Validation of OMRON BF306 in samples of five European populations

by Dr. P. Deurenberg

In 1998, OMRON has launched their first hand-held Body Fat Monitor, the BF300, followed by the BF302 one year later. These models were developed and validated in collaboration with research centres in the USA (1).

Due to differences in body composition, more specifically differences in body build between American Caucasians and European Caucasians, OMRON has initiated the development of a new Body Fat Monitor with an incorporated European algorithm. The new European algorithm is based on comparative measurements with densitometry (underwater weighing) in 378 males and females in the age range of 18 to 75 years with a wide range of body fat percentage. The prediction error of the new equation is 3 to 4 percent body fat.

The validity of the new OMRON BF306 hand-held body fat monitor (impedance analyser) was recently tested in 234 females and 182 males, ranging in age from 18 to 70 years and ranging in body mass index (BMI, kg/m^2) from 17.0 to 41.9 kg/m^2 . The study (2) was performed in 5 European centres were body composition studies are routinely performed:

- Department of Human Biology, University of Maastricht, The Netherlands;
- International Centre for the Assessment of Body Composition, Department of Food Science and Microbiology, University of Milan, Italy;
- Department of Human Physiology, University 'Tor Vergata', Rome, Italy;
- UKK Institute for Health Promotion Research, Tampere, Finland, and
- Department of Nutrition and Epidemiology, Wageningen University, The Netherlands.

Table 1 gives some characteristics of the subjects. In each centre BF% was measured with the OMRON BF306. In addition body fat percent (BF%) was measured by a reference method. In Milan and Rome this was dual energy X-ray absorptiometry (DXA). In Maastricht, Tampere and Wageningen densitometry (underwater weighing) was used. The comparability between DXA and densitometry was tested in Wageningen, where the subjects were measured using both techniques. In the 112 subjects in Wageningen there were no significant differences between the two techniques.

Table 1. Characteristics of the subjects.

	females				males			
	minimum	maximum	mean	SD	minimum	maximum	mean	SD
Age (years)	19	70	36	14	18	70	36	14
Height (cm)	147.0	195.1	166.3	7.4	157.9	200.8	179.7	7.4
Weight (kg)	44.5	114.3	64.5	10.1	54.4	125.8	77.4	10.1
BMI (kg/m2)	17.0	41.9	23.4	4.0	17.3	34.9	24.0	3.0
BF%	13.8	57.1	31.2	7.8	5.3	36.4	20.1	7.6
BF%306	19.1	51.4	31.0	6.1	6.1	33.7	19.1	6.3

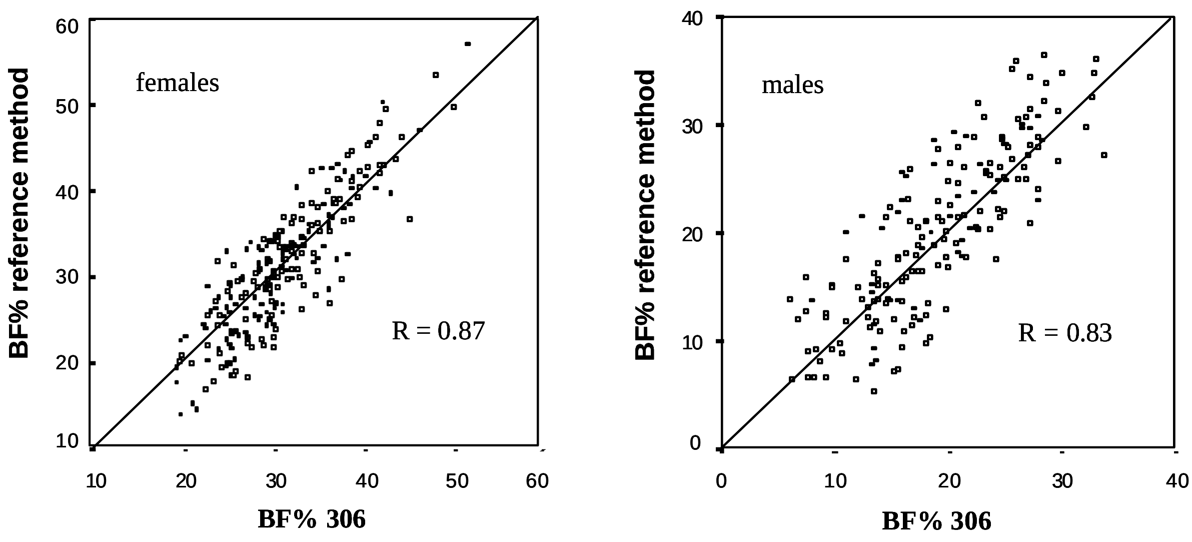
BMI: body mass index (kg/m^2); BF%: body fat percent as measured by reference method; BF%306: body fat as measured by OMRON BF306; SD: Standard Deviation

In females measured BF% was 31.2 ± 7.8 and BF% as predicted by BF306 was 31.0 ± 6.1. In males these figures were 20.1 ± 7.6 and 19.1 ± 6.3 percent, respectively, for measured and predicted BF%. The difference between measured and predicted BF% in females was not significant. In males the difference in body fat percentage of 1 percentage point was statistically significant, but entirely due to an underestimation in the Finish males. This underestimation was not observed in males for the other four centres. The correlation between measured and predicted BF% was high in females (R=0.87, p<0.001) and males (R=0.83, p<0.001). Individual differences between measured and predicted BF% were related to age and level of body fatness in each centre.

Figure 1 gives for males and females separately the relation between BF% measured by the reference method and BF% as measured using the OMRON BF306. The values of all individuals are scattered around the line of identity, indicating a good overall validity of BF% as measured by BF306.

There were slight differences in validity between the 5 centres. These differences were found to be due to differences in age and in level of body fat percentage. If the data were statistically corrected for these variables using analyses of co-variance, the differences in validity between the centres disappeared completely, except for the females and males in Tampere, in which the BF% (measured by BF306) remained an underestimated body fat percentage by about 1 percent in females and about 3 percent in males (see Table 2).

Figure 1. The relationship between measured and predicted body fat percentage in females and males.



BF% reference method: body fat percentage as measured by the reference method;
BF%306: body fat percentage as measured by the new OMRON BF306

The reason for the found underestimation of BF% using BF306 in Finish males is not clear. Differences in body build, especially differences in muscularity of arms and/or length of arms could provide an explanation, as was shown in a validation study that was conducted among three different ethnic groups in Asia (3). However, unfortunately no such data on body build were measured in this validation study.

Table 2. Differences * in predicted BF% from reference method after correction for differences in age and level of body fat percentage in each centre.

	Maastricht		Milan		Rome		Tampere		Wageningen	
	mean	SE	mean	SE	mean	SE	mean	SE	mean	SE
females	-0,2	0,4	0	0,6	1,1	0,6	0,9	0,4	-0,6	0,4
males	0,5	0,6	0,1	0,7	-0,6	0,8	2,8	0,5	0,5	0,5

* values are means and standard error (SE) of difference measured minus predicted BF%

In conclusion, the overall validity of the BF306 body fat monitor measurements was good in this international validation study. The study (2) suggests that the monitor provides a reliable tool for the assessment of body fat percentage in epidemiological studies. The easy and user friendly applicability makes the body fat analyser also suitable for individual use and monitoring of body fat percentage.

References:

1. Loy SF, Likes EA, Andrews PM, Vincent WJ, Holland HJ, Kawai H, Cen S, Swenberger J, van Loan M, Tanaka K, Heyward V, Stolarczyk L, Lohman TG, Going SB.
   Easy grip on body composition measurements.
   ACSM's Health and Fitness Journal 1998; 2:16-19
2. Deurenberg P, Andreoli A, Borg P, Kukkonen-Harjula K, de Lorenzo A, van Marken Lichtenbelt W, Testolin G , Vigano R Vollaard N.
   The validity of predicted body fat percent from body mass index and from impedance in samples of five European populations.
   Eur J Clin Nutr, in press
3. Deurenberg P, Deurenberg-Yap M.
   Validation of skinfold thickness and hand-held impedance measurements for estimation of body fat percentage among Singaporean Chinese, Malays and Indians.
   Asia Pacific J Clin Nutr, in press