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A Retrospective Research of Osteoporosis Diagnostic Criteria in China with Evidence Based Medicine

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Abstract

According to evidence based medicine, about 10 years bone mineral density (BMD) results were analyzed retrospectively which came from DEXA, pDEXA, RA, and SPA methods in China mainland. This paper tries to get out Chinese osteoporosis diagnostic criteria more objectively and more exactly. Searching Chinese magazine and paper databases, 52,166 male case-times and 107,929 female case-times BMD lose rate data were quoted and calculated from 49 papers. The average values and standard deviations also were calculated by SPSS 11.0 (SPSS Inc., Chicago, IL) and the BMD lose rate curves were drawn according to 10 to 90 years old phases. It is suggested that the Chinese criteria of osteoporosis diagnosis should use 25% in BMD lost rate or 2 SD. The measure position is suggested in some sequences that femoral neck is better than forearms, lumbar P-A position, phalanges (2nd, 3rd, and 4th) detected by RA and femoral Troch's region. The femoral WARD's region and lumbar lateral measurements are not supported. To use evidence based medicine can get more accuracy and more reliable results. It is worthy of developed, deeper research.

Key words: Evidence based medicine; Osteoporosis; Diagnostic criteria; BMD lost rate; DEXA; pDEXA; SPA; RA.

1. Introduction

In this century, China's population has risen to 1.3 billion. There are about 10% people older than 60 years old. That means there are a huge amount of osteoporosis patients in China mainland. So it is very important to confirm an easy remember and scientific China osteoporosis diagnostic criteria.

In many researches, reporters analyzed the incidences of osteoporosis in the different areas according to peak value of bone mineral density (BMD) lost 2.5 SD. However, there remains a question that couldn't be ignored. This question is the diagnostic criteria used by many researches were American Criteria and China Criteria that are commended by Osteoporosis Committee of China Gerontological Society (OCCGS) in 1999, though these criteria still remain many disputes themselves. In order to establish an actual popular criterion of Chinese osteoporosis, we try to collect and analyze the data of DEXA, pDEXA, RA, SPA from relative China cultures since 1994. So we may get some more scientific, actual and effective results.

2. Materials and Methods

2.1 Data Resources

Data were cited from officially published Chinese medical journals since 1994 in the Chinese Medical Database from China Union Medical University Library (1-45). Bone mineral density (BMD) data (from published tables of the literature) measured by DEXA, pDEXA, SPA, RA (Middle segment of phalanges 2nd, 3rd, 4th) was included for analysis. Data of QCT, PQCT, and ultrasound was excluded from the analysis of the paper. In total, there were 107,929 case-times female data, and 52,166 case-times male data. The results of SPA data measured prior to 1997 were as result cells here, but its 40,000 patients cases were excluded from statistics.

2.2 Calculation Method and Statistics

There are currently several different DEXA machines from different manufacturers in China. It is obviously that the peak bone mass value, BMD and standard deviations vary from one brand of DEXA machine to another. It is inappropriate to compare the data directly collected from different brands of DEXA machines. To avoid the confusion of diagnosis and data analysis, we suggest implementing the percentage change of the BMD loss as a calculation tool and diagnostic criteria.

BMD lose rate of different age groups was used directly for data analysis. BMD data presented with average values and standard deviations (Mean ± SD) was calculated, and then converted into BMD lose rate before the statistical analysis. SPSS11.0 (SPSS Inc., Chicago, IL) and Excel 2000 (Microsoft inc.) were used for data analysis. The BMD lose rate curves were drawn from 20 to 90 years old phases.

3. Results

52,166 case-times male BMD lose rate showed in Table 1~7 according to measuring sites, ages and methods. Also, some age-BMD lose rate curves were drawn in Figure 1~7. Different measuring sites'

BMD lose rate values and curves were different (Table 8 and Figure 8), especially at average values and standard deviations. From upper data and curves, most curves coincide and are close to each other. All these curves could reflect the real trend of old Chinese people. The results and curves of men femoral neck are located in the middle of these curves that could show the actual osteoporotic state. There are 18 percent BMD lose rate when men are 60-70 years old and 22 percent at 70-80 years old. This rate is up to the actual osteoporotic state. Forearm, lumbar vertebra P-A position and femoral Troch region also fit to the state. Though RA (Middle segment of phalanges 2nd, 3rd, 4th) results zigzagged a lower curve, it is a very simple and relative stabilization measuring method which made it a relative objective values. So, the China male osteoporosis diagnostic criteria should be 25% BMD lose rate or 2SD and the real diagnosis age is about 70 years old. Because there are obvious differences from the values of femoral neck ($p<0.05$), the femoral WARD's region measurements are not supported. That means it will be 28% BMD lose rate at 60 years old. It is not clinical reality. The value of lateral lumbar measurement are also obvious differences from the values of femoral neck ($p<0.05$) at 20~40 and 70~90 years old. Lumbar hyperosteogeny will disturb the measurement results. So the femoral WARD's region and lateral lumbar measurement should not be supported.

Table 1. Comparison of male P-A Lumbar spine BMD loss rate among devices by different authors

Refer-ences	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
	Device Types													
Ages	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	XR36	Sophos L-XRA	QDR4 500	XR-26
20-	0	0	0			0	0	0	0	0	0			
30-	-2.70	-3.80	-1.60		0	-0.90	-0.50	-3.12	-2.70	-1.6	-4.72	0	0	0
40-	-4.60	-7.20	-6.00		-12.03	-4.50	-2.20	-6.39	-4.10	-6.0	-5.28	-8.5	-7.12	-6.88
50-	-9.50	-10.20	-10.20	-2.07	-6.39	-9.00	-7.20	-8.36	-8.10	-10.2	-6.75	-10.9	-15.58	-9.79
60-	-9.80	-10.70	-15.40	-12.71	-11.69	-9.20	-8.50	-15.14	-8.90	-15.4	-12.15	-8.5	-16.21	-14.92
70-	-12.10	-13.40	-18.50	-15.30	-12.11	-11.50	-10.40	-19.29	-19.30	-18.5	-13.28	-16.6	-34.02	-15.60
80-	-14.70	-13.20	-26.80	-20.48		-14.30	-11.70	-22.00	-23.80	-26.8				
Cohorts	591	685	1204	292	210	593	1226	478	1226	267	901	162	653	408

Table 2. Comparison of male lateral Lumbar spine BMD loss rate among devices by different authors

References	**10**	**15**	**16**	**17**	**18**	**8**	**19**
	Device Types						
Ages	DPX-L	DPX-L	DPX-L	QDR-4500W	EXPERT	DMS	XR-36
20-	0	0					0
30-	-1.60	-3.54	0	0	0	0	-3.12
40-	-6.00	-1.21	-0.78	-10.20	-10.33	-4.25	-6.39
50-	-10.20	-10.45	-7.97	-13.20	-22.92	-13.11	-8.36
60-	-15.40	-16.71	-18.87	-29.00	-26.60	-14.36	-15.14
70-	-18.50	-16.30	-24.50	-41.60	-35.99	-14.98	-19.29
80-	-26.80		-28.67		-41.81		-22.00
Cohorts	267	127	527	630	528	242	478

Table 3. Comparison of Male Femoral neck BMD loss rate among devices by different authors

References	20	15	21	2	7	3	22	9	18	5	12	10
						Device Types						
Ages	expert-XL	DPX-L	DPX-L	DPX-L	DPX-L	DPX-IQ	DPX-IQ	DPX-L	expert-XL	DPX-L	Sophos L-XRA	DPX-L
20-	0	0	0	0	0	0	0	0		0	0	0
30-	-6.60	-2.20	-5.40	-3.90	-3.70	-6.10	-3.70	-3.30	0	-7.95	-2.40	-6.10
40-	-11.20	-10.30	-6.00	-9.60	-9.70	-14.10	-10.00	-7.90	-7.06	-12.74	-7.30	-14.10
50-	-14.20	-14.00	-11.10	-11.40	-12.70	-19.50	-12.80	-11.50	-13.28	-14.45	-17.40	-19.50
60-	-19.80	-20.40	-16.50	-13.80	-16.90	-20.20	-16.90	-15.60	-17.70	-23.58	-18.90	-20.20
70-	-22.30	-18.30	-19.80	-24.20	-21.20	-24.20	-21.00	-21.90	-20.06	-25.29	-23.20	-24.20
80-	-28.40		-22.10	-26.50	-25.00	-25.50	-23.80	-26.80	-27.12	-28.27		-25.50
Cohorts	2824	189	1087	685	1226	1204	1338	1226	528	210	162	268

Table 4. Comparison of Male Troch BMD loss rate among devices by different authors

References	10	23	5	18	9	22	3	6	7	2	20	21
						Device Types						
Ages	DPX-L	DPX-L	DPX-L	expert-XL	DPX-L	DPX-L	DPX-IQ	DXA-L	DXA-L	DXA-L	expert -XL	DXA-L
20-	0		0		0	0	0	0	0	0	0	0
30-	-7.4		-9.37		-4.2	-1.5	-7.4	-11.7	-1.5	-3.4	-5.10	-5.40
40-	-13.3		-12.92	-4.92	-6.2	-6.7	-13.3	-12.8	-6.6	-6.4	-6.20	-6.00
50-	-15.7		-13.44	-6.10	-6.7	-7.2	-15.7	-16.0	-7.1	-15.3	-7.30	-11.10
60-	-18.0	-18.08	-18.85	-9.96	-11.8	-11.6	-18.0	-18.4	-11.7	-12.1	-9.90	-16.50
70-	-19.0	-20.97	-20.00	-12.90	-16.3	-13.8	-19.0	-21.3	-13.7	-17.7	-12.20	-19.80
80-	-21.0	-23.76	-20.83	-16.88	-20.9	-17.3	-21.0	-24.1	-18.6	-14.2	-18.80	-22.10
90-		-14.67			-30.6	-33.0		-14.9	-36.4			
Cohorts	268	231	210	528	1226	1338	1204	365	1226	685	2824	1087

Table 5. Comparison of Male BMD loss rate at Ward region among devices by different authors

Refer-ences	10	12	23	5	18	4	9	22	3	6	7	24	20	21
							Device Types							
Ages	DPX-L	Sophos L-XRA	DPX-L	DPX-L	expert -XL	DPX-L	DPX-L	DPX-L	DPX-IQ	DPX-L	DXA-L	expert - XL	expert - XL	DPX-L
20-	0	0		0			0	0	0	0	0	0	0	0
30-	-11.30	-16.00		-14.92	0	0	-4.90	-5.10	-11.30	-22.80	-4.30	-9.70	-7.10	-3.70
40-	-21.30	-25.60		-25.16	-14.10	-14.11	-15.00	-16.50	-21.30	-26.60	-16.10	-15.10	-9.60	-6.00
50-	-26.80	-28.70	-26.10	-26.10	-22.08	-21.37	-20.00	-20.80	-26.80	-33.20	-21.50	-19.90	-18.40	-11.30
60-	-30.00	-30.80	-30.11	-34.37	-28.09	-22.42	-26.70	-27.90	-30.00	-38.10	-27.60	-26.20	-23.20	-27.40
70-	-32.50	-38.90	-32.11	-35.40	-30.49	-31.37	-31.90	-31.90	-32.50	-41.70	-31.60	-28.80	-26.40	-26.40
80-	-34.50		-26.21	-40.19	-36.17	-36.00	-31.90	-36.20	-34.50	-43.20	-36.20	-38.30	-37.80	-33.70
Cohorts	268	162	231	210	528	484	1226	1338	1204	365	1226	1917	2824	1087

Table 6. Comparison of Male phalange BMD loss rate among RA devices by different authors

References	25	26	27	28
		Device Types		
Ages	RA	RA	RA	RA
20-			0	0
30-	0	0	-1.5	-2.64
40-	-1.4	-5.74	-0.9	-6.97
50-	-9.6	-8.92	-6.6	-7.74
60-	-7.7	-10.34	-16.2	-12.40
70-	-12.3	-12.16	-16.9	-15.01
80-		-14.12	-19.1	-18.10
cohorts	258	567	279	1181

Table 7. Comparison of male forearm radius and ulna BMD loss rate using DEXA and SPA by different authors

References	29	29	30	12	45	31	32
			Device Types				
Ages	SPA-Radius	SPA-Ulna	osteometer	Sophos L-XRA	ALOKA-600E	ALOKA-600E	ALOKA-600E
20-							
30-	-4.48	-4.87	0	0	-0.996	0	0
40-	-8.96	-8.56	-4.8	-1.7	-3.74	-0.26	-1.38
50-	-13.04	-13.18	-8.1	-8.8	-7.72	-5.45	-8.7
60-	-18.05	-17.79	-15.9	-9	-11.46	-11.68	-12.51
70-	-25.98	-25.3	-22.6	-24.3	-11.58	-17.27	-14.05
80-	-24.64	-27.4	-36.1			-25.06	
Cohorts	(40000) #	(40000) #	932	162	1070	348	465

The results of SPA data measured prior to 1997 were as result cells here, but its patient's cases were excluded from statistics.

Table 8. Comparison of BMD average loss rate at different body sites among different devices by different authors

Ages	Male Femoral Neck	Male TROCH	Male WARD	Male Forearm	Male Phalange RA	Male lateral lumbar spine	Male PA lumbar spine
20-	0	0	0	0	0	0	0
30-	-4.28±2.23	-5.70±3.31	-8.55±6.65*	-1.48±2.22	-1.04±1.28	-1.18±1.59*	-1.66±1.61
40-	-10.00±2.68	-8.67±3.53	-17.42±6.25*	-4.20±3.46	-3.75±3.05	-5.59±3.84*	-5.77±2.39
50-	-14.32±2.95	-11.06±4.24	-23.08±5.35*	-9.28±2.84	-8.21±1.32	-12.32±5.10	-8.87±2.99
60-	-18.37±2.65	-14.57±3.65	-28.78±4.06*	-13.77±3.49	-11.66±3.59	-19.44±5.93	-12.09±2.89
70-	-22.14±2.14	-17.22±3.31	-32.28±4.19*	-20.15±5.81	-14.09±2.29	-24.45±10.37*	-16.42±5.91
80-	-25.90±1.96	-19.96±2.91	-35.76±4.08*	-28.30±5.34	-17.11±2.63	-29.82±8.47*	-19.31±5.94
90-	--	-25.91±10.37	--	--	--	--	--
Total	10947	11192	13070	2977	2285	2799	8896

* That means there are obvious differences from the values of femoral neck ($p<0.05$).

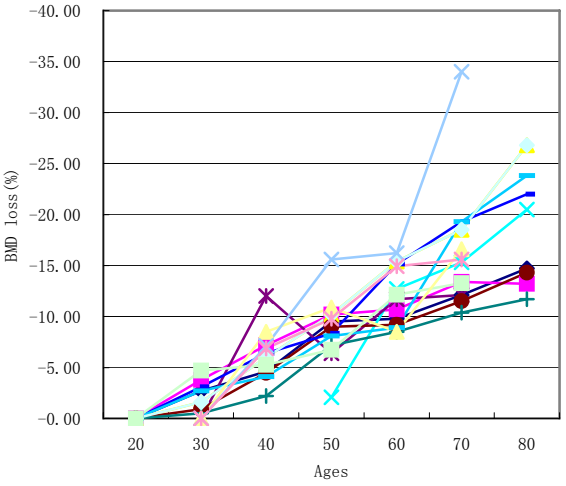


Figure 1. 8896 cases male PA Lumbar Spine BMD Loss rates

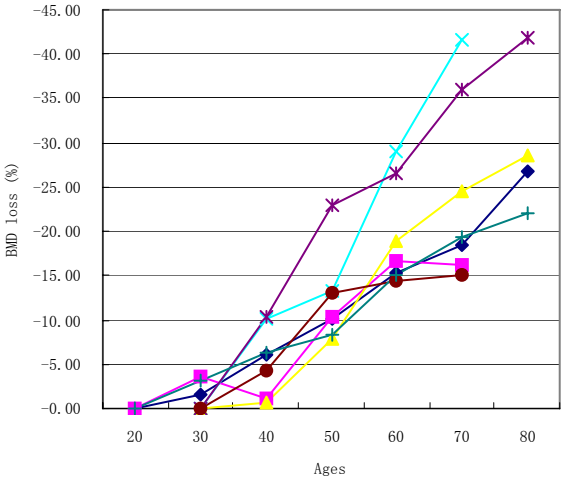


Figure 2. 2799 cases male lateral spine BMD loss rates

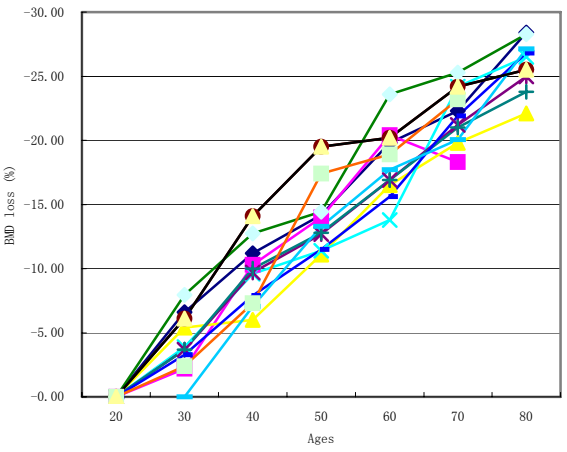


Figure 3. 10947 cases male femoral neck BMD loss rates

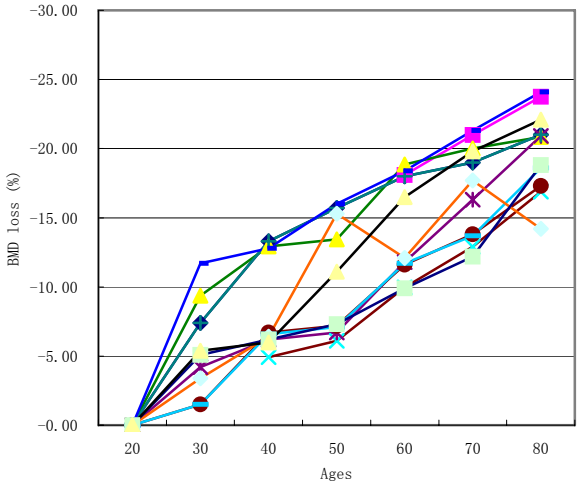


Figure 4. 11192 cases male Troch BMD loss rates

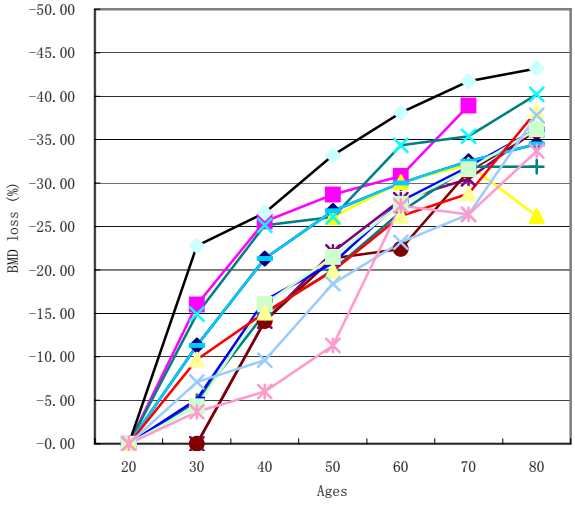
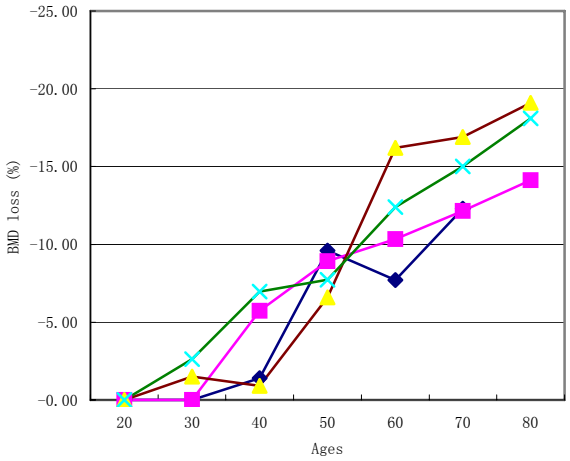


Figure 5. 13070 cases male Ward BMD loss rates



Graph. 6、2285 cases male phalange BMD loss rates

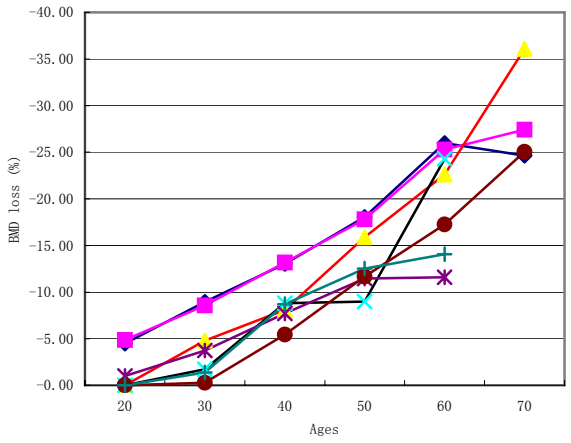


Figure 7. 2977 cases male forearm radius and ulna BMD loss rates using DEXA and SPA.

107,929 case-times female BMD lose rate showed in Table 9~15 according to measuring sites, ages and methods. Also, some age-BMD lose rate curves were drawed in graph 9~15. Different measuring sites' BMD lose rate values and curves were different (Table 16 and graph 16), especially at average values and standard deviations. Because of about double samples, female results could show more real trend of osteoporosis than that of male. The female femoral neck values show that only 4 percent of BMD lose rate at 40 years old before emmenia over. After 50 years old, most women have no emmenia and there are more BMD lose rate. So 25 percent loss at 60 years old and 30 percent at 70 years old. Especially, curves of forearm and lumbar P-A position are coincided with femoral neck that is never reported before. Though femoral Troch region curve is lower than the former curves, it can be as measuring and diagnosis position. The femoral WARD and lateral lumbar should not be diagnosis region because there are higher curves that have significant difference from femoral neck. Not only $P<0.05$, but 36 percent lose rate after 60 years old. It falls short of Chinese reality. So it is counterevidence of 25 percent BMD lose rate and 2 SD as diagnostic criteria.

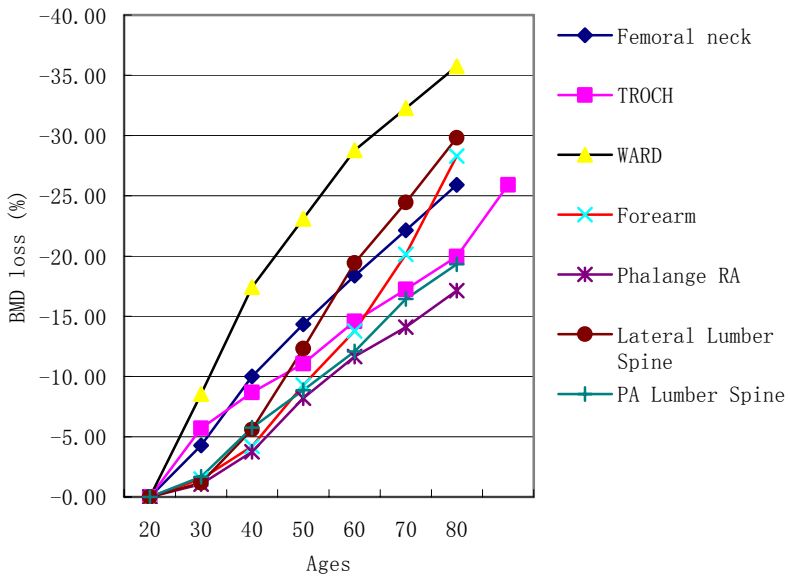


Figure 8. Comparison of male BMD loss rates at different body sites

Table 9. Comparison of female P-A lumbar spine BMD loss rate among devices by different authors

Refer-ences	1	2	3	5	6	7	8	9	10	11	12	13
	Device Types											
Ages	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	DPX-L	XR-36	Sophos L-XRA	QDR-4500W
30-	0	0	0	0	0	0	0	0	0	-3.30	0	0
40-	-1.10	-2.80	-6.40	-2.21	-2.70	-2.20	-5.73	-3.40	-6.37	-3.87	-7.14	-4.75
50-	-12.30	-16.30	-18.00	-14.65	-10.90	-9.60	-14.58	-10.30	-18.02	-12.93	-16.96	-18.08

60-	-18.10	-27.30	-25.00	-21.29	-18.50	-22.80	-23.23	-24.40	-25.31	-26.24	-25.89	-28.83
70-	-20.90	-30.20	-27.00	-24.87	-21.30	-26.70	-28.47	-28.60	-26.66	-29.48	-29.46	-30.92
80-	-26.80	-28.80	-33.00	-26.15	-30.60	-34.10		-37.80	-32.61			
90-					-18.50	-42.80						
Cohorts	976	775	1320	824	740	1105	544	1115	267	791	151	488

References	**14**	**33**	**34**	**35**	**22**	**36**	**18**	**37**	**38**	**46**	**39**	**40**	**15**
	Device Types												
Ages	XR-26	DPX-L	DMS	QDR2000	DPX-L	QDR4500a	expert-XL	DPX-IQ	QDR4500a	DPX-L	DPX-L	EXPERT-XL	DPX-L
30-	-2.70	0	0	0	-0.90	0	0	0	0	0	0		0
40-	-5.98	-1.10	-9.50	-7.08	-6.60	-9.75	-3.55	-6.48	-3.30	-2.24	-3.48		-2.83
50-	-14.96	-12.30	-12.38	-10.01	-10.60	-21.36	-15.66	-13.89	-11.80	-6.22	-14.30	-6.00	-15.72
60-	-34.55	-18.10	-23.81	-22.95	-18.40	-28.23	-23.36	-17.59	-25.00	-21.26	-23.99	-16.50	-19.48
70-		-20.90	-27.62	-24.81	-19.90	-30.01	-20.93	-24.07	-25.30	-26.19	-26.15	-23.80	-24.13
80-		-26.80	-30.48	-27.50	-24.60		-23.52		-29.70	-37.25	-30.20		
90-					-36.6								
cohorts	209	976	266	2111	2177	2702	1072	227	1818	1060	1805	138	255

Table 10：Comparison of female lateral lumbar spine BMD loss rate among devices by different authors

References	**36**	**12**	**17**	**18**	**13**	**8**
	Device Types					
Ages	QDR-4500A	DPX-L	QDR-4500W	expert-XL	QDR-4500W	DMS-chanllenger
20-	0					
30-	-3.34	0	0	0	0	0
40-	-15.19	-7.70	-9.80	-4.10	-9.80	-9.39
50-	-31.40	-18.80	-10.55	-26.50	-10.55	-19.93
60-	-39.38	-31.30	-36.70	-39.18	-36.70	-28.95
70-	-43.63	-38.50	-50.04	-53.04	-50.01	-36.47
cohorts	2702	162	330	1072	330	464

Table 11. Comparison of female femoral neck BMD loss rate among devices by different authors

References	**36**	**41**	**24**	**20**	**6**	**42**	**43**	**35**	**44**	**40**	**21**	**2**	**7**
	Device Types												
Ages	QDR-4500A	DPX-L	EXPERT-XL	EXPERT-XL	DXA-L	QDR-4500	DPX-L	QDR-2000	XR36	EXPERT-XL	DPX-L	DPX-L	DPX-L
30-	0	-0.60		-1.20	-4.20	-0.90	-0.50	-2.80	0	0	-4.50	-1.70	-1.80
40-	-1.60	-3.40		-4.40	-4.70	-5.60	-5.60	-2.20	-4.61	-7.70	-7.40	-6.00	-6.00
50-	-9.30	-12.10	-11.60	-13.00	-17.60	-13.70	-14.90	-16.40	-9.19	-18.70	-18.30	-16.60	-10.90

60-	-21.00	-20.80	-20.00	-22.80	-24.50	-23.70	-19.80	-24.50	-15.34	-27.20	-29.50	-27.40	-21.00
70-	-26.60	-21.90	-23.00	-30.00	-29.00	-29.00	-30.70	-29.60	-25.83		-33.20	-32.50	-29.40
80-	-39.60		-31.60		-37.90	-39.50		-33.00	-34.78			-36.90	-36.10
Cohorts	2702	605	3186	2973	740	1367	254	2111	717	138	1213	775	1105

References	**3**	**22**	**9**	**4**	**18**	**5**	**12**	**10**
				Device Types				
ages	DPX- IQ	DPX- IQ	DPX-L	expert-XL	DPL+	DPX-L	Sophos L-XRA	DPX-L
30-	-1.50	-2.80	-5.20	0	0		-0.10	-1.50
40-	-2.80	-5.50	-5.10	-11.01	-5.28		-5.40	-2.80
50-	-13.40	-9.30	-11.40	-18.62	-16.16	-13.05	-16.50	-13.40
60-	-25.20	-18.50	-22.70	-28.23	-24.09	-24.39	-21.10	-25.20
70-	-32.00	-25.90	-31.80	-27.23	-25.91	-27.38	-30.40	-32.00
80-	-36.70	-32.10	-37.40		-30.28	-34.33		-36.70
Cohorts	1320	2177	1115	306	1072	232	162	268

Table 12. Comparison of female TROCH BMD loss rate among devices by different authors

References	**36**	**41**	**24**	**20**	**6**	**42**	**43**	**35**	**44**	**40**	**21**	**2**	**7**
						Device Types							
Ages	QDR-4500 A	DPX-L	EXPERT -XL	EXPERT - XL	DXA-L	QDR-4500	DPX-L	QDR-2000	XR36	EXPERT-XL	DPX-L	DPX-L	DPX-L
20-	0	0		0	0	0	0	0			0	0	0
30-	-2.70	-4.00	0	-0.40	-2.70	-0.90	-1.20	-4.50	0		-1.20	-1.20	-2.90
40-	-3.70	-2.80	-0.50	-3.60	-4.70	-5.20	-3.40	-3.60	-6.24		-4.50	-3.30	-3.50
50-	-11.10	-6.60	-13.60	-9.00	-11.60	-9.90	-11.60	-8.80	-10.99	-6.00	-10.00	-11.90	-8.50
60-	-24.20	-13.40	-19.60	-19.10	-19.30	-19.80	-11.40	-12.40	-20.10	-17.40	-24.50	-20.70	-18.80
70-	-31.10	-19.50	-22.80	-28.00	-22.70	-31.40	-22.10	-28.60	-33.11	-25.00	-27.90	-23.50	-26.40
80-	-46.00		-29.90		-29.70	-44.00		-34.10	-38.55		-30.40	-30.10	-33.40
Cohorts	2702	605	3186	2973	740	1367	254	2111	717	138	1213	775	1105

References	3	22	9	4	18	5	12	10
				Device Types				
Ages	DPX- IQ	DPX- IQ	DPX-L	Expert-XL	DPX-L	DPX-L	Sophos L-XRA	DPX-L
20-	0	-0.3	0					0
30-	-5.20	-5.14	-3.30	0	0		0	-5.00
40-	-7.90	-7.15	-3.80	-3.83	-0.39		-3.40	-7.90
50-	-13.60	-9.76	-14.80	-18.53	-11.49	-11.75	-15.20	-13.60
60-	-20.30	-16.77	-23.30	-21.64	-19.32	-22.62	-33.20	-20.30
70-	-24.50	-23.88	-25.90	-22.46	-20.10	-25.28	-35.10	-24.50
80-	-26.40	-30.39	-32.20		-28.07	-31.61		-25.40
Cohorts	1320	2177	1115	306	1072	232	162	268

Table 13. Comparison of female WARD BMD loss rate among devices by different authors

Refer-ences	36	41	24	20	6	42	43	35	44	40	21	2	7
						Device Types							
Ages	QDR-4500 A	DPX-L	EXPERT -XL	EXPERT - XL	DXA-L	QDR-4500	DPX-L	QDR-2000	-XR36	EXPERT-XL	DPX-L	DPX-L	DPX-L
20-	0	0		0	0	0	0	0			0	0	0
30-	-2.10	-3.70	-3.40	-3.20	-6.00	-0.70	-3.40	-8.50	0	0	-3.80	-3.80	-5.40
40-	-10.10	-8.30	-8.80	-6.60	-11.60	-8.30	-10.40	-8.90	-8.57	-12.00	-6.60	-13.10	-11.80
50-	-24.00	-24.30	-20.90	-20.00	-27.20	-21.90	-23.50	-21.30	-19.45	-25.70	-20.00	-27.20	-19.80
60-	-44.10	-34.90	-35.20	-32.60	-37.50	-38.20	-33.10	-34.90	-32.28	-36.90	-32.30	-40.00	-32.50
70-	-52.50	-36.00	-42.30	-39.90	-42.90	-53.70	-43.90	-49.80	-49.65	-46.40	-38.90	-47.00	-43.20
80-	-66.20		-49.70		-54.00	-65.60		-58.00	-57.98		-42.90	-51.80	-50.90
cohorts	2702	605	3186	2973	740	1367	254	2111	717	138	1213	775	1105

References	3	22	9	4	18	5	12	10
				Device Types				
Ages	DPX- IQ	DPX- IQ	DPX-L	expert-XL	DPX-L	DPX-L	Sophos L-XRA	DPX-L
20-	0	0	0		0	0	0	0
30-	-6.50	-7.20	-8.80		0	-7.15	-6.20	-6.50
40-	-10.70	-14.50	-12.20		-10.51	-12.72	-13.70	-10.70
50-	-28.90	-21.60	-30.00	-19.92	-24.88	-26.91	-27.90	-28.90
60-	-41.80	-31.50	-40.40	-23.98	-35.10	-41.21	-33.00	-41.80
70-	-51.30	-41.30	-45.60	-28.05	-39.67	-46.04	-35.60	-51.30
80-	-56.30	-47.80	-52.10		-43.08	-52.68		-56.50
cohorts	1320	2177	1115	306	1072	232	162	268

Table 14：Female phalange BMD loss rate among RA devices by different authors

References	25	26	27	28
		Device Types		
Ages	RA	RA	RA	RA
30-	0	0	-4.1	-0.74
40-	-2.7	-2.52	-7.4	-1.97
50-	-13	-14.95	-17.6	-16.48
60-	-24.4	-27.93	-27.5	-25.97
70-	-29.2	-31.34	-35.9	-32.58
80-		-46.86	-43.4	-35.3
cohorts	358	556	281	1403

Table 15. Measured female forearm radius and ulna BMD loss rate using SPA and DEXA devices by different authors

References	29	29	30	12	45	31	32
				Device Types			
Ages	SPA-Radius	SPA-Ulna	osteometer	Sophos L-XRA	ALOKA--600E	ALOKA--600E	ALOKA--600E
30-	0	0	0	0	0	0	0
40-	-5.10	-6.47	-1.6	-3.4	-0.15	-3.20	-3.03
50-	-15.16	-16.95	-12.1	-15.2	-22.20	-13.06	-19.99
60-	-23.37	-25.29	-26.0	-33.2	-25.87	-25.96	-25.03
70-	-33.85	-34.2	-34.8	-35.1	-28.78	-32.57	-28.34
80-	-46.74	-44.83	-51.1		-32.12	-33.49	
90-	-44.76	-45.11			-32.85		
Cohorts	(40000) #	(40000)#	932	162	664	705	282

The results of SPA data measured prior to 1997 were as result cells here, but its patient's cases were excluded from statistics.

Table 16. Comparison of different site BMD loss rate in different age group among different devices by different authors

Ages/Site	Femoral Neck	TROCH	WARD	Forearm	Phalange RA	Lateral Lumbar Spine	PA Lumbar Spine
20-	0	-0.02±0.08	0	0	0	0	0
30-	-1.54±1.65	-2.12±1.94	-4.32±2.80*	0	-1.21±1.96	-0.56±1.36	-0.29±0.86
40-	-4.86±2.40	-4.18±2.05	-10.51±2.24*	-3.28±2.09	-3.65±2.52	-9.33±3.60*	-4.61±2.44
50-	-14.01±3.12	-11.35±2.93	-24.01±3.51*	-16.38±3.64	-15.51±1.99	-19.62±8.38*	-13.51±3.69
60-	-23.19±3.45	-19.91±4.63	-35.87±4.69*	-26.39±3.14	-26.45±1.60	-35.36±4.29*	-23.20±4.22
70-	-28.67±3.14	-25.90±4.16	-44.05±6.41*	-32.52±2.83	-32.26±2.80	-45.28±6.81*	-25.77±3.29
80-	-35.49±2.90	-32.68±5.92	-53.70±6.79*	-41.66±8.41	-41.85±5.93	--	-29.99±4.17
90-	--	--	--	-40.91±6.98	--	--	-32.63±12.63
Total	24538	24538	24538	2745	2598	5060	23912

* That means there are obvious differences from the values of femoral neck ($p<0.05$).

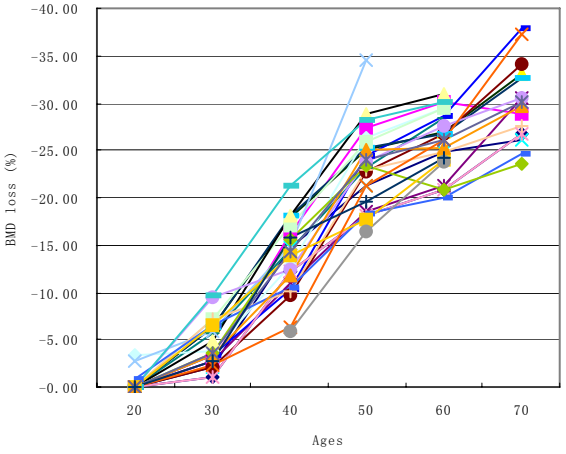


Figure 9. 23912 cases Female P-A lumbar spine BMD loss rates.

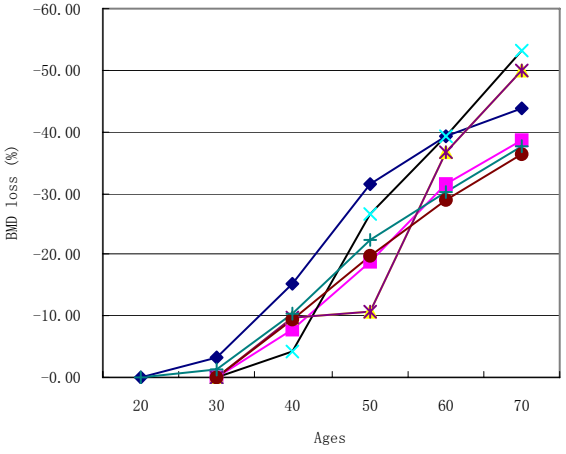


Figure 10. 5060 cases Female lateral lumbar spine BMD loss rates.

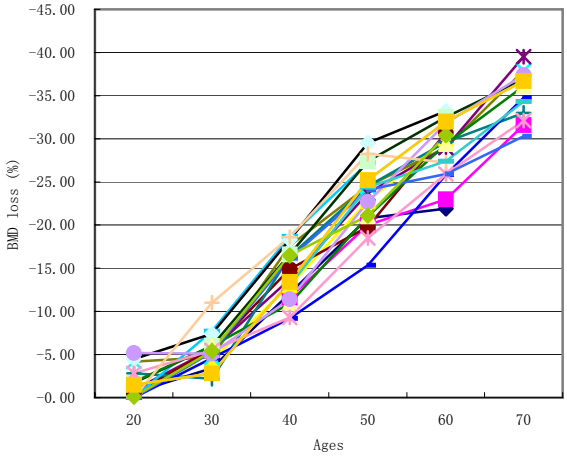


Figure 11. 24538 cases female femoral neck.

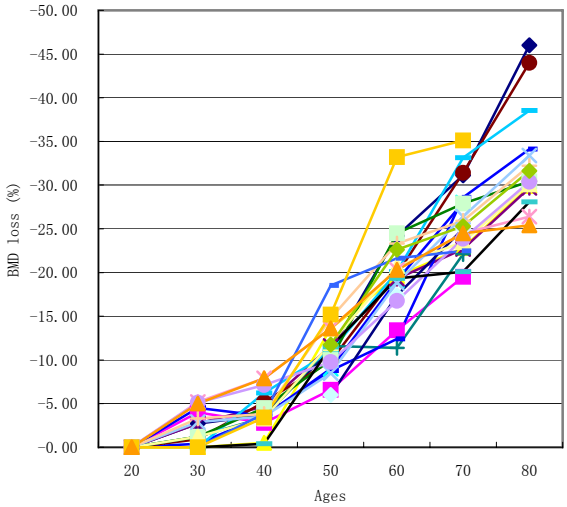


Figure 12. 24538 cases female TROCH BMD loss rates.

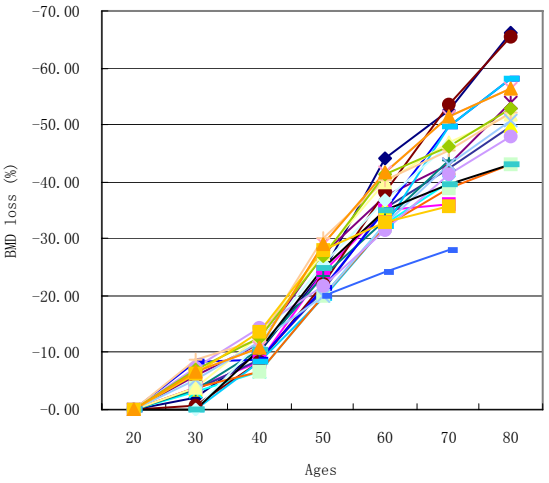


Figure 13. 24538 cases female WARD BMD loss rates.

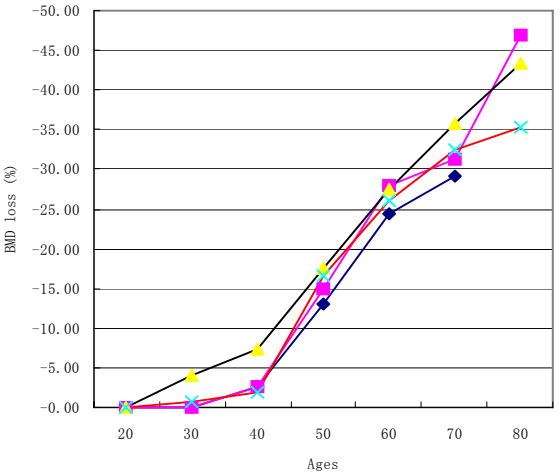


Figure 14. 2598 cases female phalange BMD loss rates by RA.

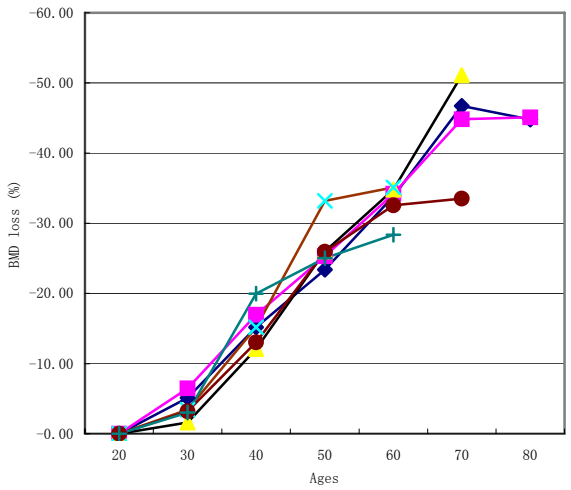


Figure 15. 2745 cases Female forearm radius and ulna BMD loss rates using SPA and DEXA.

4. Discussion

Evidence based medicine is very important to establish policies for government medical department. It is difficult to determinant a scientific and reasonable diagnosis criteria without Evidence based medicine certification. Its connotation is, according to results of multi-center research studies with some requests, to set up these disputed diagnostic criteria.

To keep agreement with the WHO criteria, we have previously used the same cut off value of –2.5 SD as the diagnostic criteria for osteoporosis in Chinese women in year 2000 (46). It also suggests this cut off value for men as well. We now recognize that, in fact, this criterion is unsuitable for the diagnosis of osteoporosis in Chinese women and men as it is too low. By using 2.5 SD cut off value, most of Chinese particularly in men would be delayed for diagnosing as osteoporosis and will be falling into the age group of 80-90 years old. Most of the previous studies in Chinese women suggest that 2SD cut off value may be the optical cut off value used for the diagnosis of osteoporosis in Chinese women, and the results in this study support this view.

Generally, 1 SD ≈ 12% BMD lose rate. Thus, 25% of BMD loss rate is about 2SD. Accordingly, we suggest that applying the percent rate of BMD loss rather than SD to assess osteoporosis for clinical purpose in Chinese. In men, the cut off value is set up at 25% or 2 SD, while same values in women, too. That means he or she will be diagnosed osteoporosis when BMD lose rate is 25% or BMD decreases 2 SD. So the new criteria for diagnosis of osteoporosis in Chinese men and women are as follows: Normal: rate of BMD loss no more than 1-12% below young adult peak BMD value. Osteopenia: rate of BMD loss no more than 13-24% below young adult peak BMD value. Osteoporosis: rate of BMD loss no more than 25-36% below young adult peak BMD value. Severe Osteoporosis: rate of BMD loss greater than 37% below young adult peak BMD value. The new Chinese diagnostic criteria is different in several aspects from the previous criteria made by several investigators (47-49), particularly the previous studies lacked of male diagnostic criteria. This criteria is easy to remember and convenient to use in clinic though male is not same as female at morbidity ages.

Inconsistencies of SD score produced by different manufacture's DEXA instruments were reported among various bone density centers across China. It is very difficult to unify and compare the results using SD score by different population in different regions. As the percentage rate of BMD loss with age within a skeletal site were similarly reported by different studies by using different DEXA devices in different population. Thus using the percentage BMD loss is more accurate than using of the SD scores.

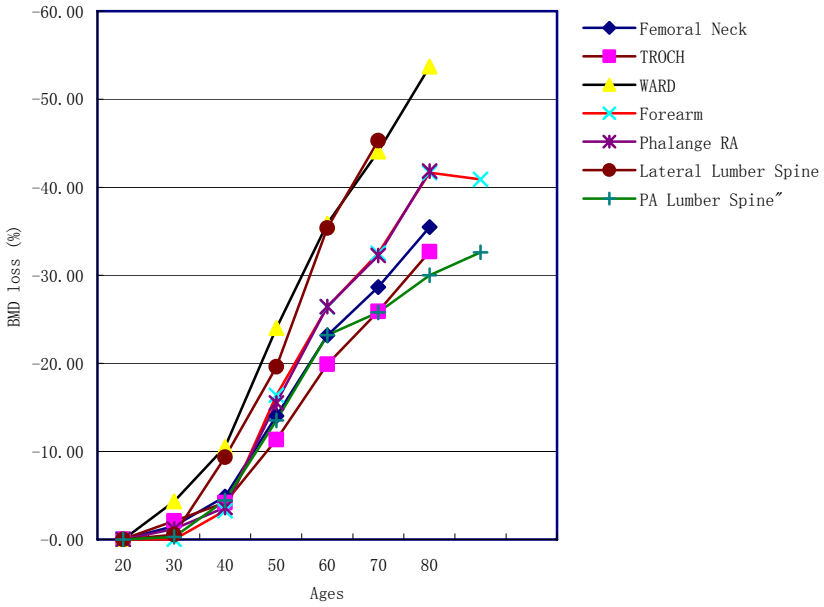


Figure 16. Female BMD loss rates at different sites.

The advantages of using percentage rate of BMD loss over T scores in the diagnosis of osteoporosis include: (1) For the purpose of clinical practice, it is easy to understand and easy to explain to the patients; (2) Avoiding using some complicated mathematic concept such as SD in the diagnosis, moreover, SD was affected by different manufacture's bone densitometry devices; (3) Although it might be more accurate by applying "fracture risk index", this concept is not easy to understand and involves complicated calculations; (4) To overcome the T-score limitation caused by different machine, different center, operator and technical errors. We conclude that there is significantly clinical value by establishing a standard nation-aide criteria for the diagnosis of osteoporosis by applying percentage rate of BMD loss.

5. Conclusions

A: Man osteoporosis diagnostic criteria: rate of BMD loss is more than 25% or 2SD, the disease ages are older than 70 years old.

B: Women osteoporosis diagnostic criteria: rate of BMD loss is more than 25% or 2SD, the disease ages are older than 60 years old.

C: The suggested testing parts are followed: femoral neck> forearms > AP lumbar spine (L1-4) > Phalanges 2nd、3rd、4th tested by RA> femoral Troch's Region. It is not recommended to use lateral lumbar spine and femoral WARD's Region for diagnosis.

Facing increasing aging population in the near future, it is urgent to establish standard, easy to use, and reliable osteoporosis diagnostic criteria in China. The best way to reach this goal is to conduct a multi-center research study using the same protocol. We encourage discussions and suggestions from all colleagues, clinical scientists, and clinicians.

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