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REVISION

**MS: 1580534259135245 - Dietary factors associated with obesity indicators in Flemish adults with different levels of sports participation: a cross-sectional study**

Dear editors and reviewers,

We thank you for giving us the opportunity to revise our manuscript "*Dietary factors associated with obesity indicators in Flemish adults with different levels of sports participation: a cross-sectional study"* (MS: 1580534259135245) and to reconsider the revised manuscript for publication in *Nutrition Journal*.

We would also like to thank the two referees for their critical review, helpful suggestions and for the appreciation of our work.

Our response to each of the points raised by the referees and the point-by-point description of the changes incorporated in the manuscript are given below.

**Referee 1: Zalilah Mohd Shariff**

Major Compulsory Revisions

1. Title

We agree with the comment of the reviewer indicating that the objective of the study was twofold and that the title should reflect both objectives.
Hence, we changed the title of the manuscript into:
"*Dietary factors associated with obesity indicators and level of sports participation in Flemish adults: a cross-sectional study"*

2. Method

a. The reviewer indicated that it was not clear if the sample was nationally representative and asked for the sampling method utilized.
The data collection performed by the Flemish Policy Research Centre Sport, Physical Activity and Health (SPAH) took place in 46 Flemish municipalities, selected on the basis of clustered random sampling. Subjects with ages between 18 and 75 years were selected at random within these municipalities by the National Institute for Statistics. A total of 5170 subjects volunteered to participate in the SPAH Study. They correspond to 28% of the original sample. Part of the lower participation rate can probably be explained by the fact that the test battery was rather comprehensive (given the context of a large epidemiological study), and also included physical measurements of anthropometric fitness, and health parameters, besides questionnaires. The mean duration of a test was 1.5 hours. This might have put off individuals to participate in the study. Comparable participation rates have been reported for other epidemiological studies in which certain variables were actually measured instead of using (mailed) questionnaires (e.g. BIRNH Study: Belgian population aged 25-74y, participation rate = 36.5%, Int J Obes 1999, 23 Suppl 1:1-19). Detailed establishment and description of our sample has been given in a recent publication (Arch. Public Health 2006; 6: 123-142). As dietary reports were not available for all subjects, only data of 1520 subjects could be included in the present study. In addition, after exclusion of the inaccurate dietary reports, the sample was even smaller. Consequently, we can not assume that it is representative for the Flemish adult population. No statistical adjustments have been made for the present analyses. In the revised version we added one reference and following paragraph:
"*For this purpose, 46 Flemish municipalities were selected on the basis of clustered random sampling. Within these municipalities, the National Institute of Statistics randomly selected a sample of Flemish men and women aged 18 to 75 years. In each municipality, the size of the random sample was proportionate to its population size. Detailed establishment and description of this sample have been given elsewhere [27]. A total of 5170 subjects volunteered to participate in the SPAH Study. This sample was compared with the total Flemish adult population to evaluate its representativeness. Although some small differences were observed, the sample of the SPAH Study can be considered as sufficiently representative for geographic distribution, age, gender and educational level [27]. Only 1520 subjects filled in a 3-day diet report and could be included in the present analyses. Consequently, we can not assume that that they are fully representative for the Flemish adult population. Participants with incomplete data for anthropometry and/or physical activity were also excluded, as well as participants with implausible energy intake."*

Following reference was added in the method section:
27. Duvigneaud N, Wijndaele K, Matton L, Deriemaeker P, Philippaerts R, Lefevre J, Thomis M, Duquet W. **Prevalence of overweight, obesity and abdominal obesity in Flemish adults**. Arch Public health 2006; **6**: 123-142
This manuscript has been added as attachment for the reviewers.

b. We agree with the comment of the reviewer indicating that different food quantification methods were utilized namely food weighing and food estimation. It is true that the use of different food quantification methods will affect the quality of dietary data. Of course it is better to weigh the amount of food eaten, but in some cases e.g. lack of time, eating away from home,…the subjects might not be able to weigh all foods eaten. A strict rule of having to weigh all ingredients would have discouraged the subjects to return their 3-day diet record. Therefore, although the subjects were instructed to weigh all foods eaten, in the 3-day diet record standard household measures were given to estimate the amount of foods eaten e.g. slice of bread (40g), tablespoon (15g), glass milk, soft drink, (200 ml),…This method aimed to increase the quality of the dietary intake when weighing was not possible.
To clarify this aspect, the following sentences were added in the method section:
*"Whenever possible the subjects were instructed to weigh the amount of foods eaten. Nevertheless, if weighing was not possible, the subjects were instructed to estimate the amount of all foods eaten, using standard household measures, e.g. tablespoon (15g). This information was included in the 3-day diet record booklet. This method aimed to increase the quality of the food estimation."*

3. Results and Discussion

a. The reviewer correctly remarks that the fibre intake was unexpectedly significantly higher ($P<0.05$) in overweight and obese women compared to lean women. As suggested by the referee, we added some explanation for this finding and we emphasized the sex difference found regarding fibre intake.
Consequently the paragraph regarding fibre intake in the discussion section was adapted and extended:
"*In the present study, regarding carbohydrate, starch, sugar and fibre intake, opposite results were found for men and women. In men, percentages energy from carbohydrates, starch and fibres are significantly lower in overweight and obese men compared to lean men, whereas in women the intake of carbohydrates, starch, sugars and fibres were found to be positively related with overweight and obesity. A possible explanation for this sex difference regarding fibre intake could be that women tend to be more health-conscious and more knowledgeable about food and nutrition than men [49-51]. In addition, one could assume that fibre intake will generally increase with higher total energy intake which is the case in overweight and obese women, although this is not the case in men.*"
Following references were added in the discussion section to support the higher health-consciousness in women:


49. Fagerli RA, Wandel M: **Gender differences in opinions and practices with regard to a "healthy diet"**. *Appetite* 1999, **32**:171-190.
50. Nanakorn S, Osaka R, Chusilp K, Tsuda A, Maskasame S, Ratanasiri A: **Gender differences in health-related practices among university students in northeast Thailand**. *Asia Pac J Public Health* 1999, **11**:10-15.
51. Girois SB, Kumanyika SK, Morabia A, Mauger E: **A comparison of knowledge and attitudes about diet and health among 35- to 75-year-old adults in the United States and Geneva, Switzerland**. *Am J Public Health* 2001, **91**:418-424.


b.
i. We agree with the comment of the reviewer indicating that the higher sugar consumption is not in line with the discussion on the role of carbohydrates in physically active individuals as a high sugar intake can not be considered as health enhancing. Therefore, the higher sugar intake in physically active women was specifically added in the results section and the following sentence was added in the discussion:
"*The higher sugar intake in physically active women might be explained by the assumption that these women try to compensate their higher intake of sweets by doing more sports."*

ii. The referee suggested that there could be an interaction between BMI and sports participation. To test this hypothesis we performed ANCOVA analyses between BMI groups for participation in health related sports with age as covariate in men and women separately. No interaction was found between BMI and level of sports participation in both genders. Nevertheless, although not significant, overweight and obese individuals show a lower participation in health related sports.

iii. As suggested by the reviewer a paragraph concerning sex differences in dietary intakes was added in the discussion and conclusion sections as some of the findings were indeed sex specific.
The following paragraph was incorporated in the discussion section:
"*The findings of the present study revealed that regarding dietary intake some sex differences were observed between obese men and women. Obese women show a higher consumption of all macronutrients, and surprisingly also of fibres, while men show a higher fat and protein intake, but a lower intake of carbohydrates and fibres. In addition, there was a positive association between alcohol intake and abdominal obesity in men, but not in women. On the other hand, women with abdominal obesity show a significantly higher calcium intake compared to lean women, but this trend was not significant in men."*
The following sentence was added in the conclusion section:
"*The sex differences for dietary intake between obese men and women might reflect the generally higher health consciousness of women. In addition, the current findings also pointed to sex differences between men and women with high level of sports participation.*"

4. Conclusion

a.
i. We agree with the comment of the reviewer emphasizing that the present study has a cross-sectional design, implying that no cause-effect relationship could be established. Therefore, the findings of the present study were expressed with more caution in the conclusion section of our manuscript.

ii. As suggested by the reviewer, the higher fibre intake found in obese women was also highlighed in the conclusion section.

iii. As suggested by the reviewer, we also underlined the importance of exclusion of underreporters when establishing associations between dietary intake and anthropometric status.

Hence, the conclusion section was rewritten taking into account the above mentioned comments of the reviewer:
"*The present study highlighted the importance of excluding implausible dietary reports when investigating associations of overweight and obesity with dietary intake. If underreporters are not excluded, one runs the risk that no or other erroneous conclusions are drawn. Bearing in mind the limitations related to a cross-sectional design, implying that no cause-effect relationship could be drawn, the findings of the present study seem to support that dietary intake might play a role in the development of overweight and abdominal obesity. Overweight and obese men reported a higher consumption of fats and proteins, whereas their energy percentages from carbohydrates and fibres was lower compared to their normal weight counterparts. On the other hand, in overweight and obese women, a higher intake of all macronutrients was observed compared to lean women. Unexpectedly, the overweight and obese women had also a higher fibre intake. The positive association between alcohol intake and abdominal obesity was confirmed by the present results in men, but not in women. The sex differences for dietary intake between obese men and women might reflect the generally higher health consciousness of women. In addition, the current findings also pointed to sex differences between men and women with high level of sports participation. Finally, the present study highlighted the importance of waist circumference as additional measurement in epidemiological studies, as alcohol and calcium intake are only associated with waist circumference, and not with BMI.*"

**Referee 2: Marta Garaulet**

1. The reviewer had some questions related to the use of the equation to evaluate inaccurate dietary reports.
   - Why do authors take into account the technical error of measuring energy expenditure by doubly labeled water method?
     To detect implausible dietary reports we used the method proposed by McCrory and colleagues. Following this method inaccurate energy intake were identified by comparing reported energy intake (rEI) with predicted total energy expenditure (pTEE). To predict TEE the equation proposed by Vinken et al. was used. Vinken et al. developed this equation based on simple anthropometric and laboratory measures by using the doubly labeled water method. Hence the technical error of measuring energy expenditure by doubly labeled water method was taken into account when calculating cut-offs for excluding rEI at ±1 SD for the agreement between rEI and pTEE.

   To clarify the use of the technical error of measuring energy expenditure by doubly labeled water method we added the following sentence in the method section:
   "*The equation of Vinken et al. [29] was used to predict TEE in each subject. This equation to predict adult energy requirements from simple anthropometric and laboratory measures was developed by using the doubly labeled water method [29] and is at follows:*"

   - Is this error the same for every subject?
     Yes, ±1 SD is indeed 24% for every subject

   Example for one subject:

$$\pm 1\,SD = \sqrt{(CV_{wEI}^2 / d) + CV_{wpTEE}^2 + CV_{tmTEE}^2}$$

with $CV_{wEI}$ = 23%; d = 3 (3 days of diet record); $CV_{wpTEE}$ = 17.7%; $CV_{tmTEE}$ = 8.2%

$$\pm 1\,SD = \sqrt{(23^2 / 3) + 17.7^2 + 8.2^2}$$

$$\pm 1\,SD = \sqrt{(529/3) + 313.29 + 67.24} = 24\% \Rightarrow 76\%\ \text{pTEE} < \text{rEI} < 124\%\ \text{pTEE}$$

pTEE = *7.377 – 0.073 × age + 0.0806 × weight + 0.0135 × height - 1.363 × sex*

pTEE = *7.377 – 0.073 × 18.10 + 0.0806 × 68.6 + 0.0135 × 178.1 - 1.363 × 0*

pTEE = 13.99 MJ  76% pTEE = 10.63 MJ  124% pTEE = 17.35MJ

rEI = 7.56 MJ ⇒ rEI < 10.63 MJ (< 76% pTEE) ⇒ underreport

2. The reviewer wonders whether the skinfold measurements were performed by the same anthropometrist.
   Not all subjects were measured by the same anthropometrist because the study sample was too large to be measured by one person. Therefore the staff members underwent specific training in anthropometric measurements given by experienced anthropometrists and quality control was performed at several moments. The mean intraclass correlation coefficients (ICC) of skinfold measurements performed by the different anthropometrists ranged from 0.69 to 0.97.

3. As suggested by the reviewer we investigated whether significant differences in BMI or % body fat exist between subjects depending on the degree of participation in health related sports. Hence ANCOVA analyses with age as covariate were carried out for BMI and the sum of 6 skinfolds between groups with different levels of sports participation in men and women separately. The results revealed no significant difference in BMI between groups with different levels of sports participation in both genders. On the other hand, men participating more than 3.5h/week in health related sports had significant lower values for the sum of 6 skinfolds compared to men with no or a lower level of sports participation. These results were added in Table 4. Following sentence was incorporated in the results section of our manuscript:
   "*No significant difference was observed for BMI between men and women with different levels of sports participation. On the other hand, men participating in health related sports 3.5h/week or more had significantly lower values for the sum of 6 skinfolds*."

4. As suggested by the reviewer the following sentence and reference were added in the discussion section in order to reinforce the importance of fat in the obesity development:
   "*In the study of Garaulet et al. it is suggested that, even though obesity is a multifactorial phenomenon, dietary intake, especially fat intake, is the most important factor contributing to obesity*."
   43. Garaulet M, Perez-Llamas F, Canteras M, Tebar FJ, Zamora S. **Endocrine, metabolic and nutritional factors in obesity and their relative significance as studied by factor analysis.** *Int J Obes* 2001; **25**: 243-251

We hope that these revisions correspond to the expectations of the reviewers, and we thank them for their valuable advice.

Sincerely,

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