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Letter to the Editor

Within-subject non-concordance of abdominal *v.* general high adiposity: definition and analysis issues

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We were very interested in the recent study by Kowalkowska *et al.*[1] who analysed the relationship between assessments of general adiposity and assessments of abdominal high adiposity, and how it varies according to place of residence and individual and socio-economic factors. Their study is indeed very relevant because there is cumulative evidence that the prevalence of abdominal adiposity seems to be increasing independently of general adiposity (as assessed by BMI) in several countries[2–4] and that abdominal adiposity could be a better predictor of cardiovascular mortality than general adiposity[5,6]. One of the main issues addressed in the study is that the authors analysed what they termed ‘compatible’ *v.* ‘incompatible’ classifications of subjects in different categories of high adiposity by comparing assessment of general adiposity based on BMI with abdominal adiposity as assessed by the waist:height ratio (WHtR). As a matter of fact, they distinguished between what, according to standard epidemiological terminology to describe agreement between binary ratings, are ‘concordant’ and ‘non-concordant’ subjects: the former are those in the same – low or high – category for both measures of general and abdominal adiposity and the latter are those for whom the two classifications do not coincide (i.e. subjects who have either high general adiposity but not high abdominal adiposity or high abdominal adiposity but not high general adiposity). They should be praised for tackling this issue as relevant data are scarce, although their work is not the first published large-scale study pertaining to this topic[7].

Nevertheless, regarding their definition of ‘high general adiposity’, we wonder why they chose to contrast overweight subjects (i.e. $\text{BMI} \geq 25{\cdot}0\,\text{kg/m}^2$) with ‘normal’ subjects (i.e. $18{\cdot}5 \leq \text{BMI} < 25\,\text{kg/m}^2$), thus excluding underweight individuals with $\text{BMI} < 18{\cdot}5\,\text{kg/m}^2$ from the analyses and the comparisons. This is not consistent, neither with the World Health Organization[8] definition of overweight *v.* not nor with the authors’ definition of ‘high’ *v.* ‘normal’ abdominal adiposity, which is based on a single cut-off point ($\text{WHtR} \geq 0{\cdot}5$ *v.* $\text{WHtR} < 0{\cdot}5$, respectively). Moreover, as it is likely that most of the underweight subjects also feature a $\text{WHtR} < 0{\cdot}5$, excluding underweight subjects from the analyses may overestimate the rate of non-concordant subjects. If so, the effect may be small in populations studied by the authors, where the prevalence of underweight is scarce, although this would not be always so in other contexts.

As emphasised by the authors, there is evidence that WHtR could be a better proxy of abdominal obesity than other measures or indices such as waist circumference (WC) or waist:hip ratio. However, these are still quite standard for anthropometric assessment of abdominal adiposity. For example, WC is among the measurements recommended by the WHO for the surveillance of non-communicable diseases and also a component of the definition of the metabolic syndrome[8,9]. Thus, it could be interesting to assess how concordance and/or non-concordance rates vary according to different definitions of high abdominal adiposity. Indeed, in a study pertaining to the same purpose of comparing within-subject agreement of assessments of abdominal *v.* general adiposity, which the authors did not discuss, it was shown that the rate of discrepancy between general and abdominal excess adiposity among women could depend on the anthropometric proxy used for the assessment of abdominal adiposity[7]. For a given measure of abdominal adiposity, it can also depend on the choice of cut-off points to define high or excess abdominal adiposity.

The authors conducted most of their analyses on their whole cohort, without performing separate analyses and/or estimating different parameters for men and women in their models. However, they emphasised that when analysing general and abdominal high adiposity separately, there were no sex-specific associations. However, anthropometric indices such as BMI, WHtR or WC are only indirect and quite crude estimates of ‘true’ total and/or abdominal fat mass. Moreover, there is evidence that the associated measurement bias could be of different magnitude between men and women[10,11]. Consequently, it could be problematic to analyse within-subject non-concordance between two different anthropometric estimates of high adiposity without estimating covariate × sex interaction parameters in the models.

Most importantly, the authors analysed factors of non-concordance between their classifications of general *v.* abdominal high adiposity using a binary ‘concordant’ *v.* ‘non-concordant’ coding for the response variable. However, the latter category is a mix of two very different types of subjects; those with abdominal adiposity, but not general high adiposity, and those with general, but not abdominal, high adiposity. These two types of non-concordance have quite different cardiovascular- and metabolic-associated risks, due to the specific association of abdominal *v.* general high adiposity with these health outcomes as discussed above. It is also likely that these two types of non-concordance have different determinants at all levels of causality: this includes genetic, epigenetic factors, lifestyle characteristics (dietary intake, physical activity and smoking) and also factors that influence the latter, such as place of residence and socio-economic factors, as studied by the authors. In a previous study, based on a national random sample of about 3000 Tunisian adult women, we assessed the within-subject concordance of general excess adiposity (as BMI ≥30 kg/m^2) *v.* abdominal excess adiposity (WC ≥88 cm)[7]. For analyses of the variation of non-concordance between the two assessments of excess adiposity and individual, place of residence and socio-economic factors, we distinguished the two types of non-concordance. Therefore, we used multinomial logistic regression to analyse a three-category response variable: abdominal but not general excess adiposity, general but not abdominal excess adiposity and concordant subjects (this latter category was used as the reference response category). We did not include in the final version of the paper the detailed results for the general but not abdominal excess adiposity category because of its quite low prevalence of 1·6 % in our setting (*v.* 25·0 % for the abdominal but not general excess adiposity category). Nevertheless, we did observe quite different relationships with the cofactors depending on the type of non-concordance analysed, sometimes even almost inverse. Therefore, it could be that, beyond the drawback of having analysed men and women together, not distinguishing the two types of non-concordance may explain why the authors found a few associated factors and/or associations that were not straightforward to interpret. It could also be because of the different context or over-adjustment due to including height, weight and WC in their final multivariate model, of which the rationale is not clear. This would require further investigation.

We hope that these comments will be of interest to researchers in the field. We thank Kowalkowska *et al.* for their interesting study, and we do agree with them that the discrepancy between abdominal *v.* assessments of high adiposity must be taken into account for the assessment of health risks related to obesity. This would require more systematic assessments of abdominal obesity in large-scale studies (which usually primarily report BMI data), all the more in low- and middle-income countries, where, due to the nutrition transition, the progression of obesity is the fastest[12].

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