Figure S1 Locations of the 20 centers in multicenter study of IO in China. The multicenter study of IO in China have 20 participated centers, which are tertiary hospitals that have started performing IO in the lung function laboratories for clinical use. Green marks indicate centers that provided IO data included in the final analysis of reference equations, pink marks indicate centers that collected IO data of healthy subjects but not being included in the final analysis. Grey mark indicates center that provided no IO data of healthy subjects but data of respiratory diseases in the study. IO, impulse oscillometry.
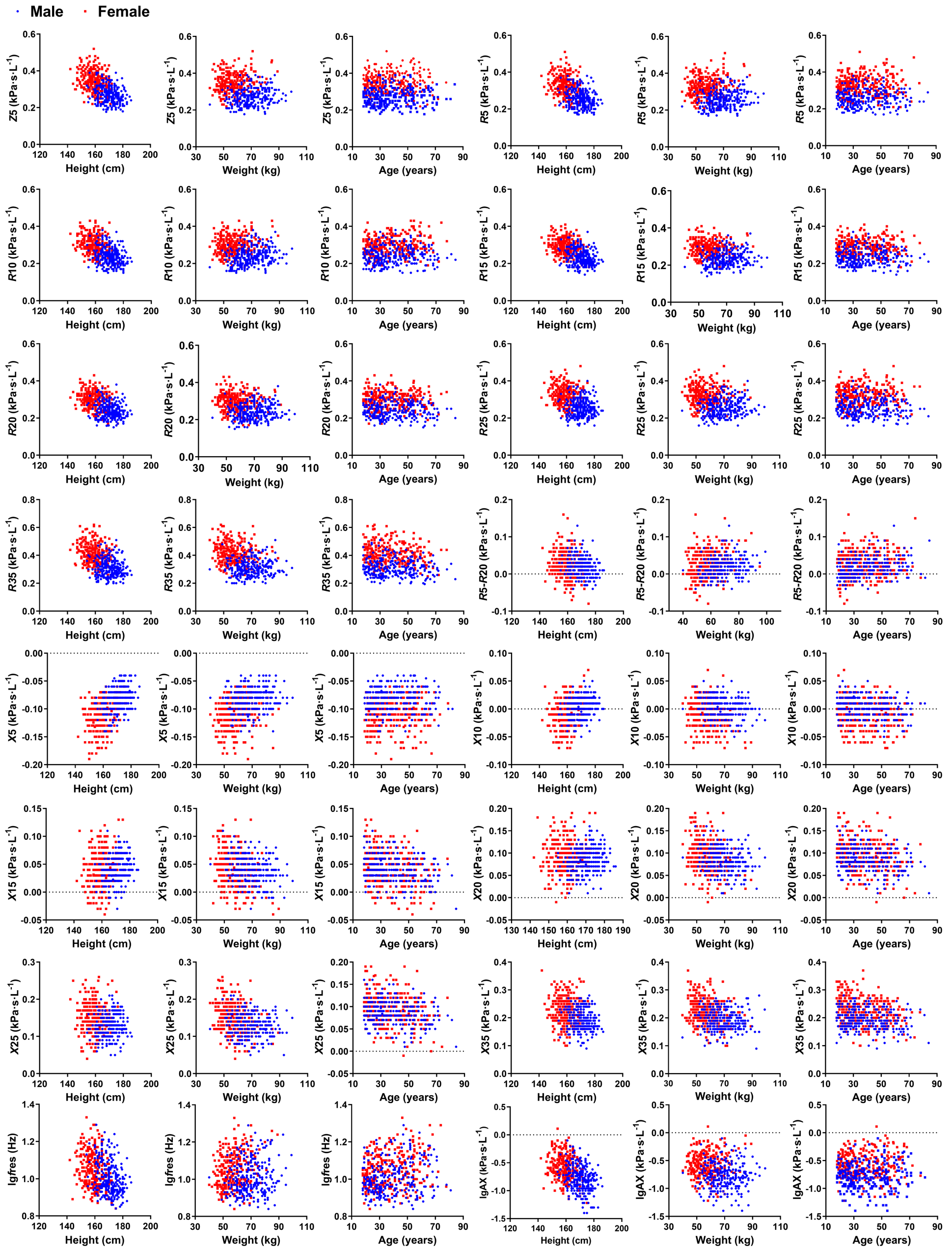
Figure S2 Scatter plots between IO indices and height, weight, age of the study population. IO, impulse oscillometry.

Table S1 Numbers of collected data and analyzed data of each centers

Centers	Number of collected data	Number of analyzed data
The First Affiliated Hospital of Guangzhou Medical University	73	45
Beijing Hospital	187	0
Beijing Children's Hospital, Capital Medical University	5	0
West China Hospital of Sichuan University	144	129
Tongji Hospital Affiliated to Tongji Medical College of Huazhong University of Science and Technology	71	11
Xiangya Hospital, Central South University	52	26
Guizhou Provincial People's Hospital	28	0
Shanghai Pulmonary Hospital	108	78
Beijing Chao-Yang Hospital, Capital Medical University	55	44
Henan Provincial People's Hospital	30	1
Guangdong Provincial Hospital of Traditional Chinese Medicine	140	0
Qilu Hospital of Shandong University	33	0
Tianjin Medical University General Hospital	30	1
General Hospital of Ningxia Medical University	3	2
The First Hospital of Lanzhou University	1	0
Shanxi Bethune Hospital	124	92
The First Affiliated Hospital of Fujian Medical University	185	100
Zhujiang Hospital of Southern Medical University	3	2
Union Hospital of Tongji Medical College, Huazhong University of Science and Technology	51	36
Total	1,318	567

Table S2 Median (interquartile range) of IO indices in the study population and comparisons between genders

IO indices	Total (n=567)	Male (n=270)	Female (n=297)	P value
$Z5$ (kPa·L^{-1}·s^{-1})	0.31 (0.10)	0.27 (0.06)	0.35 (0.07)	<0.001
$R5$ (kPa·L^{-1}·s^{-1})	0.29 (0.09)	0.26 (0.07)	0.32 (0.07)	<0.001
$R10$ (kPa·L^{-1}·s^{-1})	0.27 (0.08)	0.23 (0.07)	0.29 (0.06)	<0.001
$R15$ (kPa·L^{-1}·s^{-1})	0.26 (0.08)	0.23 (0.06)	0.29 (0.06)	<0.001
$R20$ (kPa·L^{-1}·s^{-1})	0.27 (0.08)	0.24 (0.06)	0.30 (0.06)	<0.001
$R25$ (kPa·L^{-1}·s^{-1})	0.29 (0.10)	0.25 (0.07)	0.32 (0.07)	<0.001
$R35$ (kPa·L^{-1}·s^{-1})	0.31 (0.08)	0.31 (0.08)	0.40 (0.10)	<0.001
$R5$-$R20$ (kPa·L^{-1}·s^{-1})	0.01 (0.03)	0.01 (0.03)	0.03 (0.05)	0.001
$X5$ (kPa·L^{-1}·s^{-1})	−0.10 (0.04)	−0.08 (0.03)	−0.11 (0.04)	<0.001
$X10$ (kPa·L^{-1}·s^{-1})	0.00 (0.03)	0.00 (0.03)	−0.01 (0.04)	<0.001
$X15$ (kPa·L^{-1}·s^{-1})	0.04 (0.04)	0.04 (0.03)	0.04 (0.04)	0.856
$X20$ (kPa·L^{-1}·s^{-1})	0.09 (0.04)	0.08 (0.03)	0.09 (0.05)	0.002
$X25$ (kPa·L^{-1}·s^{-1})	0.14 (0.04)	0.13 (0.04)	0.15 (0.04)	<0.001
$X35$ (kPa·L^{-1}·s^{-1})	0.20 (0.06)	0.19 (0.05)	0.22 (0.07)	<0.001
AX (kPa·L^{-1}·s^{-1})	0.21 (0.16)	0.16 (0.10)	0.26 (0.19)	<0.001
$f$res (Hz)	10.21 (3.40)	9.55 (2.89)	10.87 (3.76)	<0.001

Data are presented as median (interquartile range). P values were derived from the comparison of respiratory impedance between males and females. $Z5$, total respiratory impedance at 5 Hz; $R5$, $R10$, $R15$, $R20$, $R25$ and $R35$ respectively indicates resistance at 5, 10, 15, 20, 25 and 35 Hz. X5, $X10$, $X15$, $X20$, $X25$ and $X35$ respectively indicates reactance at 5, 10, 15, 20, 25 and 35 Hz. IO, impulse oscillometry; AX, low-frequency reactance area; $f$res, resonant frequency.

Table S3 Reference equations of IO indices for males

IO indices	Components	β coefficients (95% CI)	SE of β	P	R^2	RSD
Z5	Intercept	0.6811 (0.5387, 0.8236)	0.0723	<0.001	0.1877	0.0415
	Height	−0.0032 (−0.0041, −0.0023)	0.0005	<0.001		
	Weight	0.0019 (0.0013, 0.0024)	0.0003	<0.001		
R5	Intercept	0.6275 (0.4850, 0.7700)	0.0724	<0.001	0.1789	0.0420
	Height	−0.0030 (−0.0039, −0.0020)	0.0005	<0.001		
	Weight	0.0019 (0.0013, 0.0025)	0.0003	<0.001		
R10	Intercept	0.6361 (0.4965, 0.7757)	0.0709	<0.001	0.2099	0.0408
	Height	−0.0032 (−0.0041, −0.0023)	0.0005	<0.001		
	Weight	0.0021 (0.0015, 0.0026)	0.0003	<0.001		
R15	Intercept	0.5247 (0.3913, 0.6581)	0.0678	<0.001	0.1224	0.0389
	Height	−0.0023 (−0.0031, −0.0014)	0.0004	<0.001		
	Weight	0.0014 (0.0009, 0.0019)	0.0003	<0.001		
R20	Intercept	0.5038 (0.3445, 0.6630)	0.0809	<0.001	0.0668	0.0401
	Height	−0.0019 (−0.0028, −0.0009)	0.0005	0.005		
	Weight	0.0010 (0.0004, 0.0015)	0.0003	0.002		
	Age	−0.0004 (−0.0008, −0.0001)	0.0002	0.032		
R25	Intercept	0.2103 (0.1717, 0.2489)	0.0196	<0.001	0.0209	0.0451
	Weight	0.0007 (0.0001, 0.0012)	0.0003	0.018		
R35	–	–	–	–	–	–
R5–R20	Intercept	0.2485 (0.1780, 0.3181)	0.0358	<0.001	0.2249	0.0205
	Height	−0.0018 (−0.0022, −0.0013)	0.0002	<0.001		
	Weight	0.0010 (0.0007, 0.0013)	0.0001	<0.001		
X5	Intercept	−0.3100 (−0.3863, −0.2337)	0.0388	<0.001	0.1105	0.0195
	Height	0.0013 (0.0009, 0.0017)	0.0002	<0.001		
	Age	0.0002 (0.0001, 0.0004)	0.0001	0.009		
X10	Intercept	−0.1620 (−0.2166, −0.1074)	0.0277	<0.001	0.1956	0.0157
	Height	0.0013 (0.0009, 0.0016)	0.0002	<0.001		
	Weight	−0.0007 (−0.0019, −0.0005)	0.0001	<0.001		
X15	Intercept	−0.1269 (−0.2418, −0.0718)	0.0406	0.002	0.2575	0.0199
	Height	0.0015 (0.0011, 0.0021)	0.0002	<0.001		
	Weight	−0.0010 (−0.0013, −0.0007)	0.0001	<0.001		
	Age	−0.0003 (−0.0004, −0.0001)	0.0001	0.0028		
X20	Intercept	−0.1506 (−0.2371, −0.0642)	0.044	<0.001	0.1556	0.0247
	Height	0.0017 (0.0012, 0.0023)	0.000	<0.001		
	Weight	−0.0009 (−0.0012, −0.0005)	0.000	<0.001		
	Age	−0.0003 (−0.0004, −0.0001)	0.0001	0.003		
X25	Intercept	0.1789 (0.1511, 0.2068)	0.0141	<0.001	0.0666	0.0292
	Weight	−0.0005 (−0.0008, −0.0001)	0.0002	0.012		
	Age	−0.0005 (−0.0007, −0.0002)	0.0001	0.001		
X35	Intercept	0.3844 (0.2495, 0.5193)	0.0865	<0.001	0.0454	0.0382
	Height	−0.0010 (−0.0018, −0.0002)	0.0004	0.010		
	Age	−0.0005 (−0.0008, −0.0002)	0.0002	0.001		
lgfres	Intercept	1.9238 (1.6487, 2.1988)	0.1397	<0.001	0.1963	0.0801
	Height	−0.0068 (−0.0085, −0.0050)	0.0009	<0.001		
	Weight	0.0033 (0.0022, 0.0044)	0.0006	<0.001		
lgAX	Intercept	1.3268 (0.5965, 2.0572)	0.3709	0.004	0.1179	0.2124
	Height	−0.0142 (−0.0189, −0.0095)	0.0024	<0.001		
	Weight	0.0043 (0.0014, 0.0072)	0.0015	0.004		

IO, impulse oscillometry; 95% CI, 95% confidential interval; SE, standard error; R^2, coefficient of determination; RSD, residual standard deviation. Z5, total respiratory impedance at 5 Hz; R5, R10, R15, R20, R25 and R35 respectively indicates resistance at 5, 10, 15, 20, 25 and 35 Hz; X5, X10, X15, X20, X25 and X35 respectively indicates reactance at 5, 10, 15, 20, 25 and 35 Hz; AX, low-frequency reactance area; fres, resonant frequency.

Table S4 Reference equations of IO indices for females

IO indices	Components	β coefficients (95% CI)	SE of β	P	R^2	RSD
Z5	Intercept	0.9110 (0.7378, 1.0841)	0.0880	<0.001	0.1673	0.0493
	Height	−0.0042 (−0.0053, −0.0030)	0.0006	<0.001		
	Weight	0.0023 (0.0015, 0.0031)	0.0004	<0.001		
	Age	−0.0008 (−0.0013, −0.0003)	0.0002	0.001		
R5	Intercept	0.8103 (0.6379, 0.9828)	0.0876	<0.001	0.1606	0.0491
	Height	−0.0038 (−0.0049, −0.0026)	0.0006	<0.001		
	Weight	0.0024 (0.0016, 0.0032)	0.0004	<0.001		
	Age	−0.0005 (−0.0010, −0.0001)	0.0002	0.023		
R10	Intercept	0.7013 (0.5641, 0.8386)	0.0697	<0.001	0.1614	0.0440
	Height	−0.0032 (−0.0041, −0.0023)	0.0005	<0.001		
	Weight	0.0019 (0.0012, 0.0025)	0.0003	<0.001		
R15	Intercept	0.5488 (0.4201, 0.6775)	0.0654	<0.001	0.0593	0.0409
	Height	−0.0019 (−0.0027, −0.0010)	0.0004	<0.001		
	Weight	0.0007 (0.0001, 0.0013)	0.0003	0.035		
R20	Intercept	0.5042 (0.3668, 0.6415)	0.0698	<0.001	0.0282	0.0442
	Height	−0.0013 (−0.0021, −0.0004)	0.0004	0.004		
R25	Intercept	0.4928 (0.3363, 0.6494)	0.0795	<0.001	0.0154	0.0506
	Height	−0.0011 (−0.0021, −0.0001)	0.0005	0.033		
R35	Intercept	0.8407 (0.6050, 1.0764)	0.1197	<0.001	0.0700	0.0499
	Height	−0.0025 (−0.0039, −0.0011)	0.0007	0.001		
	Age	−0.0009 (−0.0015, −0.0003)	0.0003	0.005		
R5–R20	Intercept	0.2360 (0.1405, 0.3315)	0.0485	<0.001	0.1865	0.0306
	Height	−0.0019 (−0.0026, −0.0013)	0.0002	<0.001		
	Weight	0.0017 (0.0013, 0.0022)	0.0003	<0.001		
X5	Intercept	−0.3605 (−0.4406, −0.2805)	0.0407	<0.001	0.1233	0.0236
	Height	0.0015 (0.0010, 0.0019)	0.0002	<0.001		
	Age	0.0004 (0.0002, 0.0006)	0.0001	0.006		
X10	Intercept	−0.2253 (−0.2956, −0.1551)	0.0357	<0.001	0.2123	0.0225
	Height	0.0018 (0.0013, 0.0023)	0.0002	<0.001		
	Weight	−0.0012 (−0.0015, −0.0009)	0.0002	<0.001		
X15	Intercept	−0.1829 (−0.2706, −0.0951)	0.0446	<0.001	0.2138	0.0281
	Height	0.0020 (0.0014, 0.0026)	0.0003	<0.001		
	Weight	−0.0017 (−0.0021, −0.0013)	0.0002	<0.001		
X20	Intercept	−0.0534 (−0.1579, 0.0511)	0.0531	0.316	0.1140	0.0335
	Height	0.0014 (0.0007, 0.0021)	0.0004	<0.001		
	Weight	−0.0014 (−0.0019, −0.0010)	0.0002	<0.001		
X25	Intercept	0.2297 (0.2013, 0.2581)	0.0144	<0.001	0.1123	0.0358
	Height	−0.0010 (−0.0015, −0.0005)	0.0003	<0.001		
	Age	−0.0005 (−0.0008, −0.0002)	0.0002	0.006		
X35	Intercept	0.3214 (0.2863, 0.3565)	0.0186	<0.001	0.1239	0.0440
	Weight	−0.0012 (−0.0012, −0.0004)	0.0003	0.003		
	Age	−0.0008 (−0.0018, −0.0005)	0.0002	<0.001		
lgfres	Intercept	1.8261 (1.5738, 2.0785)	0.1282	<0.001	0.2505	0.0805
	Height	−0.0067 (−0.0084, −0.0050)	0.0009	<0.001		
	Weight	0.0051 (0.0039, 0.0063)	0.0006	<0.001		
lgAX	Intercept	1.6639 (0.9404, 2.3875)	0.3676	<0.001	0.1540	0.2037
	Height	−0.0166 (−0.0214, −0.01188)	0.0024	<0.001		
	Weight	0.0089 (0.0055, 0.0122)	0.0017	<0.001		
	Age	−0.0029 (−0.0049, −0.0009)	0.0010	0.004		

IO, impulse oscillometry; 95% CI, 95% confidential interval; SE, standard error; R^2, coefficient of determination; RSD, residual standard deviation. Z5, total respiratory impedance at 5 Hz; R5, R10, R15, R20, R25 and R35 respectively indicates resistance at 5, 10, 15, 20, 25 and 35 Hz; X5, X10, X15, X20, X25 and X35 respectively indicates reactance at 5, 10, 15, 20, 25 and 35 Hz; AX, low-frequency reactance area; fres, resonant frequency.
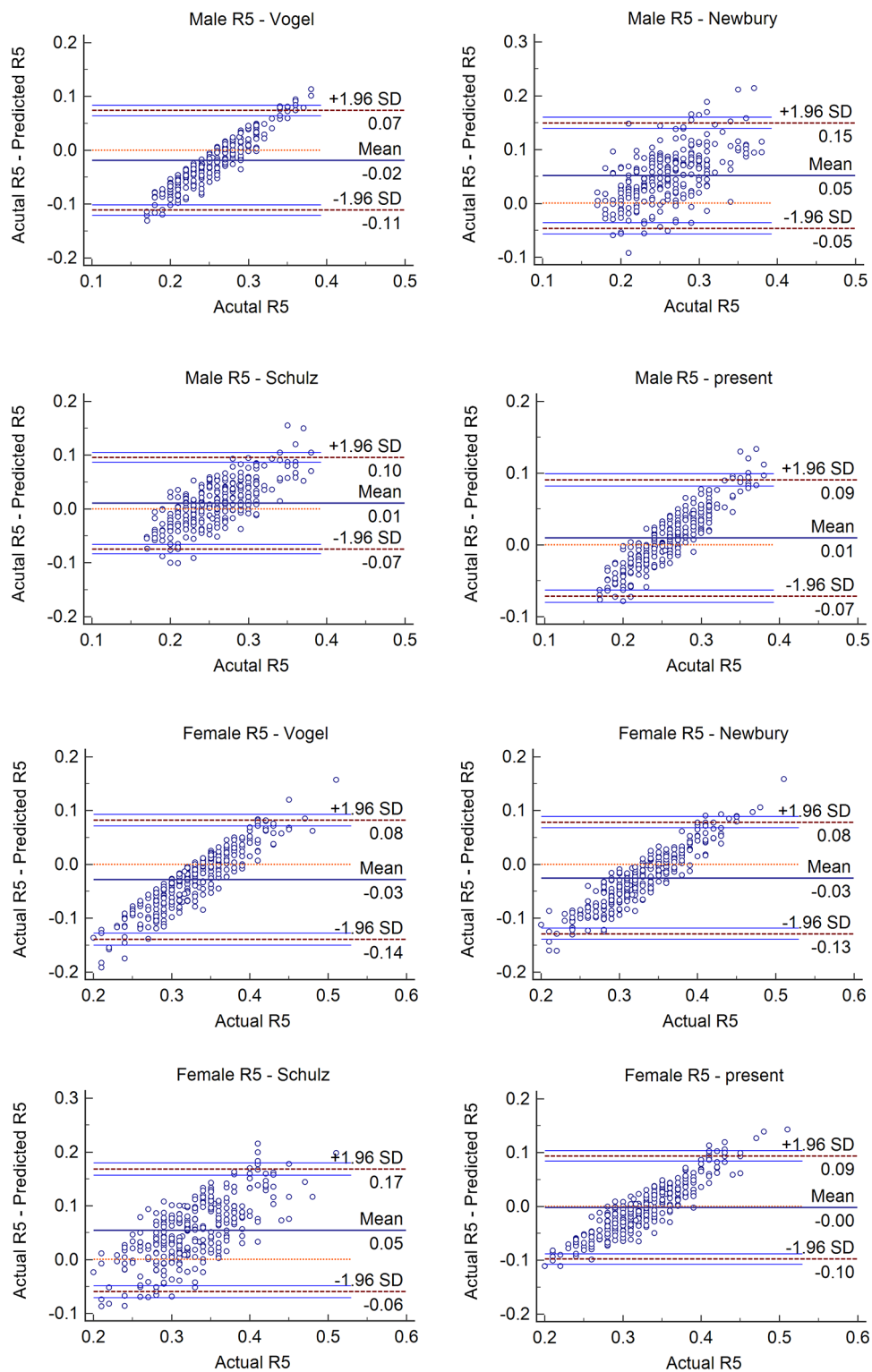
Figure S3 Bland Altman plots for *R*5. X-axis were the actual values of *R*5 in healthy subjects of this study, Y-axis were the differences between the actual values and the predicted values. Predicted values were derived by equations of Vogel (9), Newbury (15) and Schulz (18) and the present study. Systematic differences were shown in reference values of Newbury in males, and reference values of Schulz in females.
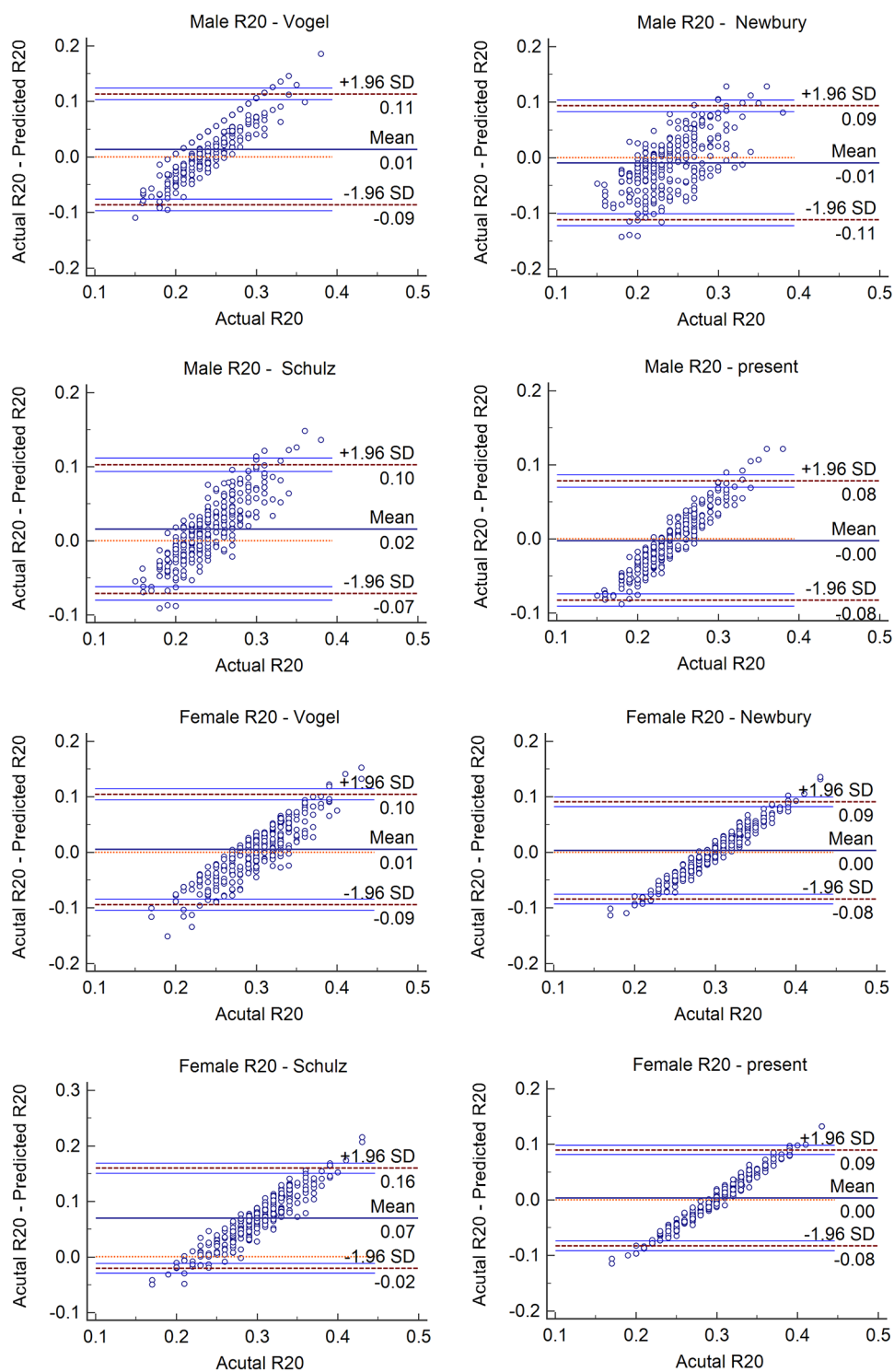
Figure S4 Bland Altman plots for *R*20. X-axis were the actual values of *R*20 in healthy subjects of this study, Y-axis were the differences between the actual values and the predicted values. Predicted values were derived by equations of Vogel (9), Newbury (15) and Schulz (18) and the present study. Systematic differences were shown in reference values of Schulz in females.
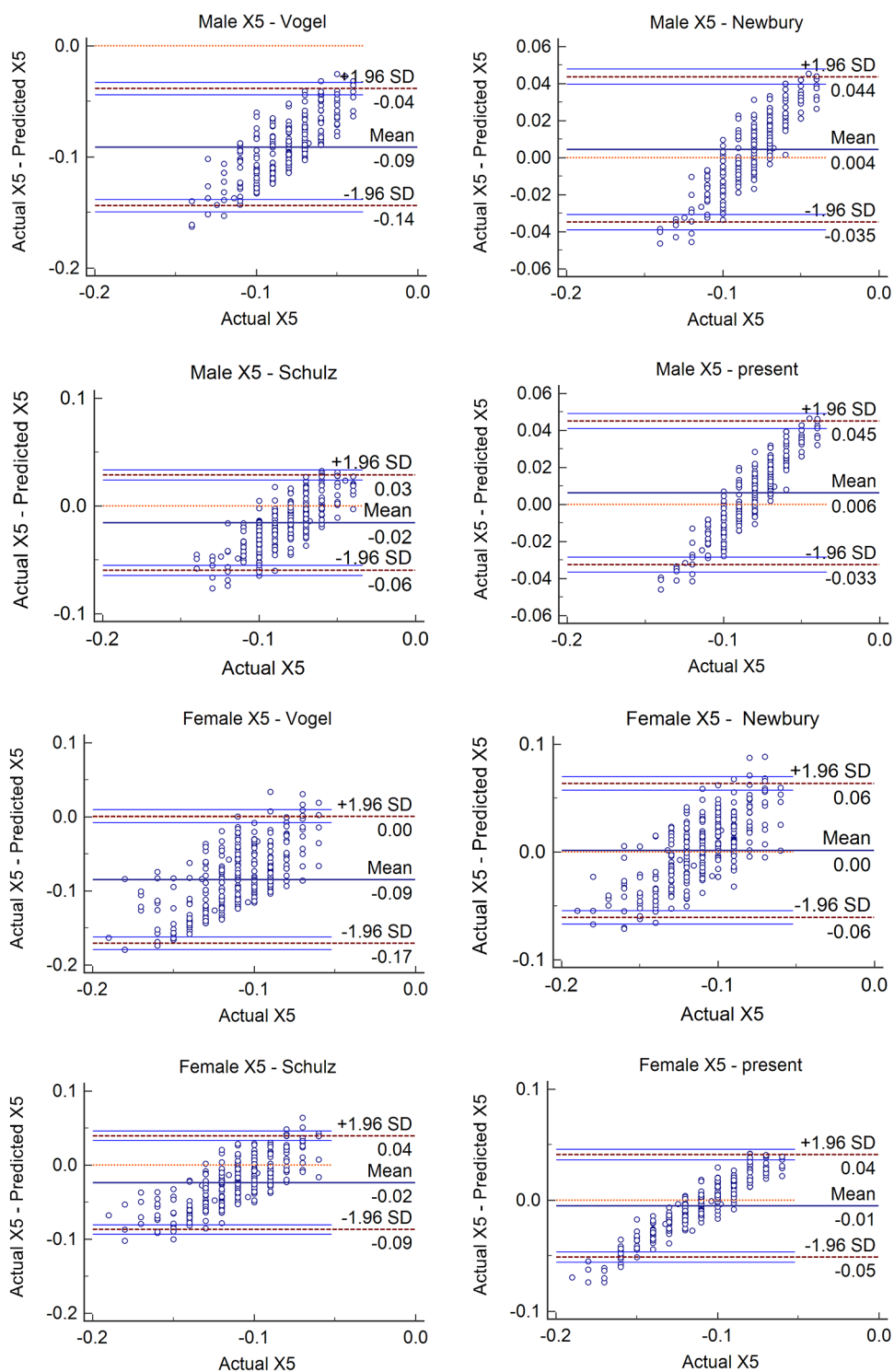
Figure S5 Bland Altman plots for *X*5. X-axis were the actual values of *X*5 in healthy subjects of this study, Y-axis were the differences between the actual values and the predicted values. Predicted values were derived by equations of Vogel (9), Newbury (15) and Schulz (18) and the present study. Systematic differences were shown in reference values of Vogel in both males and females.