

- Kahn R, Buse J, Ferrannini E, Stern M, the American Diabetes Association, the European Association for the Study of Diabetes: The metabolic syndrome: time for a critical appraisal: joint statement from the American Diabetes Association and the European Association for the Study of Diabetes. *Diabetes Care* 28:2289–2304, 2005
Comments and Responses

A Single Factor Underlies the Metabolic Syndrome: A Confirmatory Factor Analysis

Response to McCaffery et al.

We thank McCaffery et al. (1) for their comments on our study (2). In their first report (3), they used confirmatory factor analysis to analyze the metabolic syndrome structure and to expose the limitations of exploratory factor analysis (EFA). We agree that their results support the concept of a common factor underlying the different components of the metabolic syndrome.

What, therefore, are the differences between our studies? The one-factor model in our study was based on a critical review of previous EFAs. In our estimation, those analyses have failed to identify a single factor because they included mostly redundant measures to represent the same component of the metabolic syndrome, insuring clustering within three or four factors. Therefore, our model included only one factor and only one measure for each of the metabolic syndrome traits. On the other hand, McCaffery et al. seemed to assume that the three- to four-factor solution, from previous EFAs, was correct and proposed a hierarchical four-factor model, where each

factor included more than one measure per trait, with a second-order factor reflecting the metabolic syndrome.

McCaffery's group also tested a one-factor model (Fig. 2 in ref. 3) that performed poorly in their analysis. However, our analysis (Fig. 3 in ref. 2) of their data showed that a modified version of that one-factor model, allowing correlations between error terms (residuals) for measures of the same trait, had goodness-of-fit indexes comparable to the other two models they tested (four-factor hierarchical and four-factor correlated models).

Both study groups agree that their models support the notion of a single underlying factor. We view the one-factor model as statistically more parsimonious and its interpretation more straightforward than the hierarchical four-factor model. Unfortunately, most authors of the previous EFAs, and even the recent ADA Statement by Kahn et al. (4), interpreted the presence of more than one factor as evidence against a common pathophysiological process underlying the clinical expression of the syndrome. We trust that McCaffery et al. would agree that it could be misleading to interpret the goodness-of-fit indexes of four-factor confirmatory factor analysis models, hierarchical or not, as evidence against the existence of a single factor explaining the clustering of the metabolic syndrome components.

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References

- McCaffery JM, Shen B-J, Todaro JF, Niaura RS: A single factor underlies the metabolic syndrome: a confirmatory factor analysis (Letter). *Diabetes Care* 29:1719–1720, 2006
- Pladevall M, Singal B, Williams LK, Brotons C, Guyer H, Sadurni J, Falces C, Serrano-Rios M, Gabriel R, Shaw JE, Zimmet PZ, Haffner S: A single factor underlies the metabolic syndrome: a confirmatory factor analysis. *Diabetes Care* 29:113–122, 2006
- Shen BJ, Todaro JF, Niaura R, McCaffery JM, Zhang J, Spiro A 3rd, Ward KD: Are metabolic risk factors one unified syndrome? Modeling the structure of the metabolic syndrome X. *Am J Epidemiol* 157:701–711, 2003
- Kahn R, Buse J, Ferrannini E, Stern M, the American Diabetes Association, the European Association for the Study of Diabetes: The metabolic syndrome: time for a critical appraisal: joint statement from the American Diabetes Association and the European Association for the Study of Diabetes. *Diabetes Care* 28:2289–2304, 2005