To the Editor,

Although primary antibody deficiencies may be associated with undernutrition, there is just one published study on the nutritional status of patients with primary immunodeficiencies [1]. Kouhkan et al. studied 38 patients with different primary immunodeficiencies and showed that 21% of them were underweight, 8% overweight and 3% obese [1].

Between April 2012 and November 2014, we evaluated the nutritional status of 73 patients (71 males) with X-linked (XLA, \( n = 67 \)) or autosomal recessive agammaglobulinemia.
study visit are given in Table 1. Blood samples were collected
(7 %) were underweight, 26 (63 %) had a normal weight, 11 (27 %) were overweight and 1 (2 %) was obese. The first
lesterol, apolipoprotein A, apolipoprotein B and triglycerides.

<table>
<thead>
<tr>
<th>BMI status (WHO), N (%)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>4 (5 %)</td>
</tr>
<tr>
<td>Normal weight</td>
<td>41 (56 %)</td>
</tr>
<tr>
<td>Overweight</td>
<td>19 (26 %)</td>
</tr>
<tr>
<td>Obese</td>
<td>9 (12 %)</td>
</tr>
</tbody>
</table>

SDS of weight-for-age available from 0 to 10 years of age; SDS of length-for-age available from 0 to 2 years of age; SDS of height-for-age available from 2 to 19 years of age; SDS of BMI-for-age available from 0 to 19 years of age.

Table 1 Anthropometric measurements at the study visit

<table>
<thead>
<tr>
<th>Age (years), mean (SD)</th>
<th>73</th>
<th>22 (11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg), mean (SD)</td>
<td>73</td>
<td>61.1 (21.2)</td>
</tr>
<tr>
<td>Weight-for-age (SDS WHO), mean (SD)</td>
<td>11</td>
<td>0.88 (0.95)</td>
</tr>
<tr>
<td>Height (m), mean (SD)</td>
<td>72</td>
<td>1.63 (0.21)</td>
</tr>
<tr>
<td>Height-for-age (SDS WHO), mean (SD)</td>
<td>31</td>
<td>0.08 (1.10)</td>
</tr>
<tr>
<td>Length (m), mean (SD)</td>
<td>1</td>
<td>0.86 (NA)</td>
</tr>
<tr>
<td>Length-for-age (SDS WHO), mean (SD)</td>
<td>1</td>
<td>0.5 (NA)</td>
</tr>
<tr>
<td>BMI (kg/m2), mean (SD)</td>
<td>73</td>
<td>22.5 (4.7)</td>
</tr>
<tr>
<td>BMI-for-age (SDS WHO)</td>
<td>32</td>
<td>0.90 (1.35)</td>
</tr>
</tbody>
</table>

Among the 41 patients aged >19 years at the study visit, 3 (7 %) were underweight, 26 (63 %) had a normal weight, 11
(27 %) were overweight and 1 (2 %) was obese. The first
undernourished patient had no complications. The second un-
dernourished patient had chronic obstructive pulmonary disease (COPD) and chronic sinusitis. The third undernourished
patient had severe thinness (BMI < 16.0 kg/m2), anemia and hypoalbuminemia (3.1 mg/dl), and was treated with parenteral
nutrition. Evidence of a chronic inflammatory infiltrate at je-
junal biopsy in this patient suggested infection with Microsporidium, which was treated following standard guide-
lines. The hypoalbuminemia of this patient was the only in-
stance of an altered laboratory marker of nutritional status
identified during the study. In fact all other nutritional indexes
were within the normal limits according to the different labo-

COPD, the most frequent complication of agammaglobu-
linemia, was present in 22 (30 %) of our 73 patients, mostly in
those aged ≥19 years. Its appearance would be independent of
nutritional status. For 44 patients, we were able to retrieve the
anthropometric measurements performed when agammaglobu-
linemia was diagnosed and compared them with the anthro-
pometric measurements performed at the study time. The me-
dian duration of follow-up for these 44 patients was 17 years.
Among the 6 patients that were underweight at diagnosis, 1 was underweight, 3 were normal-weight, 2 were overweight and none was obese at the study time. Among the 18 patients who were normal-weight at diagnosis, 1 was underweight, 13 were normal-weight, 3 were overweight, and 1 was obese at the study time. Among the 17 patients who were overweight at diagnosis, 1 was underweight, 8 were normal-weight, 6 were overweight and 2 were obese at the study time. Among the 3 patients who were obese at diagnosis, none was underweight, 1 was normal-weight, 2 were overweight, and none was obese at the study time.

In this multi-center study of XLA and ARA patients, overweight and obesity (38 %) were much more common than undernutrition (5 %). The low frequency of undernutrition is at least partly attributable to the appropriate immunoglobulin replacement therapy, which is known to decrease the occurrence of infectious disease and to increase the life expectancy. The median age at the diagnosis of immunodeficiency was in fact 2 years, with 3 cases diagnosed prenatally. Early diagnosis is the gold standard for primary immunodeficiencies, with the aim to start therapy as soon as possible in order to reduce complications and improve quality of life. A limitation of the present study is the lack of a control group, due to the difficulty of finding healthy children similar to XLA and ARA patients for age and other features when many tertiary care centers are involved. Although a direct comparison with population data is unwarranted because our study was performed in subjects with a rare disease followed by tertiary care centers, it is certainly of interest that overweight and obesity were nearly as common in young and adult Italian patients with XLA and ARA as they are in the general Italian population [5, 6], but with a trend towards a higher rate of obesity in those patients aged less than 19 years.

In conclusion, the most interesting finding of this study is the unexpected high frequency of apparent overnutrition with excess body weight in a group of XLA and ARA patients. No one displayed enough features justifying the diagnosis of metabolic syndrome.

Low physical activity, partly motivated by an unsubstantiated fear of infection, together with a poor diet and the psychological burden of a chronic illness, may contribute to the risk of overweight and obesity in these patients. During follow-up of XLA and ARA patients a nutritional counseling may be recommended to keep under control the development of risk factors for cardiometabolic disease. Further surveys are needed to confirm our observations in order to better investigate the nutritional status (and the body composition, if possible) in patients with agammaglobulinemia and other primary immunodeficiencies with the aim of improving their quality of life.

Conflict of Interest The Authors declare that they have no conflict of interest.

Compliance with Ethical Standards This study was performed in accordance with the ethical standards of the institutional research committees and with the 1964 Helsinki declaration and its later amendments.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References