



BIOELECTRICAL IMPEDANCE ANALYSIS COMBINED WITH 3D IMAGE PROCESSING FOR BODY FAT MEASUREMENT -A PRELIMINARY STUDY

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INTRODUCTION AND AIM

This study intends to combine the body composition data of standing single-frequency multi-limb bioelectrical impedance analysis (BIA) and three-dimensional image option technology (3DO) for establishing a new body composition estimation model and equation.

METHOD

- A total of **52** male and female subjects were recruited in this study, and the free fat mass (FFM) and fat percentage of the human body (PBF) were measured by Dual X-ray Absorptiometry (DXA). as the measurement standard.
- Furthermore, using a single-frequency multi-limb bio-impedance analyzer to measure the biological impedance parameters (50KHz resistance and reactance), and using the depth camera to perform the three-dimensional image of the length and circumference of each limb.
- So, a new body fat mass measurement model was established by multivariate regression analysis.
- Finally, compared with the results of multi-frequency and multi-segment BIA device-InBody770 in the percentage body fat (PBF) measurement, by using Bland-Altman plot, distribution map, correlation analysis, and other results to judge the accuracy of this new body fat mass measurement model.

CONCLUSIONS

Bioelectrical impedance analysis or three-dimensional image option technology has its advantages and disadvantages in the measurement of body composition. Combining the advantages of both, the estimation of body fat can still be very convenient, fast, and non-invasive. Our results may be a new application model for human body composition measurement in the future.

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RESULTS

Using stepwise regression analysis, it can be obtained that the variables entering the PBF estimation equation are the right upper limb impedance factor, trunk impedance factor, gender, weight, left upper limb reactance, waist circumference, and hip circumference. The correlation coefficient obtained from the measurement of the standard (dualenergy X-ray absorptiometry, DXA)-FFM are 0.933, 0.961, 0.973, 0.987, 0.991, 0.993, 0.994, and the BPF are 0.785, 0.879, 0.880, 0.935, 0.952, 0.961, 0.969. Between the BIA device InBody770 and the DXA, the correlation coefficient of the BPF is 0.920.

Table 3 Summary patterns corresponding to each FFM estimation model

Mode	R	R-square d	Adjusted R-squared	Estimated standard error	change statistics				
					R squared change	F change	df1	df2	Significant F change
1	.933 ^a	.871	.869	3.918	.871	337.853	1	50	.000
2	.961 ^b	.924	.921	3.035	.053	34.316	1	49	.000
3	.973 ^c	.946	.943	2.577	.022	19.999	1	48	.000
4	.987 ^d	.974	.972	1.803	.028	51.058	1	47	.000
5	.991 ^e	.982	.980	1.520	.008	20.086	1	46	.000
6	.993 ^f	.985	.983	1.404	.003	8.901	1	45	.005
7	.994 ^g	.987	.985	1.321	.002	6.887	1	44	.012

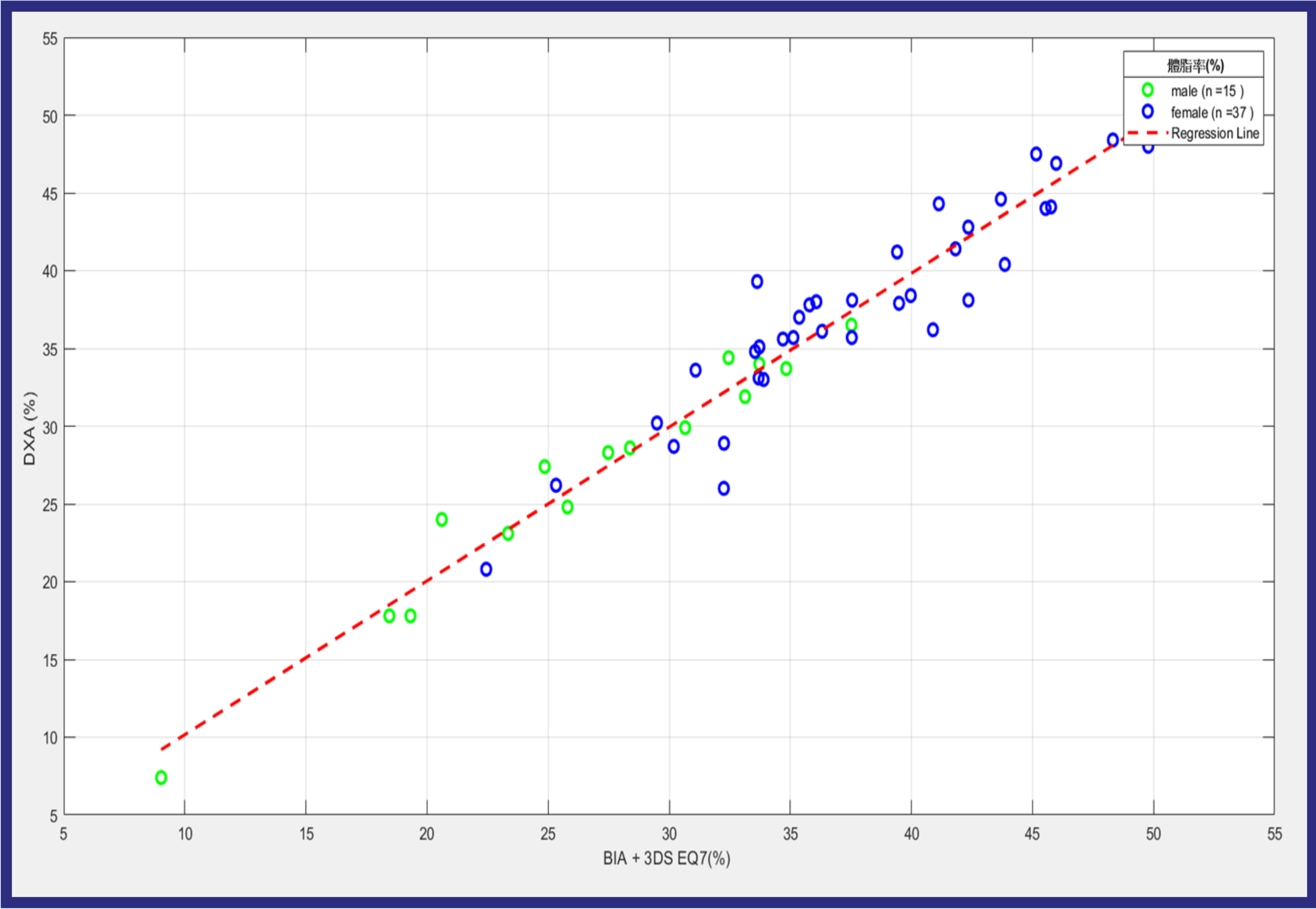


Figure 18. Eq (7). (h2/ZLA, h2/ZTR, Sex, Weight, h2/XLA, WC, HC) estimated total body fat percentage (PBF) and DXA measurement results (r = 0.969)

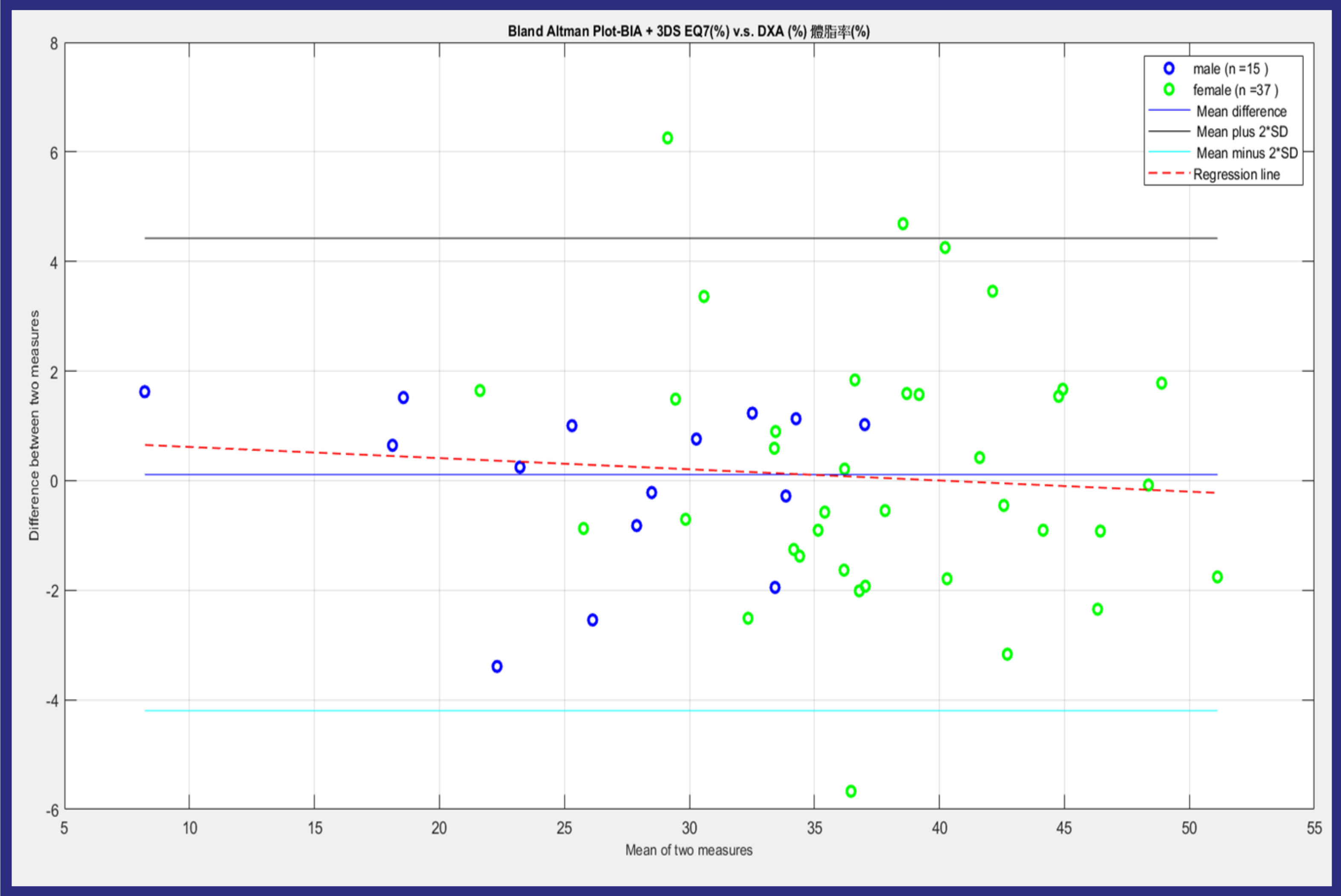


Figure 19. Eq (7). Bland-Altman Plot of total body fat percentage (PBF) estimated by (h2/ZLA, h2/ZTR, Sex, Weight, h2/XLA, WC, HC) and DXA measurement results (bias:0.112%, SD: 2.155%