to a measure of self-reported PA instead of a single item assessment of self-rated PA. However, this brings with it inherent challenges; for example, it is obviously impractical for participants to wear an objective measure for the whole time frame captured by most PA questionnaires. In order to address the possible impact of time frame differences we have now carried out sensitivity analyses which examine whether differences in the time frames captured by these two tools affect the validity of our findings. Specifically we assessed whether the between-instrument correlation is similar when examined in individuals, as well as season-balanced clusters. The following text has been added:

Methods (p13):

Finally, to examine if differences in the time frames captured between self-report and objective methods (5 days versus 12 months, respectively) effect validity, (iv) one individual from each season (in which objective PA was measured) was randomly selected to form groups of four (n=100 draws) and between-group correlations were compared with individual-level correlations using random effects regression.

Results (p16/17):

Self-reported and objectively measured PAEE were significantly positively correlated, even when season of objective measurement was adjusted for (Spearman’s correlation coefficients (rho) in men: rho=0.28, \(P <0.001\) and women: rho=0.27, \(P=0.006\) adjusted for season). Furthermore, very similar correlations were observed when participants were randomly grouped in season-balanced groups of four; the between-cluster rho for self-reported and objective PAEE was 0.24 and 0.23 in men and women, respectively.

In addition, although the time frames covered by our two PA tools differ it should be noted that:

(1) Both our objective and self-reported activity assessments aim to capture total habitual physical activity; our objective PA measure assesses total activity via
continuous combined heart rate and accelerometer wear over the previous 4 days, and
our self-reported measure assesses past-year activity across four different domains.
(2) The time frames covered by our two instruments overlap; the 4-day continuous
wear period captured by our objective instrument is included in the time period
captured by the self-reported questionnaire.
Thus, although different total time frames are covered by these instruments, they both
assess total daily habitual activity in overlapping time periods in participant’s lives,
and taken in conjunction with the sensitive analysis performed above, it is unlikely
here that time frame differences are major contributors to the difference between
objective and self-reported activity. We have now added sentences in the Discussion
to clarify the importance and novelty of methods used here to assess PA perception
and have also added sentences to the Methods to address the time periods covered:

Discussion (p18 & 19):
To our knowledge, this is the first study to identify characteristics associated with the
disparity between objective and self-reported PA on a continuous scale….Previous
studies assessing ‘PA awareness’ – the difference between an individual’s belief and
measured attainment of PA guidelines – have predominantly relied on self-reported
and self-rated assessments. We have extended previous work by incorporating an
objective measure of PA, which likely reflects true PA more accurately than self-
reported or self-rated PA.

Methods (p21):
However, results from sensitivity analyses do not support a major role of between-
instrument differences in the time frames.

3) “Can the authors explain the enormous percentages of underestimators, it
seems that in this population underestimation of PA is a much bigger issue than
overestimation. I have not seen these numbers in other studies, but the
measurement methods might be related to these results. Could it also be a result
from the interventions undergone? Although underestimation of PA might be less
of a problem for health interventions, there still might be practical consequences
for health promotion. Could authors address this issue?”

We thank the Reviewer for this suggestion. Due to (1) use of different methods, as
well as (2) different populations studied, we were hesitant to make direct comparisons
to previous findings. However, we agree that this finding merits further discussion
and have added the following sentences to address these important findings. We have
now also looked at predictors of under-estimators (see our reply to Reviewer 2,
Comment 2 below).

(1) Methodological differences (Discussion paragraph 3 page 19):
The different approaches used to classify PA awareness make it difficult to compare
proportions- and characteristics- of PA overestimators and underestimators. Previous
studies report a lower proportion of underestimators (ranged from 6.1 to 22.5%) and a
slightly higher proportion of overestimators (ranged from 15% and 35%) compared
with our study (67% and 19%, respectively), with the remaining individuals falling
into two other awareness categories [11-13]. Reasons for the lower proportion of
underestimators in prior studies include the fact that the self-reported PA
questionnaire captures specific activities over four domains. Thus, inevitably there will be some activities people engage in that are not included in questionnaires and we expect lower total activity levels from these questionnaires compared to complete 24-hour recall obtained from continuous wear of objective monitors which capture all activity. Furthermore, the method used here to convert self-reported PA into PAEE removes resting metabolic rate (RMR) to produce estimates that better reflect PA in its own right and not total energy expenditure [40]. Most studies include RMR and may therefore produce inflated PA estimates.

(2) Study population differences:
Methods (p9)
All participants received advice regarding the importance of a healthy lifestyle, including PA, for the control of diabetes, as well as a target for behaviour change (for PA a gradual increase to reach the equivalent of 35 minutes of brisk walking per day, 7 days per week).

Results (p15).
The proportions of individuals in the three awareness groups (over- and under- estimator and aware) did not differ significantly by trial arm ($\chi^2=4.5$, $P=0.11$).

(Discussion paragraph 3 page 19)
The proportions of individuals in the three awareness groups (over- and under- estimator and aware) did not differ by trial arm suggesting that the intervention was not responsible for the large percentage of underestimators.

Level of interest: An article of importance in its field

Quality of written English: Acceptable

Statistical review: No, the manuscript does not need to be seen by a statistician.

Declaration of competing interests:
I declare that I have no competing interests
Reviewer 2: Mireille van Poppel

Reviewer's report:
Socio-demographic and behavioural correlates of physical activity perception in individuals with recently diagnosed diabetes: results from a cross-sectional study

The paper studies differences between objectively measured and self reported PA and assesses factors related to the magnitude of these differences and to overestimating PA. The paper is of interest to all who work in the field of physical activity promotion. In general, the paper reads well, but there are some confusing elements that need rectifying.

Major Compulsory Revisions
1. "In the paper, PA disparity has been defined as 'the absolute difference between objective and self reported PA energy expenditure'. Personally, I misunderstood this definition almost to the very end of the paper. ‘Absolute’ was for me the opposite of ‘relative’, and not the mathematical meaning of the word absolute. I would absolutely urge the authors to the definition of PA disparity more clear, from the start of the paper (already in abstract)."

We thank the Reviewer for this suggestion. We have now included a clear definition of PA disparity in the abstract (p6) and introduction (p8):

We define PA disparity as the non-negative value of the difference (in mathematical terms the absolute difference) between objective and self-reported PAEE.

2. "What I find surprising, is that self reported PA energy expenditure was lower then objectively measured PA energy expenditure. To my understanding, PA is usually overestimated on average in self reports. The finding of lower PA levels in the self reports is not discussed in the paper. Also looking at the figure, for me this means that the PA disparity is more driven by UNDERestimating than overestimating. What I do not understand after reading the paper, is why PA disparity is important, and not looking at under- and overestimation instead. For me that would be more informative."

We thank the Reviewer for this suggestion and have now added sentences in the Discussion clarifying that, on average, the sample underestimated their PA (please also see our reply to Reviewer 1, Comment 3 above). We feel that PA disparity is important as it captures the magnitude of the difference between objective and self-reported measures and can be modelled as a continuous variable. Previous researchers have categorised PA data into awareness groups, which increases the risk of misclassification. We agree that disparity is predominantly driven by underestimation and therefore additionally studied correlates of PA overestimation as we felt that this group was is more important from a public health perspective. We have now additionally examined predictors of PA underestimators (see Supplementary Table 1 overleaf), but would prefer not to include it in the final paper to avoid confusion. We will look to the Editor to decide if it is a useful addition.
## Table 1
Association between physical activity underestimation and socio-demographic, clinical and health behaviour characteristics in the Addition-Plus cohort, UK, 2004 – 2007

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Category/units</th>
<th>Underestimators</th>
<th>% (n)</th>
<th>Univariable OR (95%CI)</th>
<th>P</th>
<th>Multivariable OR (95%CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Socio-demographic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>♂</td>
<td>63.5 (101)</td>
<td>1</td>
<td>0.27</td>
<td>1</td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>♀</td>
<td>69.5 (185)</td>
<td>1</td>
<td>1.32 (0.871 to 1.99)</td>
<td>1</td>
<td>1.21 (0.77 to 1.91)</td>
<td></td>
</tr>
<tr>
<td>Age category (years)</td>
<td>42-54.9</td>
<td>71.7 (66)</td>
<td>1</td>
<td>0.19</td>
<td>1</td>
<td>0.047</td>
<td></td>
</tr>
<tr>
<td></td>
<td>55-59.9</td>
<td>73.3 (66)</td>
<td>1</td>
<td>1.08 (0.56 to 2.09)</td>
<td>1</td>
<td>1.19 (0.60 to 2.36)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60-64.9</td>
<td>66.7 (54)</td>
<td>1</td>
<td>0.79 (0.41 to 1.54)</td>
<td>1</td>
<td>0.79 (0.40 to 1.54)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65-71</td>
<td>61.7 (100)</td>
<td>1</td>
<td>0.63 (0.36 to 1.09)</td>
<td>1</td>
<td>0.65 (0.36 to 1.16)</td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td>Asian/Black=0</td>
<td>72.7 (8)</td>
<td>1</td>
<td>1.27 (0.83 to 1.95)</td>
<td>1</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Caucasian=1</td>
<td>67.1 (278)</td>
<td>1</td>
<td>1.21 (0.77 to 1.91)</td>
<td>1</td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td><strong>Socio-economic category (Occupation)</strong></td>
<td>Managerial &amp; professional</td>
<td>72.5 (124)</td>
<td>1</td>
<td>0.39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>64.4 (67)</td>
<td>1</td>
<td>0.79 (0.46 to 1.38)</td>
<td>1</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Routine &amp; manual</td>
<td>62.1 (90)</td>
<td>1</td>
<td>0.71 (0.43 to 1.16)</td>
<td>1</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical</strong></td>
<td>BMI (kg/m²)</td>
<td>31.9 (5.4)</td>
<td>1</td>
<td>0.14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waist Circumference (cm)</td>
<td>108.9 (14.2)</td>
<td>1</td>
<td>0.07</td>
<td>0.98 (0.97 to 1.00)</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smoking status</td>
<td>Current</td>
<td>65.5 (38)</td>
<td>1</td>
<td>0.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former</td>
<td>69.9 (146)</td>
<td>1</td>
<td>1.26 (0.66 to 2.37)</td>
<td>1</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>64.7 (101)</td>
<td>1</td>
<td>1.03 (0.53 to 1.98)</td>
<td>1</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td><strong>Health behaviours</strong></td>
<td>Alcohol consumption (units/week)</td>
<td>7.8 (11.3)</td>
<td>1</td>
<td>0.73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Daily dietary intake</td>
<td>Total energy (Kcal)</td>
<td>1708 (475)</td>
<td>1</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fat (g)</td>
<td>59 (22)</td>
<td>1</td>
<td>0.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fruit (g)</td>
<td>285 (197)</td>
<td>1</td>
<td>0.001</td>
<td>0.99 (0.97 to 0.99)</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetable (g)</td>
<td>239 (139)</td>
<td>1</td>
<td>0.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EuroQol EQ-5D (scale: -0.3 to 1)</td>
<td>0.84 (0.2)</td>
<td>1</td>
<td>0.19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ADDQoL (scale: -9 to 9)</td>
<td>0.90 (1.2)</td>
<td>1</td>
<td>0.28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SF-36 general health (scale: 1 to 5)</td>
<td>2.9 (0.9)</td>
<td>1</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diabetes treatment satisfaction (scale: 0 to 36)</td>
<td>30.2 (5.5)</td>
<td>1</td>
<td>0.51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quality of life &amp; well being</strong></td>
<td>Intention</td>
<td>3.5 (0.8)</td>
<td>1</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perceived behavioural control</td>
<td>3.6 (0.9)</td>
<td>1</td>
<td>0.31</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Output is taken from logistic regression models with PA underestimation as the binary outcome.

- **Mean characteristic of underestimation (SD).**
- **Adjusted for age, sex & study.**
- **Adjusted for age, sex, SES category & study**
- **Weighted health state index, where dead=0 & full health=1.**
- **Weighted impact of diabetes index, where -9=maximum negative; +9 is maximum positive diabetes impact.**
- **General health utility scale ranging from 1=excellent to 5=poor.**
- **Diabetes treatment satisfaction scale, where 0=very dissatisfied & 36=very satisfied.**
- **5-point Likert-type agree/disagree scale, where 5 represents highest behaviour change beliefs.**
3. “On page 21 in the discussion, the following sentences completely confuse me: “The magnitude of PA overestimation observed..... interventions aimed at increasing PA. The average PA overestimation in this study (....) equates to 2 hrs of brisk walking per day.” Before coming to this sentence, I was in the absolute conviction that on average PA was underestimated in this study sample. I would delete the second sentence I refer to, and change the first into: “the proportion of people overestimating their PA observed in this study .... “.

We have now rephrased and deleted as suggested.

**Minor Essential Revisions**

“Page 10: write numbers with which you start a sentence in full.”

Amended as suggested.

“Page 10: it is not clear to me why the one year follow up data were chosen and analysed cross-sectionally? Were objective PA data not available from baseline? Please add information”

We have now added a sentence in Methods section to clarify that objective data were not available at baseline (see Comment 1 to Reviewer 1 above).

“Page 10: what is ‘.. randomised to ’study s’…?’”

This was a typographical error and had now been removed.

“Page 13 third and fourth lane: use past tense.”

Amended as suggested.

“Page 13, second line of statistical analysis: is this with and without objective PA data or any PA data?”

This is with and without both self-reported and objective PA. We have now clarified this in the text.

“Page 13, statistical analysis: was study or study GROUP considered as confounder. I hope study GROUP otherwise I have not understood the design.”

The Reviewer absolutely understands the design; study group was considered an *a priori* confounder in all analyses. To avoid confusion, we have now reworded to ‘study group’ to ‘trial arm’ throughout the manuscript.

“Page 18: last paragraph: others (delete space from other s)”

Deleted as suggested.

“Page 19, 4th line: difficult to understand. If levels of perceived inactivity declined, (younger) people nowadays report MORE PA compared to older people? And why would that be related to higher PA disparity, if disparity is mostly driven by
"UNDER reporting? And is this declining perceived inactivity related to age or to time?"

Thank you for identifying this potential source of confusion; we have updated the text to include the following (p19):

Several factors may contribute to the observation that PA disparity is greater in younger participants. Social approval has been shown to be associated with underestimation of PA (Adams, Matthews et al. 2005) and this factor may be more important in younger age groups. Indeed, post-hoc analyses show that underestimation is most prevalent in the youngest age group (data not shown). In addition, our self-report PA measure may have not adequately captured the activity of this age group, also leading to PA underestimation.

"Page 19, line 5: why would low self reported medication adherence be related PA disparity? I don’t see the connection. I can almost understand the connection that has been made with knowledge. But knowledge about health and guidelines does not have to be related to reporting on your own behaviour. A similar reasoning is given in the last sentence of this paragraph. Is it not that people with lower SES might, in addition to higher occupational PA levels (which has not been shown by the way) have more difficulty in filling out questionnaires, and therefore have higher PA disparity?"

We thank the Reviewer for these suggestions. On reflection, we agree that it is not clear how self-reported medication adherence might relate to PA. We have now removed self-reported medication adherence as an exposure variable from our analyses and Tables. We have added sentences in the Results which present differences in self-reported total work PA between socio-economic groups. We have also added sentences in the Discussion to address how difficulties in completing questionnaires may vary by SES group and may contribute to the observed associations.

Results (p14):
Total self-reported occupational PA was lower in those with professional/managerial compared to routine/manual occupations (97.8 ± 73.2 and 80.1 ± 52 Net Activity MET hours · week⁻¹ respectively, t=1.88, p=0.07).

Discussion (p19):
Thus, inadequate perception of occupational PA in people with routine/manual relative to professional/managerial occupations may help explain the association between socio-economic category and increased PA disparity. An alternative explanation could be that individuals in lower socio-economic categories may experience more difficulty in completing the questionnaire, resulting in higher PA disparity.

Discretionary Revisions
“Why is ‘daily dietary intake’ in italics in the tables?”
This now appears in regular text format in tables.

**Level of interest:** An article whose findings are important to those with closely related research interests

**Quality of written English:** Acceptable

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**
I declare that I have no competing interests


Griffin, S. J., R. K. Simmons, et al. (in submission). "Does a facilitator-led, individually-tailored behaviour change intervention improve outcomes for people with recently diagnosed type 2 diabetes in UK general practice? One-year results from ADDITION-Plus randomised controlled trial ".