Diagnosis of obesity in chronic kidney disease: BMI or body fat?

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Excess of body fat is a major global public concern that is associated with both mortality and comorbidities such as diabetes, cardiovascular disease, some types of cancer and chronic kidney disease (CKD) [1–4]. In most epidemiological studies and clinical trials, excess fatness has been defined on the basis of body mass index (BMI; in kg/m²). According to the 1997 report of the World Health Organization Consultation on Obesity, BMI cutoffs of ≥25 and <30 kg/m² and ≥30 kg/m² are defined as overweight and obesity, respectively [5]. In the general population, BMI >30 kg/m² is associated with higher rates of mortality when compared with ‘normal’ BMI (≥18.5 and <25 kg/m²) which has been recently confirmed in a systematic review and meta-analysis on a sample of more than 2.88 million individuals [6]. Although objective and simple methods to identify obesity such as BMI are greatly convenient, its use in clinical settings has created a number of problems. The mortality J-shaped relationship with BMI found in the general population is not seen in patients with severe chronic diseases including advanced CKD [7]. In contrast, higher BMI, in the range of obesity, has been consistently associated with decreased mortality in this population of patients, a phenomenon named obesity paradox or reverse epidemiology of obesity. This finding has raised concerns over the suitability of BMI as a marker of adiposity under such clinical conditions.
The imperfections of BMI as a surrogate of body composition have long been recognized [8]. Although BMI is highly correlated with body fat, it is well known that this index fails to distinguish components of the body and to differentiate the regional distribution of fat. Therefore, BMI may have a low sensitivity and/or specificity for certain groups of individuals, since it tends to overestimate obesity in individuals with a high degree of muscle mass or with volume overload, and conversely obesity may be underestimated in the elderly and in patients with wasting conditions [5].

Given that clinical disturbances such as fluid accumulation and muscle wasting are very common in CKD, BMI may not accurately reflect excess body fat, which could explain, at least in part, the paradoxically association of obesity, as determined by BMI, on mortality.

In this issue of NDT, the study by Gracia-Iguacel et al. [9] expands the debate on the problems related to BMI as a marker of excess adiposity in CKD previously addressed in a report by Agarwal et al. [10]. The investigation was conducted in two different large Swedish cohorts of CKD patients. One composed of patients with CKD stage 5 referred to dialysis, and the other was composed of prevalent patients undergoing hemodialysis. The percentage of body fat was estimated by the simple and relatively accurate anthropometric method of skinfold thickness. On the basis of body fat cutoffs of >25% for men and >35% for women, 65% of the patients in both cohorts were classified as obese, while according to BMI ≥ 30 kg/m² only ~10% were obese. Therefore, a large proportion of patients were diagnosed as obese according to body fat, but in the context of a normal to an overweight range of BMI, condition that was termed ‘subclinical obesity’. Further analysis demonstrated that patients with ‘subclinical obesity’ were older and had lower muscle mass which may explain the lack of sensitivity of BMI in detecting excess of adiposity. There is no doubt that this study is of great importance since it draws attention to a condition that is a result of changes in the nutritional profile of CKD patients due to the obesity epidemic. It also offers an excellent opportunity to discuss whether the thresholds of percentage of body fat used are suitable to define obesity.

The appropriateness of levels of percentage of body fat in the definition of obesity is still a matter of debate among researchers [11, 12]. Furthermore, no consensus on the percentage of body fat criteria exists to define obesity or excess body fat. A significant number of past and currently relevant studies have used the body fat cutoffs >25% for men and >35% for women as a reference to identify obesity [10, 13–15]. It is intriguing that these studies have attributed this criterion to the 1995 WHO Technical Report despite there being no recommendation regarding thresholds of body fat for the diagnosis of obesity quoted in the WHO report [16]. This misquotation has led many investigators to search for the primary source of those body fat thresholds, which apparently have not been clearly identified [11, 12]. In some reports [17], the reference values used were derived from studies designed to examine the association of BMI cutoff points with body fat and then to develop equations to predict body fat. Among them, there is a study performed by Gallagher et al. [18], which provided values of predicted percentage of body fat (by DXA) within the ranges of BMI. In the BMI range of overweight, percentage of body fat according to age and ethnicity varied from 33 to 36% in women and from 20 to 24% in men, while in the BMI range of obesity, the percentage of body fat was within 39–42% and 25–30% for women and men, respectively. It is of note that the body fat cutoff points often used in the previously mentioned studies (>35% and >25%) include individuals with both overweight and obesity if based on the values generated by the Gallagher et al. This might explain, at least in part, the large difference in the prevalence of obesity if defined by BMI ≥ 30 kg/m² or by the percentage of body fat cutoffs. Although attractive, this is speculative since the data by Gallagher et al. should not be used as a reference as the study was not designed for that purpose and the population studied was not representative. More recently, the same group of researchers has advanced toward the development of cutoff guidelines on the percentage of body fat [19]. For this purpose, they used the large and representative US NHANES (1999–2004) cohort data of adults. For the development of the percentage of body fat and total body fat (measured by DXA) in reference to BMI status, the sample was stratified by sex, age and ethnicity. The findings of this study are relevant and can help to better understand the discrepancies between the BMI and body fat often observed. It was demonstrated that the cutoffs of percentage of body fat that corresponds to BMI cutoffs varied substantially depending on age, sex and race ethnicity. Specifically, the cutoff of percentage of body fat was the highest for the same BMI in the oldest age group, was the lowest in black individuals and was higher in women. Therefore, unlike BMI, the reference for body fat cutoffs should take into consideration these demographic factors. It is also important to address that, although the cutoffs of percentage body fat developed in the study can serve as a reference, the morbidity and mortality risks associated across the body fat cutoff points is unknown, and consequently its clinical use is still limited. Thus, it seems premature to assume any cutoff of percentage body fat as a criterion in the diagnosis of obesity, especially in patients with severe chronic diseases like CKD. Furthermore, under such clinical conditions, to rely on a single maker to characterize a nutritional condition is undoubtedly not recommended. Similarly to what is proposed for the diagnosis of protein energy wasting, the recognition of obesity and its related adverse effects in CKD should take into account a set of markers of fatness. This includes not only markers of total body fat, but also surrogates of abdominal fat. Indeed, evidence is accumulating on the deleterious role of abdominal obesity, either obtained by gold standard methods [20] or by simple methods such as waist circumference [21–23] waist-to-hip ratio and conicity index [24]. Of note, abdominal obesity is an important component of the metabolic syndrome that has been shown to be associated with the development of CKD [25].

The study by Gracia-Iguacel et al. is of importance since it provides insights and raises questions on the use and interpretation of simple anthropometric measures in face of the increasing rates of obesity among patients with CKD. However, it is important to highlight that the conclusions...
CONFLICT OF INTEREST STATEMENT

None declared.

(See related article by Gracia-Iguacel et al. Subclinical versus overt obesity in dialysis patients: more than meets the eye. Nephrol Dial Transplant 2013; 28 (Suppl. 4): iv175–iv181.)

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Received for publication: 12.3.2013; Accepted in revised form: 30.4.2013